



**FINAL REPORT**

**AIC 17-1004**

## **CONTROLLED FLIGHT INTO TERRAIN**

**North Coast Aviation**

**P2-ISM**

**Britten Norman BN-2A Islander**

**6.1 nm E SE of Dinangat Airstrip**

**Morobe Province**

**PAPUA NEW GUINEA**

**23 December 2017**

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The Papua New Guinea Accident Investigation Commission (AIC) was informed by the PNG Air Services Limited (PNG ASL) on 23 December 2017, of a fatal accident involving a Britten Norman Islander, registered P2-ISM, that impacted a ridge at about 9,500 ft, that runs down towards the Sapmanga Valley from the Sarawaget Ranges, Morobe Province. The AIC immediately commenced an investigation.

The AIC notified other States in accordance with ICAO Annex 13. The State of Manufacture of the aircraft appointed a non-travelling Accredited Representative to assist with the investigation.

This final *Aircraft Accident Investigation Report* was produced by the AIC, PO Box 1709, Boroko 111, NCD, Papua New Guinea. The AIC Chief Commissioner has approved the report for public release.

The report is based upon the investigation carried out by the AIC, in accordance with *Annex 13* to the *Convention on International Civil Aviation*, Papua New Guinea (PNG) *Civil Aviation Act 2000 (as amended)*, and *Chapter 31* of the *Commissions of Inquiry Act 1951*. It contains factual information, analysis of that information, findings and contributing (causal) factors, other factors, safety actions, and recommendations.

Readers are advised that in accordance with *Annex 13* to the *Convention on International Civil Aviation*, it is not the purpose of an AIC aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the final report is the prevention of accidents and incidents. (Reference: *ICAO Annex 13, Chapter 3, paragraph 3.1.*) Consequently, AIC reports are confined to matters of safety significance and may be misleading if used for any other purpose.

When the AIC makes recommendations as a result of its investigations or research, safety is its primary consideration. However, the AIC fully recognises that the implementation of recommendations arising from its investigations will in some cases incur a cost to the industry.

Readers should note that the information in AIC reports and recommendations is provided to promote aviation safety. In no case is it intended to imply blame or liability.



**Hubert Namani, LLB**

**Chief Commissioner**

**31 July 2018**

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# INTRODUCTION

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## SYNOPSIS

On 23 December 2017, at 00:10 UTC (10:10 local), a Britten Norman BN-2A Islander aircraft, registered P2-ISM, owned and operated by North Coast Aviation, impacted a ridge, at about 9,500 ft, that runs down towards the Sapmanga Valley from the Sarawaget Ranges, Morobe Province. The pilot had elected to track from Derim Airstrip to Nadzab Airport, Morobe Province across the Sarawaget ranges. The aircraft impacted the ridge in a steep nose-down, right wing-low attitude about 150 m beyond the last GPS fix. It was destroyed by impact forces. Rescuers arrived at the accident site on 27 December and reported that the pilot, the sole occupant, was deceased. They felled trees on the steep heavily timbered, densely vegetated slope about 20 metres from the wreckage and constructed a helipad.

The pilot was expected to contact Nadzab ATC (Nadzab Tower) by 00:22 prior to entering Nadzab controlled airspace. However, because the pilot had not established contact by 00:22, the Nadzab Tower controller commenced radio communication checks, and subsequently declared a distress phase, which initiated search operations. The aircraft operator contacted the Nadzab Tower controller and reported that, according to their GPS tracker, the aircraft was stationary between Yalumet and the Saidor Gap, Morobe Province.

The AIC on-site investigation determined that there was no evidence of any prior defect or malfunction in the aircraft that could have contributed to the accident. Propeller blade damage and bending was consistent with the engines producing significant power at impact. The investigation concluded that cloud build up along the pilot's chosen route may have forced the pilot to manoeuvre closer to the ridge, in order to avoid flying into the cloud. The flight track for the last 30 to 60 seconds suggests that the pilot had deviated from his planned track to cross the ridge, possibly to avoid entering cloud. The aircraft impacted terrain while under the control of the pilot; Controlled Flight Into Terrain (CFIT).

The investigation determined that PNG had no Rescue Coordination Centre established in accordance with *Annex 12 to the Convention on International Civil Aviation*. There was no evidence of clear coordination between the search teams and the rescue team during the first two days.

Prior to 9 July 2010, under *Section 13*, of the *Civil Aviation Act 2000*, the Civil Aviation Authority (CAA) that existed at that time was the agency responsible for ensuring the provision of search and rescue services. On 9 July 2010, the *Civil Aviation (amendment) Act 2010* was passed in Parliament, in which *Section 13* was repealed.

Despite PNG's international obligations under ICAO Annex 12 Standards, there was no PNG legislated obligation on any organisation in PNG for the provision of search and rescue operations, or the establishment of a RCC, although PNGASL continued to provide some coordination services to the aviation industry through the activation of a RCC on a needs basis.

On 13 December 2016, the *Civil Aviation (Amendment) Act 2016* was certified. *Sections 8A* and *8B* included the requirement for the Minister to direct agencies for which he is responsible, and whose functions are consistent with search and rescue operations, to operate and maintain the search and rescue coordination centre.

During the AIC investigation interviews with managers and staff of the relevant agencies, it was apparent that none of the personnel interviewed were aware of this *2016 Amendment Act*. The AIC was unable to find evidence that PNG had notified ICAO of Differences that exist between PNG's Civil Aviation Rules and practices and the *International Standards and Recommended Practices of Annex 12 (Eighth Edition)*.

On 18 April 2018 the PNG Accident Investigation Commission issued *Safety Recommendation AIC18-R03/17-1004* recommending that the Minister for Civil Aviation, in compliance with *Sections 8A* and *8B* of the *Civil Aviation Act 2000* (as amended in 2016), should ensure that a Rescue Coordination Centre is established, maintained, and operated, to co-ordinate and conduct aviation search and rescue

operations in PNG. This will also ensure compliance with *ICAO Annex 12*, thereby specifically complying with *Section 8A(1)(b)(ii)* of the Act.

Under international investigation Standards set by the International Civil Aviation Organization, recipients of safety recommendations are expected to respond to the investigation authority proposing the recommendation within 90 days of it being issued.

On 9 July 2018, the Hon. Alfred Manase, MP, Minister for Civil Aviation issued Minister's Directive No. MD 2018/01 titled Search and Rescue. The Directive requires PNG Air Services Limited to operate and maintain the PNG Search and Rescue Coordination Centre (RCC). On 11 July 2018 the Minister directed PNGASL to establish and perform the functions of the RCC on behalf of the State in accordance with ICAO Annex 12.

It requires PNGASL to promulgate, without delay, operational Search and Rescue Policies and Procedures; ensure that the PNG RCC established under the Minister's Directive is equipped and manned as a dedicated stand-alone unit that is independent of all other Air Traffic Services facilities in order that it cannot be rendered ineffective; and ensure that the RCC is staffed 24/7 by a dedicated team of trained and qualified personnel to coordinate and conduct aviation search and rescue operations in PNG.

On 27 July 2018, the Civil Aviation Safety Authority of PNG informed the AIC that a new Rule Part 176, titled, "Search and Rescue Services Organization - Certification and Operations" will be released for Industry comments in August, as part of CASA's NPRM Phase 5 rule-making cycle and hopefully will be signed into law by the Minister of Civil Aviation by 08 Nov 2018.

The decisive safety actions taken by the Minister for Civil Aviation and CASA have addressed the search and rescue safety concerns identified by the AIC.

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# 1 FACTUAL INFORMATION

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## 1.1 History of the flight

On 23 December 2017, at 00:10 UTC<sup>1</sup> (10:10 local), a Britten Norman BN-2A Islander aircraft, registered P2-ISM (ISM), owned and operated by North Coast Aviation, impacted a ridge, at about 9,500 ft (6°11'29"S, 146°46'11"E) that runs down towards the Sapmanga Valley from the Sarawaget Ranges, Morobe Province. The pilot elected to track across the Sarawaget ranges (See figure 1), from Derim Airstrip to Nadzab Airport, Morobe Province, not above 10,000 ft. The track flown from Derim was to the northwest 6.5 nm (12 km) to a point 0.8 nm (1.5 km) west-southwest of Yalumet Airstrip where the aircraft turned southwest to track to the Saidor Gap. GPS<sup>2</sup> recorded track data<sup>3</sup> immediately prior to the last GPS fix showed that the aircraft was on a shallow descent towards the ridge. The aircraft impacted the ridge about 150 m beyond the last fix.



**Figure 1: Aircraft track and wreckage location**

There were no reports of a transmission of an ELT distress signal.

During the search for the aircraft, what appeared to be the right aileron was found hanging from a tree near the top of the heavily-timbered, densely-vegetated ridge.

The remainder of the wreckage was found about 130 m from the aileron along the projected track. The aircraft impacted the ground in a steep nose-down, right wing-low attitude

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1 The 24-hour clock, in Coordinated Universal Time (UTC), is used in this report to describe the local time as specific events occurred. Local time in the area of the accident, Papua New Guinea Time (Pacific/Port Moresby Time) is UTC + 10 hours.

2 The **Global Positioning System (GPS)** is a global navigation satellite system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals.

3 V2 Tracker: A very small GPS tracker capable of logging GPS data to a cloud server at configurable intervals using hypertext transfer protocol (HTTP).



Figure 2: P2-ISM right aileron hanging from a tree.



Figure 3: Projected entry point

The majority of the aircraft wreckage was contained at the ground impact point. The aircraft was destroyed by impact forces. The pilot, the sole occupant, who initially survived, was reported deceased by the rescue team on 27 December 2017 at 22:10. The pilot had made contact with one of the operator's pilots at 16:15 on 23 December. The pilot's time of death, recorded on the Death Certificate, was 10:40 am local on 24 December. Rescuers felled trees on the steep heavily timbered, densely vegetated slope about 20 metres from the wreckage and constructed a helipad.



Figure 4: Accident site through the canopy (overhead)



Figure 5: Accident site with respect to the rescue team constructed helipad<sup>4</sup>

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<sup>4</sup> The area of dense vegetation and trees around the helipad was cleared by the rescue team.

According to the PNG Air Services Limited (PNGASL) *Air Traffic Control Incident Report*, at 23:57 the aircraft was cleared to track to Nadzab and descend to 3,000 ft. The pilot was expected to contact Nadzab ATC (Nadzab Tower) by 00:22 prior to entering Nadzab controlled airspace. However, because the pilot had not established contact by 00:22, the Nadzab Tower Controller initiated radio communication checks. At 00:32 the tower controller declared an INCERFA<sup>5</sup>. At 00:34 the operator contacted the Nadzab Tower Controller and reported that, according to their GPS tracker, ISM was stationary between Yalumet and the Saidor Gap, Morobe Province. The tower controller immediately upgraded the phase to an ALERFA<sup>6</sup>. At 00:55 the operator informed the Nadzab Tower Controller that they were sending an aircraft to search in the area of the last known GPS fix. At 01:15 the controller upgraded the phase to a DETRESFA<sup>7</sup>.

## 1.2 Injuries to persons

Injuries	Flight crew	Passengers	Total in Aircraft	Others
Fatal	1	-	1	-
Serious	-	-	-	-
Minor	-	-	-	Not applicable
Nil Injuries	-	-	-	Not applicable
<b>TOTAL</b>	<b>1</b>	<b>-</b>	<b>1</b>	<b>-</b>

## 1.3 Damage to aircraft

The aircraft was destroyed by impact forces.

## 1.4 Other damage

The vegetation around the area of impact sustained minimal damage.

## 1.5 Personnel information

### 1.5.1 Pilot in command

Age	: 34 years
Gender	: Male
Nationality	: Australian
Position	: Line Pilot
Type of licences	: PNG CPL, Australian CPL
Route	: Endorsed
Type ratings	: BN-2A, PAC750 XL
Total flying time	: 1,982.0 hours

<sup>5</sup> INCERFA – The code word used to designate an uncertainty phase.

<sup>6</sup> ALERFA - The code word used to designate an alert phase.

<sup>7</sup> DETRESFA - The code word used to designate a distress phase.

Total on this type	: 139.5 hours
Total hours PNG	: 347.2 hours
Total hours last 30 days	: 39.1 hours
Total hours last 7 days	: 10.5 hours
Last Competency Check	: 9 February 2017
Medical class	: One
Valid to	: 7 December 2018
Medical limitation	: Nil

The pilot successfully completed a *BN2 Line Competency Check* on 9 February 2017. This was conducted by a NCA Check Captain and included knowledge and competency. The flight check was conducted over the route Nadzab to Yalumet to Nadzab, via the Saidor Gap.<sup>8</sup> The check pilot's report specifically mentions knowledge of terrain and gap flying. The pilot had flown the route numerous times during the months prior to the accident.

## 1.6 Aircraft information

### 1.6.1 Aircraft data

Aircraft manufacturer	: Britten Norman
Model	: BN-2A
Serial number	: 227
Date of manufacture	: 1952
Date of conversion to freighter	: December 2001
Nationality	: PNG
Registration	: P2-ISM
Name of the owner	: North Coast Aviation
Name of the operator	: North Coast Aviation
Certificate of Airworthiness number	: 301
Certificate of Airworthiness issued	: 15 July 2013
Valid to	: non-terminating
Certificate of Registration number	: 301
Certificate of Registration issued	: 11 July 2013
Valid to	: non-terminating
Total airframe hours	: 32,232 hours

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<sup>8</sup> During the accident flight the pilot tracked from Derim to Nadzab via a point 0.8 nm west-southwest of Yalumet, then turned left and tracked to the Saidor Gap.

### **Engine data**

Engine type : Normally aspirated, 6 cylinder, horizontally opposed, direct drive, wing mounted

Manufacturer : Lycoming

Type : IO-540-KIB5

#### **Engine number one (Left)**

Serial number : L24212-48A

#### **Engine number two (Right)**

Serial Number : L15789-48A

The investigation determined that the engines were functioning normally prior to the accident.

### **Propeller data**

Propeller type : Clockwise rotating, 2 bladed, full feathering

Manufacturer : Hartzell

Type : HC-C2YK-2CUF

#### **Propeller number one (Left)**

Serial Number :AU9745B

#### **Propeller number two (Right)**

Serial Number : AU9739B

## **1.6.2 The aileron**

Ailerons are aircraft control surfaces designed to control an aircraft along its longitudinal axis (roll/bank attitude). The ailerons on ISM were hinged to the trailing edge on the outboard section of each wing.

To avoid flutter<sup>9</sup> during airflow across an aileron, counter-balances are installed. The Britten Norman Islander has mass balances installed at the outboard end of each aileron (see figure 6). This mass balance protrudes down and forward near the wing tip.

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<sup>9</sup> **Flutter** is an unstable oscillation which can lead to destruction. **Flutter** can occur on fixed **surfaces**, such as the wing or the stabilizer, as well as on **control surfaces** such as an aileron or the elevator.



The right aileron separated from the wing during the initial impact with trees. It is likely that the aileron separated when the mass balance became caught in a tree branch when it initially clipped a tree on the ridge.

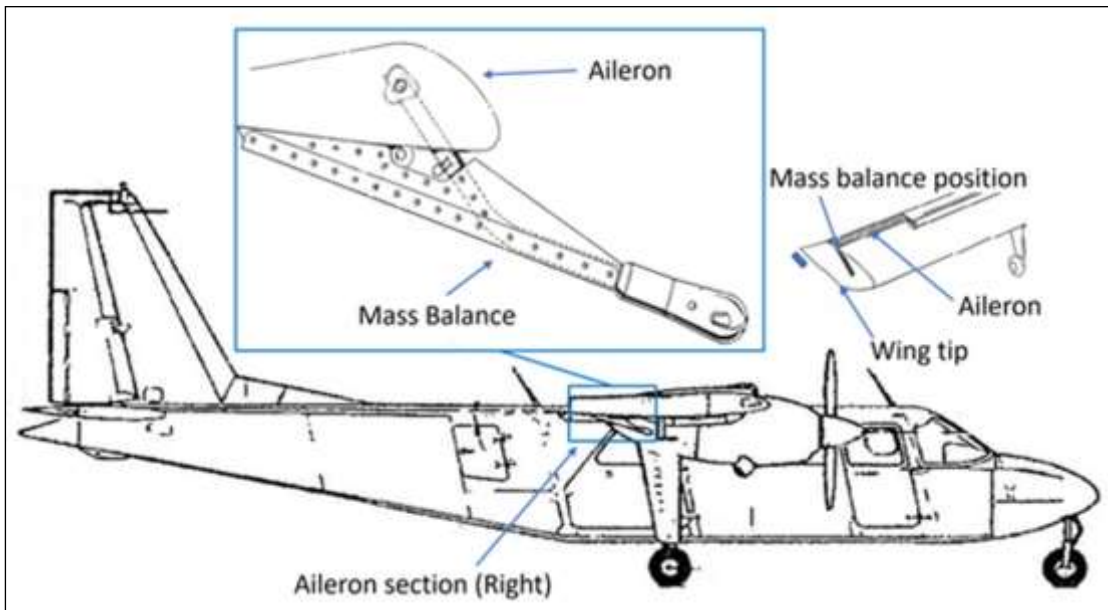


Figure 6: Britten Norman Islander aileron design

### 1.6.3 Collision avoidance equipment

The aircraft was equipped with a ground proximity warning system (GPWS) and terrain awareness warning system (TAWS).

## 1.7 Meteorological information

Weather patterns across the area are greatly influenced by topography. The Sappmanga Valley, to the north of the Sarawaget Range, is surrounded by mountain ranges. Cloud forms rapidly when air is forced up the mountain slopes. This weather phenomena is well known to pilots who fly across the area.

The general meteorological conditions across the Sappmanga Valley were fine during the morning of the accident.

Other North Coast Aviation (NCA) pilots stated that the route flown by the pilot of ISM was a 'shortcut' that was normally only taken when the northern ridges of the Sarawaget Range were clear of cloud. One of the NCA pilots reported that he had flown across the Sappmanga Valley about 20 minutes before ISM's last flight, and he could see cloud building up on the ridges along that route. He said that he informed the pilot of ISM.

## 1.8 Aids to navigation

Ground-based navigation aids, on-board navigation aids, and aerodrome visual ground aids and their serviceability were not a factor in this accident.

## 1.9 Communications

All communications between air traffic services (ATS) and the pilot were normal and did not contribute to this accident.

## 1.10 Aerodrome information

Not relevant to this investigation.

## 1.11 Flight recorders

The aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR); neither were they required by PNG Civil Aviation Rules.

## 1.12 Wreckage and impact information

The aircraft was determined to be in a right wing low attitude at the initial point of impact with a tree. The aircraft's right aileron separated from the wing when it's mass balance impacted and was snagged by a tree protruding from the forest canopy at the top of the ridge. (see figure 2).

It is likely that the aircraft flew another 130 metres unobstructed (about 3 to 4 seconds) before it impacted another tree and rapidly descended at a steep nose-down attitude, between 55 and 60 degrees, through the forest canopy and impacted the ground. The forest canopy for the most part closed over after the aircraft went through it. Few signs of entry were left, and it was almost impossible to sight the wreckage from the air. The majority of the wreckage was confined to the main impact area. All major parts were accounted for during the site investigation.



**Figure 7: P2-ISM wreckage (overhead view)**

The tip bending on all propeller blades was consistent with the blades impacting solid objects, with the propellers being driven by the engines. The amount of propeller blade bending shows that there was considerable power being produced by the engines at the time of impact. (see figure 8)



**Figure 8: Propeller tip bending**

### **1.13 Medical and pathological information**

There was no evidence that physiological factors or incapacitation affected the performance of the pilot. The pilot sustained injuries to his hands and wrists. The injuries were indicative of him holding the flight and engine controls at the time of impact and was evidence of controlled flight into terrain (CFIT).

### **1.14 Fire**

There was no evidence of pre- or post-impact fire.

### **1.15 Survival aspects**

ICAO Annex 13 requires the search and rescue activities to be addressed in an investigation of an aircraft accident. Search and rescue activities are covered in later sections of this report.

#### **1.15.1 The pilot**

The pilot initially survived the impact. His seatbelt was securely fastened at the time of impact. According to the pathologist's report, the pilot was estimated to have survived for about 24 hours before he succumbed to his injuries and the high-altitude conditions. His body was recovered from the aircraft on 28 December.

### 1.15.2 Weather and terrain

The search and rescue efforts were to a large extent affected by the weather in the area. The search aircraft were able to get into the area around the last known coordinates on the day of the accident but could not search for long before clouds and adverse weather encompassed the area.

Every effort was made to continue the search, but the forest floor was barely visible because of the dense forest vegetation.

The terrain and vegetation made it impossible for a helicopter to land anywhere close enough to facilitate the rescue on foot. The rescue teams were dropped off at the nearest villages but were unable to reach the accident site.

The terrain was steep, and the forest vegetation dense. The nearest village was 6.1 nm from the accident site, and over 4000 ft lower in the valley. Even walking around the area of the accident site was difficult due to the dense undergrowth.

### 1.15.3 The Emergency Locator Transmitter (ELT)

The ELT installed on ISM had not been dislodged during the impact, and the antenna did not appear to have been shielded. The ELT ~~installed on ISM~~ was recovered during the on-site investigation. The battery was serviceable. There was no evidence to prove if the ELT had transmitted a distress signal.

The ELT was a 406 MHz signal transmitting beacon. The signal is received through satellite transmission by the COSPAS-SARSAT and relayed to the Rescue Coordination Centre. According to the *Manual of Air Traffic Services (MATS)*, the frequencies that ATC officers request aircraft to monitor are 121.5 and 243 MHz.

Aircraft flying in the vicinity of the search area were asked by ATC to monitor 121.5 MHz frequency. They reported that they did not receive any transmissions from an ELT.

The radio frequency 243 MHz is a Ultra High Frequency band used by military aircraft. There was reportedly no military aircraft operating in, or overflying, PNG at the time.

### 1.15.4 Rescue Coordination Centre (RCC)

#### 1.15.4.1 Background

The Civil Aviation Authority (CAA) that existed in PNG prior to 1 January 2010 maintained the PNG Rescue Coordination Centre (RCC) up until the formation of PNGASL in July 2007. The CAA had coordinated Search and Rescue (SAR) services, performed by the Air Traffic Services section of the CAA.

Following the aviation regulatory reform in 2007, PNGASL continued providing SAR coordination services to the aviation industry, through the activation of an RCC on a needs basis. However, that RCC was not established and structured in compliance with *Annex 12 Standards*.

The *Civil Aviation Act* was amended in 2016 with the certifying of the *Civil Aviation (Amendment) Act 2016* on 13 December 2016. The amended Act enabled the Minister for Civil Aviation to formally delegate to PNGASL or any government agency for which the Minister is responsible and whose functions are consistent with search and rescue operations to establish, maintain and operate a search and rescue coordination centre in accordance with Section 8A(1)(a) and Section 8B(a) of the Act.

*ICAO Annex 12, Chapter 1* defines a Rescue Coordination Centre (RCC) as:

A unit responsible for promoting efficient organization of search and rescue services and for coordinating the conduct of search and rescue operations within a search and rescue region.

*Annex 12, Section 2.3 Rescue Coordination Centres and rescue subcentres* states:

2.3.1 Contracting States shall establish a rescue coordination centre in each search and rescue region.

2.3.3 Each Rescue Coordination Centre and, as appropriate, rescue subcentre, shall be staffed 24 hours a day by trained personnel proficient in the use of the language used for radiotelephony communications.

PNGASL air traffic control managers and supervisors informed the AIC investigators that the PNGASL room assigned for the RCC was not resourced, and the documentation required to efficiently and effectively conduct SAR operations was not up-to-date. The SAR coordination operation was conducted at the Port Moresby ATS Centre Supervisor's work station. There was no designated RCC office with equipment and documentation to facilitate the conduct of RCC responsibilities. Air Traffic Services staff did not have that responsibility as a full-time role as required in *Annex 12, Paragraph 2.2.3, Standard*.

The RCC SAR operations did not meet the Standards of *ICAO Annex 12*.

Funding for the establishment, operation, and maintenance of an *Annex 12 Standard* RCC was not being provided by the government to the agency conducting RCC duties, to ensure its full functionality and to meet PNG's international obligations.

The State (PNG) has Memoranda of Understanding with Australia and Indonesia making provision for search and rescue (SAR) coordination and assistance. There was no evidence that the State called either of these States for assistance.

### **1.15.5 Search and rescue relating to P2-ISM**

The pilot of ISM was confirmed to have lived for the first few hours after the impact. Aside from the calls made between himself and the other company pilots. The investigation established that the pilot's social media account (Facebook) was active at about 15:00.

The *PNG Aeronautical Information Publication (AIP) Gen 3.6-7, 6.3.9 (a)* states:

As soon as a SAR phase is declared, the RCC becomes active in coordination assistance to the aircraft in emergency.

The first SAR phase, the uncertainty phase, was declared at 00:32, and the alert phase was declared at 00:34 following concerns raised with the tower controller by the aircraft operator.

The distress phase was declared at 01:15. The PNGASL designated RCC coordinator was notified at 01:55. He arrived at the PNGASL ATC office at 04:02.

The request for a winch equipped rescue helicopter was made by one of the search aircraft pilots, to Nadzab Air Traffic Control at 03:35. That request was based on the observed challenges that appeared to be posed by the terrain and the dense vegetation. There were no suitable landing areas close enough to the accident site to facilitate a rescue on foot.

At 04:28 the rescue coordinator phoned Barrick Gold in Porgera "to enquire if they have any rescue team and aircraft capable for the rescue operations to go into the crash site". The request made no mention of a winch equipped helicopter. It only mentioned an aircraft capable of going into the crash site.

A specific request for a winch equipped helicopter was sent to Barrick by email at 21:19, on 24 December 2017.

Hevilift was copied on the email. Barrick and Hevilift notified the coordinator at about 21:50 that their helicopter, P2-HSM, was not winch equipped. The AIC has not been able to find evidence of further queries regarding winch equipped helicopters.

The PNG AIP Gen 3.6-8, 6.3-14 (a), dated 16 Oct 2014, and the version current at the time of the accident states:

When required by RCC to carry out SAR operation, the aircraft and crew are deemed to be requisitioned by the director of Civil Aviation Safety Authority under the terms of the Civil Aviation Act of 2000.

This subsection of the AIP as well as subsection 6.3-14, do not have any legal basis because *Section 13* of the *Civil Aviation Act* (2000) was repealed through the 2010 amendment.

### **1.15.6 Flight projection**

The aerial search teams conducted the search around the coordinates where the aircraft appeared stationary. The aircraft was discovered 150 m (4 seconds, based on last known speed) out from its last known coordinates.

## **1.16 Tests and research**

The battery of the Emergency Locator Transmitter (ELT) was tested and found to be serviceable. No other tests or research were required to be conducted as a result of this accident.

## **1.17 Organisational and management information**

### **1.17.1 The Operator**

North Coast Aviation (NCA) is a general aviation charter company based at Nadzab, Morobe Province. It has been in operation for many years providing air transport to and from remote areas throughout the country, mainly within Morobe Province and surrounding Provinces.

NCA employed the pilot as a line pilot towards the end of 2016. All his initial line training, and competency checks were conducted by company check and training pilots. NCA provided its pilots with appropriate and adequate route guidance material for the routes that the pilot routinely flew. On 9 February 2017, an NCA Check Captain tested the pilot's knowledge and competency of terrain and gap flying over the route Nadzab to Yalumet to Nadzab, via the Sidor Gap. (The same route as the accident flight.) The check pilot's report specifically mentions knowledge of terrain and gap flying. The pilot passed this check flight and was cleared for line flying.

The operator has a subscription to a third-party aircraft GPS tracker (see footnote 2). The operator can track their aircraft in real time using an internet application. Using this system, the operator discovered that the aircraft was stationary 6.1 nm E SE of Dinangat Village at about 9,600 ft. They alerted Nadzab tower of the situation and their concern.

At 01:15 the operator sent an aircraft to the last recorded location of the aircraft and commenced a search, which they coordinated with Nadzab tower. At about 00:00 the next morning, a large piece of wreckage was discovered hanging from a tree. The coordinates of the located wreckage were transmitted by radio to the Nadzab Air Traffic Control Unit. The operator's aircraft, in coordination with a helicopter from a Lae based helicopter operator, continued searching over the next 3 days.

### 1.17.2 Papua New Guinea Air Services Limited (PNGASL)

PNG Air Services limited (PNGASL), is a State-owned enterprise. It provides Air Navigation services that include communications, navigation, surveillance and air traffic management systems.

The Centre Supervisor was the overall supervisor of Air Traffic Control and the Flight Services Unit. Search and rescue (SAR) coordination was reportedly conducted by the Centre Supervisor. When a Centre Supervisor was not available, SAR coordination was reported to have been conducted by on-duty senior air traffic controllers. When a Centre Supervisor was on-duty, he/she was located adjacent to the air traffic controllers' consoles. The Centre Supervisors were not rated air traffic controllers, nor were they required to be rated.

Only one of the Centre Supervisors had received training to conduct SAR operations, and that training dated back to when the former Civil Aviation Authority (CAA) was responsible for air traffic services, prior to the establishment of PNGASL. He said that he had not received re-currency training and was called upon to perform SAR RCC coordinator operations duties because of his past experience.

The Centre Supervisor was regarded by PNGASL as the RCC coordinator during the SAR period that commenced following the accident on 23 December 2018.

However, he was on a rostered day off at the time of the accident and was recalled to duty. (see section 1.15.4). He carried out the RCC coordinator's duties from the Centre Supervisor's desk.

According to the PNGASL website, there was a Rescue Coordination Centre (RCC). However, the investigation found that there was in fact no RCC established in accordance with *ICAO Annex 12*, and there was no evidence to demonstrate that there had been an *ICAO Annex 12* established RCC during the CAA era and since July 2007 following the establishment of PNGASL .

When asked by the AIC during an interview, the PNGASL coordination team members involved in the SAR phase stated that there were no provisions for an RCC in PNGASL in accordance with *ICAO Annex 12* requirements.

PNGASL is required under its mandate to provide alerting services. However, it must be stated that there was no mandate on PNGASL at the time of the accident to establish, operate and maintain an RCC.

The *Search and Rescue Manual* provided to the AIC investigation by PNGASL was dated 5 October 2000. It predated the establishment of PNGASL. Since the promulgation of the *SAR Manual* in 2000 there had been amendments to the *Civil Aviation Act 2000*, in 2010 and 2016, both of which directly related to SAR responsibilities. There had also been two amendments to *ICAO Annex 12*. The first in *July 2001 (Seventh Edition)* and the second in *July 2004 (Eighth Edition)*. A subsequent amendment to the Eighth Edition became effective on 16 July 2007 and covered Rescue Coordination Centre responsibilities.

The SAR Manual had not been amended since its promulgation on 5 October 2000.

### 1.17.3 Civil Aviation Safety Authority of Papua New Guinea

The Civil Aviation Safety Authority of Papua New Guinea (CASA PNG) was established in 2010 by the *Civil Aviation Act 2000 (as amended)*. CASA PNG is a statutory body with legal mandate to promote aviation safety and security through effective safety regulation of the civil aviation industry, with particular emphasis on preventing aviation accidents and incidents within the civil aviation system in Papua New Guinea.

The CASA PNG website states:

*As a signatory to the Convention of International Civil Aviation on international civil aviation, Papua New Guinea is responsible for maintaining an ongoing compliance with its international obligations and CASA PNG provides for this in its management of the civil aviation sector. To this end, the achievement of aviation safety and security outcomes are essential to our interests and, more broadly, the region.*

Prior to the creation of CASA PNG, the then Civil Aviation Authority (CAA) was the legally responsible agency for the establishment, maintenance and operation of a Search and Rescue Coordination Centre (RCC) in PNG. With the repeal of *Section 13* of the *Civil Aviation Act 2000 (as amended)* on 7 May 2010, there was no legislated requirement in PNG for a SAR RCC.

There was no evidence to support there being a formal structured *ICAO Annex 12* RCC in PNG under the CAA. There was also no reference to aviation search and rescue in the *Civil Aviation Act* for the six years from 7 May 2010 to 13 December 2016.

The Civil Aviation Authority (CAA) that existed prior to the formation of CASA PNG as a result of the regulatory reform, coordinated search and rescue activities until the formation of PNGASL in July 2007. The search and rescue services were performed by the Air Traffic Services section of the CAA, although there is no evidence that this was in accordance with *ICAO Annex 12 Standards*.

Following the aviation regulatory reform, PNGASL continued providing SAR coordination services to the aviation industry, through the activation of an RCC on a needs basis. However, that RCC was not established and structured in compliance with *ICAO Annex 12 Standards*.

The Supplement to *ICAO Annex 12* titled *Search and Rescue* dated 31 March 2005 listed States that had notified ICAO of Differences that exist between their national regulations and practices and the *International Standards and Recommended Practices of Annex 12 (Eighth Edition)*, up to and including *Amendment 17*, or have commented on implementation. *Section 3* of the Supplement listed Papua New Guinea as a State from which no information had been received by ICAO.

The AIC was unable to find evidence that PNG had notified ICAO of Differences that exist between PNG's national regulations (rules) and practices and the *International Standards and Recommended Practices of Annex 12 (Eighth Edition)* current at the time of the accident and current at the time of the public release of this report.

In the *Foreword* of all *ICAO Annexes* to the *Convention on International Civil Aviation* it states:

*Notification of differences.* The attention of Contracting States is drawn to the obligation imposed by Article 38 of the Convention [Convention on International Civil Aviation] by which Contracting States are required to notify the Organization [ICAO] of any differences between their national regulations and practices and the International Standards contained in this Annex and any amendments thereto....

Attention of States is also drawn to the provisions of Annex 15 related to the publication of differences between their national regulations and practices and the related ICAO Standards and Recommended Practices through the Aeronautical Information Service, in addition to the obligation of States under Article 38 of the Convention.

PNG is a Contracting State and this obligation is of international importance to ensure other States and aircraft operators flying to and from and within PNG are informed of the status of PNG's compliance with the requirements of the Annexes, in particular with aviation systems and procedures of safety significance such as *ICAO Annex 12 – Search and Rescue*.

On 13 December 2016, a *Civil Aviation Act* amendment was promulgated, titled the *Civil Aviation (Amendment) Act 2016*. No evidence was provided to the AIC that the Minister at that time, or the current Minister following his appointment to the Ministry in August 2017, had been informed of the new *Sections 8A* and *8B* of the *Act*.



The new sections made the Minister responsible for compliance with those sections; specifically, to establish, maintain, and operate a Search and Rescue Coordination Centre to coordinate and conduct aviation search and rescue operations. The authority of the Minister also extended to delegating this function to any agency under his port-folio.

The current Minister was notified of the relevant Sections of the *Act* in the AIC's Safety Recommendation AIC 18-R03/17-1004 addressed to the Minister on 17 April 2018 and during a subsequent briefing by the AIC on 9 July 2018. (See Section 4.1.1 of this report *Recommendations and Safety Actions*).

In response to the AIC Recommendation, on 25 April the Director CASA PNG wrote to the Minister recommending that he issue a *Minister's Directive* pursuant to *Sections 8A and 8B* of the *Act* and an *Instrument of Delegation* pursuant to *Section 8B(d)* delegating PNGASL to exercise the Minister's powers under *Section 8A(1)(b) and (c) and 8A(2)*.

#### **1.17.4 The Office of the Minister for Civil Aviation (Minister)**

The office of Minister for Civil Aviation was held by another Member of Parliament when the *Civil Aviation (Amendment) Act 2016* was proposed and certified.

The current Minister for Civil Aviation was appointed to the portfolio in August 2017, following his election to Parliament and appointment to the Ministry. The Minister was still relatively new to the post when the accident occurred on 23 December 2017.

On 9 July 2018 the Minister for Civil Aviation issued a Minister's Directive and Instrument of Delegation to PNGASL directing PNGASL to establish and perform the functions of a Search and Rescue Coordination Centre on behalf of PNG. (See Section 4.2.1 of this report *Minister for Civil Aviation safety action*.)

On 16 July 2018, on advice from CASA PNG dated 9 July 2018, the Minister correctly informed the AIC that:

*The amendment to the Civil Aviation Act 2000 (as amended) in 2016 that became effective in early 2017 now enable my Office to formally delegate to PNG ASL in accordance with Section 8B(a) to operate and maintain the RCC established under Section 8A(1)(a) of the Act.*

The AIC investigation found that had the former Minister been informed of *Sections 8A and 8B* of the *Civil Aviation (Amendment) Act 2016* in January 2017, he would have been in a position at that time to issue a *Minister's Directive* and *Delegation* of his powers under the relevant Sections of the *Act* to any government agency for which the Minister was responsible and whose functions were consistent with search and rescue operations.

Likewise, had the current Minister been informed of *Sections 8A and 8B* of the *Civil Aviation (Amendment) Act 2016* upon taking office in August 2017, he would have been in a position at that time to issue a *Minister's Directive* and *Delegation* of his powers in this regard.

## 1.18 Useful or effective investigation technique

The accident site was densely vegetated, wet, and covered by a thick layer of fallen leaves and branches. Movement around the site, during the on-site phase, was very difficult.

The investigators who travelled to the accident site made use of a drone to capture evidence in video and photographic form. Close-up pictures and video of damage to the trees, including propeller slash marks, was made easy by use of the drone.



**Figure 9: Tree branch showing definitive propeller slash**

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## **2 ANALYSIS**

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### **2.1 Aircraft**

The evidence shows that the engines were functioning normally during the lead up to the accident, and also during the impact sequence. There was no evidence to suggest that any component or equipment malfunction was a factor in the accident.

The battery of the Emergency Locator Transmitter (ELT) was tested and found to be serviceable. The reason(s) a signal was not transmitted from the beacon could not be determined.

### **2.2 Accident site**

The accident site was difficult to locate. The forest canopy closed over the aircraft as it descended steeply through the trees, leaving few signs. It was almost impossible to sight the wreckage from the air. The main wreckage came to rest at about 9,500 ft, on the side of a ridge, that was densely covered by trees.

### **2.3 Flight projection**

After the accident site was located, the coordinates were used to calculate, to a certain degree of accuracy, the time it took from the last GPS fix to the final impact point. In this case the accident site was about 150 m along the aircraft's track from the last known coordinates. At the speed of the aircraft that was about 4 to 5 seconds.

The search, using GPS navigation, covered a radius of 1,500m around the aircraft's last fix, which was the maximum possible distance that the aircraft could have covered at maximum speed in level flight before impacting terrain.

The pilot sustained injuries to his hands and wrists. The injuries were indicative of him holding the flight and engine controls at the time of impact and was evidence of controlled flight into terrain (CFIT).

### **2.4 The aircraft operator**

The investigation found that the operator provided its pilots with appropriate and adequate route guidance material for the routes that the pilot routinely flew.

The pilot's knowledge and competency of terrain and gap flying over the route Nadzab to Yalumet to Nadzab, via the Saidor Gap had been tested. (The same route as the accident flight.) The pilot passed the check flight and was cleared for line flying.

### **2.5 Survivability**

#### **2.5.1 The pilot**

The pilot initially survived the impact. According to the pathologist's report, the pilot was estimated to have survived for about 24 hours before he succumbed to his injuries and the high-altitude conditions. His body was recovered from the aircraft on 28 December.

## 2.5.2 Search and rescue

The investigation determined that PNG had no RCC established in accordance with *ICAO Annex 12 Standards*.

The *Search and Rescue Manual* first promulgated by the CAA on 5 October 2000 had not been amended despite two subsequent *Civil Aviation Act* amendments and two *ICAO Annex 12* amendments.

The request for a winch equipped helicopter was made from an experienced search pilot in the accident area, but his request was not relayed in a timely manner. This was a key piece of information that the search team had provided as a result of their assessment of the search area.

There was no evidence of clear coordination between the search teams and the rescue team during the first two days.

## 2.5.3 Rescue Coordination Centre (RCC)

As stated in Section 1.17.3 of this report, the investigation found that prior to the creation of CASA PNG, the then Civil Aviation Authority (CAA) was the legally responsible agency for the establishment, maintenance and operation of a Search and Rescue Coordination Centre (RCC) in PNG. With the repeal of *Section 13* of the *Civil Aviation Act 2000 (as amended)* on 7 May 2010, there was no legislated requirement in PNG for a SAR RCC.

Following the aviation regulatory reform in 2007, and the establishment of PNGASL, SAR coordination services to the aviation industry continued. They were performed by PNGASL, through the activation of an RCC on a needs basis. However, that RCC was not established and structured in compliance with *ICAO Annex 12 Standards*, which presents safety concerns.

There was no evidence to support there being a formal structured *ICAO Annex 12* RCC in PNG under the former CAA or PNGASL.

There was no reference to aviation search and rescue in the *Civil Aviation Act* for the six years from 7 May 2010 to 13 December 2016.

## 2.6 Notification

The obligation to notify the Commission (AIC) of a SAR operation was not followed. The AIC did not receive a notification from CASA PNG as required under *Section 62* of the *Civil Aviation Act*.

## 2.7 Weather

The area where the accident occurred, and the surrounding areas, are known for rapid changes of the weather, in particular the rapid onset deteriorating weather. The orographic clouds form upwards over the ridge, quickly changing from fog or scattered patches of cloud into large cumulus formations. The geographical profile, location and altitude contribute greatly to this weather phenomena.

## 2.8 Terrain warning systems

It is not uncommon for pilots flying under visual flight rules (VFR) to ignore warnings from these systems when flying across PNG terrain in visual conditions, with full situational awareness.

Cloud build up along the pilot's chosen route may have forced him to manoeuvre closer to the ridge, in order to avoid flying into the cloud.

## **2.9 Notifications to ICAO of State compliance with ICAO Annexes**

The Supplement to *ICAO Annex 12* titled *Search and Rescue* dated 31 March 2005 listed States that had notified ICAO of Differences that exist between their national regulations and practices and the *International Standards and Recommended Practices of Annex 12 (Eighth Edition)*, up to and including *Amendment 17*, or have commented on implementation. *Section 3* of the *Supplement* listed Papua New Guinea as a State from which no information had been received by ICAO.

The investigation determined that CASA PNG had not notified ICAO of Differences that exist between PNG's national regulations (rules) and practices and the *International Standards and Recommended Practices of Annex 12 (Eighth Edition)* current at the time of the accident and current at the time of the public release of this report.



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## 3 CONCLUSIONS

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### 3.1 Findings

#### 3.1.1 Aircraft

The maintenance records indicated that the aircraft was equipped and maintained in accordance with the *Civil Aviation Rules*.

The aircraft was certified as serviceable when dispatched for the first flight of the day.

The ELT installed on the aircraft had not been dislodged during the impact, and the antenna did not appear to have been shielded.

There was no evidence to prove if the ELT had transmitted a distress signal.

The right aileron separated from the aircraft, in flight, when its mass balance became snagged on a tree protruding above the forest canopy, on a ridge.

There was no evidence of any prior defect or malfunction in the aircraft that could have contributed to the accident.

Propeller blade damage and bending was consistent with the engines producing significant power at impact.

The aircraft was destroyed by impact forces.

#### 3.1.2 Pilot

The pilot was licensed and qualified for the flight in accordance with the existing PNG *Civil Aviation Rules*.

The pilot had been tested and found to have the knowledge and competency required to fly the route taken on the day of the accident.

The pilot's injuries were indicative of him holding the flight and engine controls at the time of impact.

#### 3.1.3 Flight operations

Cloud build up along the pilot's chosen route may have forced him to manoeuvre closer to the ridge, in order to avoid flying into the cloud.

The flight track for the last 30 to 60 seconds suggests that the pilot had deviated from his planned track to cross the ridge, possibly to avoid entering cloud.

The investigation was unable to determine if the aircraft entered cloud prior to the tree impact and the resultant controlled flight into terrain.

#### 3.1.4 Operator

The operator provided its pilots with appropriate and adequate route guidance material for the routes that the pilot routinely flew.

The operator's check and training of its pilots included testing knowledge and competency of terrain and gap flying.

### **3.1.5 Air Traffic Services and airport facilities**

The Air Traffic Controller followed correct procedures for the declaration of the SAR phases.

The controller requested search aircraft to monitor the 121.5 MHz radio distress frequency.

The radio frequency 243 MHz is a Ultra High Frequency band used by military aircraft. There was reportedly no military aircraft operating in, or overflying, PNG at the time.

### **3.1.6 Flight recorders**

The aircraft was not fitted with flight data and voice recorders, nor were they required by PNG Rules. However, the aircraft's track data was recorded on a third-party system, providing accurate tracking data that included speed and altitude.

### **3.1.7 Medical**

There was no evidence that incapacitation or adverse physiological issues were a factor that could have contributed to the accident.

### **3.1.8 Survivability**

The pilot survived for about 24 hours before he succumbed to the injuries and the environmental conditions.

There were significant delays during the search and rescue operation.

There was no Search and Rescue Coordination structure or operations procedures in PNG in accordance with *ICAO Annex 12 Standards*.

The search team observed the need for a winch equipped helicopter and notified the ATC of this need.

The rescue operation required a winch equipped helicopter. However, the rescue team did not use any winch capable helicopters for the rescue operation.

The SAR coordinator did not request a winch capable aircraft when the enquiry was first made, via telephone, with the Barrick rescue team or Hevilift. The Barrick rescue team only became aware that a winch capable helicopter was required on the morning after the accident, through an official email request from the SAR coordinator.

### **3.1.9 Safety Oversight**

The *Civil Aviation Rules* do not address *Annex 12 - Search and Rescue Standards and Recommended Practices*.

## **3.2 Causes [Contributing factors]**

Cloud build up along the pilot's chosen route may have forced him to manoeuvre closer than normal to the ridge, in order to avoid flying into the cloud.

The aircraft's right wing struck a tree protruding from the forest canopy during controlled flight into terrain. It is likely that the right aileron mass balance became snagged on the tree and rapidly dislodged the aileron from the wing. The loss of roll control, and the aerodynamic differential, forced the aircraft to descend steeply through the forest and impacted terrain.



### **3.3 Other factor**

Other factors is used for safety deficiencies or concerns that are identified during the course of the investigation, that while not causal to the accident, nevertheless should be addressed with the aim of accident and serious incident prevention, and the safety of the travelling public.

#### **3.3.1 Search and Rescue**

While not contributing to this accident, the lack of appropriate and effective Search and Rescue capability, and the lack of a Rescue Coordination Centre established, maintained and operated in accordance with *ICAO Annex 12 Standards*, likely contributed to the delayed rescue.



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## 4 RECOMMENDATIONS AND SAFETY ACTIONS

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### 4.1 Recommendations

On 17 April 2018 the PNG Accident Investigation Commission issued the following *Safety Recommendation*.

#### 4.1.1 Recommendation number AIC 17-R03/17-1004 to the Minister for Civil Aviation

The PNG Accident Investigation Commission recommends that the Minister for Civil Aviation, in compliance with *Sections 8A and 8B* of the *Civil Aviation Act 2000* (as amended in 2016), should ensure that a Rescue Coordination Centre is established, maintained, and operated, to co-ordinate and conduct aviation search and rescue operations in PNG. This will also ensure compliance with *ICAO Annex 12*, thereby specifically complying with *Section 8A(1)(b)(ii)* of the Act

#### Action requested

The AIC requests that the Minister for Civil Aviation note recommendation *AIC 18-R03/17-1004* and provide a response to the AIC within 90 days of the issue date (**response due 17 July 2018**), and explain (including with evidence) how he has addressed the safety deficiency identified in the AIC investigation report *AIC 17-1004*. AIC Status: **ACTIVE**.

### 4.2 Safety action

#### 4.2.1 Minister for Civil Aviation safety action

**On 11 July 2018**, Hon. Alfred Manase, MP, Minister for Civil Aviation informed the PNG Accident Investigation Commission that:

On 9 July 2018, he took the following actions pursuant to Sections 8A and 8B of the *Civil Aviation Act 2000 (as amended)* to address the safety concerns:

Issued Minister's Directive No. MD 2018/01 titled Search and Rescue. The Directive requires PNG Air Services Limited to:

1. Exercise the Minister's powers under Section 8B (a) to operate and maintain the Search and Rescue Coordination Centre (RCC) under Section 8A (1) of the Act.
2. Exercise Minister's powers under Section 8A (1) (b) and (c) of the Act as duly authorised by Instrument of Delegation dated 9<sup>th</sup> July 2018.

On 11 July 2018, the Minister for Civil Aviation directed the PNG Air Services Board and PNG Air Services Limited to:

- Establish and perform the functions of the Rescue Coordination Centre (RCC) on behalf of the State in accordance with ICAO Annex 12.
- Promulgate, without delay, operational Search and Rescue Policies and Procedures.

- Ensure that the PNG RCC established under the Minister's Directive is equipped and manned as a dedicated stand-alone unit that is independent of all other Air Traffic Services facilities in order that it cannot be rendered ineffective.
- Ensure that the RCC is staffed 24/7 by a dedicated team of trained and qualified personnel to coordinate and conduct aviation search and rescue operations in PNG.

He stated that he requires that in any future AIC investigations involving a requirement for Search and Rescue that the AIC shall assess the effectiveness of the operation of the PNG Air Services Limited RCC and its compliance with ICAO Annex 12.

#### **PNG Accident Investigation Commission (AIC) assessment of the response from the Minister for Civil Aviation**

The AIC has reviewed the response from the Hon. Alfred Manase, MP, addressing the AIC recommendation AIC 18-R03/17-1004 addressed to the Minister for Civil Aviation. The AIC assigned this response a *fully satisfactory* rating and records the **Status of the AIC Recommendation: CLOSED RESPONSE ACCEPTED.**

#### **4.2.2 Civil Aviation Safety Authority of PNG (CASA) safety action**

**On 27 July 2018**, CASA informed the PNG Accident Investigation Commission that:

CASA can confirm that a new Rule Part 176, titled, "*Search and Rescue Services Organization - Certification and Operations*" will be released for Industry comments in August, as part of CASA's NPRM Phase 5 rule-making cycle and hopefully will be signed into law by the Minister of Civil Aviation by 08 Nov 2018.

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## 5 APPENDIXES

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### 5.1 Appendix 1: *Civil Aviation (Amendment) Act 2016.*

#### New section 8A and 8B

“8A. SEARCH AND RESCUE OPERATION

- (1) The Minister –
- (a) shall establish, maintain, and operate a search and rescue co-ordination centre to co-ordinate and conduct aviation search and rescue operations: and
  - (b) may exercise any powers that may be necessary or desirable –
    - (i) for effective co-ordination and performance of a search and rescue operation specified in Subsection 1; and
    - (ii) to implement any international convention or agreement relating to search and rescue to which Papua New Guinea is a Party; and
  - (c) May appoint persons to, either generally or in any particular case, participate or coordinate a search and rescue operation specified in paragraph (a).
- (2) The Minister may authorise the payment, out of money appropriated for the purpose by Parliament, of an amount that the Minister considers appropriate to –
- (a) any person who assisted in a search and rescue operation specified in Subsection (1)(a) in response to a request by a person appointed under Subsection (1)(a); or
  - (b) the owner of any vehicle, ship, or aircraft used in a search and rescue operation specified in Subsection (1)(a) in response to a request by a person appointed under Subsection (1)(c).

8B. MINISTER MAY DIRECT AGENCIES WITH RESPECT TO SEARCH AND RESCUE OPERATIONS.

The minister may direct CASA, Papua New Guinea ASL or any government agency for which the Minister is responsible and whose functions are consistent with search and rescue operations, to do any or all of the following:

- (a) operate and maintain the search and rescue co-ordination centre established under Section 8A(1)(a); or
- (b) co-ordinate, or participate in the co-ordination of any search and rescue operation specified in Section 8A(1)(a);  
or
- (c) perform, or participate in the performance of any search and rescue operation specified in Section 8A(1)(a); or
- (d) exercise any or all of the powers of the Minister under Section 8A(1)(b) and (c) and Section 8A(2), as duly authorised by instrument of delegation.”