Australian Government
Australian Transport Safety Bureau

Wirestrike involving a Robinson R44, VH-ZWK

20 km from Naracoorte, South Australia, on 13 March 2019

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Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 4150 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Email: atsbinfo@atsb.gov.au
Website: www.atsb.gov.au

Addendum

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Safety summary

What happened

On 13 March 2019, a Robinson R44 helicopter, registered VH-ZWK and operated by Helifarm, was conducting aerial spraying operations at Bool Lagoon, around 20 km south of Naracoorte, South Australia.

While spraying along a drainage channel, the helicopter pilot momentarily forgot about the location of a powerline spanning the channel, as he manoeuvred the helicopter over a bridge. The helicopter collided with the powerline, then crashed into the ground. The helicopter was destroyed and the pilot sustained minor injuries.

What the ATSB found

The helicopter pilot momentarily lost awareness of the powerline as he manoeuvred over the bridge. Nearby vegetation, which reduced the pilot's ability to see the power poles and visually identify the powerline, probably reduced the pilot's ability to maintain this awareness. The operator had a number of policies and procedures to support pilots' powerline awareness, and it may not be possible to completely mitigate the risk of wirestrike during repeated low-level flying near powerlines.

As a result of this momentary loss of awareness, the helicopter collided with the powerline, which led to a collision with terrain. The bladder-type fuel tank installed in the accident helicopter, as compared to an all-aluminium fuel tank, probably reduced the risk of a post-accident fire.

What's been done as a result

The operator has implemented new policies and procedures to increase pilots' awareness of powerlines during spraying operations, particularly spraying of drains. These include improved maps and other planning documents for drain spraying operations involving flying near powerlines, and increased training of helicopter pilots engaged in these operations.

Safety message

This accident provides another reminder of the dangers posed by powerlines during low-level spraying operations.

The ATSB has released, in association with the Aerial Application Association of Australia (AAAA), an educational booklet, *Wirestrikes involving known wires: A manageable aerial agriculture hazard* (AR-2011-028). This booklet contains numerous wirestrike accidents and lessons learned from them. The AAAA has now launched its Powerline Safety Program that aims to encourage and facilitate power companies to improve aviation safety. The program includes marking of powerlines by powerline network operators (with a marker in accordance with Australian Standard AS 3891-2) wherever it is requested by a pilot, aviation company or landholder.

As this accident highlights, there may be limits to the extent to which operators can mitigate the risk of wirestrike during repeated low-level operations near powerlines. Helicopter wirestrike protection (WSPS) can provide a last line of defence in the event of a wirestrike. Some aircraft selected for aerial agriculture operations can be configured to include WSPS. However, this technology is not currently available on smaller helicopters such as the R44.

Pilots and operators involved in low-level spraying are also reminded that flight helmets can reduce the risk of serious injury in the event of an accident.

The occurrence

What happened

On 13 March 2019, a Robinson R44 helicopter, registered VH-ZWK and operated by Helifarm, was conducting aerial spraying operations at Bool Lagoon, around 20 km south of Naracoorte, South Australia. The operations involved spraying weeds in Bool Lagoon, then in the drain at the western edge of the lagoon. The pilot was the sole occupant of the helicopter.

At the start of the day, the pilot met with a representative of the client organisation, the operations manager of Helifarm, and the Helifarm ground crew who would be in charge of loading the helicopter with spray. Discussions included reviewing the planned spraying job, maps of the area, and a job safety analysis for the spraying work. The risk of colliding with powerlines was noted during the meeting.

Spraying operations involved loading the helicopter with spraying chemicals from a loader vehicle. The pilot would then conduct spray flights before returning and reloading.

After spraying the lagoon in the morning, the loader was relocated in preparation for the remaining work around the drain. The pilot flew towards the new loading point and, prior to landing, conducted a brief reconnaissance flight around the drain. During this flight, the pilot sighted several hazards, including a weir bridge and a single-wire powerline spanning the drain.

After landing at the new loading site, the pilot rested for around 15 minutes before resuming operations at around 1400 Central Daylight-saving Time (CDT). The pilot then conducted another reconnaissance flight and sprayed two loads of chemicals in the drain area. The pilot passed under the powerline on three occasions during the two spray flights.

The pilot commenced another spray flight at around 1430. The pilot started the spray run from a public road at the eastern end of the drain section, flying west towards the weir bridge and the powerline (Figure 1). The pilot recalled that, as he commenced this run, he reminded himself of the presence of the powerline further along the drain. The pilot turned on the spray nozzles, then looked at the nozzles and spray pressure gauge to confirm the spraying equipment was functioning as expected.

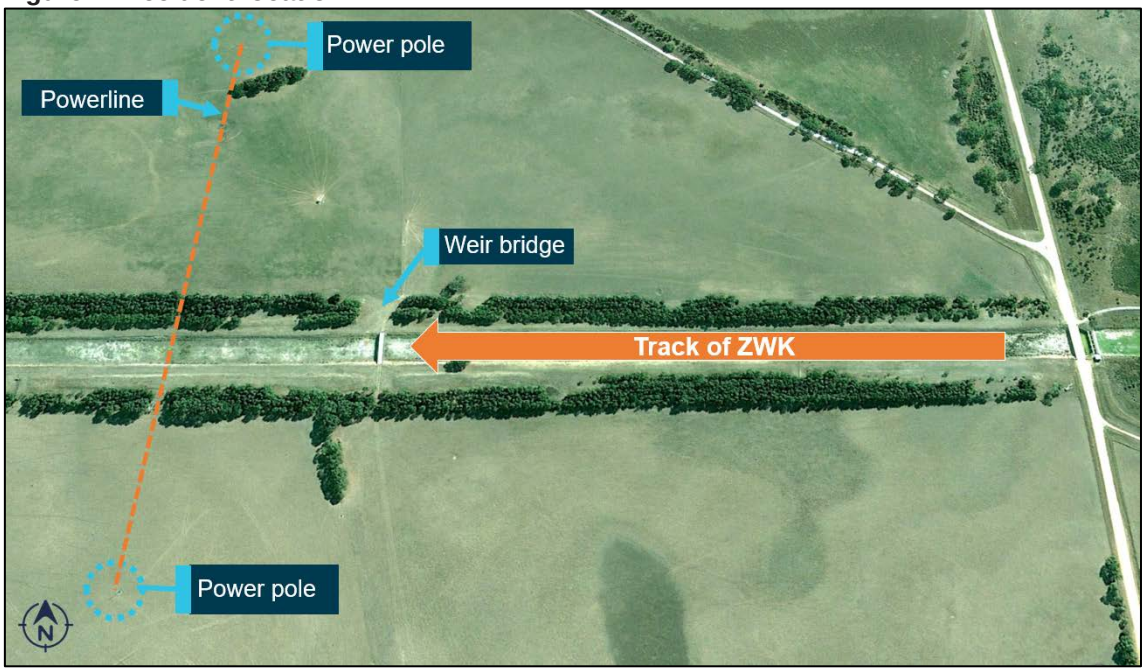
As ZWK flew along the drain, the pilot engaged in a visual scan both inside and outside of the helicopter. This included looking outside at where the helicopter was going, monitoring the track of the helicopter using a satellite track display, and monitoring the spraying equipment. This scan reflected the pilot's normal practice and he had no particular concerns about the performance of the aircraft or the equipment.

When ZWK was around 50-100 m before the weir bridge, the pilot looked at the spray nozzles, as part of his scanning sequence. When the pilot looked up and outside the helicopter, he noticed that ZWK was slightly lower than intended, in terms of achieving adequate clearance over the bridge.

The pilot manoeuvred the helicopter in order to pass over the weir bridge. The control inputs caused the helicopter to 'balloon' over the bridge. The pilot reported that this manoeuvre meant the helicopter was higher than it would otherwise have been as it passed over the weir bridge. The pilot then applied control inputs to move the helicopter back down to the desired altitude. The pilot characterised these control inputs as 'smooth', noting that it was his preference and normal practice to not manoeuvre the aircraft aggressively unless necessary.

The pilot reported that it was his plan was to fly over the weir bridge and under the powerline. However, as he adjusted the flight path of ZWK over the bridge, he momentarily forgot about the powerline. The pilot noted that if he had been aware of the powerline at that moment, he would have descended more aggressively.

Figure 1: Accident location



The image shows the track of ZWK, the location of weir bridge, and the location of power infrastructure. Source: Google Earth, modified by ATSB

Shortly after passing the weir bridge, ZWK struck the powerline. The helicopter's ground speed was around 60 kt at the time of impact.

The initial impact occurred around the centre of the front windscreen, just above the helicopter's headlights. The powerline wire then cut into the helicopter, slowing its forward movement. The wire cut up into the helicopter cabin and the control instruments.

The pilot reported that that he retained some control of the aircraft following the impact, and was able to partially cushion the landing. However, the helicopter landed hard on the bank of the drain. The pilot exited the helicopter with minor injuries. There was no fire, but the helicopter was destroyed (Figure 2).

Figure 2: **Helicopter wreckage**

The image shows the helicopter wreckage, drainage channel and weir bridge. Source: SA police, modified by ATSB

Context

Pilot information

The pilot of ZWK was experienced in agricultural spraying operations at low levels, including using the R44. In the 90 days prior to the accident, the pilot had conducted around 150 hours flying, including 36 hours in an R44.

The pilot had conducted spraying operations in the area previously, including the drain where the accident occurred. The most recent time was around a year before the accident.

The pilot had all required approvals for conducting agricultural spraying operations. The pilot had conducted SpraySafe training, and had current accreditation issued by the Aerial Application Association of Australia.

The pilot did not wear a helmet during flying operations that day. The pilot reported he would typically wear a helmet. However, he was wearing a standalone headset due to problems with the headset in his helmet.

Powerline information

The powerline struck by ZWK was a single-wire earth return (SWER) line, which consisted of a single line of intertwined narrow-gauge steel wires. The powerline spanned 244 m, and the approximate point of contact was 60 m from the nearest power pole. At the approximate point of contact, the powerline was about 8.9 m high, above the edge of the drain bank. There were no markers or other devices installed on the powerline to enhance its visibility, nor was there any requirement to install such devices.

Location information

The drainage channel was about 30 m wide, with a further 10-15 m clear bank on each side before a tree-lined boundary. This tree-lined boundary obscured visibility of the power poles from

within the drainage channel (Figure 3). It is likely that this reduced the ability of the pilot to use the power poles as visual cues for the position of the powerline.

The weather the time of the accident was clear, a temperature of about 20 °C, and a light breeze from the north-west. The pilot described the conditions as fine and said that wind had no effect on the handling of the helicopter.

Figure 3: Powerline and drain boundary

Shows powerline in profile view, and vegetation obscuring power pole beyond edge of the drain. Source: SA Power Networks. Annotated by ATSB

Helicopter information

The Robinson R44 helicopter is a single-engine, four-seat light helicopter produced by Robinson Helicopter Company.

For this accident, there was no evidence to suggest any defects or anomalies were contributory to the wirestrike.

Helicopter operators who routinely engage in low-level operations can have wirestrike protection systems (WSPS) installed on the helicopter. Helicopter WSPS commonly include cutting blades, which can provide a recovery defence when helicopters come into contact with wires. There was no WSPS installed on ZWK and no commonly available system available for the R44. The nature of these systems is such that their fitment on the outside of an aircraft is not typically possible for smaller helicopters, such as the R44.

R44 helicopters with all-aluminium fuel tanks are susceptible to post-accident fuel leaks increasing the risk of a potentially fatal post-impact fire following a collision with terrain. In 2012, the manufacturer issued a service bulletin requiring R44 helicopters with all-aluminium fuel tanks be retrofitted with bladder-type tanks as soon as practical. The ATSB issued a Safety Advisory Notice on 9 March 2012, advising of the potential dangers of the all-aluminium fuel tank. This followed from ATSB Safety Investigation *Loss of control involving Robinson R44 helicopter* (AO-2012-021).

ZWK had been fitted with a bladder-type fuel tank.

Helifarm risk management procedures

Helifarm utilised several procedures and other defences in order to manage the risks associated with low-level aerial application flying, particularly risks related to wirestrike. These included a requirement for:

- Pilots engaged in aerial application to have current 'SpraySafe' accreditation with the Aerial Application Association of Australia, as well as other licences, ratings and endorsements.
- Pilots to study maps and note the location of wires and other hazards.
- Pilots to conduct reconnaissance flights prior to commencement of operations and prior to any clean up runs.

Helifarm and the pilot associated with this accident had complied with these procedures.

Related occurrences

The ATSB has reviewed trends in wirestrike accidents in several research reports, including *Under Reporting of Aviation Wirestrikes* (AR-2011-004) and *Wire-strike Accidents in General Aviation: Data Analysis 1994 to 2004* (B2005/0055). This research has shown that many wirestrike accidents involve aerial agriculture operations.

The ATSB has also released, in association with the Aerial Agriculture Association of Australia, an educational booklet, *Wirestrikes involving known wires: A manageable aerial agriculture hazard* (AR-2011-028). This booklet contains numerous wirestrike accidents and lessons learned from them.

Reduced visibility of powerlines due to nearby vegetation has been noted in other wirestrike accident investigations. An investigation of an accident involving a Bell 206B JetRanger found that power poles were obscured by nearby trees, reducing the ability of the pilot to identify the powerline.[1] Similarly, an investigation of a wirestrike accident involving an Eagle DW1 found that a line of trees obscured vision of power poles.[2]

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1 ATSB Safety Investigation Report AO-2016-027 *Collision with terrain involving Bell 206B helicopter VH-WHU near Carmila, Qld. on 25 March 2016*

2 ATSB Safety Investigation Report AO-2015-087 *Wirestrike involving an Eagle DW1, VH-FHP, 77 km SE of Townsville, QLD on 27 July 2015*

Safety analysis

Loss of awareness of powerlines

While the pilot knew about the location of the powerline spanning the drainage channel and had flown under it earlier that day, while manoeuvring over a bridge, he momentarily forgot and lost awareness of the powerline. As a result of this momentary loss of awareness, the pilot unintentionally flew the helicopter into the powerline, resulting in ZWK colliding with terrain.

Immediately before the wirestrike, the pilot's attention was diverted towards flying and other equipment for the spraying activity. This was normal and required.

Native vegetation near the power poles obscured additional visual cues for the presence of the powerline. The powerline was narrow-gauge and had no markings. Due to the limits of the human eye, powerlines can be very difficult to see, particularly in low level flight.[3]

Humans have a limited capacity for working memory. Situational requirements to attend and respond to immediate and/or unexpected demands can mean that awareness and memory of other hazards can be lost. Other ATSB published wirestrike occurrence briefs and investigation reports have shown how awareness of powerlines can slip when pilots respond to demands such as unexpected obstacles[4] and checking a GPS display.[5]

Flying at low altitudes, particularly around powerlines, means that pilots must contend with many demands on their attention. The nature of low-level operations also means that there are very low margins for recovery from even momentary losses of awareness.

For this accident, once the pilot lost awareness of the powerline as he manoeuvred the helicopter over a bridge, it was difficult for him to regain awareness visually, as there were limited prompts for the position of the powerline.

Defences against wirestrike accidents

The operator's defences against wirestrike sought to reduce the likelihood of aircraft colliding with powerlines by supporting pilots' awareness of powerlines. The nature of spraying around powerlines is such that demands on attention are high and the ability to recover from any lapse in awareness is relatively low. It may not be possible to completely mitigate the risk of collision in this context. However, there may be some control measures that might reduce the potential consequence.

WSPS can provide an effective last-line of defence in the event of a wirestrike accident,[6] reducing the likelihood of a subsequent crash. However, these systems cannot typically be fitted to smaller helicopters, such as the R44. Helmets provide another valuable defence in the event of a crash, reducing the risk of more serious injury.[7] The ATSB noted in this accident, that the pilot was not wearing a helmet.

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3 For analysis of the difficulty detecting powerlines in flight, see ATSB Safety Investigation Report AO-2014-068 *Wirestrike involving Maule M-5, VH-HOG, 50 km WSW of Casino, NSW on 12 April 2014*

4 ATSB Occurrence Brief AB-2018-041 *Wirestrike involving Robinson R44, Whitton, NSW, on 24 March 2018*

5 ATSB Safety Investigation Report AO-2015-087 *Wirestrike involving an Eagle DW1, VH-FHP, 77 km SE of Townsville, QLD on 27 July 2015*

6 For an example of the effectiveness of WSPS, see ATSB Occurrence Brief AB-2018-039 *Wirestrike involving Bell Helicopter 206L, Pappinbarra, NSW, on 19 March 2018*

7 For an example of the effectiveness of flight helmets, see ATSB Safety Investigation Report AO-2017-115 *Collision with terrain involving PZL Warszawa-Okecie M-18A Dromader aircraft, VH-WHR, near Emerald Airport, Queensland, on 1 December 2017*

R44 Bladder Tank

Although the helicopter in this accident collided with terrain and was destroyed, there was no post impact fire. The helicopter had been fitted with a bladder-type fuel tank, and there was no indication of a fuel leak. The bladder-type fuel tank probably reduced the likelihood of a fuel leak and post-impact fire following the collision.

Findings

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- The helicopter pilot momentarily lost awareness of the position of an overhead powerline as he adjusted the track to navigate over a bridge during low-level aerial agriculture flying. It is likely that nearby vegetation contributed to the pilot's reduced awareness of the powerline.
- The helicopter collided with the overhead powerline, which led to a collision with terrain.
- The installation of a bladder-type fuel tank in the R44 helicopter reduced the risk of a post-impact fire.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety actions in response to this occurrence.

Safety action by Helifarm

Helifarm advised that as a result of this accident, they have implemented the following actions in order to reduce safety risk:

- Discussing the accident in team meetings, in order to increase focus on key hazards and risks.
- Providing pilots conducting future spraying operations at the Bool Lagoon with georeferenced maps of the area.
- Introducing additional company documentation for drain spraying to further document site-specific hazards prior to the start of each job.
- Making human factors training mandatory for pilots conducting aerial application. This training intends to increase pilot awareness in the wire and low-level environment.

General details

Occurrence details

Date and time:	13 March 2019 1428 CDT	
Occurrence category:	Accident	
Primary occurrence type:	Wirestrike	
Location:	20 km south of Naracoorte, SA	
	Latitude: 37° 9.027' S	Longitude: 140° 38.424' E

Aircraft other details

Manufacturer and model:	Robinson R44	
Registration:	VH-ZWK	
Serial number:	1994	
Operator:	Helifarm Pty. Ltd.	
Type of operation:	Aerial Work - Aerial Agriculture	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 1	Passengers – 0
Aircraft damage:	Destroyed	

About the ATSB

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

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

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

Purpose of safety investigations

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

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