AAIPU# A10-01312

AIR ACCIDENT INVESTIGATION AND PREVENTION UNIT
CIVIL AVIATION DEPARTMENT

NASSAU, N. P., BAHAMAS

AIRCRAFT ACCIDENT REPORT

LOSS OF CONTROL & UNCONTROL FLIGHT INTO TERRAIN
ACKLINS BLUE AIR CHARTER
CESSNA 402C

C6-NLH

LAKE KILLARNEY, NASSAU, N.P., BAHAMAS
OCTOBER 5, 2010

Bahamas Department of Civil Aviation
Air Accident Investigation and Prevention Unit
P. O. Box AP-59244
Lynden Pindling International Airport
Nassau N. P., Bahamas

AIRCRAFT ACCIDENT REPORT

CESSNA 402C

C6-NLH

LOSS OF CONTROL & UNCONTROLLED FLIGHT INTO TERRAIN
LAKE KILLARNEY, NASSAU, N. P., BAHAMAS
OCTOBER 5, 2010

Abstract: This report outlines the circumstances involving the accident of Lebocruise Air Limited [Acklins Blue Air Charter[1]] aircraft C6-NLH, a Cessna 402C aircraft which crashed shortly after becoming airborne from Runway 14 at Lynden Pindling International Airport into Lake Killarney, Nassau, Bahamas on October 5, 2010. Safety and security issues in this report addresses the use of unauthorized air charter operators, inadequate pilot training, inadequate security procedures at Fixed Based Operations, inadequate aircraft maintenance, CAD oversight and surveillance of unauthorized / non-certified commercial air transportation operations, weight and balance and non compliance with search and rescue requirements.

[1] Acklins Blue Air Charter is not a Bahamas recognized Air Taxi Operator

Bahamas Department of Civil Aviation
Air Accident Investigation and Prevention Unit

The Air Accident Investigation and Prevention Unit (AAIPU) is a unit within the Flight Standards Inspectorate (FSI), the regulatory unit of the Bahamas Civil Aviation Department (BCAD).

The AAIPU's function is to promote and improve safety and public confidence in the aviation industry through excellence in:

- independent investigation of aviation accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The AAIPU does not investigate for the purpose of apportioning blame or to provide a means for determining liability.

The AAIPU performs its functions in accordance with the provisions of the *Bahamas Civil Aviation (Safety) (Amendment) Regulations (CASAR) 2010, Schedule 19, International Civil Aviation Organization (ICAO) Annex 13* and, where applicable, relevant international agreements.

The Flight Standards Inspectorate established in 2001, is mandated by the Ministry of Tourism and Aviation to investigate air transportation accidents and incidents, determine probable causes of accidents and incidents, issue safety recommendations, study transportation safety issues and evaluate the safety effectiveness of agencies and stakeholders involved in air transportation.

The AAIPU makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations and safety alerts. When the AAIPU issues a safety recommendation, the person, organization or agency must provide a written response within 90 days. That response must indicate whether the person, organization or agency accepts the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

Copies of accident reports can be obtained by contacting:

Captain Patrick L. Rolle
Director
Bahamas Department of Civil Aviation
P. O. Box N975
Nassau N. P., Bahamas
(242) 326-0339/40

Bahamas Department of Civil Aviation
Air Accident Investigation and Prevention Unit

Table of Contents

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

When the following terms are used in this report, they have the following meanings;

AAIPU	Air Accident Investigation and Prevention Unit
AEC	Airmotive Engineering Corporation, A division of Danbury Aerospace
ADDS	Aviation Digital Data Service - Report by Meteorological Department
AGL/agl	Above ground level
AOC	Air Operator Certificate Holder
ARFF	Airport Rescue and Fire Fighting Service
ATC / ATS	Air Traffic Control / Air Traffic Services
AVGAS	Aviation Gasoline
CAD	Civil Aviation Department
CASR	Bahamas Civil Aviation (Safety) Regulations (April 17, 2001)
CMI	Continental Motors, Inc., formerly Teledyne Continental Motors
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CG	Center of Gravity
DAS	Danbury Aerospace
Deg / °	Degrees
DCA	Director of Civil Aviation
DST	Daylight Savings Time (+4 hours to convert to UTC)
ECi	Engine Components, Inc., a division of Danbury Aeropsace
EOC	Emergency Operations Center
EFS	Executive Flight Support
FAA	Federal Aviation Administration
FBO	Fixed Base Operator / Operation
FSI	Flight Standards Inspectorate
FSS	Flight Service Station
g	Gravity at standard sea level
ICAO	International Civil Aviation Organization
KIAS	knots indicated airspeed
kt	Knot(s)
LBS/lbs	Pounds
MYNN	Lynden Pindling International Airport
MET	Meteorological Office / Department
METAR	Weather Report furnished by Meteorological Department
MTOW	Maximum take-off weight
MYNN	ICAO identifier for Lynden Pindling International Airport Nassau, Bahamas
MYSM	Cockburn Town, San Salvador Int'l Airport
NAD	Nassau Airport Development Company
NM or nm	Nautical Miles
NTSB	National Transportation Safety Board
PMH	Princess Margaret Hospital
RBDF	Royal Bahamas Defense Force
RBPF	Royal Bahamas Police Force
SAP	Superior Airparts
TRACON	Terminal Radar Approach Control
USA/US	United States of America
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
UTC / Z	Universal Coordinated Time / Zulu time

DEFINITIONS

When the following terms are used in this report, they have the following meanings as per CASR 2001 and ICAO Annex 13;

“Aircraft Accident”– means an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage or the aircraft is missing or completely inaccessible.

"Fatal injury" - means any injury which results in death within 30 days of the accident.

“Flight recorder”-Any type of recorder installed in the aircraft for the purpose of complementing accident/incident investigation.

"Incident" - means an occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations.

“Investigation”- A process conducted for the purpose of accident prevention which includes the gathering and analysis of information, the drawing of conclusions, including the determination of causes and, when appropriate, the making of safety recommendations.

“Serious injury" - means any injury which:

- Requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received;
- Results in a fracture of any bone (except simple fractures of fingers, toes, or nose);
- Causes severe hemorrhages, nerve, muscle, or tendon damage;
- Involves any internal organ; or
- Involves second or third degree burns, or any burns affecting more than 5 percent of the body surface.
- Involves verified exposure to infectious substances or injurious radiation.

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

“State of Design” - The State having jurisdiction over the organization responsible for the type design

“State of Manufacture” - The State having jurisdiction over the organization responsible for the final assembly of the aircraft.

Stall - An **accelerated stall** is a stall that occurs while the aircraft is experiencing a load factor higher than 1 (1g), for example while turning or pulling up from a dive. In these conditions, the aircraft stalls at higher speeds than the normal stall speed (which always refers to straight and level flight). Considering for example a banked turn, the lift required is equal to the weight of the aircraft plus extra lift to provide the centripetal force necessary to perform the turn.

"Substantial damage" - means damage or failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component. Engine failure or damage limited to an engine if only one engine fails or is damaged, bent failings or cowling, dented skin, small punctured holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered "substantial damage" for the purpose of this Report.

September 30, 2011

Captain Patrick L. Rolle
Director
Bahamas Civil Aviation Department
P.O. Box N-975
Nassau, N.P.,
Bahamas

Sir

I am duty-bound to submit this report on the circumstances of the fatal accident involving C6-NLH, a Cessna 402C aircraft, registered in the Bahamas to Lebocruise Air Limited, and operated by Acklins Blue Air Charter Ltd[2]., Nassau, N.P., Bahamas. This accident occurred on October 5, 2010 at 12:36pm local time (1636 UTC) in waters of Lake Killarney, approximately ¼ mile from the approach end of Runway 27 at Lynden Pindling Int'l Airport, Nassau N. P., Bahamas.

This report is submitted pursuant to Part XII, Regulation 80, and Schedule 19 of the Bahamas Civil Aviation (Safety)(Amendment) Regulation (CASR 2010) and in accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO).

In accordance with Annex 13 to the Convention on International Civil Aviation (ICAO), and Schedule 19 of the Bahamas Civil Aviation (Safety)(Amendment) Regulations (CASAR), the fundamental purpose of such investigations is to determine the circumstances and causes of these events, with a view to the preservation of life and the avoidance of similar occurrences in the future. It is not the purpose of such investigations to apportion blame or liability.

This report contains facts which have been determined up to the time of publication. Information is published to inform the aviation industry and the public of the circumstances surrounding this accident. The contents of this report may be subjected to alterations or corrections if additional factual information becomes available.

Regards

Delvin R. Major
Investigator in Charge
Air Accident Investigation and Prevention Unit
Bahamas Department of Civil Aviation
Lynden Pindling International Airport
Nassau, N. P., Bahamas

[2] Acklins Blue Air Charter was not a Bahamas recognized Air Taxi Operator

BAHAMAS CIVIL AVIATION DEPARTMENT
AIR ACCIDENT INVESTIGATION AND PREVENTION UNIT

TITLE

Registered Owner:	Lebocruise Air Limited
Operator:	Acklins Blue Air Charter / Nelson Hanna
Manufacturer:	Cessna Aircraft Company
Aircraft Type:	Cessna Model 402C
Nationality:	Bahamas
Registration:	C6-NLH
Place of Accident:	In waters of Lake Killarney, approximately ¼ mile from the approach end of Runway 27 (MYNN) of Lynden Pindling International Airport, Nassau, Bahamas
Date and Time:	October 5, 2010 at 1636 UTC (12:36pm DST)
Notification:	DCA, NTSB, ICAO, FAA, Cessna Aircraft Company and Continental Motors, Inc., formerly Teledyne Continental Motors
Investigating Authority:	Civil Aviation Department Air Accident Investigation and Prevention Unit
Investigator in Charge:	Delvin R. Major
Accredited Representatives:	Mr. Tim Monville – NTSB Mr. Derek Nash – NTSB
Technical Advisors:	Mr. Randall S. Mainquist – Cessna Aircraft Company. Mr. Rodney Martinez – Continental Motors Inc. Mr. James Jelinski – FAA Mr. James L. Tubbs – Danbury Aerospace [ECi cylinder manufacturer]
Releasing Authority:	Director of Civil Aviation Department, Nassau, N. P., Bahamas
Date of Draft Report Publication:	July 7, 2011

SYNOPSIS

On October 5, 2010 about 1636 UTC / 12:36pm Eastern Daylight Time (EDT), C6-NLH a Cessna 402C aircraft registered to Lebocruise Air Limited and operated by Acklins Blue Air Charter/Nelson Hanna crashed into lake Killarney shortly after becoming airborne from runway 14 at Lynden Pindling International Airport, Nassau, New Providence, Bahamas. The airplane sustained substantial damages by impact forces. The pilot, copilot and seven (7) passengers aboard the airplane received fatal injuries. The aircraft was on a passenger carrying flight from Lynden Pindling Int'l Airport (MYNN) to Cockburn Town, San Salvador, Bahamas (MYSM). The aircraft was on a visual flight rules flight plan. Visual meteorological conditions prevailed at the time of the accident.

The official notification of the accident was made to the Manager of the Flight Standards Inspectorate at Lynden Pindling Int'l Airport, Nassau, N. P., Bahamas shortly thereafter. The investigation began the same day at approximately 1655 UTC upon notification of the IIC. The investigation was conducted by the Bahamas Civil Aviation Department [BCAD], Inspector Delvin R. Major (Investigator-in-Charge) of the Air Accident Investigation and Prevention Unit (AAIPU), Management of BCAD and Flight Standards Inspectorate (FSI), Airworthiness Inspectors, Operations Inspectors, Human Factors and other administrative staff. Valuable assistance was also received from the National Transportation Safety Board (NTSB), the Federal Aviation Administration (FAA) and Manufacturers of the aircraft and engine components.

Three (3) Air Operator Certificate (AOC) holders at the Domestic Section of Lynden Pindling Int'l Airport stated that on the day of the accident flight; one of the victims of the accident aircraft approached each of them individually at different times, requesting a quote and their availability to conduct a charter flight to Cockburn Town, San Salvador, Bahamas.

Each AOC holder reported that they declined to conduct the charter because by looking at the amount of luggage and other equipment that accompanied the passengers and the size of the passengers that wanted to travel, in their estimation the combined weight appeared to be in excess of the weight that their respective aircraft (Cessna 402C and Hawker Beechcraft B100) can accommodate. After the AOC holders declined to conduct the charter, sometime thereafter, the same individual that was arranging the flight with the previous AOC holders made contact with Nelson Hanna / Acklins Blue Air Charter where arrangements were made to conduct the charter flight.

The aircraft type certificate allowed for the aircraft to be operated by one (1) pilot, but the fatal flight was operated by a crew of two (2) pilots (according to eyewitness reports). The aircraft actual weight and center of gravity was unknown. As far as could be determined, the takeoff weight exceeded the maximum weight allowed of 6,850 pounds by more than 500 pounds. This excess in weight also placed the center of gravity of the aircraft outside of the safe envelope / limits for flight allowed by the manufacturer.

The flightcrewt was given instructions by ATC to taxi from the business aviation apron (Executive Flight Support) for a takeoff on Runway 14 at intersection Foxtrot. *(Intersection Foxtrot is 2,000 feet beyond the threshold of Runway 14, with a take-off run available of 9,353 feet. (Runway 14 - 11,353 feet long by 150 feet wide, see* *Appendix 5.15**).*

According to eyewitness reports, from the initiation of takeoff power up to the point when the aircraft lost control white smoke was observed trailing behind the left engine of the aircraft. Eyewitnesses also reported that the take off appeared normal with gear being retracted shortly after takeoff and the aircraft seemed to be struggling to climb. The aircraft was seen at a low height, turning in a left direction over the lake as if trying to return for a landing at the airport. The bank of the aircraft changed from shallow to very steep to almost perpendicular to the ground, gears were extended and almost immediately the aircraft lost control and nose dived into the lake inverted. It cart wheeled, coming to rest upright, approximately ¼ mile from the approach end of runway 27. The aircraft came to rest on an approximate heading of 210 degrees.

Eyewitness also reported hearing the engine run for a few seconds after the aircraft made contact with the water of the lake. There were no reports from the pilot to ATC of an emergency or any abnormalities with the aircraft or its systems after takeoff.

The flight plan form filed for this flight listed one (1) soul on board; however, there were 7 additional occupants including a "second pilot" discovered onboard the accident flight the day of the accident. The aircraft's recovery and search for luggage, equipment and additional victims commenced shortly after the accident. This effort however, was hampered by inclement weather, rough lake conditions and darkness. On October 6th, the day after the crash, aircraft recovery continued. Family members of an additional person believed to be on board, advised the authorities that there was a ninth (9th) person on board. Search to recover any additional bodies continued but search and recovery efforts proved fruitless. On October 7th, the second day after the crash, the body of the ninth (9th) victim was found in the marshes and recovered from the southwestern end of the lake in the vicinity of where the fatal crash occurred.

The investigation identified the following causal factors:

The left engine of C6-NLH suffered a mechanical failure of the #2 cylinder, and therefore could not produce rated shaft horsepower. No indication of total loss of power with the left engine reported.

The electrical and engine control switches for the right engine of C6-NLH were found in the "OFF" position; therefore the aircraft was incapable of climbing on the power of one engine alone.

The excess weight above the maximum weight allowed for takeoff may have been an important factor in the aircraft's inability to gain adequate altitude after takeoff.

Previous discrepancies existed with the left engine not producing power when required to which both pilots were made aware prior to the accident flight.

A total loss of thrust occurred once the right engine was secured and a steep turn was initiated with gear down and the left engine already developing insufficient shaft horsepower to sustain lift.

The pilot attempted to return to the departure airfield but lost control of the aircraft during a turn to the left.

Several safety and security recommendations were made during the course of this investigation.

1.0 Factual Information:

1.1 History of the Flight

On Tuesday October 5, 2010 at 12:36 EDT (1636 UTC[3]) a fixed wing, twin-engine, Cessna 402C aircraft Bahamas registration C6-NLH, serial number 402C 0458, crashed into waters of Lake Killarney shortly after becoming airborne from runway 14 at Lynden Pindling International Airport (MYNN), Nassau, New Providence, Bahamas. The pilot, second pilot and seven (7) passengers on board were fatally injured. The airplane sustained substantial damage as a result of the impact and post impact crash sequence. The crash occurred at approximate coordinates 28˚ 02.218'N and 077˚ 27.150'W. The passenger carrying flight departed at 12:35 EDT (1635 UTC). The destination was Cockburn Town, San Salvador, Bahamas. The flight was operated on a Visual Flight Rules (VFR[4]) flight plan. Visual meteorological conditions (VMC) prevailed at the time of the accident. This was the second flight of the day for the aircraft and crew. This flight was a charter flight conducted by an operator that was not recognized / authorized by the Bahamas to perform charter work.

1.1.0 Background

The pilot and copilot's duty or other activities up to 24 hrs prior to the accident, with the exception of the flight that took place prior to the accident flight, is unknown. The aircraft remained in the open air on the business aviation ramp at Lynden Pindling Int'l Airport where it is normally parked. Although the aircraft was certified for single-pilot operation, it was reported that there was a crew of two Bahamian pilots on the accident flight. It was reported that the pilot (Mr. Hanna) operated a significant portion of flights himself; however, the same pilot often accompanied him as his co-pilot. The co-pilot was qualified to fly the generic group of aircraft to which C6-NLH belonged, but he was not qualified to operate revenue flights in a 402C as a single pilot. He had not undergone the requisite type specific checks and test. As he was "time-building" his duties should have been chiefly to assist the pilot with radio telephony and administration; consequently, a more appropriate description for his role was 'second pilot'.

After returning to Nassau, arrangements were made for Acklins Blue Air Charter to fly passengers and their luggage and equipment to San Salvador, Bahamas. This was the flight that crashed resulting in nine fatalities. After loading the aircraft with passenger and luggage the aircraft obtained ATC clearance for VFR departure before taxiing from the Fixed Based Operation (FBO), Executive Flight Support (EFS).

1.1.1 Early Morning Activity

On the morning of the October 5, 2010 at 8:45am, C6-NLH was fuelled with 80 gallons of aviation gasoline (avgas) by Executive Flight Support. *(See Appendix 5.8)*. A flight plan was filed to Treasure Cay, Abaco, Bahamas. The flight plan form listed two (2) souls on board. *(It was later revealed that there were in fact six (6) souls on board for that flight)*. At approximately 9:30 am, the pilot conducted that charter flight from Lynden Pindling Int'l Airport to Treasure Cay, Abaco, Bahamas (the flight prior to the accident flight).

One of the passengers of that flight (who holds a USA Airline Transport Pilot rating [ATP]) reported that he paid Mr. Hanna to conduct a charter flight to Treasure Cay, Abaco, Bahamas. The same passenger reported that he sat in the seat behind the co-pilot (seat #4) and he observed technical problems with the aircraft's left engine manifold pressure gauge needle readings *(see Appendix 5.17)* during the engine run up exercise at the runway prior to take-off.

[3] UTC - The 24 hour clock is used to describe the time of day, Coordinated Universal Time (UTC) as particular events occurred.

[4] Visual Flight Rules - are a set of regulations which allow a pilot to operate an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

The passenger reported that he observed the left engine manifold pressure needle not reacting as it should. There was a split (or difference) of approximately 90˚ between the left engine and right engine manifold pressure reading as evidenced by the manifold pressure gauge needles. The passenger stated that he advised both pilots and they both shrugged it off as no big deal and said it will clear up once full power is applied. (See *Eyewitness Evidence 1.1.4*)

Having himself been involved in an aircraft incident with the exact type of manifold pressure discrepancy previously, the passenger stated that he was uneasy. However, the manifold pressure reading eventually came up during the take-off roll and the flight departed. The pilot was unable to land the aircraft at his destination of Treasure Cay due to bad weather. He eventually diverted and landed at Marsh Harbour International Airport, Marsh Harbour, Bahamas instead. (*See Eyewitness Evidence 1.1.4)* Aside from the enroute weather conditions that were encountered, the flight was uneventful. The crew departed Marsh Harbour and returned to Nassau.

1.1.2 Accident Flight Preparations

Sometime after returning from Marsh Harbour, a flight plan for C6-NLH was filed for a flight from Nassau to San Salvador, Bahamas. The flight plan form was received by EFS and filed with ATC with a proposed flight time of 1 hour enroute, at an altitude of 7,500 feet and four (4) hours of fuel endurance. An additional 60 gallons of Aviation Gasoline (Avgas) was loaded in the tanks of C6-NLH by Executive Flight Support at 12:06pm. (*See Appendix 5.8*). The flight plan form listed one (1) soul on board. (*Post accident, eight (8) bodies were recovered from the crash. All occupants received fatal injuries. On Thursday October 8, 2010 two (2) days after the accident, a ninth body was recovered from the waters)*. (*See Appendix 5.7 Flight Plan Form*).

The crew prepared for their flight without assistance of the EFS staff with the exception of a ramp agent who carried and loaded a box weighing approximately 30 pounds on the aircraft. The ramp agent confirmed that the co-pilot was the one that loaded the aircraft and he did not see what was loaded in the luggage compartments. He further stated that he observed the pilot while at the aircraft make some adjustments to seats 7 and 8 (the double seats at the entrance door of the aircraft). *(See seating diagram figure 4)*Apart from this encounter, no personnel at EFS paid much attention to the aircraft or the preflight activities of the crew.

The passengers gained access to the aircraft through the EFS' facility. However, no one at the facility's desk knew who they were, who took them out to the aircraft or what aircraft they boarded. No personnel at EFS knew who boarded the aircraft or where they were seated on the aircraft. No personnel knew if the luggage or equipment was weighed or whether or not a weight and balance document was prepared. The crew did not leave a copy of a weight and balance document with EFS.

1.1.3 Ground Maneuvers

At 16:31 hrs the second pilot*[5] requested ATC clearance for the flight to San Salvador and shortly thereafter clearance for taxi to the Foxtrot Intersection of Runway 14. The flight crew was cleared to taxi and to hold short of the runway and then to contact Nassau Tower controller.

1.1.4 The Take-off

At 16:35:15 Clearance to take-off was given and the second pilot acknowledged the clearance. While on the take-off roll and prior to becoming airborne, eyewitnesses observed white smoke trailing behind the left engine of the aircraft. Additional witness reported hearing sounds like a misfiring engine and observing intense white smoke during the take-off, progressively getting worse just after lift-off.

[5] * The voice recorded on ATC tapes making contact with ATC from taxi through the final transmission to land was not the voice of Mr. Nelson Hanna. Luggage handlers at Executive Flight Support confirmed that a co-pilot was on board the aircraft and the co-pilot was responsible for loading the aircraft with luggage prior to departure. Post accident investigations revealed that the copilot was a pilot employed with the RBDF who was time building. They both had recently just returned from a flight to Treasure Cay, Abaco, Bahamas.

The aircraft appeared to become airborne near intersection of Runway 14 and taxiway Bravo1 and commenced a left turn just prior to the intersection of the two runways (27 and 32).

At 16:36:15 ATC tower controller advised the pilot that he needed him to return as there was white smoke trailing behind his left engine. The pilot acknowledges and stated they were returning. At 16:36:24 the tower controller questioned the pilot if he was able to return and land on runway 27. The copilot of C6-NLH replied in the affirmative. The tower controller then approved the pilot to return to runway 27. There were no further recorded communications from the flight crew of C6-NLH. The aircraft crashed a short time later. *(See Eyewitness Evidence 1.1.5 for more information).* According to ATC tower tapes and transcription, at no time did the flight crew of C6-NLH report an emergency or any abnormalities with any engine or instrumentation.

Figure 1 and 1 C6-NLH Pre and Post Accident

1.1.5 Eyewitnesses Evidence

(*All eyewitnesses evidence presented here are from persons in the aviation field and / or knowledgeable of aviation procedures and terminology)*

A passenger (USA rated airline pilot) who had just chartered the aircraft the morning of the crash stated that while the pilots were conducting the run-up checks at the runway, prior to take-off, he observed technical problems with the manifold pressure gauge needle readings for the left engine. Concerns were raised with the pilots and he was advised that the problem would go away once full power was applied. He stated that the needles of the right and left engine manifold pressure gauge were at odds with each other by approximately 90 degree difference (*See Appendix 5.17*). The right needle of the manifold pressure gauge responded appropriately when the power lever was manipulated, but the left needle was slow to respond or did not respond at all. Eventually, the needle indications matched each other and once the pilots were satisfied, the aircraft departed. In addition to the discrepancy observed with the engine, navigational instruments in the aircraft, required for instrument meteorological conditions (IMC) flight were inoperative. The weather at the time was Instrument Meteorological Conditions (IMC). In his opinion, as a professional pilot, the passenger stated that the aircraft was un-airworthy.

A mechanic who was standing on the ramp near Executive Flight Support (EFS) at the time of the crash, told investigators that he observed the airplane take off from MYNN on runway 14, heading south. He stated that he observed white smoke trailing behind the aircraft. When he “looked at the aircraft again it appeared to be experiencing engine trouble”. He observed the aircraft banking to the left with landing gears in the down position. He stated he believed the airplane was attempting to land on runway 27, but the aircraft was flying abnormal. The witness further stated that he believed the aircraft went into a stall and that is when he believes the pilot lost control of the aircraft. He then saw the aircraft flipped upside down and plunged into the lake. He saw and heard a loud explosion.

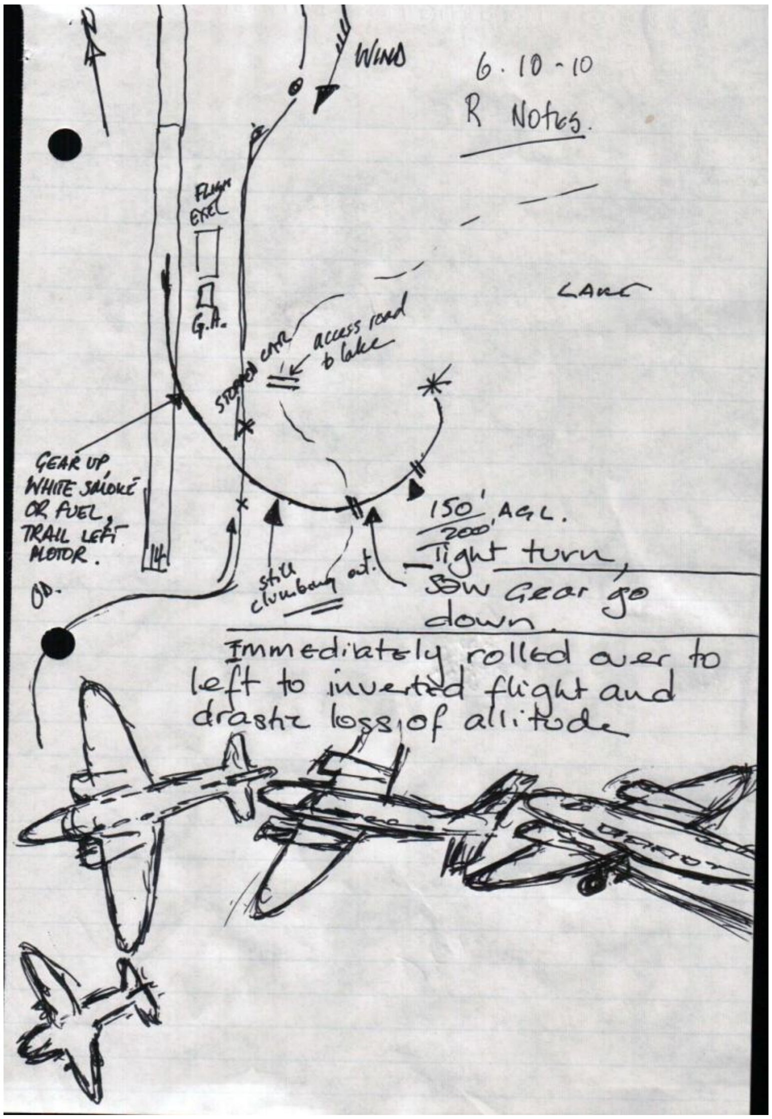


Figure 2 Eyewitness account of the accident

Another eyewitness, who is an ATC ground controller, stated “I observed aircraft C6-NLH which departed at 1633, with white smoke trailing behind the left engine. The pilot made a left turn attempting to return to the field. It was then that I noticed that the aircraft began an immediate descent and ditched into waters at the approach end of runway 27.”

Another eyewitness, who is a boat captain and private pilot, passing on the perimeter road near to runway 14/32 stated that he was travelling along Coral Harbour road / airport perimeter north bound when he observed a twin engine airplane departing the runway. The aircraft appeared to be lower than normal and white smoke was bellowing from the left engine. He stated that he thought the odor of the white smoke was consistent of aviation gas.

The plane intersected his position as it crossed the perimeter fence and disappeared from view due to the roof of his car. At that time he believes the landing gears were up. He was again able to see the airplane from his rear view window as it crossed the road and began to cross Lake Killarney.

The pilot started a bank over the lake prior to lowering the gears. The bank became more severe before finally going into a hard over and nosing into the water. The witness stated he stopped his car and ran in the direction of the crash to investigate and help. At this time he was on the phone calling 911. He advised them of the plane crash. He stated that he was the first on the scene. However, he stayed out of the water due to the presence of avgas. He stated that the plane was in the water but it was impossible to tell what attitude it was in. It was approximately 300 to 400 yards from his position. It appeared to be fractured into a number of pieces. According to the eyewitness, personnel from the airport (NAD) were next arriving on scene followed by personnel from the police force. Eventually two persons swam out to the plane and began the rescue prior to his departure.

Additionally, an eyewitness who was located on the airport at the time of the accident late stated that the airplane became airborne at intersection of runway 14 and taxiway B which in his estimation was a long and late time for an aircraft to get airborne. "At rotation the gears were up, like in a normal take-off and white stuff sprayed at about 50 feet in climb. I noticed at climb it (aircraft) seemed nose high, and trail of white smoke from left engine." "It did not get high, approximately 150 feet" He also stated that "it seemed weird to me, the engine made funny sound to me, like he was pulling down on the props, like the power was pulled back." “The aircraft turned deep and rolled over to the left. I heard the engine running for about 10 seconds after it hit the water, the engine was on, and then stopped."

Another eyewitness (an aviation technician) who was located on the ramp at MYNN at the time of the accident stated that he saw the aircraft taxi out and became airborne in a southeast direction. Approximately 3 - 5 minutes after becoming airborne he stated that he could still see white smoke trailing behind the left engine. He also stated he saw the aircraft go from a gradual left bank, to a more severe bank. “It began a left steep bank trying to return as to land.” “The aircraft went from a normal left turn to a sharp turn; left wing was almost perpendicular to the ground.” “There was a sudden flip, like a shift or a jerk to the left as though something opened like a door.” “At that point the aircraft continued in a barrel roll nose first, we heard the impact and water splash.”

A pilot who was next in line for takeoff reported that while at the threshold awaiting his takeoff clearance, he noticed the aircraft at intersection Foxtrot (C6-NLH) took an unusually long time conducting its pre-takeoff run up checks. According to this and other eyewitnesses reports, from the application of power and the initiation of the take-off roll, (from intersection Foxtrot), through the take-off, white smoke was observed trailing behind the left engine of the aircraft. The aircraft became airborne near the intersection of runway 14 and taxiway Bravo 1. The white smoke seemed to get worse after the aircraft became airborne.

Additional eyewitnesses on the field at the time stated, from initiation of the take-off roll, seeing white smoke and hearing sounds trailing behind the aircraft which sounded like the aircraft was backfiring. Eyewitnesses further stated “the gears were retracted and it appears the aircraft was struggling to climb. The aircraft made a gradual left bank increasing to a sharper bank as if trying to return for a landing. The bank continued until the wings were almost perpendicular to the ground.” “Gear was extended somewhere in the turn and the aircraft went into a barrel roll and crashed into the lake.” Witnesses reported hearing sounds as if the pilot was pulling back on the propeller levers just prior to the crash.

Eyewitnesses’ stated the aircraft was approximately 150 to 200 feet when all of this occurred. A number of eyewitnesses in cars and at the General Aviation Center saw the aircraft after it became airborne. The majority were travelling along the airport perimeter road (Coral Harbour Road). They noticed that the aircraft was at a low height as it crossed the perimeter road. The aircraft commenced a bank to the left, and increased the bank sharply as if trying to return for a landing on runway 27. They saw the aircraft angle increased until it was near vertical and then the nose dropped. They saw the aircraft enter a steep dive before disappearing behind trees and into the lake.

1.2 Injuries to Persons

Injuries	*Crew*	*Passengers*	*Others*	*Total*
Fatal	**2**	**7**	**0**	**9**
Serious				
Minor/None				

1.3 Damage to Aircraft

The aircraft sustained substantial damage due to the impact sequence and subsequent water submersion. It was later recovered from the crash site and transported to a secure facility for the field investigation.

1.4 Other Damage

Other than damage sustained by the aircraft and subsequent recovery efforts, no other damage was reported. Unknown environmental damages may have been sustained by the lake due to the amount of fuel spilled as a result of the ruptured fuel tanks.

1.5 Personnel Information

1.5.1 Pilot

43 yr old Nelson Leo Hanna, a Bahamian of Nassau, Bahamas was listed as the pilot in command on the flight plan form filed at EFS. Mr. Hanna was the holder of a valid Bahamas Commercial Pilot Certificate number 392 CP, issued on 07 October, 1999 with airplane multi-engine land, instrument airplane category and class rating with no limitations. Mr. Hanna was the holder of a Bahamas second class medical certificate issued August 04, 2009. However, he could not exercise the privileges of his commercial pilot license as this second class medical certificate expired on August 31, 2010. Mr. Hanna's medical certificate held no medical limitations.

Mr. Hanna received a medical examination for renewal of his second class medical certificate (minimum required for commercial operations) on September 7, 2010. The medical exam results were submitted to the FSI for renewal and reissuance of his second class medical on September 16, 2010. The Second Class Medical was processed and authorized shortly thereafter. However, Mr. Hanna had not returned to the FSI to retrieve his Second Class Medical certificate up to the time of the accident on October 05, 2010.

He was also the holder of a USA issued commercial pilot license with airplane - multi-engine land, instrument privileges and private pilot privileges for airplane - single engine land. Mr. Hanna's total flying experience recorded on the insurance documents retrieved post accident listed his total civilian flight times as in excess of 12,000 flight hours. His flying experience on this type of aircraft is listed as in excess of 10,000 hours. Mr. Hanna's pilot logbook was not made available to investigators therefore an accurate up to date account of his total flight time is unknown.

The amount of hours flown by Mr. Hanna in the last 24 hr, 7 days or the last 30 days prior to the accident is unknown with the exception of the flight conducted to Marsh Harbour, Abaco on October 5, 2010, the same day prior to the accident flight, which accounted for approximately 2 hours. FAA and CAD records indicate there have been no violations or prior FAA/CAD recorded aviation accident history or violations against Mr. Hanna. No records were made available to the investigation team to verify whether Mr. Hanna had accomplished a required proficiency check (required of all pilots engaged in commercial air transportation) within the specified time frame stipulated by his insurance policy and CASR Schedule 14.095, 14.120 or 14.180 for commercial operations.

1.5.2 Second Pilot

Mr. Devon Storr age 27, acted as a second pilot for the accident flight as well as several previous flights with Mr. Hanna. Mr. Storr was the holder of a valid US Commercial Pilot Certificate issued on March 15, 2008, with airplane multi-engine land and instrument airplane ratings and also held a Private Pilot Certificate with airplane single-engine land rating. Mr. Storr was also the holder of a Bahamas Commercial Pilot Certificate number 704 CP, issued on 11 August, 2010 with airplane multi-engine land, instrument airplane category and class rating with no limitations.

Mr. Storr was also the holder of a valid Bahamas First Class Medical Certificate issued 09 August, 2010 with no limitations and no restrictions. The amount of hours flown by Mr. Storr in the last 24 hours, 7days, and 30 days prior to the accident, with the exception of the flight conducted to Marsh Harbour, Abaco on October 5, 2010, the same day, prior to the accident flight which accounted for approximately 2 hours, could not be verified as no duty log or records were made available to the investigation team. No records were made available to verify whether Mr. Storr had accomplished a required proficiency check (required of all pilots engaged in commercial air transportation) within the specified time frame stipulated by CASR Schedule 14.095, 14.120 or 14.180 for commercial operations.

1.6 Aircraft Information

1.6.1 General

Aircraft C6-NLH a Bahamas registered Cessna 402C aircraft was manufactured in 1981 by Cessna Aircraft Company and designated serial number 402C0458.

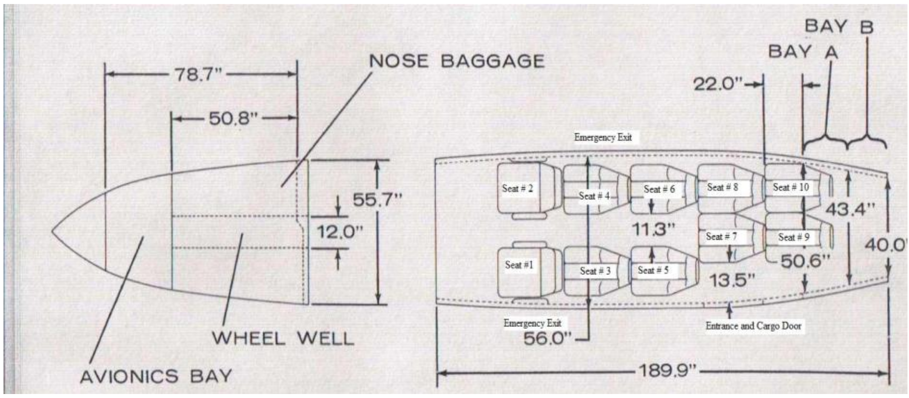


Figure 3 C402C Seating diagram

The aircraft was fitted with two (2) reciprocating engines, model number TSIO 520 VB manufactured by Teledyne Continental Motors. The aircraft was listed in the normal category, standard classification. The aircraft was issued an Airworthiness Certificate on May 19, 2010 by the Flight Standards Inspectorate, Nassau, Bahamas.

The accident airplane was configured with 10 seats, 2 pilot's seat, and eight (8) additional seats. Six of those eight passenger seats were single seats and 1 set of seats were a double seat which was positioned near the entrance door and was designated seats 7 and 8. The airplane had a main entry door which was located on the left side of the aircraft aft of the left wing and adjacent to seats 7 and 8, and two emergency exits one located forward and above the left wing, next to the pilot's seat (seat 1) and one at seat four (which was located behind the co-pilot's seat) on the right side of the aircraft, above the right wing.

The aircraft also had a cargo door on the left side aft of the left wing, which was joined to the main entry door and adjacent to seats 9 and 10 just forward of cargo area Bay A. The cabin cargo storage area began just aft of seats 9 and 10 and was designated cargo areas Bay A and Bay B. Cargo areas were also located in each wing lockers aft of each respective engine nacelles. Additionally, cargo was also stored in the Nose Luggage and Avionics Bay area of the aircraft above the nose wheel storage compartment.

1.6.2 Aircraft Description

The Cessna 402C is a twin engine, all metal, low wing airplane with retractable tricycle landing gear. The fuselage is of semi-monocoque[6] construction: the wing, tailplane and fin are of conventional aluminum construction. The aircraft can be configured for either passenger or freight transport. In the passenger role, the two forward seats are pilot's seats. A maximum of eight (8) passenger seats may be installed aft of the pilot seats. Minimum flight crew required is one (1) pilot.

1.6.3 Engines

The Cessna 402C is powered by two Teledyne Continental Motors model TSIO-520-VB engines which are turbo charged, fuel injected, direct drive, air-cooled and horizontally opposed with six cylinders each with a 520 cubic inch displacement. It is rated at 325 horsepower at 2700 propeller rpm and 39.0 inches hg manifold pressure to the critical altitude of 12,000 feet. Each engine is provided with an oil pump, fuel pump, vacuum pump, propeller governor, tachometer generator, starter and alternator.

[6] Monocoque is a construction technique that supports structural load by using an object's exterior, as opposed to using an internal frame or truss that is then covered with a non-load-bearing skin or coachwork.

1.6.4 Propellers

Propellers installed on the Left and Right engines of C6-NLH, were manufactured by McCauley Accessory Division Cessna Aircraft Company. The types of propellers were all metal, three-bladed, constant speed, full feathering, single acting, non-reversible, hydraulically actuated, governor regulated propellers. Each propeller utilizes oil pressure which opposes the force of springs and counterweights to obtain correct pitch for engine load. They were both part number 0850334-29 and had an operating limit of 2700 rpm maximum speed.

Propeller Serial number 815478 was installed on the left engine and serial number 920620 was installed on the right engine of C6-NLH. The maintenance history and times accumulated on both propellers or date installed on each respective engine could not be determined. Permanent maintenance records were requested from the pilot's wife and other local personnel up to the publication of this final report, but none were provided.

The engine and propeller controls are conventional in that each engine is controlled by three levers [1. Throttle. 2. Propeller and; 3. Mixture], which are mounted on the control pedestal in pairs in the order 1, 2, and 3 from left to right. The **Throttle control** lever is used to increase or decrease the engine power by moving the butterfly valve in the fuel air control unit. The **Propeller control** lever is used to change the propeller pitch to maintain or set a desired engine rpm. The **Mixture control** lever is used to control the amount of fuel to be metered by the fuel-air control unit.

1.6.5 Flight Controls

The flight controls consists of the ailerons, elevators and rudder and their respective trim systems. All of these systems are constructed of aluminum and are statically balanced.

Each **aileron** is attached to the rear main wing spar at two points. The aileron is actuated by a bellcrank which is attached to a wheel in the wing. The wheel is actuated by cables attached to the pilots control wheel. When the rudder is actuated, a spring assembly, interconnected to the aileron system, causes the ailerons to automatically assist the turn. **Aileron trim** is achieved by a trim tab attached to the left aileron with a full length piano type hinge. The trim tab is actuated by a push pull rod which is attached to a jack screw type actuator in the wing. The actuator is driven by cables attached to the trim control knob on the cockpit control pedestal. The aileron trim tab also acts as a servo tab so that aerodynamic forces on the tab will move the ailerons to the selected position, which reduces the forces required to activate the ailerons in flight

The **rudder** is attached to the vertical stabilizer rear main spar at three points. The rudder is actuated by a bellcrank attached to the bottom of the rudder. The bellcrank is actuated by cables attached to the cockpit rudder pedals. When the rudder is actuated, a cable and spring assembly that is connected to the aileron system causes the ailerons to automatically assist the turn. The **rudder trim** is achieved by a trim tab attached to the lower half of the rudder with a full length piano type hinge. The trim tab is actuated by a push-pull rod which is attached to a jack screw type actuator in the vertical stabilizer. The actuator is driven by cables attached to the rudder trim wheel on the cockpit control pedestal. The rudder trim tab also acts as a servo tab so that aerodynamic forces on the tab will move the rudder to the selected position, which reduces the forces required to activate the rudder in flight.

The **elevator** control surfaces are connected by a torque tube. The resulting elevator assembly is attached to the rear spar of the horizontal stabilizer at six points. The elevator assembly is actuated by a push pull rod which is attached to a bellcrank in the empennage. The bellcrank is actuated by cables attached to the pilots control wheel. **Elevator trim** is achieved by an elevator trim tab attached to the right elevator with a full length piano-type hinge. The trim tab is actuated by a push pull rod which is attached to a jack screw type actuator in the horizontal stabilizer. The actuator is driven by cables attached to the trim control wheel on the cockpit control pedestal.

1.6.6 Aircraft Fuel System

The fuel system consists of two main tanks outboard of each engine, two fuel selector valves and emergency shutoff valves and necessary components to complete the system. The main fuel tanks are an integral portion of the sealed wet wing. These tanks supply their respective engine with fuel for normal operations including take-offs and landings.

An auxiliary fuel pump, located outside the tank, provides fuel pressure for priming during engine start. In the event of an engine fuel pump failure, the auxiliary fuel pump will supply fuel to the engine if the auxiliary fuel pump switches are on.

There are two fuel selector valves controlling fuel supply to the engines. They are located in the wings and are operated by cables from selection knobs situated on the cockpit floor between the pilots' seats. Each valve has three selection positions; OFF, LEFT MAIN AND RIGHT MAIN.

Normally each engine is fed from its own tank, i.e. left engine from left tank, but the valves allow an engine to be fed from the opposite tank. This is referred to as "cross-feed". The mechanical detents, which provide positive positioning of the valves in their three functioning positions, are built into the valves. The knobs in the cockpit can themselves move freely but they are constrained by the detents through the cable system.

There is also an emergency shutoff control adjacent to and immediately behind the fuel selector controls. Its function is to isolate the fuel cross-feed lines from the fuel tanks in the event of fire or landing with the gear retracted.

C6-NLH, a 402C aircraft was approved for 100 (formerly 100/130) Grade Aviation Fuel (Green) and as an alternate, 100LL Grade Aviation Fuel (Blue). It has a total fuel capacity of 213.4 (U.S. Gallons) and 204.0 Usable Fuel (U.S. Gallons).

1.6.7 Weight and Balance

Three (3) Bahamas certified AOC holders at the domestic section of Lynden Pindling Int’l Airport stated that they were approached by one of the victims of the accident aircraft inquiring about the price and their availability to conduct a charter to San Salvador Bahamas.

They (AOC) all confirmed they declined to conduct the charter because looking at the amount of luggage, equipment and size of person that wanted to travel, the combined weight exceeded the legal amount for the size aircraft that they operated (Cessna 402C and Hawker Beechcraft B100). One operator offered a larger aircraft that was able to accommodate all of the equipment and persons present, but his offer was declined by the victim because the price was more than he was willing to pay.

Sometime thereafter, arrangements were made by the same individual for Acklins Blue Air Charter to fly the passengers and their equipment and luggage to San Salvador, Bahamas.

The accident investigators could not determine if all of the equipment and luggage that the victims had with them, (that were presented to the previous 3 AOC holders) were placed on the accident aircraft. However, all of the persons with him were all victims of the airplane crash.

On October 5, 2010 at 8:45am, the aircraft was fueled adding 80 gallons of Avgas and 2 quarts of aviation oil were purchased from Executive Flight Support. On the same day at 12:06pm an additional 60 gallons of Avgas were purchased. No indication of how much fuel was on board the aircraft prior to the additional 60 gallons that was added. The pilot however listed his fuel endurance as 4 hours.

Some luggage was recovered from the wreckage and accident site; however, no determination could be made whether this was the total luggage and equipment that was shown to the previous AOC holders. The aircraft's total weight at takeoff could not be accurately determined. The center of gravity also could not be accurately determined due to no eyewitnesses of the loading process of the aircraft. The investigation team was able to determine that the aircraft had exceeded the weight and balance limitation and center of gravity envelope for the Cessna 402C aircraft. Post accident calculations determined that the aircraft was over the maximum allowed weight for takeoff by more than 500 pounds. *(See Weight and Balance Scenario 1.16.4)*

1.6.8 Weighing Report

No documents could be obtained to verify whether the aircraft was weighed within the specified period as per BASR Schedule 5, as the aircraft permanent records were requested from the pilot's wife and other local personnel but they were never provided up to the publication of this report.

1.6.9 Limitations

Maximum Ramp Weight:	6,885 pounds
Maximum Take-off Weight:	6,850 pounds
Maximum Landing Weight:	6,850 pounds
Maximum Zero Fuel Weight:	6,515 pounds

1.6.9.1 Operating Speeds

The following aircraft operating speeds, expressed in Knots Indicated Airspeed (KIAS) were relevant to the accident flight.

- Buffet onset speed (flaps UP at MTOW) 80
- Stalling Speed (power off flaps up) 80
- Minimum control speed (flaps UP) V_{MCA}[7] 80
- One engine inoperative best rate of climb speed (V_Y)[8] 104
- One engine inoperative best angle of climb speed (V_X) 109
- Blue Radial Line[9] 104

1.6.10 Maintenance History of the Aircraft

The permanent maintenance records were requested from the pilot's wife and other local personnel but none was provided. Therefore a history of the aircraft could not be determined. However, some major events such as engine overhauls, cylinder overhauls and repairs paperwork was obtain from the repair shop. Additional information pertaining to the manufacture of the cylinders was also obtained.

1.6.11 Maintenance History of the Left Engine and Propeller

Work orders provided by Airmotive Engineering Corp pertaining to work performed on the ECi parts was obtained, but is not a complete history. Extensive research was performed by the NTSB and is contained in the NTSB materials Laboratory factual report referred to in Appendix 5.1

---

[7] This is the minimum flight speed at which the airplane is directionally controllable with one engine inoperative and with a 5˚ bank towards the operative engine.

[8] This speed delivers the greatest gain in altitude in the shortest possible time with one engine inoperative at sea level, standard day conditions and 6,850 pounds weight.

[9] One engine inoperative best rate-of-climb speed, at sea level, standard day condition and 6,850 pounds weight.

1.6.12 Maintenance history of the Right Engine and Propeller

The permanent maintenance records were requested from the pilot's wife and other local personnel but none was provided. Therefore a history of the right engine and propeller could not be determined.

1.7 Meteorological Information

Weather observations are transmitted in coordinated universal time / Zulu time (UTC / Z). Eastern Daylight Time is 4 hours behind UTC / Z time. Bahamas Meteorological Department at the Lynden Pindling International Airport issued the Bahamas Area Forecast[10] which originated at 1630 UTC; dated Tuesday October 5, 2010 valid for 12 hours from 1800 UTC reported a combination stationary front along with a surface trough across the northwestern and central Bahamas producing unstable weather through the forecasted period. Significant Weather section of the Bahamas Area Forecast over the central and northwest Bahamas indicated scattered to broken clouds from 1,200 feet to 1,800 feet with towering cumulus[11] and cumulonimbus[12] clouds. A scattered and broken layer of clouds were at 3,000 feet and 5,000 feet respectively.

A layered broken to overcast clouds were 8,000 feet and 12,000 feet up to 24,000 feet (FL240)[13]. Widespread rain was forecasted with scattered showers and thundershowers mainly in the vicinity of the trough or front in lines and clusters with towering cumulus or cumulonimbus with tops above FL180 to FL240. Ceiling[14] and / or visibility was reduced below 1,200 feet and 3 nautical miles in heavy showers, rain and thundershowers. Moderate to severe turbulence in the vicinity of all towering cumulus and cumulonimbus clouds was forecasted.

Forecasted Upper Winds and Temperature for the same time period from 1800 UTC at the 2,000 foot level in the northwestern Bahamas were winds 030˚ at 28 knots, visibility unrestricted scattered clouds at 1,800 feet, scattered clouds at 12,000 feet, broken cloud layer at 3,500 feet, another broken layer at 10,000 feet. From the 06 October at 1200 Z expect the winds to be from 030˚ at 24 knots, visibility unrestricted, scattered clouds from 1,600 feet and a broken layer at 24,000 feet.

Aerodrome Forecasts for Lynden Pindling Int'l Airport (MYNN) indicated on the 05 October from 1600Z to the 05 October 1800Z to the 06 October at 1800Z winds from 090˚ at 06 kts. The 1600Z METAR[15] (12:00pm local time) indicated that the winds were 100 degrees at 6 knots; visibility was 7 nautical miles in light rain showers. Clouds were scattered at 1,800 feet, and broken at 10,000 feet and then again broken at 24,000 feet. The temperature was 88˚F[16] / 31˚ C[17], and the dewpoint[18] was 81˚F / 27˚C. The barometric pressure[19] was 1012.2 HPA[20] and altimeter 29.89" HG.[21]

---

[10] Area Forecast - An **Aviation Area Forecast** or FA encompasses the weather conditions over a large regional area and is considered one of the better sources of information for en route weather. It is also beneficial in verifying airport conditions at airports that do not have terminal aerodrome forecasts.

[11] Towering Cumulus Clouds - **Cumulus clouds** are a type of cloud with noticeable vertical development and clearly defined edges. *Cumulus* means "heap" or "pile" in Latin. They are often described as "puffy" or "cotton-like" in appearance.

[12] Cumulonimbus Clouds - **Cumulonimbus** (**Cb**) is a type of cloud that is tall, dense, and involved in thunderstorms and other intense weather

[13] FL - A **Flight Level** (**FL**) is a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

[14] Ceiling - With respect to weather conditions, a **ceiling** refers to the height of the lowest obscuring cloud layer above the ground.

[15] METAR - **METAR** is a format for reporting weather information.

[16] ˚F / Fahrenheit - **Fahrenheit** is the temperature scale proposed in 1724 by, and named after, the physicist Daniel Gabriel Fahrenheit (1686–1736).

1.8 Aids to Navigation

No discrepancies with navigational aids were known or reported.

1.9 Communications

No difficulties with internal or external communications were known or reported.

1.10 Aerodrome Information

Lynden Pindling International Airport (IATA: **NAS**, ICAO: **MYNN**), formerly known as **Nassau International Airport**, is the largest airport in The Bahamas, and the largest international gateway into the country. It has an airport elevation of 16 feet above mean sea level. The coordinates are 25˚ 02'20" N and 077˚ 27'58"W. It is a major hub for Bahamasair and is located in the western district of New Providence Island near the capital city of Nassau. Due to a large amount of flights to the United States, the airport contains U.S. Border preclearance facilities allowing all US flights to operate as domestic flights upon arrival at their destination.

The name of the airport was officially changed on July 6, 2006 in honor of The Right Honorable Sir Lynden Oscar Pindling (22 March 1930 – 25 August 2000), first Prime Minister of The Commonwealth of the Bahamas. The airport is served by runways 14/32 which is oriented southeast and northwest and runway 09/27 which is oriented east and west. Runway 14/32 is 11,353 feet long and 150 feet wide and runway 09/27 is 8,273 feet long and 150 feet wide, both are paved surfaces and constructed of asphalt. (*See Appendix 5.15 Aerodrome Chart)*

1.10.1 Nassau Airport Development Company (NAD)

Nassau Development Company Limited was incorporated on June 6, 2006 under the provision of the Companies Act 1992. The company is a wholly-owned subsidiary of The Airport Authority. The registered office and principal place of business is located at the Lynden Pindling International Airport, Nassau, Bahamas.

The principal functions of NAD are to manage, develop and maintain MYNN and to transform the airport into a premier world class facility in a most efficient and commercial manner. NAD commenced its operations on October 1, 2006. On October 19, 2006, NAD entered a 10 year Management Agreement with YVR Airport Services Ltd. (YVRAS), to manage, operate and maintain MYNN and to place certain executives within NAD.

On April 1, 2007 NAD entered a 30-year Lease Agreement with the Airport Authority. In accordance with this Lease Agreement, NAD is responsible to manage, maintain and operate MYNN and rent is paid to the Airport Authority.

---

[17] ˚C / Celcius - **Celsius** (known until 1948 as **centigrade**) is a temperature scale that is named after the Swedish astronomer Anders Celsius (1701–1744).

[18] Dewpoint - The **dew point** is the temperature at which a given parcel of humid air must be cooled, at constant barometric pressure, for water vapor to condense into water.

[19] Barometric pressure - **Atmospheric pressure** is the force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere.

[20] HPA - Hectopascal (hPa), a unit of pressure equivalent to about 1/1000 of 1 atmosphere.

[21] HG - **Hg** may refer to: Mercury (element) or Hg

1.10.2 Aircraft Rescue and Firefighting

The Airport Authority at Lynden Pindling International Airport (MYNN) maintains a level 7 ARFF[22] facility on the airfield for all alerts on airport property. The station is owned and operated by the Airport Authority. It is continuously staffed (24 hours) with a minimum of nine (9) firefighters. ARFF has an airport emergency plan detailing response, recovery and resolution actions in the event of an accident or incident involving aircraft at the airport or within the boundary of MYNN.

The station houses four (4) crash trucks, three (3) Oshkosh T1500 trucks with a capacity of 1500 gallons of water and 200 gallons of foam concentrate and one (1) Ford 550 truck with a capacity of 300 gallons of water and 20 gallons foam concentrate. Both trucks have a capacity of 400 pounds of dry chemical. ARFF personnel receive approximately 6 months of training initially and a minimum of 150 hours annually. This training is done in phases quarterly. This refresher training is done in South Carolina in the United States of America. The training (initial and recurrent) includes but is not limited to, hot fire drills, pressure fed fuel fires, rescue simulation and apparatus operation. The training includes practical, classroom and computer based scenarios.

1.10.3 Air Traffic Control

The ATCT at MYNN is CAD-staffed combined terminal approach radar control (TRACON)[23] and tower with about 180,000 operations per year. The tower cab is continuously open and is located north of runway 09/27, and southwest of runway 14/32 centered between runways 09/27 and 14/32. Air traffic control (ATC) radar data are provided by an Airport Surveillance Radar "ASR-8" Approach Radar System, with "ARTS 2A" Automation Software. The radar antennae head is located approximately 1 nm south of the Control Tower.

C6-NLH was handled by three (3) air traffic controllers on the day of the accident: the clearance delivery controller, the ground controller and the tower controller, all were classified as Grade One Air Traffic Control Officers. The ground controller notified ARFF as well as the Princess Margaret Hospital of the accident.

1.11 Flight Recorders

C6-NLH was not fitted with a flight recorder as none was required by regulations for this type of aircraft.

1.12 Wreckage and Impact Info

1.12.1 General Wreckage Description

The airplane sustain substantial damage to the entire upper fuselage from the windshield aft to Bay A luggage compartment, left and right engines, left and right wings, nose landing gear, nose luggage compartment and right and left elevator and horizontal stabilizer. Other damages include damages done as a result of being submerged in salt water of the lake. The wreckage path and instrument evidenced that the airplane was on a magnetic heading of approximately 220 degrees. The aircraft was not equipped with a cockpit voice recorder; therefore no information was available of what conversation, if any, took place between the crew, during the last few moments in the cockpit.

---

[22] ARFF- Aircraft Rescue and Firefighting (ARFF) is a special category of firefighting that involves the response, hazard mitigation, evacuation and possible rescue of passengers and crew of an aircraft involved in (typically) an airport ground emergency.

[23] TRACON - A **Terminal Radar Approach Control** (or **TRACON**) is an air traffic control facility usually located within the vicinity of a large airport. Typically, the TRACON controls aircraft within a 30-50 nautical mile (56 to 93 km) radius of the airport between the surface and 10,000 to 15,000 feet (4,600 m). A TRACON is sometimes called **Approach Control** or **Departure Control** in radio transmissions.

The airplane's main wreckage was located about 400 yards from shore in about 3 to 5 feet of water at high tide. It was approximately ¼ of a mile from the approach end of runway 27. It was submerged and came to rest oriented on an approximate magnetic heading of 220 degrees (about 60˚ from the westerly inbound course for runway 27). The recoverable parts of the aircraft were located within the immediate area of the wreckage.

First contact with the water was made with the nose of the aircraft in a left nose down, inverted position at a high rate of speed followed by a cart wheeling motion where the right wing and right elevator made next contact (based on evidence post accident). The left wing tank exhibited a type of bulging deformation which showed that it had contained a large amount of fuel at impact.

No fuel remained when the aircraft was recovered and examined. Both left and right wing fuel tanks were ruptured during the crash sequence which allowed all fuel in them to escape into the lake. Though all of the fuel from both left and right wing tanks had escaped during or after the crash, it had not ignited and the aircraft had not been affected by fire. Fragmented airplane wreckage was found surrounding the crash site.

A complete survey of the accident scene and aircraft structure was accomplished; however, the severity of the damage precluded a complete accounting of all the aircraft structure. From this ground evidence and the crushing damage to the fuselage, cockpit, instrument panel and right wing, it was assessed that at first impact the aircraft was at a steep bank with an angle in excess of 45 degrees as reported by eyewitnesses.   No objective indications were obtained to quantify the speed at impact or the rate of descent.

The alternator switch for the right engine was found in the "OFF" position during post accident documentation. It was one of the many switches for the right engine that was found in the "OFF" position. Engine Serial number 248270 was installed on the left wing of C6-NLH and serial number 290209 was installed on the right wing of C6-NLH. Post accident investigation revealed damage of #2 cylinder of the left engine consistent with the cylinder having experienced a mechanical failure.

The engine controls, throttle, propeller and mixture were all found in the full forward position which was inconsistent with the engine securing checklist. However, other steps in the engine securing checklist pertaining to the right engine were accomplished (Step 11) such as Magneto, Alternator, Battery, Auxiliary fuel pump switches, and both Fuel selector valve knobs, all were found in the "OFF" position, which confirms that the right engine may have been intentionally or inadvertently secured without accomplishing the first steps (Step 5) in the checklist such as retarding throttle, feathering propeller and shutting off fuel (mixture control) on the affected engine that was going to be secured. *(See Appendix 5.10 Engine Failure after Take-off checklist).*

The aircraft was not found to be structurally complete post impact with all its flying controls and control surfaces normally attached. Its landing gear was extended and the gear selector handle was in the down and lock position. The flaps were retracted. Rudder, elevator and aileron trim tabs position could not be verified as the control wheel column, where they were attached, had been destroyed by impact forces.

The engine control pedestal had been partially dislodged and the control levers (throttles, propeller and mixture) were found in line near the full forward position range of movement with the exception of the left throttle which was found slightly aft of the full forward range of movement. The feathering detents were intact and showed no gross damage.

Both left and right fuel selector knobs were discovered in the "OFF" position which may have been selected by the pilot intentionally or inadvertently during the engine securing sequence or it may be possible that one or both could have been moved by the accident sequence.

Figure 4 Fuselage post accident

1.12.2 Fuselage

Examination on site revealed that the windshield, roof and both left and right walls of the fuselage had disappeared and was folded rearward to the main entry / cargo door but was still attached at the point just beyond Seats 9 and 10 and above Bay Area A. The nose of the airplane was crushed rearward to the left.

The fuselage structure above the wing center section including both emergency exits and surrounding structures were distorted and impact damaged. The aft fuselage, just forward of the empennage was still attached but exhibited severe impact damage.

The fuselage lower structure including the floor remained intact but was damaged and separated during recovery. All cables, rudder, elevator and ailerons were accounted for in the wreckage.

1.12.3 Engines and Propeller

Both engines were Teledyne Continental Motors TSIO-520-VB. The left engine and propeller remained attached to the left wing which was still attached to the fuselage. The right engine minus its propeller was still attached to the portion of the right wing that remained post accident. Preliminary inspection of both engines revealed no evidence of pre-impact malfunction. Inspection however of the No. 2 cylinder of the left engine revealed a mechanical failure of that cylinder. Both engines exhibited damages consistent with post accident recovery efforts. The engine control pedestal received extensive damage. All control levers (throttle, propeller and mixture) were found in the full forward position. However, explanations of why all engine control levers were full forward, yet engine control switches for the right engine were found in the "OFF" position is not readily apparent. It is inconsistent with engine securing procedures in the Cessna Information Manual. All engine control levers were found bent to the right which further coincides with the crash sequence which was left to right as described by eyewitness statements. The control wheel for the elevator, rudder and aileron trim tabs was destroyed in the crash.

The **right propeller** was separated from the right engine. This may have occurred during the initial impact or subsequent post impact sequence. It however, was never recovered. The **left propeller** however, was still found attached to the left engine. The propeller hub received substantial damage but was still found attached to the left propeller. All blades for the propeller were found still attached to the propeller hub. Evidence showed that the left propeller blades were not feathered. Eyewitness reports states that the engine continued to run approximately 10 seconds after water impact. The blade damage appears to be consistent with the propeller not being feathered and would account for the rotational damages found on the left propeller which would indicate that the left propeller may have been rotating at impact

1.12.4 Wings

Pieces of the right wing outboard of the right engine nacelle, including right wing leading edge, trailing edge, flaps, wing tip, aileron and strobe light had separated and were not recovered from the lake. What remained including the right wing spar was severely fragmented with pieces located throughout the wreckage path. The left wing with engine and propeller still attached, remained attached to the fuselage and exhibited a type of bulging deformation and localized impact damages along its entire length. All fuel contained in both wing tanks escaped. Though the fuel in the left and right wing had escaped during or after the crash, it had not ignited and the left nor right wing and engines had been affected by fire. The right wing sustained substantially more damage than the left wing.

Both left and right landing gear were found in the down and locked position. The gear selector handle on the instrument panel confirmed that the gear was indeed selected to the down position. No impact damages were noted to the left and right main landing gears. The nose landing gear was separated from the fuselage possibly during the initial impact where the nose section of the airplane seemed to have received the brunt force of the impact. The impact damage to the airplane precluded the determination of flight control continuity. However, the examination of the wreckage revealed no evidence of flight control or other system malfunction before the aircraft impacted the water. Further, there was no evidence of in-flight or pre-impact fire. There were no indications of separation of parts before initial impact. The wreckage evidence indicated that both flaps were in the retracted position at the time of the impact. Both engines were examined during the field investigation. Neither showed evidence of fire damage.

1.12.5 Empennage and Flight Controls

The left aileron of C6-NLH received substantial damage in the accident. The entire right wing leading edge (9'10"), outboard of the right engine nacelle, as well as approximately 7'9" of the trailing edge of the right wing, outboard of the right engine nacelle and right flaps were destroyed. The right aileron was destroyed with the leading and trailing edge of the right wing. Approximately 4'8" of the trailing edge of the right wing, outboard of the rear right engine nacelle with wing flaps still attached was recovered. The missing wing and damages sustained to the forward attachment point and leading edge right wing outboard of the right engine nacelle is consistent with eyewitness reports of the aircraft going inverted, nose down and cart wheeling to the right after impact. *(See Appendix 5.11 Crash aircraft diagram and Appendix 5.12 Reference aircraft diagram)*

The aileron trim tab on the left aileron of C6-NLH sustained substantial damage. Additionally, the trim control knob on the cockpit control pedestal was destroyed during the crash sequence. *(See Appendix 5.11 Crash aircraft diagram and Appendix 5.12 Reference aircraft diagram).*

The vertical stabilizer, rudder and rudder trim tab remained attached to each other and the fuselage; these surfaces exhibited no evidence of direct impact damage however, minor damage was noted. The left horizontal stabilizer and elevator remained attached to each other and the vertical stabilizer. They exhibited some impact damage. The right horizontal stabilizer, portion of the elevator and the elevator trim tab remained attached to each other and to the vertical fin. They exhibited evidence of severe impact damage. The rudder of C6-NLH received minor damages however, the rudder pedals in the cockpit received substantial damages. The rudder trim tab of C6-NLH received minor damages. All cables were accounted for and had to be cut by investigators during the recovery effort. The control wheel located on the cockpit control pedestal was destroyed during the crash sequence. The lack of damage to the rudder and vertical stabilized is consistent with the nose down crash sequence eyewitnesses described.

The right horizontal stabilizer and right elevator were bent in an upward angle approximately 30 to 40 degrees. When compared to a reference 402C, it was noted that the outboard right horizontal stabilizer and the outboard right elevator were missing approximately 4'5" and a portion of the right elevator trim tab was also missing which is consistent with the aircraft going inverted and hitting nose first and cart wheeling to the right. The outboard portion of the right elevator (approximately 2.5 feet) was separated from the main wreckage and never recovered from the lake. The outboard portion of the right horizontal stabilizer was bent upward at about a 30 to 40 degree angle. *(See Appendix 5.11 Crash aircraft diagram and Appendix 5.12 Reference aircraft diagram)* The control wheel pedestal was destroyed in the accident sequence. All cables were accounted for and were cut by investigators during recovery and initial investigation to access other components during documentation.

1.12.6 Damage to Seats and Cabin Floor

The structural damage to the cabin and seats was assessed both at the accident site and after removal of the aircraft wreckage to the hanger. In some cases the complete lower seat frame had detached from the floor attachments and in one case there had been separations within the seat structure, leaving parts of the lower seat frame attached to the cabin seat tracks. The lap straps and attachments had remained intact, retaining the occupants in their seats. The seats and its occupants had been ejected during the crash sequence. Two seats were never recovered and possibly lost in the lake. All seat belts of seats found were accounted for. As all passengers were ejected, no accurate indication of where each person sat in the aircraft could be established.

There was considerable evidence, in the frames and stringers of the lower cabin structure, that the cabin floor had been subjected to high vertical and longitudinal impact loads: the result had been rotation of the lower fuselage as the cabin floor moved forward and downward. The only passenger seat that remained attached to the cabin floor was seat number 9, which it is assumed was either not occupied or if occupied, its occupant was not wearing the seat belt. It could not be positively determined what proportion of the damage to the seating had occurred in the first impact with the water and what had occurred due to the cart wheeling of the aircraft after initial impact.

1.12.7 Fuel Selection

Both fuel selector valves were found in the “OFF” position. The fuselage structure below the floor had been crushed and distorted in the crash. This was the area of the fuselage’s first impact with the ground and it is likely, therefore, that the cables to the selector valves may have been trapped and moved at first impact.
The possibility that the cable was moved prior to, or during the impact, before being trapped in the “OFF” position cannot be discounted.

Figure 5 Left Console

1.12.8 Left Console Panel

The left console panel represented here depicts the labels for switches and the picture that follows shows the actual position that those switches were found. Only affected switches that illustrate actions done with reference to the right engine which were intentionally or inadvertently secured, will be labeled here, see left and right side console panel for labels of other switches of interest.

Switches # 5 left to right (3), which represents Left Alternator, Battery and Right Alternator.

Switches #7 left to right (2), which represents Left and Right Auxiliary Fuel (boost) pumps.

Switches #8 left to right (4), which represents Left and Right Magneto Switches for the Left Engine (2) and Left and Right Magneto Switches for the right engine (2).

On the console panel located on the left fuselage wall just below the emergency exit, next to seat number 1, the investigation team discovered that both left and right magneto switches for the right engine were found in the "OFF" position, (switches #8) see system description figure 7.

The battery and right alternator switch (switches #5) for the right engine was also discovered in the "OFF" position see system description figure 7.

Auxiliary fuel pump for the right engine (switch #7) also found in the "OFF" position see system description figure 7.

The left and right magneto switches for the left engine as well as the left alternator switch for the left engine were found still in the "ON" position.

Figure 6 Actual console Panel for C6-NLH

Both fuel selector valve knobs located on the floor between the left and right pilot's seat were found in the "OFF" position.

It could not be confirmed whether the knobs were selected by the pilot intentionally or whether they were moved as a result of the accident sequence.

Figure 7 Fuel Selector Valves Left and Right Engine

Right throttle lever, left and right propeller lever as well as left and right mixture control levers were all found in the full forward position with the exception of the left throttle lever which was found slightly aft of the full forward position, (which represents full power on that engine).

Figure 8 Power Quadrant

1.13 Medical and Pathological

The body of the pilot and seven (7) victims were recovered the day of the accident; one person (identity unknown) was found still alive. He sustained serious injuries and was transported to the Princess Margaret Hospital. He was examined by Emergency Medical Technicians on the Ambulance; however, he succumbed to his injuries enroute. The pilot and the remaining six (6) victims were transported to the Rand Laboratory (Morgue) located at the Princess Margaret Hospital. On the third day after the accident, the body of the 9th victim was recovered from the lake where the accident occurred. Post-mortem examinations were performed by pathologist of the Rand Mortuary at the Princess Margaret Hospital, Nassau Bahamas on all occupants of the aircraft. The causes of death of all occupants were determined to be multiple blunt force injuries due to airplane crash.

Specimens of liver, blood, stomach contents, urine and vitreous humor of listed pilot in command on record Mr. Nelson Hanna were obtained by pathologist from the Department of Pathology at the Princess Margaret Hospital. The diagnostic specimen for toxicology was sent via DHL Express, in a Federal Aviation Administration Tox-Box Kit to the Bio-aeronautical Sciences Research Laboratory at the Civil Aerospace Medical Institute (CAMI) at the Federal Aviation Administration Mike Monroney Aeronautical Center (MMAC) 6500 South MacArthur Boulevard, Oklahoma City, Oklahoma 73169 for toxicological analysis. The analysis was to determine if there were any pre-existing disease, alcohol, drugs or any toxic substance in the pilot, which may have caused or contributed to the cause of the accident. Forensic Toxicology Report received from CAMI indicated no carbon monoxide, and no cyanide was detected in the blood. No ethanol was detected in the vitreous humor. Salicylate[24] was detected in the urine. It was not determined if the amount found in his system was sufficient to impair his judgment to operate the aircraft.

1.14 Fire

Examination of the wreckage concluded no fire was involved pre or post crash.

1.15 Survival Aspects

1.15.1 First Aid

Several persons driving along the perimeter road (Coral Harbour Road) of MYNN witnessed the crash and alerted authorities. Some of the passersby waded into the lake and proceeded to pull victims toward the shore. Search and Rescue facilities coordinators from Lynden Pindling International Airport, the Royal Bahamas Police Force (RBPF), the Royal Bahamas Defense Force (RBDF), National Emergency Management Agency (NEMA), and Nassau Airport Development Company (NAD) were notified of the accident immediately. The RBDF and RBPF were mobilized to Lake Killarney where the accident occurred. RBDF teams arrived with water rescue equipment and additional personnel about 20 minutes post accident.

The characteristics and magnitude of the impact and subsequent destruction of the airplane indicated that the accident was non survivable. The impact forces exceeded human tolerances and no occupyable space remained intact. All occupied seats were detached from the floor tracks. The pilot and all passengers were ejected from the aircraft; all but two passengers was found still strapped in their seats. One passenger initially survived the crash. Having sustained serious injuries, he later succumbed to those injuries enroute to the Princess Margaret Hospital. Postmortem examination of the occupants indicated that the characteristics of the fatal injuries sustained varied

[24] Salicylate - is an over the counter analgesic used in the treatment of mild pain. Any of several widely prescribed drugs derived from salicylic acid. Salicylates exert analgesic, antipyretic, and anti inflammatory actions. The most important is acetylsalicylic acid, or aspirin. Sodium salicylate also has been used systemically, and it exerts similar effects. Many of the actions of aspirin appear to result from its ability to inhibit cyclooxygenase, a rate-limiting enzyme in prostaglandin biosynthesis. Aspirin is used in a wide variety of conditions, and, in the usual analgesic dosage, it causes only mild adverse effects. Severe occult GI bleeding or gastric ulcers may occur with frequent use. Large doses taken over a long period can cause significant impairment of hemostasis.

according to the location of the persons in the crashed airplane. All of the injuries were consistent with deceleration trauma of different intensity consistent with the aircraft's impact and breakdown pattern.

1.15.2 Fire Service and Emergency Response

According to ATC control log aircraft C6-NLH was cleared for take-off at 1635UTC* (12:35 local). At 1636UTC* tower controller advised C6-NLH that he "needed him to return" as "white smoke was trailing behind his left engine." The pilot attempted to return and land on runway 27 and crashed in the lake. Nassau Airport Authority Aircraft Rescue and Firefighting (ARFF) vehicles and personnel, located approximately 1 mile away from the crash site, responded immediately after one rescue personnel on duty having visually observed the accident and simultaneously receiving an alarm from Nassau control tower personnel. About 3 - 4 minutes after the crash, two (2) ARFF trucks, both fire suppression vehicles (a water equipped fire truck) approximately 10 crash and rescue personnel and the chief fire officer arrived on scene. Other rescue personnel from the community, pilots from the general aviation center and passersby stopped to render assistance a few minutes later.

The first four bodies were recovered at approximately 1704 UTC (1:04pm local) approximately 30 minutes after the crash by crash and rescue personnel as well as bystanders and pilots from the General Aviation Center. Approximately 1724 UTC, NAD was advised that a total of eight (8) bodies were recovered from the waters and brought to the shore.
Approximately 30 minutes after the crash additional assistance was provided by approximately 30 to 50 persons from the Royal Bahamas Defense Force. In all, more than 100 emergency response personnel were involved.

The aircraft wreckage site was declared a "biohazard" area, and access to the site was restricted to essential personnel only. The monitoring of the site and access control was provided by the Royal Bahamas Police Force. The site was guarded from the time of the accident until the final removal of the wreckage to the secure aircraft hangar at MYNN. The procedures imposed for working in this type of environment required the AAIPU investigative team, including party members, to wear personal protective gear and or take special safety precautions while working on site and during post recovery teardown and analysis. Flight plan form filed by the pilot or his agent, listed one (1) person on board. There was mass confusion about a ninth (9^{th}) person that may have been on board the aircraft. Additional searches were conducted of the area of the crash on the second day during wreckage recovery and on the third (3^{rd}) day after the accident, the 9^{th} occupant of the aircraft was found in the marshes of the lake.

The following notification timeline was prepared by ATC.

*At 1635 UTC NAD was notified.
At 1637 UTC PMH was notified.
At 1639 UTC Mr. Hubert Adderley – Manager of Flight Standards Inspectorate was notified.
At 1640 UTC Captain Patrick Rolle Director of Civil Aviation Department was notified.
At 1650 UTC Mr. Joseph Albury Deputy Director ATC was notified.
At 1655 UTC Mr. Delvin R. Major IIC was notified by the Manager of FSI.

NAD EOC running log records indicate;

*At 12:33 hrs (1633UTC) ATC officer manning Clearance Delivery notified NAD about the accident
*At 12:35 hrs (1635 UTC) EOC was activated by EOC personnel.
*Additionally, CAD Daily Air Traffic Record lists the aircraft crash at 1633UTC / 12:33pm local.
*Discrepancies noted in the above timelines as transcript from ATC Tower controller transcript records aircraft departed at 1636UTC / 12:36pm local. However, Tower daily record of facility operation documents time of crash at 1633 UTC / 12:33pm local. *(See Appendix 5.6 ATC Tower Transcript)*

1.16 Tests and Research

Follow up examinations and testing was conducted regarding aircraft systems, operations procedures and human performance. Cylinder Analysis conducted in the United States at the NTSB Metallurgy Lab in Washington DC and Engine (Left and Right) were analyzed at Teledyne Continental Motors (TCM) Factory in Alabama. Reports attached in Appendix 5.1 and Appendix 5.2.

1.16.1 #2 Cylinder Analysis:

Examination of the No. 2 cylinder from the left engine was performed at the NTSB Materials Laboratory, located in Washington, DC.

1.16.2 Left Engine Analysis

The left engines were examined at the manufacturer's facility with Bahamas oversight. *See Appendix 2 Left Engine Factual Report TCM*

1.16.3 Right Engine Analysis

The right engines were examined at the manufacturer's facility with Bahamas oversight. *See Appendix 2 Right Engine Factual Report TCM.*

1.16.4 Human Factors Research and Analysis

Research by noted authors Klein, G., (1993) *Naturalistic Decision Making: Implications for Design.* Wright-Patterson Air Force base, Ohio Crew System Ergonomics Information Analysis Center, Klein, G., (1993) A recognition primed decision (RPD) model of rapid decision making. In Klein, G., A., Orasanu, J., Calderwood, R., and Zsambok, C.E., (Eds), *Decision Making in action: Models and Methods.* Norwood, New Jersey, Ablex, p. 146, Wickens, C. D., (1984) *Engineering Psychology and Human Performance.* Columbus Ohio: Charles E. Merrill, p. 97 has concluded that human factors and the pilots action once a decision was made, played an important role in this accident. The full context of this research as applicable to this accident is contained in Analysis section 2.11.2 the pilots decision to return.

1.16.5 Weight and Balance Scenarios

Weight and balance scenarios are as follows;

- The amount of fuel in the aircraft before the additional 60 gallons were added is unknown. However, pilot listed fuel on board as 4 hours duration. At a rate of 16.5 gal per hour, per side, for 4 hours duration, the aircraft would require a total of 132 gallons of fuel. 132 gallons of fuel calculated at a weight of 6 pounds per gallon, the weight of fuel on board was 792 pounds.
  - 16.5 gal per engine, per hour x 2 engine = 33 gallon per hour total
  - 33 gallon per hour x 4 hours = 132 gallons of fuel on board the aircraft
  - 132 gallons of fuel x 6 pounds per gallon = 792 pounds of fuel

The empty weight of the aircraft was approximately 4,100 pounds. The maximum takeoff weight of the aircraft is 6,850 pounds with a maximum total payload of 2,750 pounds. Payload weight was the aggregated weight of the pilots, their bags, equipment, the passengers and their baggage and the fuel weight.

Approximately one month after the accident the baggage and equipment recovered were weighed. The recovered luggage and other items had a total weight of 282 pounds. The fuel load was 792 pounds based on above estimates and pilots report of 4 hour endurance. None of the passengers were weighed immediately before the flight. However, the pathologist measured the weight of each deceased person. The total for the 9 deceased occupants was 2,199 pounds.

Weights listed below were retrieved from the coroner following examination of victims, it in no way indicates or suggests the seated position occupied by each occupant in the aircraft;

- Victim #1 NLH weight 154[25] 164*[26]
- Victim #2 NDS weight 280 245**[27]
- Victim #3 CLF weight 340
- Victim #4 CNW weight 375
- Victim #5 CM weight 230
- Victim #6 LC weight 130
- Victim #7 DRCT weight 190
- Victim #8 CLJ weight 320
- Victim #9 JL weight 180

Total 2199

Passenger Weight	2,199# +	(weight provided by coroner)
Fuel Weight	792# +	
Baggage Weight	282#	(weight of luggage that was recovered)
Payload	3,273# +	(max wt allowed is 2,750 pound)
Empty weight	4,100# =	(weight minus pax, fuel, luggage)
Total recovered weight on aircraft	7,373#	

Total recovered weight on aircraft	7373# -	
Max wt allowed for T/O	6,850# =	(Maximum Gross Weight)
Amount overweight	523#	

Center of gravity could not be determined as the seat each person occupied in the aircraft is unknown, and the amount of baggage and what compartment it was placed on the aircraft is unknown. As per the center of gravity graph and envelope, once weight and balance are within limits a plotted area should fall within the designated fore and aft limits of the envelope up to the maximum weight limit.

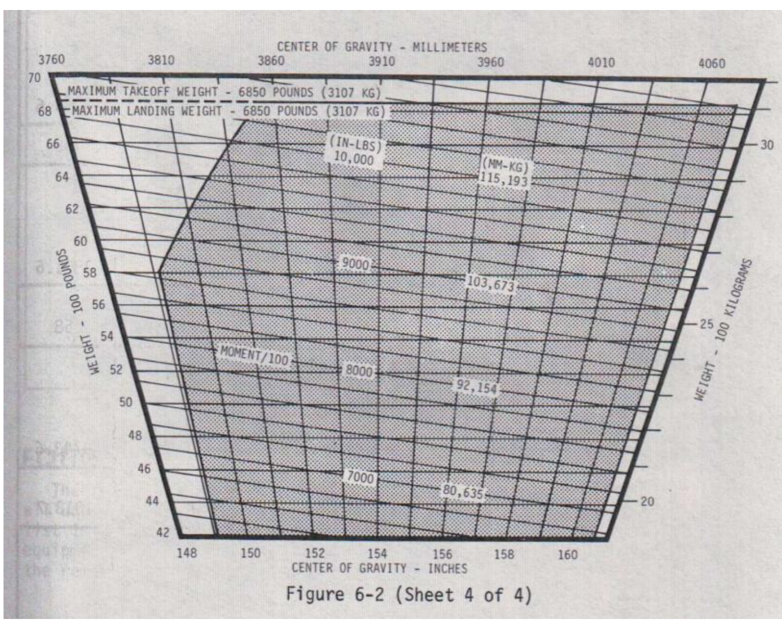


Figure 9 Center of Gravity Graph / Envelope

The **center-of-gravity** (CG) is the point at which an aircraft would balance if it were possible to suspend it at that point. It is the mass center of the aircraft, or the theoretical point at which the entire weight of the aircraft is assumed to be concentrated.

Its distance from the reference datum is determined by dividing the total moment by the total weight of the aircraft. The center-of-gravity point affects the stability of the aircraft. To ensure the aircraft is safe to fly, the center-of-gravity must fall within specified limits established by the manufacturer.

Figure 9 illustrates the center of gravity chart established by Cessna Aircraft Company for the Cessna 402C aircraft. When the weight of

[25] Weights provided by Pathologist
[26] * Pilot weight obtained from pilot last medical certificate issued 07 September, 2010
[27] **Co-pilot weight obtained from co-pilot last medical issued 11 August, 2010

the aircraft is at or below the allowable limit(s) for its configuration (parked, ground movement, take-off, landing, etc.) and its center of gravity is within the allowable range, and both will remain so for the duration of the flight, the aircraft is said to be within *weight and balance*.

Incorrect weight and balance in fixed-wing aircraft

When the center of gravity or weight of an aircraft is outside the acceptable range, the aircraft may not be able to sustain flight, or it may be impossible to maintain the aircraft in level flight in some or all circumstances. Placing the CG or weight of an aircraft outside the allowed range can lead to an unavoidable crash of the aircraft.

Center of gravity out of range

When the fore-aft center of gravity is out of range, the aircraft may pitch uncontrollably down or up, and this tendency may exceed the control authority available to the pilot, causing a loss of control. The excessive pitch may be apparent in all phases of flight, or only during certain phases, such as take-off or descent. Because the burning of fuel gradually produces a loss of weight and possibly a shift in the center of gravity, it is possible for an aircraft to take off with the center of gravity in a position that allows full control, and yet later develop an imbalance that exceeds control authority. Calculations of center of gravity must take this into account (often part of this is calculated in advance by the manufacturer and incorporated into CG limits).

Center of gravity is calculated as follows:

Determine the weights and arms of all mass within the aircraft.
Multiply weights by arms for all mass to calculate moments.
Add the moments of all mass together.
Divide the total moment by the total weight of the aircraft to give an overall arm.

The arm that results from this calculation must be within the arm limits for the center of gravity that are dictated by the manufacturer. If it is not, weight in the aircraft must be removed, added (rarely), or redistributed until the center of gravity falls within the prescribed limits.

Weight out of range

Few aircraft impose a minimum weight for flight (although a minimum pilot weight is often specified), but all impose a maximum weight. If the maximum weight is exceeded, the aircraft may not be able to achieve or sustain controlled, level flight. Excessive take-off weight may make it impossible to take off within available runway lengths, or it may completely prevent take-off. Excessive weight in flight may make climbing beyond a certain altitude difficult or impossible, or it may make it impossible to maintain an altitude.

1.16.6 Flying over Gross Weight[28]

“The problem with operating over maximum gross weight is more one of structural integrity than legality. Engineers rate each load-bearing structure with a certain maximum load. In the case of airplanes, that load is expressed in terms of G’s. In the normal category, the FAA rates aircraft as capable of withstanding G loads of 3.8 in normal operations (above which the structure may be damaged) and 5.6 maximum (beyond which the structure will likely fail). To use a simple example, a normal-category aircraft approved for a 4,000-pound gross weight in the normal category would have a theoretical maximum structural load-bearing capacity of 22,400 pounds. (5.6 x 4,000 pounds). If you loaded the same airplane to 5,000 pounds gross weight, the maximum load capacity doesn’t change, so you would reduce the G-limit from 5.6 to only 4.5G’s (22,400 / 5,000).

[28] Excerpt from Plane and Pilot march 2011 Edition, Bill Cox, Senior Editor.

No pilot want to fly a damaged airplane, so the more typical limitation is the lesser one, 3.8 G's. Here the load limit works out to 15,200 pounds at 3.8 G's but the G-limit is now down to 3.1 G's at the higher weight. Another problem with flying an airplane well over gross weight is that while it will still fly, flight characteristics may be severely compromised in terms of roll rate, pitch response and performance. Climb rate may be seriously reduced, and service ceiling may be equally poor. Cruise speed and range also will be reduced."

1.16.7 Airplane Performance

Eyewitnesses' statements were used to estimate the airplane's performance, flight path and altitude at impact *(See figure 3 and eyewitnesses statements 1.1.4)*. The airplane's pitch angle and bank angle at impact were also established based on eye witnesses' statements (section 1.1.4).

1.17 Organizational and Management Information

No organizational or management information presented here as Acklins Blue Air Charter was not an authorized or recognized Air Operator Certificate Holder certified by the Bahamas Civil Aviation Department.

1.18 Additional Information

1.18.1 Acklins Blue Air Charter

Post accident investigations uncovered that Acklins Blue Company was founded in 1994 by owner and proprietor Mr. Nelson Hanna. Although Acklins Blue Air Charter advertised its services as a Charter company *see Appendix 5.3, Appendix 5.4 and Appendix 5.5)* in contravention of Bahamas Civil Aviation (Safety) Regulations (CASR 2001) Part X, Regulation 67 (1)(2) and (3) and more specifically 67 (2)(a) *(See Appendix 5.13)* Acklins Blue Air Charter did not obtain the required certification to operate as a certified air operator certificate holder as required by CASR 2001 Part X, Regulation 68 (*See Appendix 5.14*).

C6-NLH, a 1981 Cessna 402C aircraft serial number 402C0458 was previously registered in the United States of America (US) as N68361. It was deregistered from the US registry on November 27, 2002 and registered in the Bahamas On December 05, 2002. C6-NLH was insured by Hayward Aviation Limited under a policy issued to Acklins Blue for commercial use, on demand charter, and insured for loss or damage to aircraft, third party and passenger legal liability and pilot personal accident insurance. Policy listed aircraft maintenance contracted out to an entity called Nixon Aviation. The policy lists the aircraft based at Executive Flight Support, Lynden Pindling Int'l Airport.

Aircraft utilization listed in the previous 12 months was 400 Hours. One provision of the policy was that recurrent training for the pilot was to be carried out every six (6) months. No records for the pilot were made available to verify whether this requirement for recurrent training was fulfilled by Mr. Hanna to meet the requirements of his insurance policy. The policy was executed 5 December, 2009 and was to expire 4 December, 2010. Mr. Hanna's flight times were listed as in excess of 12,000 hours with more than 10,000 hours on type (402C).

1.18.2 CAD Oversight of Acklins Blue Air Charter

At the time of this accident, CAD oversight of aviation in the Bahamas, (which is carried out by the Flight Standards Inspectorate (FSI), located at Lynden Pindling International Airport) was not conducted of Acklins Blue Air Charter (ABC) as ABC had not initiated or completed the certification process[29] as required for an Air

[29] BAHAMAS CIVIL AVIATION (SAFETY) REGULATIONS SUBPART A: GENERAL
12.001 APPLICABILITY
(a) This Schedule applies to the carriage of passengers, cargo or mail for remuneration or hires by persons whose principal place of business or permanent residence is located in The Bahamas.

Operator Certificate (AOC) holder certified under Bahamas Civil Aviation (Safety) Regulations (CASR 2001) Part X 67 and 68 (*See Appendix 5.13 and Appendix 5.14*) and Schedule 12.015[30]

Investigations uncovered that advertisements were circulated and on the internet advertizing C6-NLH as being operated in commercial air transportation by ABC airlines, located in the Executive Flight Support terminal at MYNN, offering personalize air transportation services throughout the Bahamas and to destinations in Cuba, the Dominican Republic, Cayman Isles and the Turks and Caicos Islands. Regular service was also offered to Eleuthera and Harbour Island using "properly maintained and insured 402C aircraft which can seat up to nine passengers." (*See Appendix 5.3, 5.4 and 5.5 for Acklins Blue Companies website information).*

CAD / FSI mandate is surveillance of certified AOC as per CASR 2001 Schedule 12. As ABC was not an AOC holder authorized by these regulations and schedules, no surveillance by CAD/FSI was conducted. C6-NLH was a private aircraft owned by an individual and registered to a company named Lebocruise Air Limited which is also not an authorized AOC holder certified under the provisions of CASR 2001 Schedule 12.

1.18.5 Performance Category

The Cessna 402C aircraft was certified for single pilot operation within Performance Group C.

1.18.6 Emergency Procedures

The emergency procedures relating to the power loss contained within the Cessna Information Manual for the Cessna 402C see Appendix 5.10 Engine Failure after Take-off.

1.18.7 Pre accident CAD Actions

Several months prior to this accident, the Flight Standards Inspectorate established a proactive campaign where information was shared with the daily newspaper and other media outlets. Several articles were written and the department took the message to the airwaves via talk show and media houses warning the general public about the dangers of travelling with unauthorized / uncertified persons claiming to be legal air carriers. Numerous posters were strategically placed at Fixed Base Operations and the General Aviation Center warning about the dangers of engaging in commercial air transportation using the services of unauthorized air carriers.

The Flight Standards Inspectorate additionally, engaged the assistance of the Airport Authority and NAD with meetings and strategic planning on ways to curb the incidence of unauthorized air charter operators. List of all authorized air charter operators were distributed to the media, Fixed Based Operators and other stake holders at MYNN. Additionally, The Flight Standards Inspectorate increased airside surveillance of areas frequented by general aviation traffic and possible area of unauthorized air charter operations.

(b) This Schedule of the regulations prescribes requirements for the original certification and continued validity of air operator certificates (AOC) issued by The Bahamas.

[30] BAHAMAS CIVIL AVIATION (SAFETY) REGULATIONS SUBPART B: AIR OPERATOR CERTIFICATE

12.015 COMPLIANCE WITH AN AIR OPERATOR CERTIFICATE
(a) No operator may operate an aircraft in commercial air transport unless that operator holds an AOC for the operations being conducted.
(b) No person may operate an aircraft in commercial air transport operations that are not authorized by the terms and conditions of its AOC.
(c) The AOC holder shall, at all times, continue in compliance with the AOC terms, conditions of issuance, and maintenance requirements in order to hold that certificate.

1.18.8 Post Accident Recommendations / Safety Alerts Issued

As a result of the accident involving C6-NLH on October 5, 2010,

1. Alert SA/A10-01312/001/10-9-10 was issued to Stakeholders at MYNN which includes Airport Authority, NAD, Civil Aviation Department, ATC, Odyssey Aviation, and Executive Flight Support in reference to Incomplete Flight Plan information and Inadequate security procedures that exists at Fixed Base Operations. *(See Appendix 5.9 Alert)*. Additionally, correspondences were addressed specifically to Airport Authority, CAD and NAD outlining the inadequate security procedures and the need for improvement.
2. Alert SA/A10-01312/002/10-9-10 was issued to the Flight Standards Inspectorate addressing the need to amend its information gathering document system so that it captures information that would be useful during the investigation of accidents of Bahamas Registered aircraft (*See Appendix 5.18)*. This was issued as a result of the unavailability of the historical aircraft records for C6-NLH.

   Its unavailability has impacted the investigation as there is no information available to support or verify whether the aircraft was being adequately maintained in accordance with Bahamas Civil Aviation (Safety) Regulations.

1.18.9 Post accident Airport Authority Actions

Several post-accident meetings were held between the Airport Authority and stakeholders at MYNN (Executive Flight Support and Odyssey Phoenix Aviation). Airport Authority reports meetings and follow up meetings were accomplished and progress was being made with the construction and implementation of corrective action for deficient items brought to light by recommendations put forward by the safety alert SA/A10-01312/10-9-10 issued by the investigation team.

As a result of the Alert recommendations;

- An airport security program was developed by EFS
- An airport personnel training program was developed by EFS

The Airport Authority commits to monitoring the progress of the implementation of recommendations put forward by Alert for both Executive Flight Support as well as Odyssey (Phoenix Aviation).

1.18.10 Post accident CAD /FSI Actions

Post-accident, the Flight Standards Inspectorate has;

- Amended application for Certificate of Airworthiness to capture information that can establish a baseline history of Bahamas registered aircraft in the event of an accident or incident and historical information is not available or lost. This amendment addresses issues raised in Alert SA/A10-01312/002/10-9-10.
- Increased surveillance of General Aviation Center and all Fixed Based Operators.
- Strategically placed more flyers and brochures in the media as well the General Aviation and Fixed Based Operations warning about the dangers of flying with unauthorized air carriers.
- Increased its manpower by the hiring of two (2) additional aviation safety operations inspectors.
- Increased its presence by extending its work schedule to include surveillance from 6am to 6pm, Monday to Friday and on Saturdays and all holidays.
- Increased surveillance to include other islands in the Bahamas where reports of uncertified air carriers exist.

1.18.11 Post accident EFS Actions

On December 10, 2010 Executive Flight Support submitted to the Airport Authority and the Nassau Airport Development Company (NAD) a draft copy of its Security Program as well as its Personnel Training Program which outlines and accounts for deficiencies discovered during the investigation and outlined in Safety Alert issued. A copy of the program is in possession of the investigation team and is not included in this report. The Airport Authority commits to monitoring the progress of the implementation of recommendations put forward by Alert reference Executive Flight Support.

1.18.12 Post accident NAD Actions

On November 18, 2010 NAD in its commitment to address the issues raised in Safety Alert issued to them, advised The Flight Standard Inspectorate that it had amended the Civil Aviation Department Form 63A1 back to its original version as outlined in Aeronautical Information Publication (AIP) figure ENR 1.10.1. This amendment would once again require that all items 1-22 on form 63A1 is now completed by person completing form 63A1. This amendment would now required that pilots once again list all persons onboard the aircraft prior to takeoff – this should aid in search and rescue efforts in the event of an accident in the future.

2.0 Analysis

2.1 Overview

2.1.1 Flight reconstruction

The paucity of 'firm' data, particularly the absence of any flight data or cockpit voice recording, frustrated efforts to reconstruct precisely the flight path and sequence of events which led up to the accident. The tower controller's communication transcription provided significant data to determine the timing of key events to within a few seconds, but apart from the white smoke observed by the tower controller and his alerting the pilot of C6-NLH, the pilot gave no indication of a problem. The aircraft was subsequently given permission to return to the field and accept runway 27 if able. This instruction was acknowledged by the crew and attempts were made to return to a landing by the aircraft on runway 27. There was no radar or navigation system data with which to reconstruct the flight path and so, an approximation was compiled based on the recollection of numerous eyewitness reports. All reports seemed to be consistent with each other. The probable flight path is illustrated on the eyewitness statement on Figure 3 and Appendix 5.19.

The aircraft was below the weight category for which flight recorders are required to be fitted. The investigation was thus hampered by the lack of any record of the pilots' conversation, including routine and emergency checklist actions. It is highly likely that any such record would have added greatly to the understanding of this accident. Existing airworthiness requirements for modern aircraft in this category require the carriage of both a Flight Data Recorder and a Cockpit Voice Recorder, but only if they are multiengine turbine powered and has a maximum approved passenger seating capacity of more than nine. The 402C, having piston engines and not more than 9 passenger carrying capability, was not obliged to meet this requirement.

The accident flight was the second flight for C6-NLH on 5 October, 2010. There was no evidence of pre-existing failures or malfunctions in the airplane, its components or its system. However, the client on the first charter flight of the day on C6-NLH reported to investigators that during the engine run-up, at the runway before take-off, there was a serious discrepancy noted between indications of the left and right manifold pressure needles corresponding to the left and right engines respectively as evidenced on the manifold pressure gauge. Being a pilot himself, the client was concerned. The difference between both indications was approximately 90 degrees. The right manifold pressure needle responded accurately and timely when the right throttle lever was manipulated to a predetermined value, however the left needle lagged behind and eventually moved and caught up to the indications of the right engine despite both throttles being operated at the same time to that specific predetermined value. This discrepancy was brought to the attention of both pilots who "shrugged it off" and said "everything is ok" and "it will match up when full power is applied." (*See Eyewitness Evidence 1.1.4*)

The pilot in command of record was properly qualified and certificated to operate the airplane on this flight. The specific detail of his training history was not available to the accident investigation team. No evidence was found that he was experiencing a behavioral or physiological impairment at the time that could have caused or contributed to the accident. At the time of the accident, the winds were 100˚ at 6kts and visibility was 7 miles with a forecast of a combination stationary front along with a surface trough across the northwestern and central Bahamas producing unstable weather through the forecasted period. Significant Weather section of the Bahamas Area Forecast over the central and northwest Bahamas indicated scattered to broken clouds from 1,200 feet to 1,800 feet with towering cumulus and cumulonimbus clouds. Weather however, was not a factor in this accident.

The evidence indicates that the pilot of C6-NLH after departing runway 14 and being notified about the white smoke trailing behind the aircraft's left engine, decided to return to land at MYNN and accepted the controller's offer to land on runway 27 and did not continue on the appropriate flight path. The accident occurred while the pilot was making a left turn and extending his landing gear in the turn to intercept runway 27. ATC was not a factor in the accident.

The investigation examined pilot actions to determine how a properly trained and qualified pilot with more than 10,000 flight hours in type would allow the aircraft to turn into an engine reported as having a discrepancy, extend landing gear while in the turn, turn at such a low altitude and airspeed considering the mass and balance of the aircraft and lose control after take-off.

The investigation also focused on why engine control switches for the right engine were found in the “OFF” position, whether they were intentionally or inadvertently switched off and if so when did it occur. The investigation also considered whether the second-pilot[31] had a role in the decision making process that resulted in the accident. Additionally, the voice of the person that was making radio transmission with ATC was not the voice of the pilot and assumed to be the second pilot.

2.1.2 Wreckage Analysis

The aircraft was in the correct configuration for flight following reports of white smoke trailing behind its left engine. It had gear and flaps retracted initially right after becoming airborne according to eyewitness reports. The impact evidence showed excessive angles of bank and nose down pitch. This confirmed eyewitness evidence that the pilot initiated excessive bank angles, and extended landing gear in the turn, in an attempt to return to a landing on runway 27. The rate of descent was very high at impact which would account for the extent of damage suffered by the nose of the aircraft, nose landing gear, windshield, fuselage, right elevator and stabilizer and right wing and its attachments (wing tip, aileron).

Both fuel selector valves were found at the "OFF" position and a reason for both to be so selected is not readily apparent. It is possible that had the pilot not intentionally selected them to that position, it might well have been moved by airframe distortion during the crash. According to eyewitness reports, the aircraft engine continued to run for approximately 10 seconds after impact. This would indicate that the engine was producing some power at impact. It is likely that the fuel selector cables were pulled during impact and / or recovery process.

2.1.3 The Initiating Event

The first perceived abnormal event in the sequence leading to the accident was the observation of white smoke and the abnormal sounds like an engine backfiring as reported by eyewitnesses. Also, as reported to the aircraft by ATC, white smoke was observed trailing behind the left engine of the aircraft. It is reasonable to believe that both engines were producing power, as the aircraft, prior to being notified of white smoke trailing behind the left engine and thereafter, never reported any malfunctions or advised of any emergency. Provided that one engine was producing full power and the other had failed and been correctly identified and its propeller feathered, if properly flown, the aircraft should have been able to climb, albeit slowly, and subsequently make a safe landing back at MYNN. Therefore, the damage within the left engine would not make an accident inevitable. It was the loss of thrust from the right engine, reduced horsepower on the left engine, and extension of the landing gear in a turn, the excessive rate of bank and airspeed decay that led to the loss of control. Consequently, some of the following analysis concentrates on the probability the pilot mishandled the left engine (possible) failure and in his haste to do something he inadvertently misdiagnosed and secured the wrong engine (right operating).

During the post accident investigation, investigators observed that the left and right magneto switches of the right engine as well as the alternator switch for the right engine were found in the “OFF” position. The auxiliary fuel pumps as well as both left and right fuel selector valves located between the pilots’ seats were also found in the "OFF" position. Questions arise as to whether the pilot, possibly in his haste to do something, accidentally shut off electrical power to the right engine instead of the left engine as the left engine was the one reported as “emitting white smoke.” It is not known whether the right engine was shut off intentionally or inadvertently by the pilot, and if so, when in the chain of events did this occur?

[31] Co-pilot / second (ramp agent at EFS states there was a copilot on board C6-NLH who loaded the luggage on the aircraft)

This analysis will focus on the pilot's decisions and performance that led to this accident. Also, focus will be made on the left engine # 2 cylinder which showed signs of mechanical failure. Questions arise as to when this cylinder failed and what impact, if any; its failure would have on total engine performance? Was its failure enough to cause an airplane to fall from the sky or did other factors play a role in the aircraft not being able to maintain altitude once the #2 cylinder failure occurred?

2.2 Other Factors

2.2.1 Aircraft Loading

In the context of this accident, the precise weight of the aircraft would have been relevant to the final outcome of a single engine failure. However, post accident calculations, which included the recovered luggage, fuel on board and passengers have revealed that the aircraft was over the maximum weight allowed for takeoff (6,850 pounds) by more than 500 pounds. (*See 1.16.4*)

2.2.2 Pre-take-off Events

The crew carried out final preparations for the flight without much help from the ground support staff at EFS. Apart from a ramp agent who collected and placed a box on the aircraft, the two pilots performed all the routine tasks such as preflight inspection, luggage loading and embarkation of the passengers. There were no ground crewmen or marshaller to oversee the starting and taxiing phases and no need for either. Consequently there were no eyewitnesses to engine starting, aircraft seating assignment or which pilot occupied which seat.

A pilot who was in line for take-off after the C6-NLH, reported that the pilot took an unusually long time at the holding point doing the pre take-off run up checks. *(This may have been as a result of the previous reported abnormality with the manifold pressure indication or any other number of reasons).*

Other eyewitnesses reported aircraft abnormalities prior to takeoff. They reported hearing noises as if the aircraft was backfiring. Eyewitnesses interviewed were not able to determine if the backfiring noises were heard when the aircraft was on the take off roll or prior to the aircraft taxiing into position for takeoff. The backfiring noises heard could have been from the pilot conducting his pre-takeoff checks prior to taxiing into position for takeoff. These checks which the pilot habitually carried out prior to takeoff, required the speed of each propeller to be increased before the feathering mechanism was exercised momentarily, possibly more than once for each propeller, and for each propeller in turn. These checks result in the propellers slowing down and then recovering speed over a period of two or three seconds.

The main change in perceived noise results not from the change in rotational speed, but from the changes in propeller blade angle which provoke the changes in rotational speed. These checks are unlikely to result in misfiring but the magneto test that follows may cause changes in the sound of a smooth running engine. Each engine has two magnetos (spark generators) and each cylinder has two spark plugs. During the engine checks one magneto is temporarily isolated to assess the engine's ability to run on the other ignition system. Occasionally one or more of a set of spark plugs may be contaminated which results in some rough running which is not evident when running on both magnetos. The discrepancy can often be cleared by increasing engine RPM or temporarily leaning the fuel to air ratio of the engine mixture, which may provoke some misfiring for a few seconds.

As eyewitness location on the field could not be determined when the misfiring noise was heard and other eyewitness close to the point of lift off of the aircraft not reporting any misfiring noise or abnormalities other then observing the white smoke, it seems likely that any engine malfunction noises were temporary and associated with pre-takeoff engine checks or spark plug contamination.

2.2.3 Flap Position

Whether the aircraft became airborne with the wing flaps retracted or at the take-off position could not be positively determined. However, post impact observation noted the flaps were flush with the trailing edge of the left and right wing respectively. The principal factors relevant to the choice of flap setting are runway length, take-off weight and obstacles in the departure direction. The aircraft has a shorter take-off ground roll with flaps extended but if the flaps are up for take-off, the engine failure procedure during initial climb is much simplified and the one engine inoperative climb performance is improved.

Runway 14 at Lynden Pindling International Airport is far longer that the predicted lengths required by a Cessna 402C at maximum take-off weight, to accelerate to take-off speed and then decelerate to a stop on the runway. Consequently, take-off with the flaps retracted would not have contributed to the accident sequence. However, take-off with the flaps extended could have complicated the engine failure procedure if the power loss had occurred before the flaps were raised at the customary height because of the extra drag associated with flap deployment.

2.3 Event Timing

It is reasonable to assume that with other aircraft behind him waiting to depart, the pilot would have commenced his take-off as soon as ATC clearance to do so had been acknowledged by the second pilot. There was a slight delay from the time the aircraft was cleared for take-off until the time it actually departed. The aircraft became airborne and then flew in a normal take-off configuration, and then at rotation, more white smoke was observed trailing behind the left engine. There was a brief period of climbing flight followed by a gradual bank to the left, which turned into a steep almost perpendicular bank followed by a steep nose down descent into the lake as control was lost. The aircraft was airborne for approximately 90 seconds, during which time the pilot acknowledged the white smoke and accepted runway 27 for a return.

2.4 Before the Initiating Event

2.4.1 The Take-off.

According to eyewitnesses and the ATC controller, the aircraft made a normal take-off run where white smoke was observed from the initiation of the run. The aircraft was cleared for take-off from intersection Foxtrot of runway 14.

Cessna MODEL **402C**

SECTION 5
PERFORMANCE

NORMAL TAKEOFF DISTANCE

CONDITIONS:
1. 2700 RPM and 39 Inches Hg. Manifold Pressure Before Brake Release.
2. Mixtures - CHECK Fuel Flows In the White Arc.
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.

NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 3% for each 5 knots headwind.
3. Increase distance 12% for each 5 knots tailwind.

WEIGHT-POUNDS	TAKEOFF TO 50-FOOT OBSTACLE SPEED-KIAS	PRESSURE ALTITUDE-FEET	20°C (68°F)		30°C (86°F)		40°C (104°F)	
			GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET
6850	95	Sea Level	1850	2310	2040	2560	2300	2910
		1000	1970	2440	2220	2760	2450	3080
		2000	2140	2630	2350	2920	2600	3260
		3000	2270	2790	2500	3100	2760	3470
		4000	2410	2950	2660	3290	2940	3680
		5000	2560	3130	2830	3490	3130	3920
		6000	2730	3320	3010	3710	3340	4180
		7000	2900	3530	3210	3950	3560	4460
		8000	3100	3760	3420	4210	3800	4770
		9000	3300	4000	3660	4500	4060	5110
		10,000	3530	4270	3910	4810	4350	5480

Figure 10 Normal Take-off Distance

The aircraft's ground roll started approximately 2,000 beyond the threshold of runway 14, (Intersection Foxtrot) and it became airborne either just after Intersection Bravo 1 or just about or after the intersection of runway 32/14 and runway 27/09 *(See Appendix 5.15* and Appendix 5.19 *Airport Layout MYNN).* Just after becoming airborne the landing gear were retracted as in a normal take-off.

The runway distance from the line-up position (Intersection Foxtrot) to the intersection where the aircraft became airborne (Intersection Bravo 1) was approximately 7,000 feet. The normal take-off distance performance data in the Cessna Information Manual, both engines operating *(Figure 10)* was interpolated to get a base line estimate of how much runway was required for the take-off, using the maximum weight allowed on the aircraft at take-off of 6,850 pounds and to clear a 50 ft obstacle.

The performance data with conditions; wing flaps retracted, weight of 6,850 pounds, take-off to clear 50 ft. obstacle indicated airspeed of 95KIAS a pressure altitude of sea level and temperature 30°C(86°F), was used in this computation (temperature for the day and around the time of the accident was 81°F).

Using these figures conservatively the ground roll for the aircraft should have been approximately 2,040 feet and if there was a 50 ft. obstacle that needed to be cleared, the ground roll of approximately 2,560 feet would be needed to clear that obstacle. These distances are determined using a new aircraft flown by a manufacture's test pilot. The measured take-off is performed from a stationary start with wheel brakes on and full rated power on both engines. This method is often impractical at a busy airport and unnecessary at airports with long runways. Furthermore, the reliability of piston engines such as that fitted to this aircraft, benefit from gentle changes in power and such gentle changes can add as much as 100 feet or more to the take-off run.

If a nominal increase of 100 feet for gentle power application is added to the Cessna Manual figures, the take-off ground roll should have been in the region of 2,140 feet (with the 50 ft. obstacle clearance ground roll, will use 2,800 ft. conservatively). The difference between the calculated and reported ground roll distance is in excess of 4,000 feet which is significant. Nevertheless, where runway length is not a limiting factor, it would be reasonable for the pilot deliberately to remain on the runway whilst accelerating from the recommended safe single engine speed of 95 KIAS to the one engine best rate of climb speed of 104 KIAS. The distance travelled during this acceleration could have been consistent with the extra 4,000 feet. Low engine power is an alternative explanation for the increased ground roll but it would have had to be a near symmetric loss of power for the pilot not to have noticed it. The discrepancy reported with differential in manifold pressure readings could also be an explanation as to the extended runway use. An alternate explanation might be that the pilot deliberately chose not to use full power for the take-off given the length of the runway. However, this would have been inconsistent with operating practices therefore a deferred rotation at 104 KIAS seems the more likely explanation given the manifold pressure reading and amount of passengers and weight that may have been loaded on the aircraft.

Whatever the reason for the prolonged ground roll, C6-NLH became airborne from MYNN and the controller who saw the white smoke as the aircraft climbed out advised the aircraft and asked him to return and gave him the option of runway 27. Had there been a malfunction on the runway or immediately after lift-off, and whilst the landing gear was still extended and had the full length of the runway been utilized, the pilot could have adopted the action recommended in the Cessna Manual which was to close both throttles and land straight ahead on the remaining runway length. Therefore, it seems probable that both engines were operating normally during the take-off ground roll. The pilot did not declare an emergency. If he had perceived an engine failure, he might have said so because this would have provided the air traffic controller with important information. Since he did not specifically mention an engine failure, it is possible that he was unsure which engine was malfunctioning, particularly as the left engine must have been producing some power or else the aircraft could not have climbed.

2.4.2 The Initial Climb

Assuming the pilot became airborne at 108KIAS with the flaps retracted; his subsequent action would have been to raise the landing gear. He probably intended to accelerate to 120KIAS before reducing engine power to the recommended cruise climb setting. It is possible that the act of reducing power provoked a malfunction in the left engine and hence the failure of the number 2 cylinder and that a symptom of that malfunction could also be the backfiring heard by the eyewitnesses.

2.5 The Initiating Event

2.5.1 The position of the aircraft when the misfiring was heard.

The eyewitnesses were uncertain precisely where the misfiring had occurred but had it not been during the pre-takeoff checks, it may have been somewhere after takeoff and prior to the decision to return for a landing.

None of the eyewitness on the ground reported seeing any flames or separated components from either engine so there was no evidence, apart from post accident examination of the engines, to indicate the source of the failure and engine noise. The examination found no faults within the right engine but mechanical failure of the number 2 cylinder of the left engine. Thus it is possible that the misfiring or noise heard by the eyewitnesses and possibly the crew, if they did in fact hear it, or felt the loss of thrust came from the left engine but sounded or felt like it came from the right engine hence the decision to secure the right engine and not the left.

Another possible explanation for the misfiring could be weather related. For instance, the aircraft had recently returned from a charter to Treasure Cay where they were unable to land due to the intense weather and rain. Water may have made its way into the fuel tank during this time or possibly during or after refueling. Although the pilot's standard preflight checks include a fuel check and the draining of any water from the tanks, there was no way of knowing if the crew had drained any water from the tank sumps. If they had not, a small quantity of water could have entered the fuel lines during taxiing or takeoff and made its way to the engine. Once in the injector lines, it could have cause a temporary interruption in power followed by misfiring or a bang from the exhaust as engine power is restored. No inference that this happened is intended. It is simply a plausible explanation and there might be other reasons for a temporary malfunction or misfiring noises heard.

2.6 Practical engine failure identification

In a twin engine light aircraft the generally accepted method of determining which engine has lost power is by rudder foot loads and displacement. In the event of one engine losing power, the aircraft tends to turn towards the failing engine and this undesired yaw must be corrected by applying rudder, which pilots learn to apply instinctively. If one of the Cessna 402 engines were to lose all its power immediately after take-off, the rudder foot load would be heavy and the displacement significant it is difficult to mistake which foot is applying load to the rudder pedal. Once this action has been taken, pilots use a simple phrase such as 'dead foot, dead engine' to identify the defective engine. Consequently, if an engine were suddenly to lose all its power output, there would be no need to look at the engine instrumentation to determine which engine has failed. Once the defective engine has been identified, the pilot should complete the appropriate actions listed in the Cessna Information Manual. An engine failure during takeoff is the most critical time for a failure and the procedure is complex. The vital actions must be carried out swiftly and recalled from memory.

The pilot did not declare an emergency with ATC. If he had perceived an engine failure he might have said so because would have provided the air traffic controller with important information. Since he did not specifically mention an engine failure, it is possible that he was unsure which engine was malfunctioning, particularly as the left engine must have been producing some power after the misfiring noises were heard or else the aircraft could not have climbed.

2.7 Events between the initiating event and the left turn

2.7.1 Control of Bank Angle

As the Cessna Information Manual states, straight flight on the power of one engine is best achieved by banking 5˚ towards the engine under power. This bank angle would barely be noticeable to eyewitnesses so it was not possible to determine whether the pilot adopted this procedure (if he did in fact have an engine failure). However, given his experience and qualification, the pilot would certainly have known of its relevance to his predicament as well as the requirement not to use too much bank in either direction. In this context, 10˚ of bank would be too much for straight flight and more than 30˚ bank would have been excessive for a deliberate turn.

2.7.2 Climb Performance

Eyewitnesses were generally consistent in their statements that the aircraft was still climbing after it had passed over the perimeter road towards the lake until just before it increased its bank to the left, while extending its landing gear. Some eyewitnesses estimated the aircrafts height at the start of the turn as about 150 to 300 feet. However, if the eyewitnesses' estimates are reasonable, the aircraft must have climbed between 100 and 300 feet between the runway and the start of the turn. Consequently, for the aircraft to have continued climbing after crossing the road as many witness reported, the left engine must have been producing some useful power. In simple terms, the loss of power on the left engine, if there was one, must have been more progressive than sudden.

2.8 Condition of the engine in flight

2.8.1 Right Engine

No mechanical evidence was found regarding a malfunction of the right engine. The probability that a subtle discrepancy would occur coincident with the discrepancy suffered by the left engine is highly unlikely. Corroborating evidence that the pilot may have perceived a discrepancy within the right engine was found within the wreckage. Both fuel selectors were found in the "OFF" position. Assuming the pilot became airborne with each selector in its respective position (left selector valve to left engine and right selector valve to right engine), if he moved it, the only reason for him to do so would be if he thought a discrepancy with the left engine might be related to its fuel supply consequently turning the left selector to the off position instead of the right engine position (or cross-feed position). In his haste, he may have inadvertently also turn the right selector valve to the "OFF" position when trying to secure what he may have later perceived to be a discrepancy with the right engine instead. He therefore may have inadvertently secured the right engine as both left and right magneto switches of the right engine were found in the "OFF" position. Alternator switch for the right engine as well as the Battery switch was found in the "OFF" position. Auxiliary fuel pump switch for the right engine was also found in the "OFF" position.

2.8.2 Operating the wrong propeller lever

Usually the first three actions for shutting down a reciprocating engine are to close the throttle, select the RPM lever to feather and select the mixture to cut-off. On some aircraft types this involves retarding three of the six engine control levers, working from left to right, retarding alternate levers. However the engine securing procedure in the Cessna Information Manual is slightly different; it states the order as throttle, mixture and then propeller lever. *(See Appendix 5.10)*. The difference in the order is unlikely to be significant provided that the pilot operates the lever swiftly, but it is a complication that slightly increases the probability of operating the wrong lever.

The possibility that the pilot intended to shut down the left engine but operated the right engine levers and control switches by mistake was considered. If the pilot had accidentally moved the wrong lever, it seems likely that he would have noticed his mistake in time to reverse his action. He would have heard the change in propeller noise and experienced a yaw to the right. The only contra-indication to this assumption would be the rudder deflection and perhaps the engine instruments. The confirmatory signs for his assumption would have been the power fluctuations from the right engine. A situation where one engine's power is fluctuating may be difficult to resolve for two reasons; firstly the propeller governor tends to keep the propeller RPM constant; and secondly, when both engines have similar manifold pressures, one needle is masked by the other which overlays it. If the fluctuations are rapid, the pilot may be unable to read the 'L' and 'R' symbols on each needle of the twin-needle engine instruments. (See Appendix 5.17)

2.9 Events during the Turn

To some witnesses the aircraft appeared to maintain height for a few seconds during the early part of the turn before it began to descend: to others it had started to descend shortly before the turn began. Whichever recollection is correct, the aircraft had obviously stopped climbing. Moreover, the high nose attitude in the turn reported by some eyewitnesses would have been inconsistent with sustained flight on one engine.

The landing gear was extended during the turn and the bank angle of the aircraft was almost perpendicular to the ground as reported by some eyewitnesses'. An attempted turn towards the airfield was also bound to reduce the aircraft's climb performance. Somewhere between the time the aircraft departed and the time it crashed the right engine was secured. If the pilot had fully realized his predicament, at that moment he had only two choices: either a forced landing in the lake straight ahead or a gliding turn back to the airport. Even if he was as high as 500 feet, (and none of the eyewitnesses thought it was that high) given his distance and location from the runway, a gliding return was an unrealistic choice. The eyewitness reports of a rapid increase in bank angle and the aircraft's nose pitching into a steep descent are consistent with total loss of control. Moreover, there can be little doubt that the aircraft stalled; the stall speed in level flight was in the order of 80 KIAS but any attempt to turn tightly was likely to increase the stall speed and lead to an abrupt loss of control. The observation of the eyewitnesses when used to calculate the aircraft's height, equated it to a maximum height of approximately 100 to 300 feet above the ground. Once it had stalled at that height and without power, a crash was inevitable. The rate of descent was high and penetrating the water of the lake did much to disrupt the structural integrity of the airframe. The evidence does not indicate which engine failed (if any), but it does indicate the importance of ascertaining when the pilot secured the right engine.

2.9.1 Loss of Control

Eyewitnesses' reports of a rapid increase in bank angle and the aircraft's nose pitching into a steep descent are consistent with total loss of control. Moreover, there can be little doubt that the aircraft stalled; the stall speed in level flight is in the order of 80KIAS but any attempt to turn tightly was likely to increase the stall speed and lead to an abrupt loss of control. Eyewitnesses' accounts states that the aircraft was approximately 150 to 200 feet and in some estimation as high as 300 feet above the ground. Once it had stalled at that height and without sufficient power a crash was inevitable. The extension of landing gear during this tight turn only further helps to increase the inevitable loss of control.

2.10 The loss of power from the left engine

The left engine had suffered a major mechanical failure with the number 2 cylinder and much of the effort in the engineering investigation was devoted to understanding what had led to that failure. There was evidence of pre-existing wear. The existence of fatigue displayed long term wear characteristics but no short term traumatic damage. A summary of left and right engine analysis follows and a full description of the engineering results contained in engineering reports appendix 5.1 and 5.2.

2.10.1 Summary of left and right Engine Analysis

On October 6, 2010 C6-NLH was recovered from the waters of Lake Killarney. Both engines remained attached to the fuselage. The wreckage was stored under quarantine at a hanger at Lynden Pindling International Airport, Nassau, Bahamas. Both engines were removed from the fuselage and photographed in their recovery state. Both engines were prepared for shipping to TCM for a detailed examination prior to being placed in shipping containers. Prior to shipping the left engine, the No. 2 cylinder assembly and piston were removed, photographed and transported by hand to the NTSB Materials Laboratory, Washington DC, for a detailed examination. The No. 2 cylinder, serial number 30213-3, had separated into two parts between the fourth and fifth fin from the barrel end, the lower part remaining attached to the barrel. And later research of the stamps, etching and other identifying marks established the original cylinder manufacturer as Engine Components Inc. (ECi), a division of Danbury Aerospace, both of San Antonio, Texas. The Right Engine was identified as TCM TSIO-520-VB Serial Number 290209 and Left Engine as TCM TSIO-520-VB serial Number 248270.

On October 9, 2011 preliminary inspections of both engines was accomplished by representatives of Teledyne Continental Motors at Lynden Pindling International Airport, Nassau, Bahamas. Additional photographs were taken evidencing the condition of the engines. Both engines were prepared for shipping prior to being placed in shipping containers.

The Left Hand Engine No. 2 cylinder had separated into two parts between the fourth and fifth fin from the barrel end; the upper major portion of the cylinder head and the lower portion which remained attached to the barrel. Additional photographs were taken of the stamps, etching and other identifying markings and forwarded to the NTSB. The research of the stamps, etching and other identifying markings established the manufacturer of the cylinder as ECi. ECi was notified of the accident and copies of the stamps, etching and other identifying markings was provided. ECi completed its research of the stamps, etching and other identifying markings and supplied the historical data on the birth and history of Cylinder Serial Number 30213-3.

On October 18, 2010, the No. 2 cylinder assembly of the left engine was examined by personnel from the National Transportation Safety Board (NTSB) Materials Laboratory, ECi (cylinder manufacturer) and the Bahamas Civil Aviation Department.

2.10.2 Left Hand Engine No. 2 Cylinder Analysis

The Details below was taken from the NTSB MATERIALS LABORATORY FACTUAL REPORT.

Preliminary examination of the fracture faces revealed that they were partially covered by a combustion product.

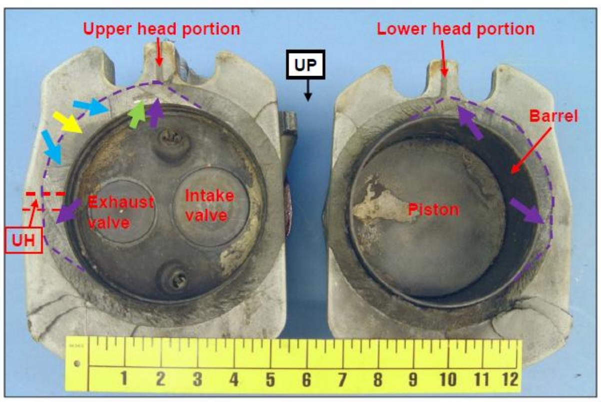


Figure 2. The mating fracture faces on the upper (left) and lower (right) portions of the cylinder head.

The fracture faces are illustrated in Figure 2 with the head portions, the barrel, the piston, the exhaust valve and the intake valve identified**.** Examination of the fracture faces revealed two zones displaying different surface textures, one located predominantly on the exhaust side of the cylinder head. The zone within the purple dashed line was relatively smooth and the zone outside of the dashed line displayed a rough uniformly grainy surface. The purple arrows in Figure 2 indicate distinct crack arrest marks that were located within the smooth zone, consistent with fatigue. The yellow arrow indicates a slightly darker arced area within the smooth zone and the blue arrows indicate radial lines that appeared to emanate from where the ends of the arced area abutted the crest of the barrel thread.

The fracture face around the smooth zone on the lower portion of the cylinder head was solvent cleaned and is illustrated in Figure 3 with the smooth zone contained within the purple dashed line. The cleaning revealed the darker arced area indicated by the yellow arrow which matched the darker arced area indicated by the yellow arrow in Figure 2 and is illustrated later in Figure 4. Examination of the smooth zone revealed that the fracture was relatively flat and oriented perpendicular to the axis of the barrel; features also consistent with fatigue.

Figure 3. The fracture face on the lower head portion, after cleaning.

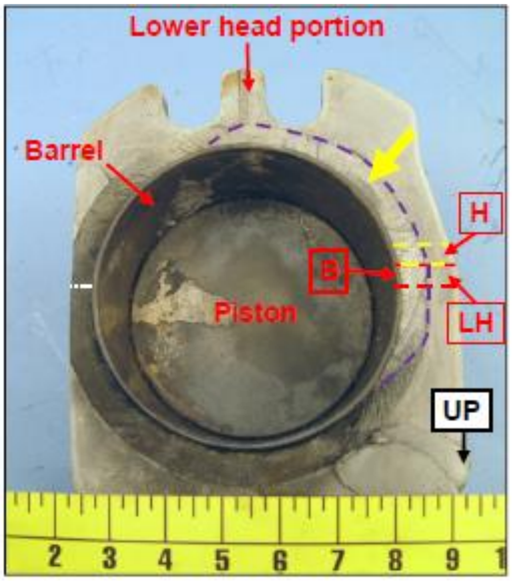
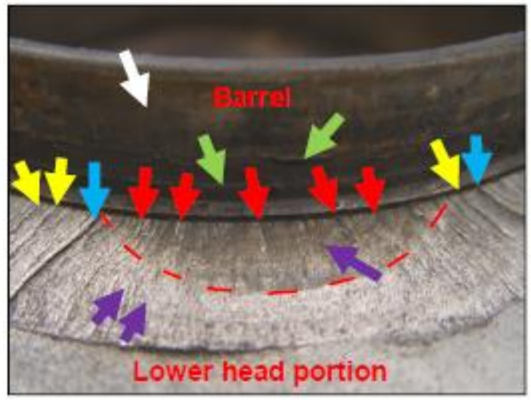


Figure 4. The fatigue zone indicated by the yellow arrow in Figure 3.



Samples were removed from the cylinder head and the barrel for detailed examination and their sectional views are illustrated later in Figure 13. The purple dashed lines in Figure 3 indicate the location of a lower cylinder head sample identified as "LH" and a mating barrel sample identified as "B". The white dashed line on the opposite side of the cylinder head in Figure 3 indicates a cut that was made in order to separate the lower head portion from the barrel so that sample "H", indicated by the yellow dashed lines, could be removed. A mating sample of the upper cylinder head, identified as "UH", was also removed and is indicated by the red dashed line in Figure 2.

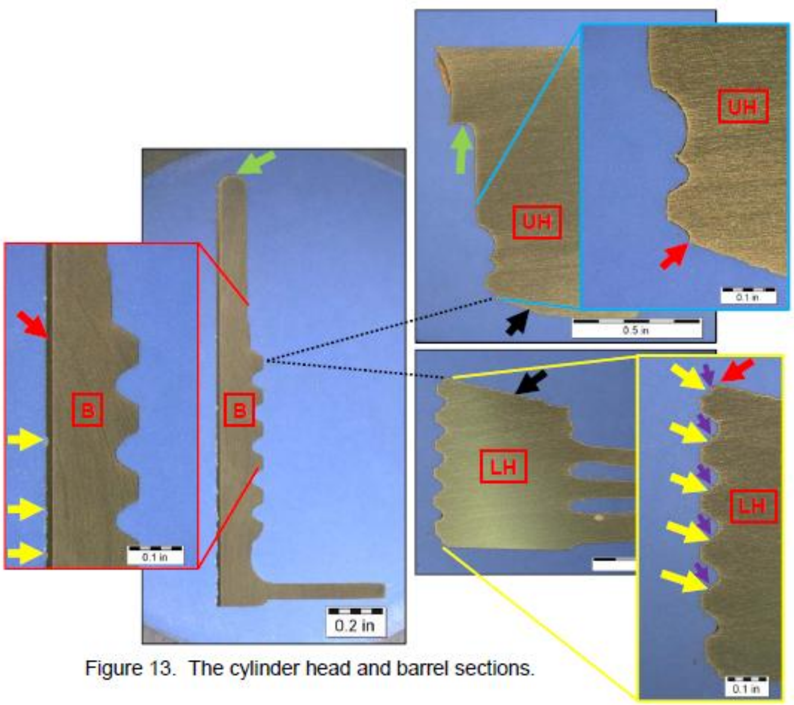


Figure 13. The cylinder head and barrel sections.

The darker arced area indicated by the yellow arrow in Figure 3 displayed a relatively smooth fracture face that abutted the crest of the first thread on the barrel. The fractured face displayed arced crack arrest marks and ratchet marks15 consistent with fatigue. The darker arced area is illustrated in Figure 4 with the barrel and the lower cylinder head portion identified. The red dashed line indicates a distinct termination of the darker area consistent with the engine not being operated for a significant time resulting in a cessation of crack propagation. The purple arrows indicate crack arrest marks within the darker area and outside of it. The red arrows indicate ratchet marks, within the darker area, that originate in the root of the cylinder head thread engaged with the first thread on the barrel.

The yellow arrows indicate ratchet marks, outside of the darker area, that also originate in the root of the cylinder head thread engaged with the first thread on the barrel. The blue arrows indicate ratchet marks similarly indicated by the blue arrows in Figure 2. The green arrows indicate residual anti-seize compound.

The locations of the identifications previously observed on the upper cylinder head portion are illustrated in Figures 5, 6 and 7.

Figure 5. Side view of the upper head portion.

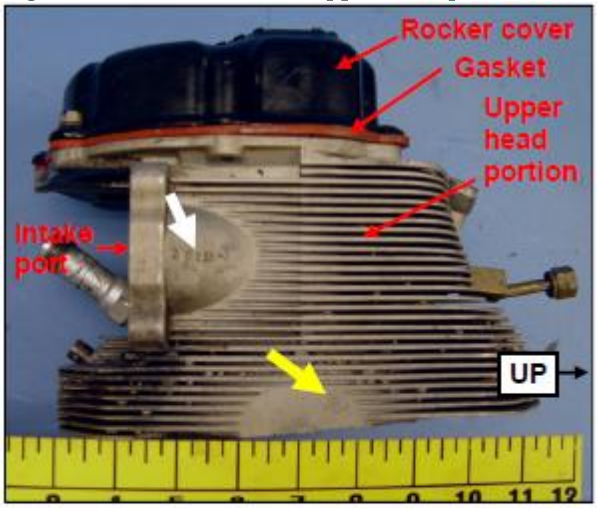


Figure 5 is a side view with the intake port, the rocker cover and the rocker gasket identified. The "up" direction, as installed, is also indicated. The white arrow indicates the serial number, 30213-3, consistent with the August 2008 cylinder history and the yellow arrow indicates the bell profile, consistent with the cylinder being the "FREEDOM™" brand.

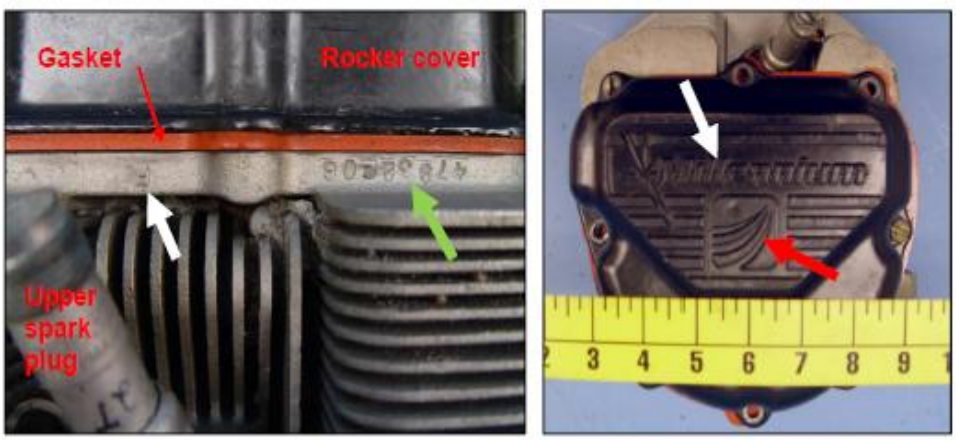
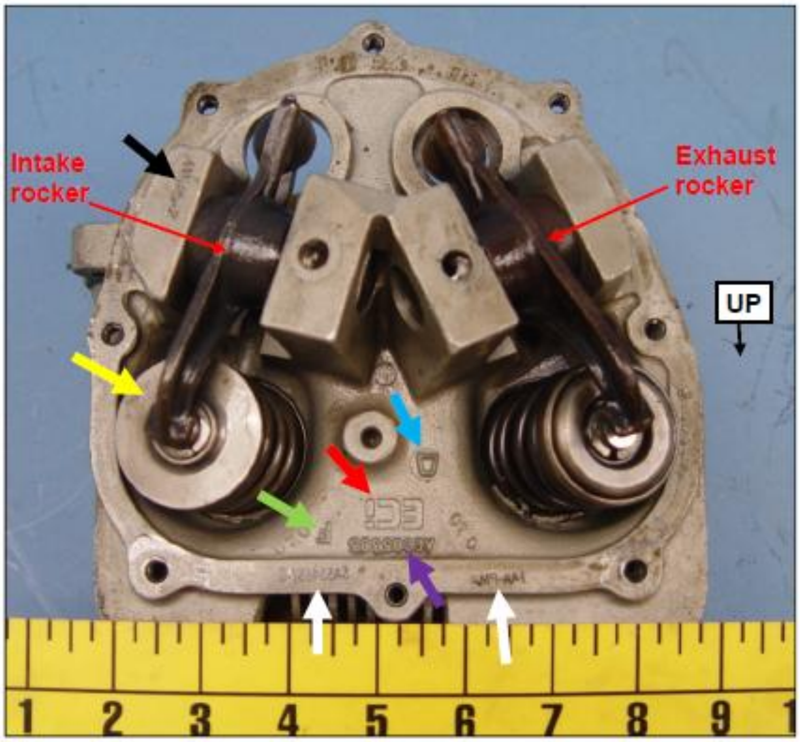


Figure 6. The upper edge of the rocker flange (left) and the rocker cover (right).

The left image in Figure 6 is a closer view of the rocker flange in the area indicated by the green arrow in Figure 5. The green arrow indicates the serial number 47932-06, consistent with the August 2006 cylinder history, and the white arrow indicates the cylinder head casting revision letter, "F".

Examination of the rocker cover revealed that it was attached to the cylinder head by two screws that were found to be loose, consistent with the rocker cover being previously removed. The rocker cover displayed the SAP16 logo, indicated by the red arrow in the right image in Figure 6, and the word "Millennium", indicated by the white arrow in the right image. These SAP components are consistent with them being transferred from the SAP cylinder this ECi cylinder replaced, as indicated by the January 2010 cylinder history.

Figure 7. The rocker space in the upper portion of the cylinder head.

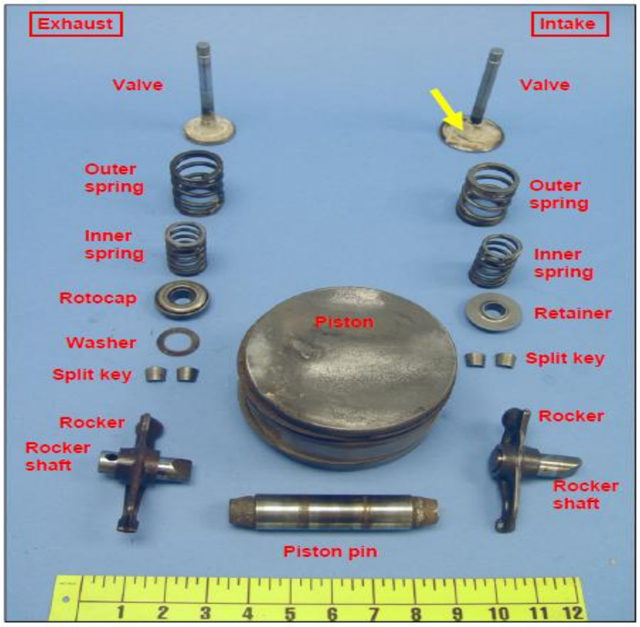


The identifications previously observed in the rocker space are illustrated in Figure 7 with a red arrow indicating the ECi logo, a purple arrow indicating the casting part number, a green arrow indicating the casting revision letter and a blue arrow indicating the Oberdorfer trapezium. The black arrow indicates the overhaul number 41525-2, consistent with the January 2010 cylinder history. The yellow arrow indicates a location on the intake valve retainer that displayed the identifications "SA35971" and "FAA-PMA", consistent with it being an SAP product.

As the August 2008 cylinder history indicated that the cylinder was overhauled by ECi and sold as a complete assembly, which included AEC valve assemblies, and the January 2010 cylinder history indicated that the cylinder overhaul included a valve and valve seat re-cut, not a valve assembly replacement, the valve assemblies were removed and examined for identifications.

Examination of the valve assembly components located p/n SA5399885 on the intake valve, p/n SA35971 on the intake retainer, p/n SA6438734A on the exhaust valve, p/n SA629117-1-E on the rotator and p/n SA652984D on the intake and exhaust rocker shafts, part numbers consistent with them being SAP products. No records were found to indicate when the ECi valve assembly was replaced by the SAP valve assembly.

Figure 8. Valve gear removed from the cylinder head and the piston extracted from the barrel.



The valve assembly components are illustrated and identified in Figure 8 with the piston, extracted from the barrel, and the piston pin, extracted from the piston. Removing combustion product from the crown of the piston revealed the part number 654840C, consistent with it being the appropriate TCM piston for the TCM model TSIO-520 engine and agreeing with the inserted number on the Airmark parts list in the January 2010 cylinder history.

The disassembly process revealed a significant, tan colored deposit in the cylinder ports and on the valves reminiscent of soil. Such a deposit would not be present during normal operation but would be consistent with lake bed material being carried into engine cavities resulting from the aircraft impacting the lake bed. A sample of the deposit at the location indicated by the yellow arrow in Figure 8 was taken for the analysis detailed later.

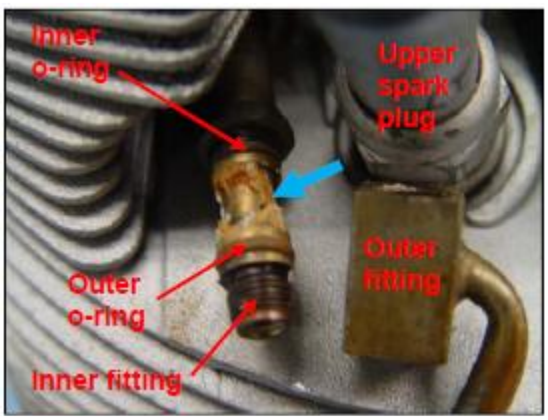


Figure 9. The injector assembly partially disassembled.

Examination of the cylinder head included the injector indicated and identified in Figure 1. The injector is illustrated in Figure 9 with the outer fitting removed to reveal the inner fitting. The inner and outer o-rings are indicated and a blue arrow indicates a mostly tan colored soil-like deposit between the o-rings. The inner fitting was removed from the cylinder head and an examination revealed three mostly obscured holes in the reduced diameter between the o-rings. One side of the inner fitting displayed a partially clear hole and is illustrated in Figure 10 with the inner and outer o-rings identified.

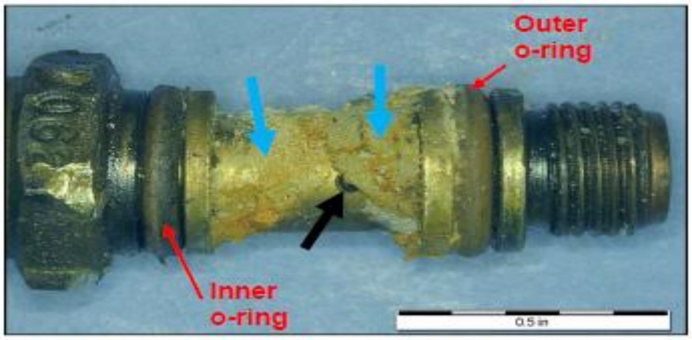


Figure 10. The deposits on one side of the injector.

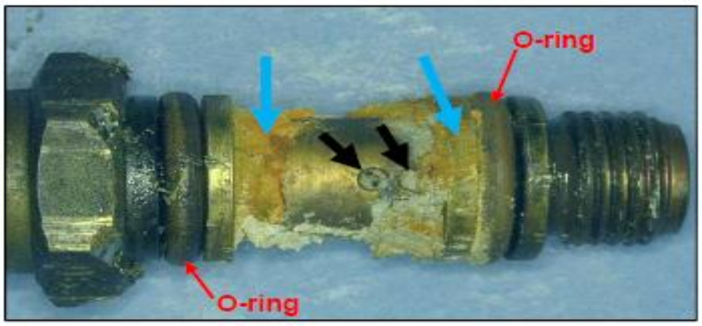


Figure 11. The deposits on the opposing side of the injector to Figure 11.

Blue arrows indicate the deposit and a black arrow indicates a partially clear hole. The opposite side of the inner fitting displayed two mostly obscured holes and is illustrated in Figure 11 with the inner and outer o-rings identified. Blue arrows indicate the deposit and black arrows indicate the two mostly obscured holes. Examination of the central hole in the inner fitting revealed that it was clear of any obstruction. A sample of the deposit was taken for analysis and comparison with the sample removed from the intake valve, indicated by the yellow arrow in Figure 8. Removal of the sample revealed that there were 8 holes (four pair) in the inner fitting, suggesting that the cylinder would require eight holes to be operational and would not be functional with a majority of the injector holes obstructed. The presence of the soil-like deposit would also be consistent with being post impact and originating on the lake bed.

Details of Sample examination and testing available in attached section "NTSB MATERIALS LABORATORY FACTUAL REPORT".

On January 18, 2011 both engines were examined at TCM, 2039 Broad Street Mobile, Alabama. The examination of the left engine was witnessed by representatives of TCM, Bahamas CAD, Danbury Aerospace, Airmotive Engineering Corporation, and Superior Air Parts, while the examination of the right engine was witnessed by personnel from TCM and Bahamas CAD."

2.10.3 Left Engine Serial Number 248270 Analysis

The engine exhibited impact damage, concentrated at the bottom components of the engine. The number 2 cylinder head and barrel were separated both by a fracture surface and the threaded junction. The maintenance history of the engine was unknown due to the records not being available.

Component	Observation
Starter	The starter rotated by hand and was intact.
Starter Adapter	The starter adapter could not be rotated by hand. The assembly was intact and the scavenge pump gears and housing were intact and undamaged. The crankshaft to camshaft timing was verified by the alignment of the gear’s timing marks.
Ignition Harness	All leads were frayed or damaged shielding and exhibited normal operating signatures.
L/H Magneto	The left-hand magneto cannot be turned through by hand. 12-23-08 Overhaul date. The unit was disassembled and found to be intact and contain corrosion.
R/H Magneto	The right-hand magneto turned with associated binding. 12-23-08 Overhaul date. The unit was disassembled and found to be intact and contain corrosion.
Oil Cooler	The oil cooler was intact and exhibited corrosion and impact damage signatures. Drake air overhaul. Additional numbers: 11-30-07, 445128, C-15387, 30449A, J07-6486-9.
Oil Pump	The oil pump drive was intact. The oil pump cavity contained light scratches and exhibited normal operating signatures. The oil pump gear teeth exhibited normal operating signatures. The oil pressure relief valve and seat contained no obstructions and exhibited signatures of proper seating.
Oil Filter	The oil filter was intact and was not opened.
Throttle and Fuel Control Assembly	The unit exhibits corrosion and the levers were immovable by hand. Finger screen removed and no material was present. The unit was disassembled and there was corrosion present. The internal components were found to be intact and seating properly. The passages where open and unrestricted.
Fuel Pump	The fuel pump turned by hand, but with substantial resistance. The fuel pump drive was intact and undamaged. The fuel pump was disassembled to examine the internal components. The internal components were intact but exhibited a corrosive material.
Fuel Manifold Valve	The fuel manifold valve exhibited normal operating signatures. The manifold valve was disassembled to examine the internal components. A jell material covered a portion of the screen. The manifold valve plunger assembly was intact, secure and undamaged. There were no signatures of fuel stains or leakage in the vent chamber side of the diaphragm.
Fuel Nozzles and Lines	The number 2 fuel nozzle was not returned with the engine or cylinder. The fuel nozzles 1, 3 and 6 were restricted the remaining were unrestricted and exhibited normal operating signatures. The fuel lines were intact and undamaged.
Spark Plugs	The number 2 cylinder sparkplugs were returned with the cylinder and were intact. The sparkplugs contained corrosion and combustion by-products. The spark plugs had normal wear signatures in accordance with the Champion aviation check-a-plug comparison chart.

Component	Observation
Alternator	The alternator turned through by hand and was intact. The drive coupling was intact and undamaged.
Oil Sump	The oil sump drain plug was not safe tied. The oil sump exhibited impact damage and was crushed. The oil sump was drained of oil and the amount was residual. The sump contained foreign material.
Oil Pick-up Tube & Screen	The oil pick-up tube exhibited impact damage. The oil suction screen was unrestricted.
Induction System	The induction risers and balance tube exhibited impact damage and corrosion.
Cylinder #1	The spot putty was not evident on the cylinder hold-down nuts. The cylinder combustion

Cylinder #3 Cylinder #4 Cylinder #5 Cylinder #6	chamber contained combustion and corrosive deposits. The cylinder bore was intact and corroded. The cylinder skirt was intact and undamaged. The intake and exhaust valve heads exhibited normal deposits and operating signatures. The rocker box area had an oil residue indicating lubrication to the overhead. The cylinder overhead components (valves, rocker arms, guides, springs, retainers and shafts) were lubricated and undamaged.
Cylinder #2	The number 2 cylinder was received separately from the engine. The cylinder head and barrel were separated both by a fracture surface and the threaded junction. Sections had been removed from the cylinder head and barrel by the NTSB Laboratory. The fracture surfaces were examined by the TCM and NTSB Metallurgical Laboratories. The intake and exhaust valve heads exhibited normal deposits and operating signatures. The cylinder overhead components (valves, rocker arms, guides, springs, retainers and shafts) were lubricated and undamaged. Head markings – AEC65385, 010, 020, 41525.2, 143071, G842G, 47932-06
No. 1, 3, 4, 5, & 6 Piston, Rings and Pin	The piston head exhibited a normal amount of combustion deposits. These deposits had an appearance of exposure to moisture. The piston skirt was free of scoring and damage. The piston rings were intact, free in their grooves, exhibited normal wear and operating signatures. The piston pin and plug assembly was intact and undamaged.
#2 Piston, Rings and Pin	The piston was received separate from the engine. The piston head had been partially cleaned. The piston skirt was free of scoring and damage. The piston rings were not installed. The piston pin and plug assembly was intact and undamaged.
Lifter Intake & Exhaust	The lifter faces were undamaged and exhibited normal operating signatures. The lifter bodies were undamaged and exhibited normal operating signatures.
Crankshaft	The crankshaft and counterweight assembly was intact. The connecting rod journals, main journals and thrust surfaces were undamaged and showed no signs of abnormal wear or lubrication distress. The crankshaft counterweight pins, plates and snap-rings were intact. The counterweights were undamaged and had free and unrestricted movement on the hanger blades. The gear bolts were tight and safe tied and the gear teeth were undamaged. The oil transfer passages were open and unrestricted. Alternator drive face gear teeth were intact and undamaged. The oil transfer collar was intact and undamaged. The oil transfer plug was tight and in position.

Component	Observation
#1 Main Bearings	The #1 (rear) crankshaft main bearings exhibited normal operating and lubrication signatures. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
#2 Main Bearings	The #2 (intermediate) crankshaft main bearings exhibited fretting at their mating surfaces. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
#3 Main Bearings	The #3 (intermediate) crankshaft main bearings exhibited normal operating and lubrication signatures. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
#4 Main Bearings	The #4 (intermediate) crankshaft main bearings exhibited normal operating and lubrication signatures. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
#5 Main Bearings	The #5 (front) crankshaft main bearings exhibited normal operating and lubrication signatures. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
No. 1, 2, 3, 4, 5 & 6 Connecting Rod	The connecting rod assembly was intact and undamaged. The connecting rod nuts and bolts were intact and secure. The connecting rod bushing exhibited normal operating and lubrication signatures.
No. 1, 2, 3, 4, 5 & 6	The connecting rod bearing exhibited normal operating and lubrication signatures. The

Connecting Rod Bearings	connecting rod bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
Camshaft	The camshaft lobes exhibited normal operating signatures. The camshaft gear was intact and exhibited normal operating signatures. The gear bolts were tight and safe tied and the gear teeth were undamaged. Work order numbers: DSC11052-1, DSI9081-6.
Crankcase	The crankcase was intact. An epoxy material was present at the number 8 and 9 backbone (lifting eye) bolt bores. The cylinder bays were intact and undamaged. The number 2 main bearing support mating surfaces exhibited rough surfaces from fretting. The right-hand number 2 main bearing support lock-slot was elongated, indicating bearing shift. The remaining main bearing support mating surfaces were intact and exhibited no signs of fretting or bearing tang lock-slot elongation. The main bearing support diameters were intact. The oil galleys and passages in the left and right crankcase halves were intact, clear and unrestricted.
Accessory Gears	The accessory gears had continuity. The teeth were undamaged and exhibited normal operating signatures.

Component	Observation
Turbocharger	The turbocharger could not be rotated by hand. The turbine housing exhibited damage to the tailpipe flange. They were no signs of turbine housing crack or leaks. The turbine blades were intact. The center housing oil inlet and outlet fittings were intact and there were no signatures of oil leakage. The center housing was intact and there were no cracks or exhaust leaks present. The compressor housing was intact and there were no cracks present. The compressor housing was attached securely to the center housing. The compressor blades were intact and they exhibited minimal erosion signatures. Debris was present in the compressor wheel.
Controller	The controller exhibits corrosion and the lever was immovable by hand. The lever was intact and secure.
Overboost Valve	The overboost valve was intact and exhibited debris in its openings.
Wastegate	The wastegate (exhaust by-pass) valve was in the full open position and the linkage was intact. The wastegate and actuator assembly was intact and undamaged.
Propeller Governor	The propeller governor could be rotated by hand, was intact and undamaged.
Vacuum Pump	The vacuum pump could not be rotated by hand and the unit was intact.

Note: - Details which pertains to manufacturers, serial numbers, work orders and other specifics of individual components available in TCM reports.

2.10.4 Right Engine Serial Number 290209 Analysis

The engine exhibited impact damage. There was no evidence of pre-impact abnormalities. The maintenance history of the engine was unknown, permanent maintenance records documenting scheduled and unscheduled maintenance were not located.

Component	Observation
External inspection of engine	The engine exhibited impact damage, concentrated at the bottom components of the engine. The right-hand accessory drive and had been fractured from the crankcase accessory section.
Exhaust System	Condition: The exhaust system components that were received exhibited impact damage.
Starter	The starter rotated by hand and exhibited corrosion
Starter Adapter	The starter adapter could not be rotated by hand. The assembly was intact and the scavenge pump gears and housing were intact and undamaged. The crankshaft to camshaft timing was verified by the alignment of the gear's timing marks.
Ignition Harness	All leads were frayed or damaged shielding and had been cut from the mounting covers.
L/H Magneto	The left-hand magneto turned freely by hand. The magneto was installed and tested on the test bench and produced a blue spark across a 7 mm gap through the full range of test bench RPM. 05-13-08 overhaul date.
R/H Magneto	The right-hand magneto turned freely by hand. The magneto was installed and tested on the test bench and produced a blue spark across a 7 mm gap through the full range of test bench RPM. 05-13-08 overhaul date.
Oil Cooler	The oil cooler exhibited impact damage. Drake air overhaul. Additional numbers: 428326, 01-27-06
Oil Pump	The oil pump drive was intact. The oil pump cavity contained light scratches and exhibited normal operating signatures. The oil pump gear teeth exhibited normal operating signatures. The oil pressure relief valve and seat contained no obstructions and exhibited signatures of proper seating.
Oil Filter	The oil filter housing was cut open using the Champion cutting tool and the filter element was cut from the canister to allow examination. The oil filter element was examined and contained an insignificant amount of material.
Throttle and Fuel Control Assembly	The unit exhibits corrosion and the levers were immovable by hand. Finger screen removed and material was present. The unit was disassembled and there was corrosion present. The internal components were found to be intact and seating properly. The passages where open and unrestricted.
Fuel Pump	The fuel pump could not be turned through by hand. The fuel pump drive was fractured by turning the engine through prior to removing the fuel pump. The fuel pump was disassembled to examine the internal components. The internal components were intact and exhibited corrosion damage.
Fuel Manifold Valve	The fuel manifold valve exhibited impact and corrosion damage. The cover was breached. The manifold valve was disassembled to examine the internal components. The manifold valve plunger assembly was intact, secure and undamaged. There were no signatures of fuel stains or leakage in the vent chamber side of the diaphragm.

Component	Observation
Fuel Nozzles and Lines	The fuel nozzles were restricted. All nozzles exhibited various degrees of distortion. The number 5 nozzle was fractured through at the large threaded (cylinder) end. All fuel nozzle lines exhibited impact damage. The numbers 2, 4, 1 and 5 fuel lines were exhibited nozzle nut separation.
Spark Plugs	The sparkplugs contained corrosion and had normal wear signatures in accordance with the Champion aviation check-a-plug comparison chart. The 5B spark plug was undisturbed from the cylinder but was intact.
Alternator	The alternator could not be turned through by hand and exhibited impact and corrosion damage. The drive coupling was intact.
Oil Sump	Condition: The oil sump drain plug was not safe tied. The oil sump exhibited impact damage and was crushed. The oil sump was drained of oil and the amount was residual. The oil was dark in color and contained earth.
Oil Pick-up Tube & Screen	Condition: The oil pick-up tube exhibited impact damage. The oil suction screen was unrestricted.
Induction System	The induction risers and balance tube exhibited impact damage and corrosion.
Cylinder #1 Cylinder #2 Cylinder #3 Cylinder #4 Cylinder #5 Cylinder #6	The spot putty was not evident on the cylinder hold-down nuts. The cylinder combustion chamber had a normal amount of combustion deposits and the bore condition was free of scoring and undamaged. The cylinder skirt was intact and undamaged and there were no hone marks visible in the cylinder bore ring travel area. The intake and exhaust valve heads exhibited normal deposits and operating signatures. The rocker box area had an oil residue indicating lubrication to the overhead. The cylinder overhead components (valves, rocker arms, guides, springs, retainers and shafts) were lubricated and undamaged.
No. 1, 2, 3, 4, 5, & 6 Piston, Rings and Pin	The piston head exhibited a normal amount of combustion deposits. These deposits had an appearance of exposure to moisture. The piston skirt was free of scoring and damage. The piston rings were intact, free in their grooves, exhibited normal wear and operating signatures. The piston pin and plug assembly was intact and undamaged.
Lifter Intake & Exhaust	The lifter faces were undamaged and exhibited normal operating signatures. The lifter bodies were undamaged and exhibited normal operating signatures.
Crankshaft	The crankshaft and counterweight assembly was intact. The connecting rod journals, main journals and thrust surfaces were undamaged and showed no signs of abnormal wear or lubrication distress. The crankshaft counterweight pins, plates and snap-rings were intact. The counterweights were undamaged and had free and unrestricted movement on the hanger blades. The gear bolts were tight and safe tied and the gear teeth were undamaged. The oil transfer passages were open and unrestricted. Alternator drive face gear teeth were intact and undamaged. The oil transfer collar was intact and undamaged. The oil transfer plug was tight and in position.

Component	Observation
#1 Main Bearings	The #1 (rear) crankshaft main bearings exhibited normal operating and lubrication signatures. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
#2 Main Bearings	The #2 (intermediate) crankshaft main bearings exhibited fretting at their mating surfaces. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
#3 Main Bearings	The #3 (intermediate) crankshaft main bearings exhibited normal operating and lubrication signatures. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
#4 Main Bearings	The #4 (intermediate) crankshaft main bearings exhibited normal operating and lubrication signatures. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.

#5 Main Bearings	The #5 (front) crankshaft main bearings exhibited normal operating and lubrication signatures. The bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
No. 1, 2, 3, 4, 5 & 6 Connecting Rod	The connecting rod assembly was intact and undamaged. The connecting rod nuts and bolts were intact and secure. The connecting rod bushing exhibited normal operating and lubrication signatures.
No. 1, 2, 3, 4, 5 & 6 Connecting Rod Bearings	The connecting rod bearing exhibited normal operating and lubrication signatures. The connecting rod bearings were intact and exhibited an insignificant amount of contamination and hard particle passage. There were no signs of lubrication distress.
Camshaft	The camshaft lobes exhibited normal operating signatures. The camshaft gear was intact and exhibited normal operating signatures. The gear bolts were tight and safe tied and the gear teeth were undamaged. W/O# RA6732-1
Crankcase	The crankcase was intact. The cylinder bays were intact and undamaged. The numbers 2, 3 and 4 main bearing support lower mating surfaces exhibited rough surfaces from fretting. The remaining main bearing support mating surfaces were intact and exhibited no signs of fretting. There were no signs of bearing tang lock-slot elongation. The main bearing support diameters were intact. The oil galleys and passages in the left and right crankcase halves were intact, clear and unrestricted.
Accessory Gears	The accessory gears had continuity. The teeth were undamaged and exhibited normal operating signatures. The right-hand accessory drive gear was not returned with the engine.

Component	Observation
Turbocharger	The turbocharger could not be rotated by hand. The turbine housing was received separated from the main assembly. The housing intact and there was no cracks or exhaust leak signatures present. The turbine blades were intact. The center housing oil inlet and outlet fittings were intact and there were no signatures of oil leakage. The center housing was intact and there were no cracks or exhaust leaks present. The compressor housing was intact and there were no cracks present. The compressor housing was attached securely to the center housing. The compressor blades were intact and they exhibited minimal erosion signatures. Debris was present in the compressor wheel.
Controller	The controller exhibits corrosion and the lever was immovable by hand. The lever was intact and secure.
Overboost Valve	The overboost valve exhibited impact damage.
Wastegate	The wastegate (exhaust by-pass) valve was in the full open position and the linkage was intact. The wastegate and actuator assembly was intact and undamaged.
Propeller Governor	The propeller governor could be rotated by hand. The lever assembly from fractured from the unit.
Vacuum Pump	The vacuum pump could not be rotated by hand and the drive was fractured from the assembly.

Note: - Details which pertains to manufacturers, serial numbers, work orders and other specifics of individual components available in TCM reports.

2.11 Training and testing for pilots of light piston engine aircraft

2.11.1 The forced landing option

If, instead of attempting to return to the airport, the pilot had decided to force land into the lake more or less straight ahead, the outcome might have been different. There would still have been a crash risk and probably a rapid longitudinal deceleration, but the vertical speed at impact could have been low, the wings could have been leveled and this would have made the end of the flight far more survivable for all on board.

Piloting skills and decisions are principally the products of training and experience. Height loss is always increased in a gliding turn; and the consequences of a mishandled turn-back are often fatal. An experienced pilot who habitually flew single-engine light aircraft would be more likely to force land than to turn back because he or she generally knows that there is seldom another realistic option. On the other hand, pilots who habitually fly twin-engine light aircraft seldom, if ever, train for a forced landing, even though there may be a written procedure for that eventuality.

2.11.2 The pilot's decision to return

The pilot had considerable experience in light twin engine aircraft. He had acquired more than 12,000 hours and more specifically, more than 10,000 hours in the 402C aircraft. Consequently, it is possible that the pilot never considered the forced landing option when the aircraft would no longer climb. What seems likely is that under extreme pressure, he maintained the only option that occurred to him – returning to the airport. That was certainly his expressed intention when he declared to ATC that he would be returning and would accept runway 27 after notified about the white smoke trailing behind his left engine. At that stage the aircraft was probably still climbing or at least in level flight, and so it was a reasonable decision at the time it was uttered.

Circumstances changed when it was apparent that the aircraft would no longer climb and that might explain why the pilot secured the right engine. If he thought that the failure was of the right engine, and not the left that was reported as smoking, he probably knew that unless he feathered the propeller and secured the engine, he had no hope of returning to the airport.

As a result of the decision to accept runway 27 the following tasks, which are standard procedure for any commercial pilot were not accomplished;

- Under no circumstance should you try and return to the runway just departed until a safe altitude has been attained, the situation has been assessed, and the aircraft can make it back safely.
- Always climb to a safe altitude before any actions are taken. If unable to climb, or turn due to obstacles (building, trees, hills/mountains, towers etc.) standard procedures are to select a location straight ahead (free of obstacles, if possible) and land while still under control.
- Under no circumstance should the gear or flaps be extended until it is certain the field can be made.
- Under no circumstance should a turn be made into the engine with a suspected discrepancy.

The evidence of the hurried nature of the tasks performed and the inadequate review of critical information between the time of the pilot's acceptance of the offer to land on runway 27 and the flight making a turn to attempt the landing on runway 27 indicates that insufficient time was available to fully or effectively carry out these actions. According to eyewitnesses' reports, the aircraft was about 150 to 300 feet when it initiated a sharp left turn while trying to intercept runway 27 and extended gear while in the turn. Immediately after gear extension the aircraft could no longer maintain altitude, stalled, became inverted and started a nose dive toward terrain (lake). Consequently, the above necessary steps were performed improperly or not at all and the pilot failed to recognize that the airplane was heading toward terrain. The evidence indicates that the pilot committed a series of operational errors that led to the accident. The errors, which individually were not causal, interacted in a way that caused the accident.

Researchers studying decision making in dynamic situations[32] have suggested that experienced persons can quickly make decisions based on cues that they match with those from previous experiences encountered in similar situations. A referenced text refers to this characteristic as Recognition Primed Decision Making, in which a decision maker's rapid assessment of the situation is almost immediately followed by the selection of an outcome.
It states:

> *Our research has shown that recognitional decision making is more likely when the decision maker is experienced, when time pressure is greater, and when conditions are less stable.*[33]

It is likely therefore that when previously faced with similar situations such as the opportunity to return for a landing after having experienced some sort of failure or problems previously, the pilot who had acquired more than 12,000 hours in total and more specifically more than 10,000 hours in this make and model airplane, accepted the offer and landed without incident. However, recognition primed decision making can present risks to the decision maker if the initial assessment of the situation is incorrect, or if the situation changes sufficiently after the decision has been made but the initial decision is not reconsidered. In this accident, the latter scenario appears to have been the case; there is no evidence that the pilot reconsidered the initial decision to accept the offer to land on runway 27 versus continuing the climb to a safe altitude and assessing his options and all subsequent actions were directed to completing the steps necessary to successfully land.

The evidence suggests that either of two reasons could account for the pilot's persistence in attempting to land rather than climb to a safe altitude and assess his situation. These include the failure to adequately consider the time required to perform the steps needed to climb to a safe altitude, assess his situation, select a suitable runway and return for a landing, considering the report of white smoke trailing behind his engine and the reluctance of decision makers in general to alter a decision once it has been made. By not reconsidering that initial decision, the pilot acted consistently with the findings of human factors research on decision making that found that decision makers are reluctant to alter a decision after it has been made. For example:[34]

> *Operators tend to seek (and therefore find) information that confirms the chosen hypothesis and to avoid information or tests whose outcome… could disconfirm it. This bias produces a sort of "cognitive tunnel vision" in which operators fail to encode or process information that is contradictory to or inconsistent with the initially formulated hypothesis. Such tunneling seems to be enhanced particularly under conditions of high stress and workload.*

Thus, in addition to simply being too busy to recognize that he could not properly and safely return to a landing on runway 27 given his altitude, weight and configuration, once the decision to land on runway 27 had been made, the course of action taken was to continue the approach rather than to discontinue it.

2.11.3 Engine failure training and testing in light twin engine aircraft

A glide landing in a twin-engine aircraft is not generally contemplated except just after take-off when the landing gear is down and there is runway remaining. All other engine failure procedures are predicated on correctly identifying the failed engine; securing it; climbing away if necessary; and flying a single-engine approach and landing to a runway. This emphasis is also reflected in the routine recurrent testing of pilot skills.

---

[32] Klein, G., (1993) *Naturalistic Decision Making: Implications for Design.* Wright-Patterson Air Force base, Ohio Crew System Ergonomics Information Analysis Center.

[33] Klein, G., (1993) A recognition primed decision (RPD) model of rapid decision making. In Klein, G., A., Orasanu, J., Calderwood, R., and Zsambok, C.E., (Eds), *Decision Making in action: Models and Methods.* Norwood, New Jersey, Ablex, p. 146.

[34] Wickens, C. D., (1984) *Engineering Psychology and Human Performance.* Columbus Ohio: Charles E. Merrill, p. 97.

2.12 The Implications of Performance Category C

An engine failure after take-off in a twin-engine Performance Group C aircraft requires immediate, prioritized and accurate corrective action from the handling pilot. This is because:

1. Many Group C aircraft will not sustain a single engine climb at maximum take-off weight unless the landing gear and flaps are retracted. Consequently, there may be a period between leaving the runway and achieving a suitable climb speed and configuration when, if an engine fails completely, the only realistic option is to force land immediately.

2. Some Group C aircraft require the pilot to feather the propeller of a failing engine immediately because if the propeller RPM decay below a certain level, it may be impossible to feather the propeller[35]. *(See Appendix 5.16)*

3. An unexpected and complete engine failure results in one propeller very rapidly changing its state from thrust to drag. The result is a reduction in forward thrust of significantly more than 50%. The sudden change tends to cause a loss in airspeed whilst the pilot recognizes the failure and takes early corrective action.

4. Until the propeller of the failed engine is feathered, a Group C aircraft at or near maximum take-off weight may be unable to accelerate in level flight or to climb.

5. The single-engine rate of climb is highly dependent on airspeed. If, after an unexpected engine failure, the airspeed has reduced below the 'blue line' optimum marked on the Air Speed Indicator (ASI), the aircraft may not climb despite it being properly configured.

Consequently, the handling skills required to successfully overcome an unexpected failure shortly after take-off in a twin-engine aircraft of Performance Category C are among the most demanding of the skills required by any airplane pilot. He or she must take immediate action to contain the situation and decide rapidly, based on a number of critical factors, whether to force land or to climb away from the point of failure.

2.13 ATC Tower Controller

The Air Traffic Controllers that handled the accident aircraft were all Grade One Air Traffic Control Officers and were properly trained and provided appropriate air traffic services. In addition, the investigation examined the actions of the ATC Tower controller to determine what role, if any, his actions may have had upon the accident. By the standards of the FAA, CAA and ICAO the pilot and not the controller was in the best position to determine the safety of the acceptance of that offer.

2.14 Survivability

The investigation also assessed survivability issues to determine the extent to which the number of fatal injuries could have been reduced and the effectiveness of the seatbelt in use. Based on the extent of the damages sustained the accident was not survivable. The emergency response for this accident was timely and effective. The accident was not survivable for the airplane occupants because they were subjected to impact forces that exceeded the limits of human tolerances.

2.14.1 Aircraft Seating

The analyses of the impact injuries suffered by the fatalities within the aircraft were found to be consistent with the cabin damage inflicted by the initial impact with the shallow water of the lake and subsequent secondary

[35] See Aeronautical Information Circular 100/2005 Propeller Feathering on Twin Piston Engined Aircraft Appendix 5.16

cartwheel motion of the aircraft hitting the lake bottom. Most of these impact injuries were chest injuries, injuries to the ankles and leg and feet and there were some head injuries. There is clear evidence that chest injuries were compounded by the separation and collapse of the seats and by the limitations of the passenger seats, where only lap strap was available.

2.15 Situational Awareness[36]

Once the decision was made to accept the offer to land on runway 27, the pilot displayed poor situational awareness, with regard to such critical factors as the following;

- His current altitude
- Proximity to terrain
- Flight Path
- Recognition of stall speed
- Extension of landing gear while in a turn
- Excessive weight - Load Factor[37]
- Excessive bank angle
- Turning an aircraft into the critical (dead) engine[38].

Situational awareness refers to a flight-crew's understanding of the status and flight-path of the aircraft and the accuracy of their prediction about its future status and flight path. Deficiencies in situational awareness can lead to potential failures involving flight-path prediction or comprehension and prediction of system parameters as in the case here involving C6-NLH. The accident indicated that from the beginning of his attempt to land on runway 27, the pilot exhibited a lack of awareness of fundamental parameters of the approach.

2.16 CAD Oversight

CAD / FSI mandate is surveillance of certified AOC as per CASR 2001 Schedule 12. As Acklins Blue Air Charter Limited was not an AOC holder, no surveillance by CAD/FSI was conducted. C6-NLH was a private aircraft owned by an individual. It was registered to Lebocruise Air Limited and operated by Acklins Blue Air Charter Limited. Neither of the above companies was registered with or underwent a certification process by the Bahamas Civil Aviation Department as required by Schedule 12 of the Bahamas Civil Aviation (Safety) Regulations 2001 to be authorized to conduct cargo or passenger operations as an authorized Air Operator Certificate holder.

Several months prior to this accident, the Flight Standards Inspectorate went on a proactive campaign where information was shared with the daily newspaper and media outlets. Several articles were written and the department took the message to the airwaves via talk show and media houses warning the general public about the dangers of travelling with unauthorized air carriers. Numerous posters were strategically placed at all Fixed Base Operations and the General Aviation Center warning about the dangers of unauthorized air carriers.

---

[36] Situational awareness has been defined as the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.

[37] Load factor - In aeronautics, the **load factor** is defined as the ratio of the lift of an aircraft to its weight and represents a global measure of the stress. Since the load factor is the ratio of two forces, it is dimensionless. However, its units are traditionally referred to as **g**, because of the relation between load factor and apparent acceleration of gravity felt on board the aircraft. A load factor of one, or 1 g, represents conditions in straight and level flight, where the lift is equal to the weight. Load factors greater or less than one (or even negative) are the result of maneuvers or wind gusts.

[38] Critical engine – an engine whose failure would mostly affect the performance of an aircraft. In most small twin engine aircraft (unless they have a counter rotating engine) the left engine is considered the critical engine.

The Flight Standards Inspectorate additionally engaged the assistance of the Airport Authority and NAD with meetings and strategic planning on ways to curb the incidence of unauthorized air charter operators. List of all authorized air charter operators were distributed to the media and all stake holders at MYNN. Post accident, the message was again presented to the television media outlets and print media for their assistance with spreading the message about the dangers of travel with unauthorized air carriers.

2.17 Summary

The experienced and competent pilot was confronted with an unenviable emergency at a critical stage of flight. A number of potentially confusing cues may have led to him misidentifying the partial loss of power from the left engine and secured the right engine. His reaction and instinct to return to the runway confounded his instinctive reaction to an emergency situation, which is much practiced in training and testing.

The time for him to make the correct diagnosis and to take the corrective action was short. During this time he announced his decision to return to the airport for a landing on runway 27 and initiated a turn to the left. With the left engine problem persisting and the right engine secured and not producing thrust at this time, the reduced thrust of the left engine was insufficient to maintain lift. In a tightening turn, with gears extended, the aircraft stalled, became inverted which resulted in a steep nose dive into the lake.

3.0 Conclusions

(a) Findings

1. Acklins Blue Air Charter was advertising and operating as a Bahamas air taxi operator without having undergone the certification process in contravention of Bahamas Civil Aviation (Safety) Regulations Schedule 12.

2. The airplane was issued a Certificate of Airworthiness on May 19, 2010, by the Bahamas Flight Standards Inspectorate, and was being operated by Acklins Blue Air Charter.

3. The Cessna 402C aircraft is classified in the performance Group C. This requires rapid feathering of the propeller of a failed engine and the raising of flap and the landing gear in order to achieve maximum climb performance.

4. The airplane maintenance records were not located; therefore, no determination could be made whether the airplane was being maintained in accordance with Bahamas Civil Aviation Regulations.

5. The 12,000 hour pilot and second pilot were not qualified to operate in Bahamas commercial air taxi operations.

6. No determination could be made whether the pilot or second pilot had completed required training and had accomplished a satisfactory recurrent flight check of their flying ability as required by CASR Schedule 12 and 14 for aircraft operating in commercial air transportation as well as the stipulation by the insurance policy.

7. Post-accident weight and balance calculations indicate the airplane was being operated approximately 523 pounds over maximum certificated takeoff weight (6,850 lb)

8. The pilot was advised by an air traffic controller that white smoke was trailing the left engine during takeoff; the pilot did not declare an emergency or advise the controller of any engine failure or mechanical abnormality.

9. The airplane's left engine could not produce rated shaft horsepower during takeoff.

10. Several factors contributing to the degradation of the airplane's performance and its inability to maintain flight include the wind-milling propeller, the pilot's intentional initiation of a steep turn to return to the departure airport, and his intentional lowering of the landing gear during the turn to return.

11. While turning to return, the airplane stalled, pitched nose down, and impacted in a lake.

12. The search and rescue efforts were timely and appropriate; however, the lack of accurate information on the pilot submitted flight plan delayed recovery of all victims.

13. The left propeller was not feathered.

14. The No. 2 cylinder of the left engine failed due to fatigue that originated in the root of the cylinder head thread that was engaged with the first thread on the barrel.

15. Post-accident inspection of the cockpit revealed several switches for the right engine were secured; however, no determination could be made when the switches were placed / moved in those positions.

16. No evidence of failure of the airplane's structures or flight control system contributed to the accident.

17. Existing regulations did not require the aircraft to be fitted with flight recorders. The lack of any recorded data about the aircraft's performance or the flight crew conversations deprived the investigation team of essential factual information.

18. Current Civil Aviation Department personnel and budget resources may not be sufficient to ensure that the quality of surveillance for certified as well as uncertified air carrier operations will improve.

19. Airside access procedures are inadequate at Fixed Base Operators. Access to the secure airside occurring without any check of individuals to challenge whether they have a legitimate reason for accessing the secure airside. FBO door to access airside is not secured or locked continuously; persons observed walking in and out without being challenged.

20. Flight Plan Forms are being accepted and transmitted to ATC with incomplete information. This information is vital for search and rescue purposes.

21. Weather was not a factor in the accident.

22. ATC was not a factor in the accident.

23. Currently flight plans for private flights are only required for international operations.

24. The pilot was aware of discrepancy associated with the manifold pressure reading of the left engine prior to takeoff. This discrepancy was brought to his attention by a client from the flight immediately preceding the accident flight.

25. The exact center of gravity of the accident airplane could not be calculated accurately as no indication of what seat each passenger occupied in the airplane and no indication of where luggage or equipment were placed on the aircraft could be determined. However, due to the exceedance of weight limits the aircraft was already outside the allowable center of gravity envelope developed by the manufacturer.

26. The pilot had insufficient time to prepare for the approach to runway 27 before beginning the approach. The airplane pitched up quickly into a stall, after extension of gear, recovery before ground impact was unlikely once the stall began.

27. Post accident inspection did not reveal any mechanical evidence or problems with the right hand engine.

28. The pilot's decision to return to the airfield was reasonable. Once the aircraft began to lose height a return to the airfield became impractical and a forced landing in the direction of flight should have been attempted.

29. The right propeller was never recovered from the lake.

(b) Causal Factors

1. The left engine suffered a mechanical failure of the #2 cylinder, and therefore could not produce rated shaft horsepower. No indication of total loss of power with the left engine reported.

2. Right Engine electrical and engine control switches were found in the “OFF” position, therefore the aircraft was incapable of climbing on the power of one engine alone.

3. The excess weight above the maximum weight allowed for takeoff may have been an important factor in the aircraft’s inability to gain adequate altitude after takeoff.

4. The pilot secured the right engine which was mechanically capable of producing power resulting in a total loss of thrust. He then sometime thereafter initiated a steep turn with gear down and the left engine already not developing sufficient shaft horsepower to sustain lift.

5. The pilot attempted to return to the departure airfield but lost control of the aircraft during a turn to the left.

4.0 Recommendations:

As a result of this investigation, the AAIPU makes the following recommendations to the Department of Civil Aviation:

1. Evaluate the surveillance programs to ensure that budget and personnel resources are sufficient and used effectively to maintain adequate oversight of the operation and maintenance of both certified and uncertified air carriers, irrespective of size.

2. Request that the Government of the Bahamas enact legislation that creates tougher penalties for persons engaging in unauthorized air charters.

3. Request that Civil Aviation Department amend regulations to enforce that flight plans be required for all flights, private and commercial, domestic and international and that the AIP be amended to show this requirement.

4. Request the Civil Aviation Department in coordination with Air Traffic Control institute policies and procedures where aircraft are not allowed or given permission to turn in any direction after takeoff prior to attaining a minimum of 500 feet as is standard practice in pilot training.

5. Request that the Civil Aviation Department amend its information gathering forms to capture vital information that may be required in the event of lost or unavailable historical information for Bahamas registered aircraft.**[39]

6. Request that the Civil Aviation Department in conjunction with NAD require that appropriate and certified weighing devices be installed at all points where aircraft are dispatched so that pilots may have a means to accurately weigh all occupants and cargo that are to be loaded onto aircraft prepared for flight.

7. Request that the Civil Aviation Department enact regulations that make it mandatory that all pilots of private aircraft be required to complete an accurate load and weight and balance document which must be left with an agent at facilities where they depart.

8. Request that the Civil Aviation Department institute policies whereby Aviation Medical Examiners can issue pilots medical certificate immediately upon satisfactory examination as the current policy causes delays in issuing medical certificates. This delay from examination to processing and issuance results in pilots taking a chance and flying without a medical certificate which invariably renders their pilot licenses invalid.

9. Request that the Civil Aviation Department amend regulations to require all private pilots to have a proficiency check or bi-annual flight review every 2 years prior to renewal of their private pilot license.

10. Request ATC to review all Flight Plan Form filing procedures to ensure all required information is gathered as it is vital for search and rescue purposes.

11. Request Airport Authority put in place tighter security measures to properly account for all persons gaining access to the secure airside.*[40]

[39] **Prior to the publication of this report, the Flight Standards Inspectorate instituted corrective action and developed an application form that captures missing information that can establish a baseline of historical aircraft information.

[40]* Prior to the publication of this report, corrective actions as a result of recommendation 5 – 9 and 11 above have been addressed by stakeholders and relevant authorities.

12. Request Airport Authority explore a surveillance program or require all Fixed Base Operators to install surveillance equipment (CCTV) to cover all areas under their control* to properly capture all activities by persons gaining access to the secure airside at all Fixed Base Operators (FBO).*

13. Request Airport Authority to coordinate with all Fixed Base Operators to develop a safety and security plan and train their personnel with secure airport access procedures.*

14. Request Airport Authority to coordinate with all FBO to install a secure system (door locking system with buzzer) whereby persons do not have unlimited and unimpeded access to the secure airside without the knowledge of representatives of the facility.*

15. Request all FBO's to ensure all information is included on flight plan form prior to transmitting it to ATC including all passenger information (item 22 on Flight Plan Form). This information is vital for search and rescue purposes.*

5.0 APPENDICES:

Appendix 5.1 Cylinder Factual Report (NTSB)

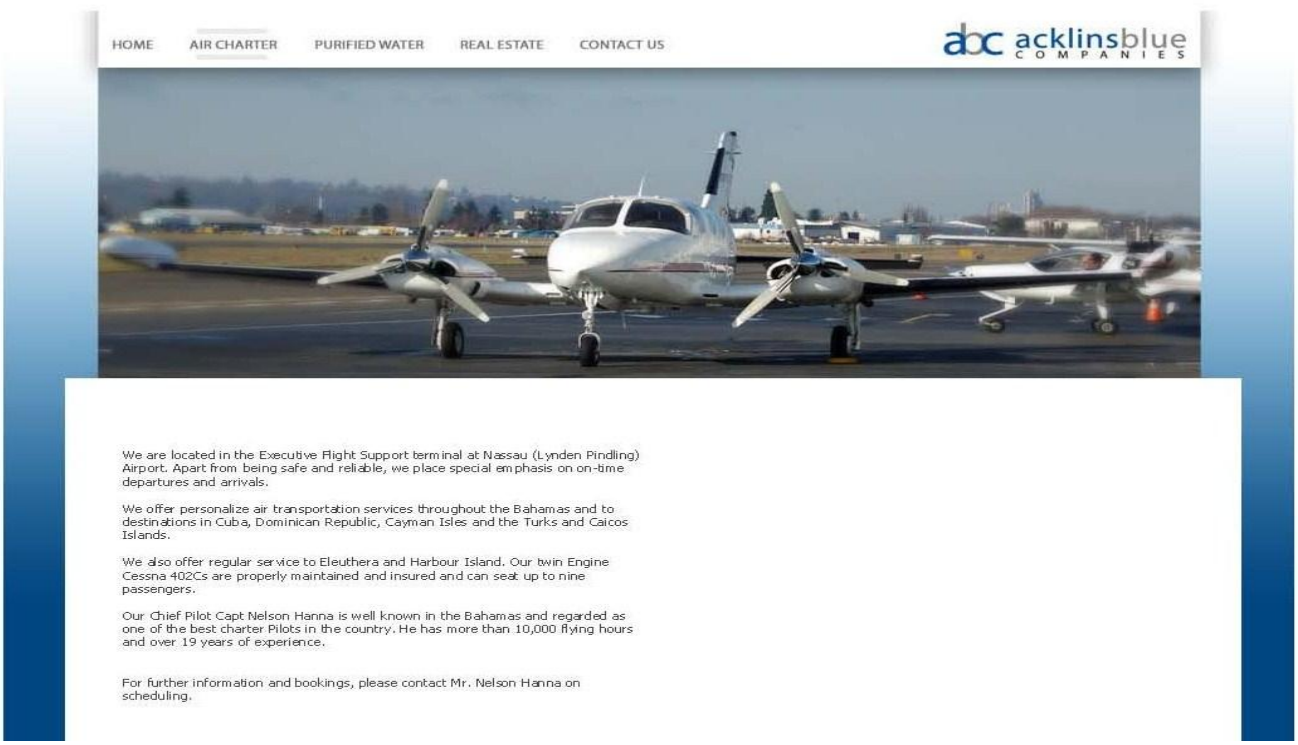
REPORT NOT INCLUDED HERE BUT MAY BE SUPPLIED IF REQUESTED

Appendix 5.2 Left and Right Engine Factual Report (TCM)

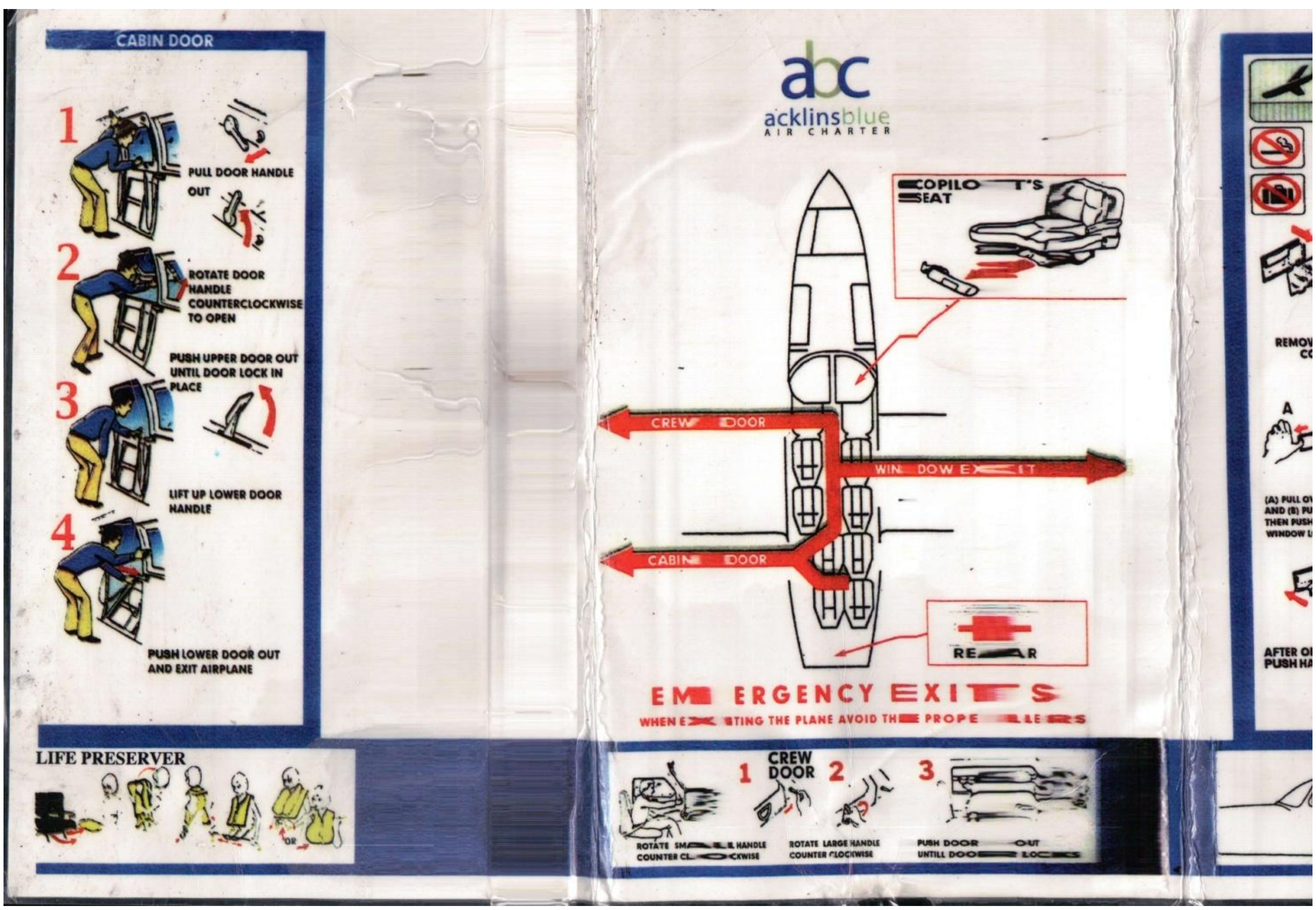
REPORT NOT INCLUDED HERE BUT MAY BE SUPPLIED IF REQUESTED

Appendix 5.3 Acklins Blue Companies

Appendix 5.4 Acklins Blue Air Charter



Appendix 5.5 Acklins Blue Air Charter



Appendix 5.6 ATC tower transcript

REPORT NOT INCLUDED HERE BUT MAY BE SUPPLIED IF REQUESTED

Appendix 5.7 Flight Plan Form

FLIGHT PLAN NASSAU TO SAN SALVADOR

(ITEM 1 – 20 MUST BE COMPLETED FOR FLIGHT PLAN TO BE PROCESSED)

ARR RPT No.

NAD Nassau Airport Development Company

FLIGHT PLAN FORM

No. 16111

FILING TIME

DATE 3/10/10

SPECIALIST INITIALS

1. TYPE OF FLIGHT	RULES	2. ACFT IDENTIFICATION	3. AIRCRAFT TYPE/ EQUIPMENT	4. TAS	5. PT. OF DEPT	6. DEP TIME (UTC) ETD	ATD
INT'L / INTER-ISLAND / TRAINING	IFR / VFR / DVFR	C6NLH	C402/G	180	NAS.	12:30	

7. ROUTE OF FLIGHT

8. ALT/LVL	9. DESTINATION	10. EST. TIME ENROUTE HOURS	MINUTES	11. OTHER INFORMATION (ADIZ, ADCUS, ETC.)
7.5	MYSM	1	0	

12. FUEL ON BOARD HOURS	MINUTES	13. ALTERNATE	14. PORTABLE RADIO	LIFE JACKETS/NO. & COLOUR	DINGHIES/CAPACITY/COLOUR
4	0		ELT	10 yel	

15. COLOUR OF AIRCRAFT	16. PILOT'S NAME (PRINT)	17. PILOT'S FULL ADDRESS OR AIRCRAFT HOME BASE	18. SOB/NO. OF U.S./NON U.S.
White/Beige	N Hanna	Executive	1

19. METHOD OF CLOSURE	20. PILOT'S SIGNATURE	21. OTHER EQUIPMENT/REMARKS
12:0	[signature]	377 3355.

NOTE: IT IS MANDATORY TO FILE A FLIGHT PLAN PRIOR TO DEPARTURE FROM NASSAU. (PTO)

FLIGHT PLAN NASSAU TO TREASURE CAY, ABACO BAHAMAS

(ITEM 1 – 20 MUST BE COMPLETED FOR FLIGHT PLAN TO BE PROCESSED)

ARR RPT No.

NAD Nassau Airport Development Company

FLIGHT PLAN FORM

No. 16106

FILING TIME

DATE 5-10-10

SPECIALIST INITIALS

1. TYPE OF FLIGHT	RULES	2. ACFT IDENTIFICATION	3. AIRCRAFT TYPE/ EQUIPMENT	4. TAS	5. PT. OF DEPT.	6. DEP TIME (UTC) ETD	ATD
INT'L / INTER-ISLAND / TRAINING	IFR / VFR / DVFR	C6-NLH	C-402/G	180Kts	MYNN	0900	

7. ROUTE OF FLIGHT

8. ALT/LVL	9. DESTINATION	10. EST. TIME ENROUTE HOURS	MINUTES	11. OTHER INFORMATION (ADIZ, ADCUS, ETC.)
9,500	MYAT		40	

12. FUEL ON BOARD HOURS	MINUTES	13. ALTERNATE	14. PORTABLE RADIO	LIFE JACKETS/NO. & COLOUR	DINGHIES/CAPACITY/COLOUR
5	00	MYAM	operable ELT	8 yellow life Jacket	

15. COLOUR OF AIRCRAFT	16. PILOT'S NAME (PRINT)	17. PILOT'S FULL ADDRESS OR AIRCRAFT HOME BASE	18. SOB/NO. OF U.S./NON U.S.
White/gray/blue	Nelson Hanna	Executive Flight Support 4278707	2 (two)

19. METHOD OF CLOSURE	20. PILOT'S SIGNATURE	21. OTHER EQUIPMENT/REMARKS
none alousl	Nelson Hanna	EFS 377 3355

NOTE: IT IS MANDATORY TO FILE A FLIGHT PLAN PRIOR TO DEPARTURE FROM NASSAU. (PTO)

Appendix 5.8 Fuel Uplift Slip

EXECUTIVE FLIGHT SUPPORT

NASSAU INTERNATIONAL AIRPORT

P.O. BOX N-8174
NASSAU, BAHAMAS

UNICOM
131.65

TEL. (242) 377-3355
FAX. (242) 377-3470

INV. # E- 163348

Date 10/5/10

Sold to C6-NLH

Address NIA

Aircraft Type C-402 Reg. No

Customer A/C No.

OPERATOR	TRUCK NO.	CASH	TIME
Ca	TP-6	CHARGE	12:06

YOUR SALE NO.	GALLONS READING - FINISH
AA 5 6 6	0 1 5 5 2 6 6
AA 5 6 5	0 1 5 5 2 0 6
PREVIOUS SALE NO.	GALLONS READING - START

GALLONS DELIVERED 60

PRODUCT	GALLONS	PRICE	TOTAL
Avgas	60		
		TOTAL $	

RECEIVED QUANTITY SHOWN ABOVE

CUSTOMER SIGNATURE

RECEIVED PAYMENT

OPERATOR SIGNATURE

GRAPHIC IMAGES INC. 954-749-5740

Appendix 5.9 Alert Issued

Alert

Alert # SA/A10-01312/001/10-9-10

To: Mrs. Deborah Coleby
Director of Operations
Nassau Airport Development Company

Captain Patrick Rolle
Director
Civil Aviation Department

Mr. Milo B. Butler III
General Manager
Airport Authority

Mr. Joseph Albury
Deputy Director
Air Traffic Control

Mr. Alphonzo Bowe
Managing Director
Executive Flight Support

Mr. Anthony Hinsey
Public Relations Manager
Odyssey Aviation

Re: Flight Plan Form Completion and Airside Security and Accountability.

In Accordance with ICAO Annex 13, Ninth Edition, July 2001, Chapter 6 Paragraph 6.8 Safety recommendations

" At any stage of the investigation of an accident or incident, the accident or incident investigation authority of the State conducting the investigation shall recommend to the appropriate authorities, including those in other States, any preventive action that it considers necessary to be taken promptly to enhance aviation safety."

In light of ongoing accident investigations the following **Alert** is being advanced in an effort to ensure safety, security and enhance search and rescue procedures.

The following findings and observations have been made and must be addressed by the relevant authority and stakeholders immediately:

1. Pilots or their agents are not completing flight plan forms in its entirety as required by Flight Plan Form Document. Though provided on the flight plan forms, accepting agents are not ensuring pilots or those acting on their behalf, list the correct passenger count.

2. Flight Plan Form in use by NAD only requires that items 1 thru 20 be completed in order for form to be processed.

3. Agents are transmitting incomplete flight plan forms to ATC.

4. ATC is accepting, processing and issuing ATC services to pilots based on incomplete flight plan forms.

5. While conducting investigations at an FBO the investigation team observed individuals who were given unimpeded access to the secure airside without being challenged, recorded or documented.

   Note: Individuals were allowed to access the secure airside; board an aircraft yet no one at the facility knew who they were or how many people left through their facility or what aircraft they boarded.

The following recommendations are hereby advanced:

1. Policy and Procedures should be developed, enhanced or enforced by relevant agency to ensure all information required by Flight Plan Form is captured by said form.

2. In light of the accident involving C6-NLH, NAD should amend this form to include items 1 thru 22 as being required prior to processing of form for all general aviation aircraft. This information would prove to be invaluable as search and rescue procedures can be enhanced as well as notification of next of kin can be made easier.

3. Training should be developed, initiated or enhanced with the entities responsible for accepting and dispensing of such information to Air Traffic Control to ensure that all information required is captured.

4. All entities involved should develop policy, procedures and institute training to its staff on methods to reject such Flight Plan Forms if required information are not completed.

5. Airport Authority as the unit with responsibility for security should ensure that all stakeholders especially in the General Aviation and Fixed Base Operations Area provide an acceptable security plan that would ensure tighter security measures and more accountability of persons that grant access to the secure airside.

6. As part of this approved security plan procedures should be in place for the continued monitoring and surveillance of the ramp used by General Aviation and all Fixed Base Operators (Suggestion CCTV).

7. Stakeholders should be made to develop policy, procedures and provide training to its staff on airside safety and security responsibilities and put stricter airside access criteria in place.

This department requests that all relevant entities institute the above recommendations with immediate effect in order to enhance safety, security and search and rescue operations.

Appendix 5.10 Engine Failure after Take-off Checklist

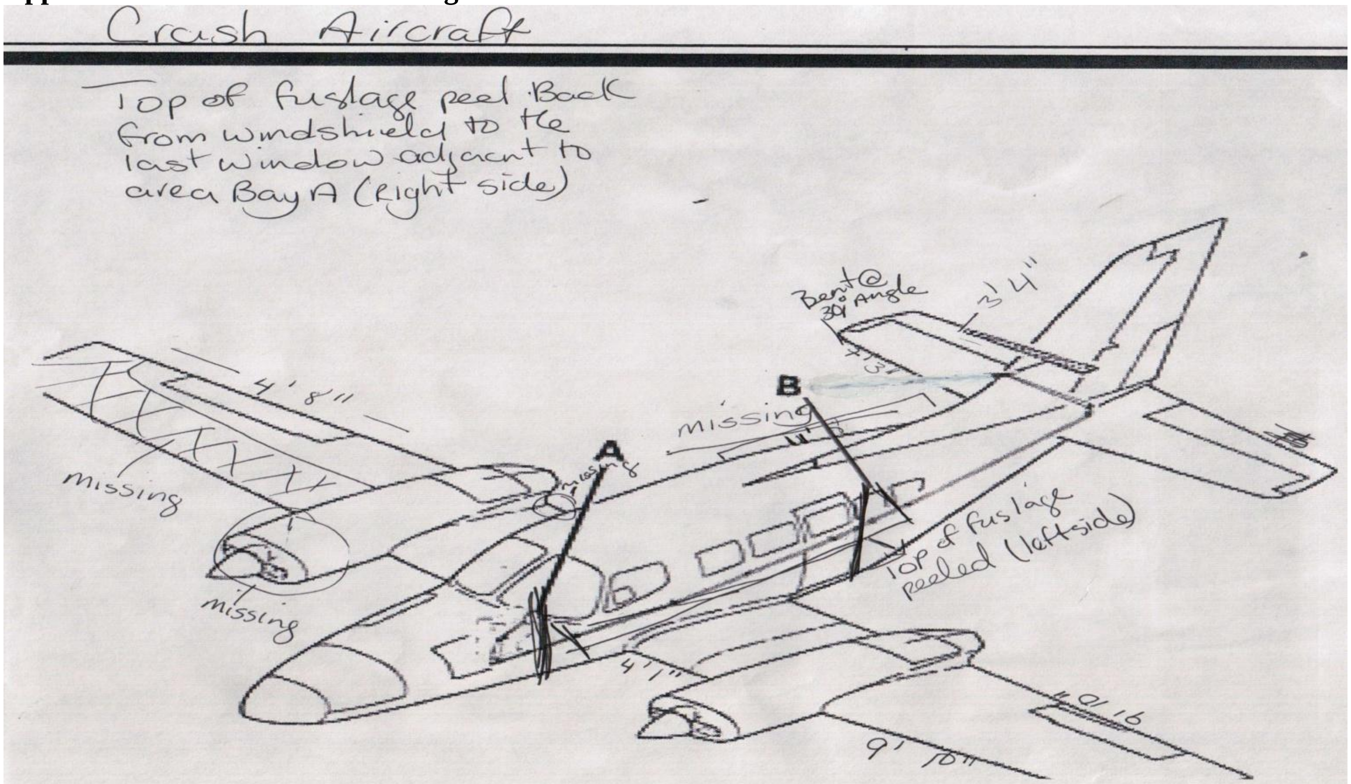
Cessna. MODEL **402C** (ABBREVIATED PROCEDURES)

SECTION
EMERGENCY PROCEDURE

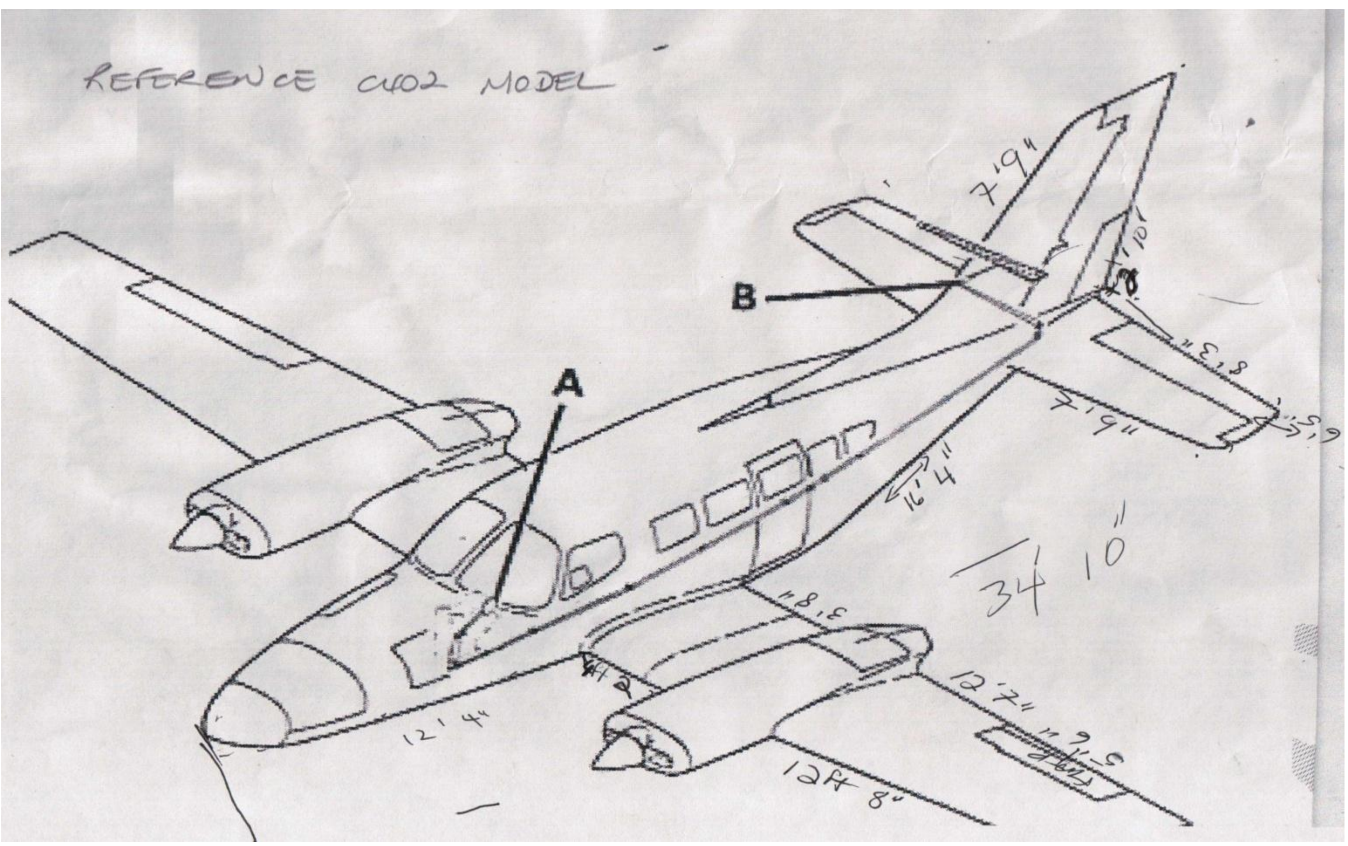
ENGINE FAILURE AFTER TAKEOFF (Speed Above 91 KIAS With Gear Or In Transit)

1. Mixtures - FULL RICH.
2. Propellers - FULL FORWARD.
3. Throttles - FULL FORWARD (39.0 Inches Hg.).
4. Landing Gear - CHECK UP.
5. Inoperative Engine:
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
6. Establish Bank - 5° toward operative engine.
7. Climb To Clear 50-Foot Obstacle - 95 KIAS.
8. Climb At One Engine Inoperative Best Rate-of-Climb Speed - 104 KIA
9. Trim Tabs - ADJUST 5° bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.
10. Cowl Flap - CLOSE (Inoperative Engine).
11. Inoperative Engine - SECURE as follows:
    a. Fuel Selector - OFF (Feel For Detent).
    b. Auxiliary Fuel Pump - OFF.
    c. Magneto Switches - OFF.
    d. Alternator - OFF.
12. As Soon As Practical - LAND.

Appendix 5.11 Crash Aircraft Diagram



Appendix 5.12 Reference Aircraft Diagram



Appendix 5.13 CASR Regulation Part X, Regulation 67.

PART X
COMMERCIAL AIR TRANSPORT OPERATIONS

Issue of air operator's certificate.

67.(1) A Bahamian operator of aircraft shall not fly on any flight for the purpose of commercial air transport, otherwise than under and in accordance with the terms of an Air Operator's Certificate (AOC) granted to the operator under paragraph (3).

(2) Any person shall be deemed to be engaged in providing commercial air transport and subject to the requirements of this Part, if—

(a) they, or persons on their behalf, have undertaken any form of advertising to carry passengers or property by aircraft for remuneration or valuable consideration without using the services of an AOC holder; or

(b) they, or persons on their behalf, verbally offer to carry passengers or property by aircraft for remuneration or valuable consideration, without using the services of an AOC holder; or

(c) they, or other persons on their behalf, provide or advertise an arrangement for meals, lodging or travel (or any other "all-inclusive" method of pricing) for compensation, in which the travel by aircraft is included at gratis or is compensated, but is not provided by an AOC holder.

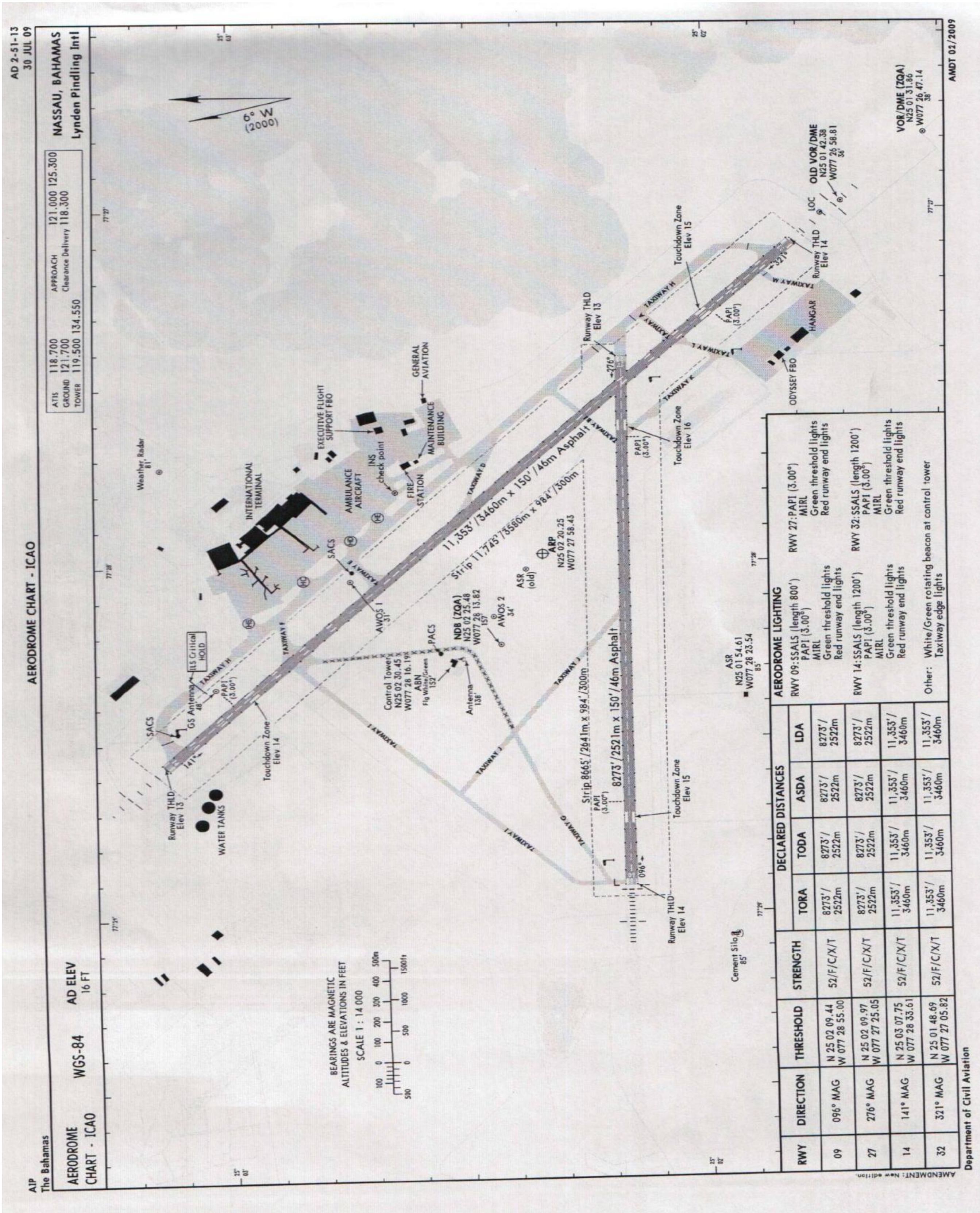
(3) The Minister may grant to any person applying therefore, an AOC if he is satisfied that person is competent and capable, having regard in particular to the person's previous conduct and experience, his equipment, organization, staffing, maintenance and other arrangements, to secure the safe operation of aircraft of the types specified in the certificate on flights of the description and for the purposes so specified.

Appendix 5.14 CASR Regulation Part X, Regulation 68

Initial certification required.

68. No person may operate, or cause to be operated, an aircraft subject to these Regulations in commercial air transport unless the AOC holder has completed the initial certification requirements of Schedule 12 for such operations;

Appendix 5.15 Aerodrome Chart Nassau, Bahamas



Appendix 5.16 Aeronautical Information Circular 100/2005

Propeller Feathering on Twin Piston Engine Aircraft

Civil Aviation Authority

UNITED KINGDOM

AERONAUTICAL INFORMATION CIRCULAR

AIC 100/2005
(Pink 90)
8 December

National Air Traffic Services Ltd
Aeronautical Information Service
Control Tower Building, London Heathrow Airport
Hounslow, Middlesex TW6 1JJ
Editorial: 020-8745 3457
Distribution: 0870-8871410 (Documedia Solutions Ltd)
Content: 01293-573089 (Flight Deprtment)
Website: www.ais.org.uk

Cancels AIC 130/1997 (Pink 153)

PROPELLER FEATHERING ON TWIN PISTON ENGINED AIRCRAFT

1 Most feathering propellers (hydraulically actuated constant speed, such as some Hartzell and McCauley types) fitted to twin piston engined light aircraft are designed in such a way that it is not possible to feather the blades below a certain low rpm (typically 700 to 1000 rpm).

2 This is because at these low rpm's, centrifugal latches operate to hold the blades in fine pitch to ensure that when the engine is shut down on the ground, the subsequent restart is not made with the propellers feathered.

3 In cases where the normal windmilling rpm at low airspeed may fall low enough to prevent feathering, the Flight Manual, Owner's Handbook, or Pilot's Operating Handbook warns the pilot that feathering cannot be accomplished below a certain rpm. However, the full implications of the situation may not always be clear, and other factors of which a pilot should be aware are:

(a) In the event of an engine failure caused by a major mechanical fault (eg seizing bearings due to loss of oil), the rate of deceleration of the engine can be rapid and it is thus imperative that the pilot takes immediate action to feather the propeller, before the rpm falls to the 1000 rpm region;

(b) on most twins the usual procedure when shutting down an engine which has failed is initially to close the throttle of the inoperative engine. This serves to confirm which engine has failed before commencing the feathering actions. However, if the windmilling rpm has reduced towards the critical region where feathering may not be successful, then re-opening the throttle will usually increase the rpm slightly and improve the probability of being able to feather;

(c) in the event of an engine failure, it is important not to let the airspeed reduce below the scheduled engine out climb speed. This will help to ensure that the propeller continues to windmill at sufficiently high rpm for feathering to be successful. If optimum performance is required it is vital to achieve and maintain this best engine out climb speed; and

(d) the loss of performance associated with a stopped propeller in fine pitch or more importantly with a windmilling propeller is potentially serious. The additional drag will considerably reduce the single engine climb performance from that available with a fully feathered propeller. The directional controllability will also be reduced, though adequate control should still be available down to the minimum control speed (V_{MCA}) as V_{MCA} is determined with the propeller in the condition existing before feathering by the pilot (ie normally with a windmilling propeller). It will probably not be possible to trim the aircraft on the rudder trim at the best rate of climb speed and a considerable foot force may have to be held to maintain heading. However, it cannot be over emphasised that, if it is necessary to gain or conserve altitude the best available performance is essential, and for this the best engine out rate of climb speed must be maintained.

This Circular is issued for information, guidance and necessary action.

Printed and distributed by Documedia Solutions Ltd, Cheltenham, Glos.

Appendix 5.17 Cessna 402C Dual Manifold Pressure Gauge

Manifold vacuum / pressure - an effect of a piston's movement on the induction stroke and the choked flow through a throttle in the intake manifold of an engine. It is a measure of the amount of restriction of airflow through the engine, and hence of the unused power capacity in the engine.

The rate of airflow through an internal combustion engine is an important factor determining the amount of power the engine generates. Most gasoline engines are controlled by limiting that flow with a throttle that restricts intake airflow. Manifold vacuum is present in all naturally-aspirated engines that use throttles (including carbureted and fuel injected gasoline engines using the otto cycle or the two-stroke cycle).

The mass flow through the engine is determined by the rotation rate of the engine, multiplied by the displacement of the engine, and the density of the intake stream in the intake manifold. In most applications the rotation rate is set by the application. The displacement is dependent on the engine geometry, which is generally not adjustable while the engine is in use (although a handful of models do have this feature, see variable displacement).

Restricting the input flow reduces the density (and hence pressure) in the intake manifold, reducing the amount of power that is produced. It is also a major source of engine drag, as the engine must pump material from the low-pressure intake manifold into the exhaust manifold (at ambient atmospheric pressure).

When the throttle is opened (in a car, the accelerator pedal is depressed), ambient air is free to fill the intake manifold, increasing the pressure (filling the vacuum). A carburetor or fuel injection system adds fuel to the airflow in the correct proportion, providing energy to the engine. When the throttle is opened all the way, the engine's air induction system is exposed to full atmospheric pressure, and maximum airflow through the engine is achieved. In a "naturally-aspirated" engine, total engine output is thus determined by the ambient barometric pressure. Superchargers and turbochargers can "boost" manifold pressure to above atmospheric pressure.

Appendix 5.18 Alert SA/A10-01312/002/10-9-10 Historical Information

BAHAMAS CIVIL AVIATION DEPARTMENT

AAIPU- Bahamas

Air Accident Investigation and Prevention Unit

Alert

Alert # SA/A10-01312/002/10-9-10

To: Hubert Adderley
Manager
Flight Standards Inspectorate

Captain Patrick Rolle
Director
Civil Aviation Department

Re: Inadequate Record Retention Information.

In Accordance with ICAO Annex 13, Ninth Edition, July 2001, Chapter 6 Paragraph 6.8 Safety recommendations

" At any stage of the investigation of an accident or incident, the accident or incident investigation authority of the State conducting the investigation shall recommend to the appropriate authorities, including those in other States, any preventive action that it considers necessary to be taken promptly to enhance aviation safety."

In light of ongoing accident investigations the following **Alert** is being advanced in an effort to ensure complete information gathering.

The following findings and observations have been made and should be addressed by the relevant authority and stakeholders immediately:

1. **The investigation is negatively impacted by the unavailability of historical information about the aircraft, its maintenance history and its last maintenance activity as required by Bahamas Civil Aviation (Safety) Regulation (CASR).**

The following recommendations are hereby advanced:

1. Policies and Procedures should be developed; enhanced or enforced by the Civil Aviation Department or its Designee to ensure that all relevant information required by the CASR, for all Bahamas Registered aircraft is captured by forms required by the Civil Aviation Department.

The Air Accident Investigation and Prevention Unit of the Bahamas Civil Aviation Department
P. O. Box AP-59244 Nassau, N. P., Bahamas
Tel: 242-376-3709(24 Hour), 242-377-3445 (w), 242-377-6060 (fax), email – aaipu.cad.bahamas@gmail.com

BAHAMAS CIVIL AVIATION DEPARTMENT

AAIPU- Bahamas

Air Accident Investigation and Prevention Unit

2. The Civil Aviation Department or its Designee should amend form (Certificate of Airworthiness) required by regulations for the issuance of a certificate of airworthiness, so that it captures the latest information on the maintenance history of the aircraft to include such items as;

    a. Aircraft (Airframe) total time

    b. Engine Total time (Left and Right)

    c. Propeller Total Time (Left and Right)

    d. Last Annual Inspection

    e. Last Maintenance activity (50 hour / 100 hour inspection)

    f. Maintenance provider / mechanic certifying work as having been completed

The unavailability of records in this investigation has led to the conclusion that maintenance may not have been conducted on this aircraft, in accordance with the required CASR.

It is strongly advised that all relevant entities institute the above recommendations with immediate effect in order to enhance accident investigation information gathering.

Regards,

Delvin R. Major - Investigator in Charge.

The Air Accident Investigation and Prevention Unit of the Bahamas Civil Aviation Department
P. O. Box AP-59244 Nassau, N. P., Bahamas
Tel: 242-376-3709(24 Hour), 242-377-3445 (w), 242-377-6060 (fax), email – aaipu.cad.bahamas@gmail.com

Appendix 5.19 CRASH SITE DIAGRAM