



AIRCRAFT ACCIDENT INVESTIGATION BOARD

FINAL AIRCRAFT ACCIDENT REPORT FOR A CESSNA U206C, REGISTRATION 9J-RHE THAT OCCURRED ON 11th JUNE, 2022 IN THE LUANO VALLEY, CENTRAL PROVINCE, ZAMBIA

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INTRODUCTION

On the 11th of June, 2022 at about 15:00 hours local time, an accident involving a Cessna Aircraft was reported to the Director General Civil Aviation Authority (by Sky Trails Limited Management) who immediately relayed the information to the Aircraft Accident Investigation Board. The aircraft involved was a Cessna U206, National Registration Marks 9J-RHE, Manufacturer's Serial Number U206-1033, belonging to Sky Trails Limited, which was reported to have crash landed in the Luano Valley in Central Province.

The Interim Director Aircraft Accident Investigation Board immediately constituted an investigation team made of four Staff pertaining to the domains of Operations and Engineering out of which two travelled to the accident scene.

SYNOPSIS

On 11th June, 2022 the aircraft departed Kenneth Kaunda International Airport (KKIA) for Royal Zambezi at around 10:10 hours local time for a revenue flight. On board was one pilot and no passengers. At Royal Zambezi, the pilot picked up three passengers for a flight to Kapamba airstrip. During the flight back to Lusaka from Kapamba at approximately 40nm from Lusaka the aircraft engine power began to decrease. The pilot then tried to troubleshoot the aircraft but to no avail. Realising that the aircraft was losing altitude, he quickly scanned for a landing area as he was over hilly terrain. After spotting a suitable landing place, the pilot made a left turn and declared an emergency with Lusaka radar control. The aircraft went on to crash into the ground with its nose down, uprooting a few trees before finally being stopped by two trees where it rested with its tail up. The pilot evacuated the aircraft with no injuries. The investigation concluded that the accident was due to fuel starvation as a result of the aircraft consuming all usable fuel on board.

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1. FACTUAL INFORMATION

1.1 History of the Flight

On Friday 10th June, 2022 the aircraft was scheduled to fly from Lusaka to Jeki Airstrip with one passenger, then fly from Jeki to Royal Zambezi and finally Royal Zambezi to Kapamba with three passengers. However, these flights did not take place and the aircraft taxied back to the hanger. On 11th June, 2022 the aircraft departed Kenneth Kaunda International Airport (KKIA) for Royal Zambezi at around 10:10 hours local time for a revenue flight. On board was one pilot and no passengers. At Royal Zambezi, the pilot picked up three passengers for a flight to Kapamba airstrip. The aircraft was flown as a chartered flight which lasted about 105 minutes before landing at Kapamba at about 12:10 hours local time.

At About 13:09 hours local time, the pilot departed kapamba airstrip for a flight to Lusaka. The pilot requested flight level FL085 and flew in clear skies with a tail wind. At approximately 40nm from Lusaka the aircraft engine power began to decrease. The pilot made a few adjustments to his fuel mixture and propeller and checked his fuel tank selector. The aircraft engine momentarily resuscitated but shutdown again. The pilot then tried to troubleshoot the aircraft but to no avail. Realising that the aircraft was losing altitude, he quickly scanned for a landing area as he was over hilly terrain. After spotting a suitable landing place, he pitched the aircraft for best glide, made a left turn and declared an emergency with Lusaka radar control. He flew the aircraft to avoid stalling until the right wing made impact with a tree forcing the aircraft to turn right with its nose down. The aircraft went on to crash into the ground with its nose down, uprooting a few trees (Fig.7a and 7b) and finally was stopped by two trees where it rested with its tail up (Fig.1). The aircraft crashed about 46 nm away from Lusaka heading 120 degrees at about 1,800 feet elevation. The aircraft was extensively damaged and is beyond economic repair.

Meteorological flight conditions at the point of departure were focused as follows:

1. Surface wind:
2. Temperature: Normal day time temperature at Kapamba for the month of June
3. Weather: CAVOK (Ceiling and Visibility OK)
4. QNH: Set by pilot according to field elevation

1.2 Personnel Information

The Captain is a Zambian who resides in Zambia and holds a Commercial Pilot's License with a Medical Certificate valid until 5th October, 2022. At the time of the accident, the total hours on the pilot license exceeded 637 hours and he had accumulated a total of 35 hours on the Cessna 206 aircraft.

The following ratings were found on his Commercial Pilot's License:

Types in Group 1

1. C150/152
2. PA 44
3. C 172
4. C 206

1.3 Aircraft Information

The Cessna U206C, MSN U206-1033 is a single engine aircraft with a Continental six cylinder engine type IO-520 with a fixed pitch propeller. It has dual controls.

The aircraft was issued with a Certificate of Airworthiness (C of A) on 1st July, 2021 and was confirmed airworthy. This aircraft was flown by other pilots during the period of validity of its C of A.

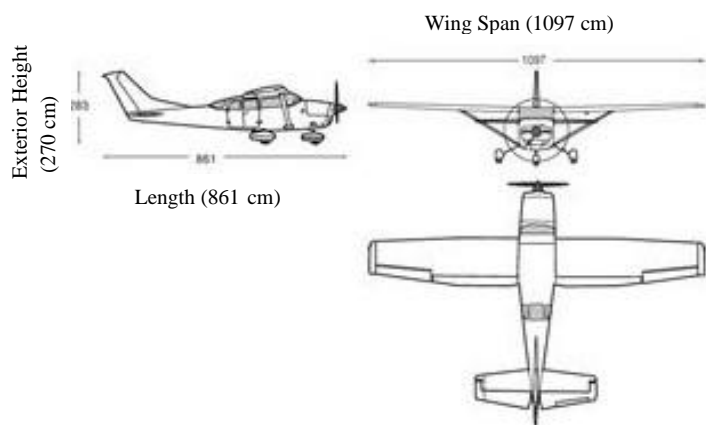
The aircraft had the following documents on board;

- a) Certificate of Registration
- b) Certificate of Airworthiness
- c) Air Operator Certificate
- d) Certificate of Release to Service
- e) Weight Schedule
- f) Radio License
- g) Certificate of Insurance
- h) Aircraft Information Manual
- i) Search and Rescue Signal Guide

The Cessna U206, Registration number 9J-RHE, MSN U206-1033 has the following technical specifications;

Exterior

- Exterior Height: 9 ft 4 in (270cm)
- Wing Span: 36 ft 0 in (1097cm)
- Length: 28 ft 3 in (861cm)



Interior

- Cabin Volume: 102 cu ft

Occupancy

- Crew: 1
- Passengers: 5

Operating Weights

- Max T/O Weight: 3600 Lbs (1,634 kg)
- Max Landing Weight: 3600 Lbs (1,634 kg)
- Operating Weight: 2116 lbs (960kg)
- Fuel Capacity: 552 lbs(250kg)
- Payload W/Full Fuel: 932 lbs (423kg)
- Max Payload: 1484 Lbs (637kg)

Range

- Service Ceiling: 15700 ft (4,785m)

Distances

- Balanced Field Length: 1780 ft (543m)
- Landing Distance: 2358 ft (719m)

Performance

- Rate of Climb: 920 fpm (280m/min)
- Max Speed: 156 kts (288km/h)
- Normal Cruise: 147 kts (272km/h)
- Economy Cruise: 117 kts (216km/h)

Power Plant

- Engines: 1
- Engine Manufacturer: Continental
- Engine Model: IO-520

Propeller

- Make: Hartzel
- Type: PHC3YF

1.4 Injuries to Persons

No one on board or outside the aircraft was reported to be injured.

1.5 Damage to the Aircraft

The aircraft was extensively damaged and is beyond economic repair as detailed below:

- a) Propeller damaged with one propeller blade bent backwards and broken windshield pieces (Fig.2)
- b) Right wing damaged and detached folded at the wing tip (Fig.3)
- c) Left wing damaged and partially detached from aircraft fuselage (Fig.4a and Fig.4b)
- d) Engine cowlings partially damaged (Fig.5)
- e) Tail section bent and damaged (Fig.6)

1.6 Meteorological Information

The meteorological information was based on pilot account with no sources of reported METAR data at Kapamba Airstrip was clear sky with light easterly winds.

1.7 Flight Recorders

The Cessna U206 is not equipped with a flight data and voice recorder.

1.8 Wreckage and Impact Information

The aircraft's right wing made first impact with a tree forcing the aircraft to turn right with its nose down. The aircraft went on to crash into the ground with its nose down, uprooting a few trees (Fig.7a and 7b) and finally was stopped by two trees where it rested with its tail up (Fig.1). The aircraft crashed about 46 nm away from Lusaka in the heading of 120 degrees at about 1,800 feet elevation. The First Officer's and Pilot in Command (PIC) instruments were visually intact.

1.9 Fire

There was no evidence of post-crash fire.

1.10 Survival Aspects

The Pilot on board survived the accident without any injuries and safely evacuated the aircraft through the windshield.

1.11 Examinations (Tests and Research)

The cockpit was critically analyzed and the throttle and propeller control levers were fully forward whilst the fuel control lever was in almost fully forward position. Although the aircraft was reported to have carried enough fuel at departure, the investigation team found no fuel in the tanks after the crash. Further, there was no visible sign of fuel leakage from the first point of impact up to the final rest point and the aircraft fuselage had no visible signs of fuel leakage.

Further examination of the aircraft and engine by the AAIB investigation team in the presence of Skytrails maintenance team revealed the following:

S/N	COMPONENT/ SYSTEM	STATE FOUND		COMMENT
01	Propeller (Fig.8)	One propeller blade found bent backwards while the other two were straight.		This indicates that the propeller was not spinning at impact.
02	Fuel Divider (Fig.9)	Diaphragm clean and not collapsed		Fuel system not blocked and fuel was flowing.
03	Spark Plugs (Fig.10)	Top Left	clean	All top spark plugs were firing. Bottom spark plugs found clean indicate firing.
		Top Right	clean	
		Bottom left	clean	
04	Throttle, Mixture and Propeller levers	All links connected		This indicates that the throttle, mixture and propeller controls were working and responsive.
05	Fuel Selector	Link connected		This indicates that the fuel selector was working.
06	Fuel Supply System (From tanks to engine) [Fig.12 to Fig.14]	Left Tank	Fuel Flow Normal	This indicates that there was no blockage or leakage in the flow of fuel from the tanks to the engine.
		Right Tank	Fuel Flow Normal	
07	Fuel Tanks	Left Tank	Found Empty	This indicates that the fuel tanks had no fuel at the time of the accident. Traces of unusable fuel were found in both tanks.
		Right Tank	Found Empty	

08	Air Filter (Fig.11)	Clean	No blockage on air filter.
09	Magnetos	Physically examined	The team found the presence of battery acid and burnt terminal cables and therefore found it unsafe to run the aircrafts electrical systems. However, physical examination of the spark plugs indicated that the Magnetos were serviceable.

The team further carried out a test on the aircraft fuel system (Fig.12 to Fig.14) to see if there was any blockage to supply of fuel from the fuel tanks to the engine. The left side tank which resides in the left wing was unstable and therefore the wing was detached and fuel was fed directly into the fuel inlet on the aircraft fuselage (Fig.12). The result indicated that fuel was running all the way to the engine (Fig.13). The left wing was set at an angle and the unusable fuel was seen exiting the tank from the fuel exits. This showed the investigation team that the tank was intact. The right side was still attached to fuselage of the aircraft and therefore, fuel was poured directly into the tank. The team noted a very small leakage in the wing root attachment area. However, the test revealed that the fuel from the right fuel tank was reaching the engine with a significant amount of pressure (Fig.14).

The test therefore revealed that the fuel system from the tanks to the engine was intact and undisturbed at the time of the accident.

1.12 Organization and Management

The pilot joined Sky Trails Limited as a freelance pilot on 1st May, 2022 and was given a series of theory and practical flights by the company before he was allowed to fly solo. He carried out several successful charters prior to the accident.

1.13 Additional Information

The Investigating Team received additional information relating to this accident from the pilot's written report and other relevant witnesses interviewed as follows:

a) Pilot In Command

On 10th June, 2022 I was scheduled to carry one passenger from Lusaka International Airport to Jeki airstrip and on 11th June, 2022 transport from Royal, three passengers to Kapamba strip. On 10th June the trip was cancelled and had full fuel on board main tank, I taxied back to the hanger. On 11th June at 09:50 local time, I started up after a preflight with full fuel on board for a flight to Royal. I departed KK at 10:10 hrs approximately and landed Royal at 10:45 hrs, picked three passengers and landed Kapamba approximately 12:10 hrs with 3 hours 30 minutes endurance at least. After departing Kapamba, I requested 085 with clear skies and a tail wind and my cruise at flight level. Approximately 40nm from Lusaka under radar without any early warning engine power began to decrease. My immediate reaction was to move the fuel and

propeller control levers to fully forward and I also checked if fuel selector was firm to the tank I periodically switched to. The engine momentarily resuscitated and quit again. I further tried troubleshooting by reselecting tank to the left and air restart but to no avail. I was losing altitude quickly and I quickly scanned for a field as I was around hilly terrain and spotted a patch that looked fairly clear. I pitched for best glide and tried my best to reach it. At this point I had declared emergency with radar control 121.3 and I pressed the emergency button on the tracking system. I flew the aircraft in a controlled decent all the way until the crash point, trying my best to avoid stalling by controlling airspeed through nose attitude. After impacting the ground, I immediately turned off the master switch to cut off power to any electrical components and I tried to access the emergency exit but the vessel was mangled at both the exits. I turned switches off, unstrapped my seatbelt and climbed out from the windshield to a safe distance as the smell of avgas was strong. I feared fire. When I observed no smoke, I returned to grab the first aid kit, water, axe and torch. Without knowing if my location was known by the rescue team, I decided to use higher ground to find cell service and met a local man who told me that there was a school nearby. I tried to reach the school and before I could reach there, I saw helicopters and I rushed back to the crash site. I signaled for help and was spotted and rescued.

TOTAL TRIP DIST – 461

TRIP TIME – 3:51

FUEL ON BOARD – 5 HRS

PERSONS ON/B – 01 NIL PAX NIL CARGO

ROUTE: FLKK – FLRZ – KAPAMBA – FLKK

b) Witness 1

He stated that he arrived at about 17:00 hours Local time to report for night shift duty the day before the accident. He was informed by his colleague that he was to refuel the aircraft (9J-RHE) from the organisations fuel reserves. He stated that PUMA had been having a problem with Avgas. He mentioned that he refuelled the aircraft with about 100 litres (50 in each tank) with about 5 by 20litre jerry cans and confirmed that the tanks were full. He stated that he refuelled using a clean funnel which was the company policy. He mentioned that the Pilot contacted him at around 21:00 hours local time to find out if the aircraft was refuelled to which he confirmed. He later filled in the company's fuel requisition form. The next morning, he again switched duty with a colleague and was off for the day. Later that day he stated that he heard the news about the aircraft accident and was very surprised.

He further informed the investigation team of previous incidents of fuel theft in the organisation but said it had not occurred in a long time.

c) Witness 2

He stated that on the material day, he was off. He later was informed about the accident and he was surprised. He stated that before the crash, the aircraft had undergone a Check I (50 hours) and Check II (100 hours) inspection. He stated that the aircraft had done between 5 to 15 hours after its last check. He mentioned that he

was not aware of any snags on the aircraft prior to the accident, except one which involved mag drops and was corrected by the replacement of a spark plug. He stated that new aircraft senders were fitted in March 2022 and he believed the fuel gauges were accurate.

d) Witness 3

He stated that the aircraft was involved in an accident three years ago and the engine was sent for shock inspection. He mentioned that the company had completed the refurbishment of the aircraft in either 2020 or 2021 and from that time it was the company's most dependable aircraft. He stated that they never received any uncommon issues with the aircraft engine but the more common ones such as the electronic display monitor not giving information on cylinders and mag drop defects. He further stated that the aircraft had undergone a Check I (50 hours) and Check II (100 hours) inspection and a further Check I inspection. This further inspection was carried out because the aircraft was going out for survey work and based on their calculations would require this Check whilst on duty. He mentioned that in this Check, they replaced all replaceable parts and carried out repairs on those repairable. He stated that on the day, he was working when he was told that the aircraft had crash landed somewhere. He mentioned that on that day he was aware that the aircraft had a number of missions.

2. ANALYSIS

2.1 Crew Resource Management

The CRM reveals that the pilot was relatively new to the organization and had significant amount of experience for the type of flight in accordance with the existing regulations. However, having received a number of theory and practical flights he was checked out by the organisation and allowed to fly solo. Further, evidence from the pilot log book and company despatch log book indicates that this was the pilots first ever flight to Kapamba Airstrip.

2.2 Engine Failure

The investigation team's analysis of the reported engine failure is as follows:

- a) **Fuel Starvation** – there could have been fuel starvation to the engine on the flight from Kapamba to Lusaka as the investigation team did not find any presence of fuel in the fuel tanks at the crash site. Further, there was no indication of fuel leakage around the wreckage area and on the fuselage of the aircraft. If there was inflight fuel leakage, the investigation team would have found the aircraft fuselage stained with Avgas (bluish stains).

The fuel selector linkage was okay – which indicates that the fuel selector was working.

Fuel flow divider was found clean and the diaphragm did not collapse – this indicates that there was no blockage and fuel was flowing.

The mixture and throttle linkages were still connected – this indicates that the throttle, mixture and propeller controls were working and responsive.

The fuel filter was found clean – this indicates that there was no blockage in the fuel system.

The fuel supply system from the tanks to the engine was found to be normal – this indicates that there was no blockage or leakage in the flow of fuel from the fuel tanks to the engine. The fuel tanks were found intact but empty.

- b) **Ignition system failure** – The investigation finds that the ignition system did not fail as the spark plugs were serviceable. In addition, physical examination of the spark plugs indicate that the magnetos were in working order.
- c) **Air starvation** – there was no air starvation to the engine as the air filter was found clean and there was no blockage in the air induction system.
- d) **Mechanical linkages** – the three power levers (propeller, throttle and mixture) were connected and functioning normally.
- e) **Propellers** – the investigation finds that the state of the propeller as evidenced by the one propeller blade bent backwards while the other two were straight indicates that the engine was not running at impact.

2.3 Maintenance

The aircraft was fully serviceable with a valid C of A. However, the aircraft had undergone two Check I (50 hours) inspections and a Check II (100 hours) inspection prior to the accident. The aircraft logbooks were sent to the CAA for issuance of C of A before the accident occurred.

2.4 Observations by the Investigation Team

- a) The team observed that the aircraft Tech Log had no records for fuel uplift. However, a company fuel uplift requisition form indicated 100L of avgas was refueled on 9th June, 2022.
- b) The Pilot in his statement indicated “I started up after a preflight with full fuel on board for a flight to Royal” and further indicated 5 hours endurance as fuel on board at the beginning of the flight. The team observed from the Company Despatch Log that the highest entry for fuel endurance was 6 hours (Ref to Sheet No. 3260, 3274, 3276, 3279, 3280, 3282 and 3283). This likely indicates that the fuel gauges may have given faulty reading of 5 hours endurance as full tanks or the aircraft did not take off with full tanks of fuel from the onset.
- c) The team observed that the pilot undertaking the flight did not physically verify the fuel quantities in both the left and right fuel tanks. He however assigned the security officer on duty at the time to check and verify the fuel quantities in the tanks.
- d) It was observed that there was no fuel in both tanks and that there were no signs of fuel leakage in flight, on and after the impact. The aircraft fuselage did not exhibit signs of fuel leakage as there was no decolourisation of the aircraft surfaces (Refer to Fig. 15).

3. CONCLUSION

3.1 Findings

- a) The Pilot had significant amount of experience for the type of flight in accordance with the existing regulations.
- b) The Pilot was on his first ever route Lusaka – Royal Zambezi – Kapamba – Lusaka.
- c) The Pilot could not recall all parameters of the aircraft performance at the time of engine failure.
- d) The Pilot did not physically verify the actual fuel quantities in both tanks during preflight exterior checks.
- e) The aircraft fuel tanks were found empty at the accident sight (there was only unusable fuel in both tanks).
- f) There was no sign of fuel leakage around the accident site or wreckage.
- g) The state of the propeller indicates that the aircraft engine was off at the time of the accident.
- h) The aircraft underwent a Check I (50 hours) inspection then a Check II (100 hours) inspection and another Check I (50 hours) inspection prior to the accident.
- i) The aircraft had 3 hours 55 minutes total time powered up with 3 hours 38 minutes total flight time.
- j) There was no evidence of any defect or malfunction in the aircraft that could have contributed to the accident.
- k) There was no evidence of airframe failure or system malfunction prior to the accident.
- l) The aircraft was structurally intact prior to impact.

3.2 Causes / Contributing Factors

The main cause of this accident from examinations of the aircraft, submitted reports and all related documentation gathered, indicate that the aircraft engine failure was due to fuel starvation as a result of the aircraft consuming all usable fuel on board.

Human Factors also played a role as there was complacency when the pilot did not physically verify the fuel quantities during the initial walk around.

4. SAFETY RECOMMENDATIONS

The Investigation Team recommends the following:

4.1 To Sky Trails Limited

AAIB/SR/2022/045

Sky Trails Limited Management is recommended to ensure that fuel replenishment procedures and documentation are followed by pilots in line with their training and Sky Trails Technical Log book which provides for the entry into the book, the amount of fuel uplifted.

Sky Trails may consider an independent person within the Company to counter check/verify the refueling of the aircraft from the Company's fuel storage.

AAIB/SR/2022/046

Sky Trails Limited Management is recommended to often discuss aircraft limitations, normal and emergency procedures in order to enhance safe handling of the aircraft during normal and emergency operation.

AAIB/SR/2022/047

Sky Trails Limited Management is recommended to add to their Pilot Checklist that the pilots undertaking the flight should physically check the quantities of fuel uplifted on all aircraft on inventory where such checks are applicable.

4.2 To the Civil Aviation Authority

AAIB/SR/2022/048

The Civil Aviation Authority is recommended to conduct random aircraft tech log record spot checks on Sky Trails Limited and other private operators in order to ensure that the correct refuelling entries into the appropriate books are made.



Fig. 1: 9J-RHE Resting Position



Fig.2: Propeller Damaged with One Propeller Blade Bent Backwards and Broken Windshield Pieces



Fig.3: Right Wing Damaged and Folded



Fig.4a: Left Wing Damaged



Fig.4b: Left Wing Partially Detached from Aircraft Fuselage



Fig. 5: Engine Cowlings Damaged and Unmounted



Fig.6: Tail Section Bent and Damaged



Fig.7a: Trees Impacted by Aircraft



Fig.7b: Trees Impacted by Aircraft



Fig.8: Propeller with One Propeller Blade Bent

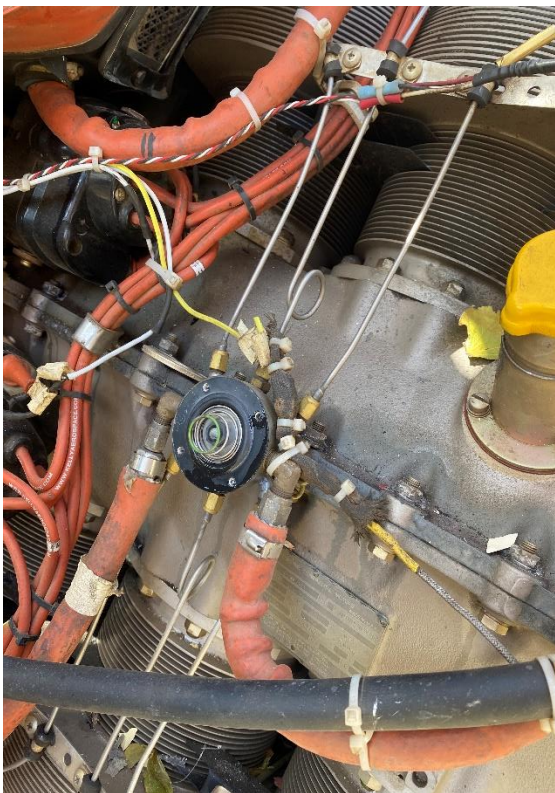


Fig.9: Fuel Divider and Diaphragm



Fig.10: Spark Plugs



Fig.11: Air Filter



Fig.12: Fuel Being Fed Directly Into the Left Side Fuel Inlet On the Aircraft Fuselage



Fig.13: Fuel From the Left Side Fuel Inlet On Aircraft Fuselage Exiting at the Engine Outlet



Fig.14: Fuel from the Right Fuel Tank Exiting at the Engine Outlet



Decolourisation of aircraft surface in contact with fuel (Avgas 100LL)

Fig. 15: When fuel is in contact with the aircraft fuselage, decolourisation occurs as seen in the photo. This decolourisation occurred when the team was conducting on-site investigations.

APPENDIX A – GLOSSARY

AAIB – Aircraft Accident Investigation Board
AGL – Above Ground Level
AOC – Air Operator Certificate
ATM – Air Traffic Management
AUW – All-Up Weight
C 206 – Cessna 206 aircraft
CAA – Zambia Civil Aviation Authority
CAVOK – Ceiling and Visibility OK
Complacency – a feeling of self-satisfaction accompanied by a loss of awareness of potential dangers. Such a feeling often arises when conducting routine activities that have become habitual and which may be “considered” as easy and safe.
CPL – Commercial Pilot Licence
CRM – Crew Resource Management
FL – Flight Level
FT – Feet
gal – Gallons
Hrs – Hours
Kg – Kilograms
KKIA – Kenneth Kaunda International Airport
Km/h – Kilometers Per Hour
Kts – Knots
Lb – Pounds
m – Meters
M° – Magnetic Degrees
MSN – Manufacturers Serial Number
MTOW – Maximum Take Off Weight
NM – Nautical Miles
PIC – Pilot in Command
PPL – Private Pilot Licence
RPM – Revolutions Per Minute
TBO – Time Before Overhaul
TSO – Time Since Overhaul
UTC – Universal Time Coordinated
VFR – Visual Flight Rules
ZCARs – Zambia Civil Aviation Regulations