CIVIL AVIATION AUTHORITY OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

CAA OCCURRENCE NUMBER 11/1148

G PEREIRA GP4

ZK-JPE

DEPARTURE FROM CONTROLLED FLIGHT

OREWA BEACH

20 MARCH 2011

Foreword

As a signatory to the Convention on International Civil Aviation 1944 ("the Chicago Convention") New Zealand has international obligations in respect of the investigation of accidents and incidents. Pursuant to Articles 26 and 37 of the Chicago Convention, the International Civil Aviation Organisation ("ICAO") issued Annex 13 to the Convention setting out International Standards and Recommended Practices in respect of the investigation of aircraft accidents and incidents.

New Zealand's international obligations are reflected in the Civil Aviation Act 1990 ("the Act") and the Transport Accident Investigation Commission Act 1990 ("the TAIC Act").

Section 72B(2)(d) and (e) of the Civil Aviation Act 1990 Act also provides:

> **72B Functions of Authority**
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> (2) The Authority has the following functions:
>
> (d) To investigate and review civil aviation accidents and incidents in its capacity as the responsible safety and security authority, subject to the limitations set out in section 14(3) of the Transport Accident Investigation Commission Act 1990:
>
> (e) To notify the Transport Accident Investigation Commission in accordance with section 27 of this Act of accidents and incidents notified to the Authority:

In the case of a fatal aviation accident, the final CAA investigation report will generally be highly relevant to an inquiry, and in some circumstances, an inquest, conducted by a Coroner. CAA investigations are not however done for, or on behalf of, a Coroner.

Contents

Glossary of abbreviations:

AC	Advisory Circular
C	Celsius
CARs	Civil Aviation Rules
E	east
ft	foot or feet
hPa	hectopascals
hrs	hours
IAS	indicated airspeed
MHz	megahertz
NZDT	New Zealand Daylight Time
PPL(A)	Private Pilot Licence (Aeroplane)
PSI	pounds per square inch
S	south
UTC	Coordinated Universal Time
WGS	World Geodetic System

Data Summary

Aircraft type, serial number and registration:	G Pereira GP4, s/n 396, ZK-JPE
Number and type of engines:	One, Subaru EG33
Year of manufacture:	2003
Date and time of accident:	20 March 2011, 1454 hours[1]
Location:	Orewa Latitude[2]: S 36° 34.902' Longitude: E 174° 42.232'
Type of flight:	Private
Persons on board:	Crew: 1
Injuries:	Crew: 1 Fatal
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence:	Private Pilot Licence (Aeroplane)
Pilot-in-command's age:	44 years
Pilot-in-command's total flight experience:	208 hours, 34 hours on type
Information sources:	Civil Aviation Authority Field Investigation
Investigator in Charge:	Mr S Walker

[1] All times in this report are NZDT (UTC + 13 hours) unless otherwise specified.

[2] WGS-84 co-ordinates.

Synopsis

On the afternoon of 20 March 2011 the Civil Aviation Authority (CAA) was notified that a light aircraft had crashed into the sea at Orewa. Numerous witnesses saw the aircraft strike the sea at high speed in a nose down attitude. Despite attempts by people close to the scene to perform a rescue, the pilot did not survive the impact. The Transport Accident Investigation Commission was notified shortly thereafter, but declined to investigate. A CAA field investigation was commenced later the same day.

1. Factual information

1.1 History of the flight

1.1.1 On the morning of the day of the accident the pilot, accompanied by a friend, had been working on ZK-JPE in a hangar situated at North Shore Aerodrome. The pilot's friend noted that there was a puddle of red coolant on the hangar floor underneath the nose of the aircraft.

1.1.2 During this maintenance the pilot explained to his friend that a seal in the auxiliary coolant pump installed in the engine compartment was leaking, and said that he was going to replace the pump with an elbow tube arrangement in its place (see Figure 1). After the elbow tube was installed the pilot and his friend performed a ten minute engine ground run, during which no leaks were detected.

1.1.3 At approximately 1430 hours the pilot's friend saw ZK-JPE take off and climb out normally.

1.1.4 Between approximately 1440 hours and 1450 hours, numerous witnesses observed a small red aeroplane flying over the sea in the vicinity of Red Beach, Orewa Beach and Hatfields Beach.

1.1.5 At approximately 1445 hours, a radio conversation occurred between the pilot of ZK-JPE and the pilot of another aircraft. The pilot of ZK-JPE said that he would be operating in the area to the east of Orewa for a while. Both pilots, who were known to each other, agreed on altitudes for separation while operating in this airspace. The pilot of ZK-JPE was to operate below 2500 ft and the other pilot above 3000 ft. No further transmissions were heard from ZK-JPE.

Figure 1, Elbow Tube Arrangement (Top) and Original Auxiliary Coolant Pump (Bottom).

1.1.6 While walking along the promenade at Orewa a witness observed a small red aeroplane flying in a south westerly direction towards him. He noted that the engine RPM and the airspeed reduced during the few seconds that he watched it. Shortly afterwards, the attention of this witness, and other people in the area, was drawn to the sight of the aircraft in a spin.

1.1.7 An experienced pilot looking out over Orewa Beach from his home, three kilometres to the south, observed ZK-JPE for a few minutes, flying adjacent to Orewa Beach. He described the manoeuvres being performed as "clearing turns[3]". At this time he noted that the sound of the engine was constant. His attention was again drawn to the aircraft after he heard an abrupt change in the sound of the engine, which he thought reflected that the throttle had reduced to idle.

[3] Ninety degree turns made before flight manoeuvres, to ensure that the flight area is free of other aircraft.

1.1.8 When he caught sight of the aircraft, he saw that it was now in a fully developed anti-clockwise spin with a steep nose down attitude. He was surprised to see it partially recover from the spin onto a northerly heading at approximately 300 ft to 500 ft above sea level, flying away from him. The witness saw the aircraft then with the nose rising and a slight roll to the right. This was followed by an abrupt roll to the left and a spin. The witness described the spin as “flicking around”.

1.1.9 A person walking on the promenade at Orewa observed the aircraft flying straight and level toward her, at an altitude that she estimated to be 2000 ft. She stated that she saw the aircraft “suddenly turn toward the ground”.

1.1.10 A witness situated in a boat near to the point of impact described how he became aware of an engine noise above him. He looked up and saw the aircraft in a spin. The witness thought that the pilot appeared to gain control, but then entered another spin, shortly before striking the sea.

1.1.11 The aircraft was seen by multiple witnesses to strike the sea at high speed in a nose down attitude and then immediately disintegrate. Several people were able to reach the accident rapidly and attempt a rescue. The pilot was extricated from the submerged wreckage but was found to be deceased.

1.1.12 The accident occurred in daylight, at 1454 hours NZDT, 500 metres from the shoreline of Orewa Beach: latitude S 36° 34.902', longitude E 174° 42.232'.

1.1.13 Airways radar data was examined which revealed information about the final portion of the flight, (see Figure 2): At 1452.12 hours the aircraft was at 1800 ft, climbing toward the east followed 5 seconds later by a climbing turn to the north. The turn was completed in 30 seconds, by which time the altitude had increased to 2300 ft. The aircraft continued to climb on a north-westerly heading, during which the groundspeed remained constant at 121 knots.

1.1.14 At 1452.55 hours, while at 2400 ft altitude and 122 knots groundspeed, the heading changed abruptly towards the south-southwest. This heading change resulted in the aircraft heading toward North Shore Aerodrome. Over the following 49 seconds the altitude gradually decreased by 200 ft and the groundspeed reduced to 70 knots. The final data point at 1453.53 hours recorded 53 knots of groundspeed, but altitude data was not recorded.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	0	0
Serious	0	0	0
Minor/None	0	0	

1.3 Damage to aircraft

1.3.1 The aircraft was destroyed.

1.4 Other damage

1.4.1 Nil.

1.5 Personnel information

1.5.1 The pilot obtained his PPL(A) on 29 May 1985. He had logged a total of 208 hours experience as pilot in command. He held a current Class II Medical Certificate.

1.5.2 Between September 1994 and May 2007 the pilot logged no flight hours. On re-commencing flying in the latter half of 2007, he logged 5.6 hours of dual flight training, and then flew 156 hours as pilot in command up to the day of the accident. The pilot completed his last Biennial Flight Review (BFR) on 28 November 2010. During the training and his last BFR the pilot exhibited no behaviours or deficiencies that were of concern to the instructor.

1.5.3 The pilot obtained type ratings for the Cessna 172RG and Cessna 182 in January 2009 and March 2010 respectively. He predominantly operated these types of aircraft until 28 November 2010 when he obtained a type rating for the G Pereira GP4, and gained ownership of ZK-JPE. The type rating involved 5.9 hours of flight instruction, and included stall recovery training. Between the date of obtaining his G Pereira GP4 rating and the date of the accident the pilot flew 34 hours on type.

1.5.4 The pilot had a background in engineering but did not hold an Aircraft Maintenance Engineers Licence.

1.6 Aircraft information

1.6.1 ZK-JPE, a G Pereira GP4, was a low wing, two seat monoplane. It was built in New Zealand using plans purchased from the overseas designer. It was first registered in New Zealand on 10 December 2003, and issued with a Special Category Experimental Airworthiness Certificate[4] on the same day. This was superseded on 15 March 2006 by the issue of a Non-Terminating Special Experimental Category Airworthiness Certificate. ZK-JPE was the only example of the G Pereira GP4 registered in New Zealand.

1.6.2 The aircraft had operated for a total of 125.2 hours since it was constructed.

1.6.3 The aircraft had a current Annual Review of Airworthiness which had been carried out on 13 November 2010. No significant discrepancies were detected.

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[4] Airworthiness Certificate issued for the purposes of demonstrating compliance with the Civil Aviation Rules and that the aircraft is safe to fly.

1.6.4 The majority of the aircraft was of wooden construction and was described by the designer as "a high performance, cross-country type plane, designed to extract the most speed from the power available".

1.6.5 ZK-JPE was fitted with a Subaru EG33 six cylinder horizontally opposed engine modified for aeronautical use. The engine had been fully overhauled after 5.2 hours of use in the aircraft, due to high oil consumption.

1.6.6 The propeller was an Aerotech 2000h RB4000T electronically controlled, variable pitch unit, driven through a SUB-4 reduction gearbox assembly.

1.6.7 The instrumentation fitted to ZK-JPE was a Dynon Avionics 'EFIS-D100' electronic flight information system (EFIS) 'glass cockpit' incorporating a full-featured dual-axis autopilot. The EFIS system had provision to display engine parameter information, such as exhaust gas temperature (EGT).

1.6.8 The aircraft flight manual, compiled by the builder, specified that 64 knots indicated airspeed was the stalling speed or minimum steady flight speed at which the aircraft is controllable.

1.6.9 ZK-JPE had no stall warning system, nor was one required to be installed for the certification of the aircraft. The EFIS system had an inbuilt function to provide warning of an impending stall, however the angle of attack (AOA) sensor required for its operation was not installed.

1.6.10 The previous owner/builder made the following improvements to the cooling system after 56 hours of use, as ZK-JPE initially exhibited a tendency for the engine to overheat:

1. The auxiliary coolant pump was installed.

2. An engine oil cooler was installed.

3. The engine coolant specification was changed from ethylene glycol based coolant to 'Evans NPG' Propylene glycol based coolant (purple in colour).

4. The engine cooling radiator intake and outlets were modified, to improve airflow.

5. The thermostat was replaced, due to the possibility of it not fully opening.

6. The baffles from the radiator tanks were removed, as coolant flow was described in the maintenance logbook by the builder as "barely adequate".

1.6.11 These improvements to the cooling system successfully reduced the normal engine operating temperature and eliminated the tendency to overheat.

1.6.12 The auxiliary coolant pump was electrically operated and activated by an adjustable thermal switch mounted on the firewall in the engine compartment, which sensed coolant temperature and illuminated an indicator light in the cockpit when the pump was activated. The thermal switch was set to switch the pump on when the coolant temperature reached 100°C.

1.6.13 The engine coolant specified in the flight manual was 'Evans Non-Aqueous Propylene Glycol (NPG)'. The manufacturer of the coolant stated that this was designed to have "efficiency considerably superior to conventional coolants and has a boiling/vaporization point considerably higher than conventional water based coolants". The flight manual for ZK-JPE described 'Evans NPG' as a long life waterless coolant with a 180°C boiling point at zero PSI. The coolant manufacturer stated that with 'Evans NPG' coolant, the cooling system operates without pressure.

1.6.14 A consignment of 20 litres of the light purple coloured 'Evans NPG' coolant had been delivered to the pilot three weeks before the accident occurred. This was discovered in the hangar after the accident, and had not been used.

1.6.15 Two containers, each of five litre capacity, were also found in the pilot's hangar. One of these containers, which once contained 'Nulon Red Premix' 50/50 ethylene glycol and water was empty, and the other container of 'Nulon Red Long Life 100 Percent Concentrated' ethylene glycol was half full.

1.7 Meteorological information

1.7.1 At the time of the accident the weather at Orewa was favourable for the intended flight with a light south-westerly wind and good visibility. Weather conditions were considered not to be a factor in the accident.

1.8 Aids to navigation

1.8.1 Nil.

1.9 Communications

1.9.1 Nil.

1.10 Aerodrome information

1.10.1 Nil.

1.11 Flight recorders

1.11.1 Nil.

1.12 Wreckage and impact information

1.12.1 The aircraft struck sea at high speed and with a nose down attitude. The impact forces resulted in the complete destruction of the aircraft.

1.12.2 The buoyant pieces of the aircraft arrived onshore soon after the accident. The engine, propeller, centre fuselage, console and landing gear were recovered from the sea a few days later.

1.12.3 A detailed examination of all of the aircraft parts that were able to be recovered was carried out. This revealed that, as far as could be determined, there were no pre-existing discrepancies with the aircraft structure or flight controls.

1.12.4 The elbow tube arrangement fitted to the coolant system by the pilot, just prior to the accident was found within the confines of the engine compartment.

1.12.5 The electrically operated flap motor gear indicated that the flaps were fully retracted at the time the aircraft struck the sea. The electrically actuated pitch trim was in the neutral position.

1.12.6 A notepad secured to a clipboard was recovered from the sea. Entries were made on the front page of the notepad which corresponded to the operation of ZK-JPE on the day of the accident:

"<u>NE-testing, Circuit, 20/3/11, 0.2 hrs, 125.2."</u>

"NE-Testing, Aerotek 2000 Flight testing."

1.12.7 Also found on the pilot's clipboard was a copy of an Aerotek 2000 propeller flight testing procedure. The cover sheet had been filled out with the leading particulars, comprising of the flight test type (*½)*, the date (*20/3/11)*, the pilot's name and the aircraft type. The flight test procedure ½ - *Take Off and Climb Test* specified that take off performance and climb rate timings were to be recorded at certain altitude increments. No times associated with this testing had been recorded on the pilot's notepad.

1.13 Medical and pathological information

1.13.1 The toxicology tests revealed that there was no evidence of excessive carbon monoxide saturation, alcohol or medicinal or recreational drugs in the pilot's bloodstream.

1.13.2 Post mortem examination showed that the pilot died of injuries consistent with a high-energy impact. The examination also revealed that the pilot had an inflammatory disorder of the heart muscle known as myocarditis. The pathologist explained this condition and its relevance in the Post Mortem Report, as follows:

"*In most incidences the cause of this is unknown, although it is speculated most cases are due to a viral infection. Certainly the microscopic pattern of the inflammation would be consistent with idiopathic or viral aetiology. This finding may or may not be significant in the causation of the accident and the resulting death. Myocarditis may be completely asymptomatic or, at the other end of the spectrum, present as sudden unexpected death. It may also present with chest pain or heart failure. I cannot exclude the possibility that this condition has contributed to the death of this man either through distracting or disabling symptoms or loss of consciousness as the result of an abnormal heart rhythm. However it is also possible that this was asymptomatic and is an incidental finding.*"

1.13.3 The pilot had no known adverse medical history and exhibited no outward symptoms which could have been associated with myocarditis. He was, according to family members, a very active and healthy individual.

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 An Artex ME406 MHz Emergency Location Transmitter (ELT) was installed in the aircraft but, owing to the forces involved in the accident, a signal from the ELT was probably not transmitted.

1.15.2 The accident was not survivable.

1.16 Tests and research

1.16.1 The engine was taken to a Subaru automotive agency and disassembled by qualified technicians. The technicians discovered that the pins in the number 5 cylinder ignition coil low tension connector had been inadvertently damaged during the last time the connector had been disturbed. This had probably rendered the number 5 cylinder ignition system inoperative since that time. No other pre-accident defects were revealed with the engine or propeller.

1.16.2 The inoperative number 5 cylinder ignition system would likely not have affected the ability of the engine to deliver sufficient power for the flight, nor would it have caused the pilot to reduce airspeed, had the pilot seen a low EGT indication on the EFIS display.

1.17 Organisational and management information

1.17.1 Nil.

1.18 Additional information

1.18.1 Nil.

1.19 Useful or effective investigation techniques

1.19.1 Nil.

2. Analysis

2.1 Although the pilot had an engineering background, he did not satisfy the authorisation criteria prescribed by the CARs to perform unsupervised maintenance on an aircraft. Any maintenance performed by the pilot must be supervised by an appropriate person. No supervising person was present when the pilot installed the elbow tube arrangement. No entries relating to this maintenance were recorded in documentation associated with the aircraft. Due to the non-compliances with the CARs, the Airworthiness Certificate associated with ZK-JPE no longer remained in force and therefore the pilot operated an aircraft that was not airworthy.

2.2 It is likely that, prior to the flight, the pilot had replenished the coolant system with the conventional ethylene glycol coolant mixed with water, indicated by the red coloured coolant seen by the pilot's friend to be pooling on the hangar floor under the aircraft, and the empty coolant container. An effect of replenishing the engine cooling system with water based coolant instead of Evans NPG coolant was that, once at operating temperature, the cooling system would be pressurised. Although no corresponding evidence was discovered, it is possible that a problem relating to the disturbance of the engine cooling system or the resulting pressurisation may have occurred, such as coolant ejection from a radiator or hose leak, accompanied by steam and odour. If this was the case, it may not have been possible to cool the engine effectively, particularly as the engine inherently exhibited a tendency to overheat.

2.3 In the case of having to manage any potentially damaging engine problem, the pilot would probably have reduced the power setting. If not properly managed the airspeed could have decayed from an optimum airspeed to airspeed close to the onset of stall.

2.4 It appears that the purpose of the flight was for the pilot to conduct flight testing of the aircraft. The open entry in the notepad indicated that the pilot intended to test the propeller, which involved varying the airspeed, engine speed, attitude of the aircraft and recording parameters from the aircraft instruments. The "clearing turns" seen by one of the witnesses could have been associated with this testing. However, as it appears that the pilot noted on the propeller testing procedure cover sheet that he only intended to test take off and climb performance, it is unlikely that the intended flight testing was being undertaken at the time of the departure from controlled flight.

2.5 Pilot incapacitation due to the pilot's myocarditis was also considered as a possible contributory factor. The pilot successfully completed the abrupt change in heading toward North Shore Aerodrome followed by 49 seconds of generally straight and level flight. The fact that the pilot also was able to partially regain control of the aircraft prior to the secondary stall, tended to discount sudden total incapacitation as a likely factor. However, distraction caused by symptoms related to the pilot's myocarditis could not be discounted as a possible contributory factor.

2.6 Although there are no indications that a precautionary landing on Orewa Beach was being attempted at the time, the pilot may have been surveying this option as he approached the beach, thus further averting his attention from the airspeed indicator.

2.7 It appears that departure from controlled flight occurred with such speed and lack of forewarning that the pilot was not able to react quickly enough. Having only 34 flight hours experience on this aircraft type the pilot may have been unfamiliar with the handling characteristics and having carried out no specific spin recovery training, he would likely have difficulty applying the correct technique to recover from the ensuing spin, particularly in a type of aircraft designed for high performance such as the G Pereira GP4. An incipient spin[5] would have developed almost instantaneously without the application of correct recovery technique.

2.8 The aircraft spun until an altitude of 300 ft to 500 ft above the surface of the sea when the pilot was able to partially regain some control. A secondary stall/spin condition[6] then developed, with insufficient height remaining to recover before the aircraft struck the sea.

2.9 Demonstration of competence in the use of correct spin recovery techniques during the PPL(A) flight test or BFR is not required by the CARs, as spinning is defined as an aerobatic manoeuvre. Aerobatic flight has a separate training syllabus and rating category.

2.10 The PPL(A) flight test syllabus and BFR requires the student to demonstrate competency in recognition and avoidance of stall/spin, rather than demonstrating competency in spin recovery. However, knowledge of spin recovery is included in the PPL(A) written examination questions.

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[5] This is the transitional stage of the spin, during which the aircraft progresses from a fully developed stall into autorotation.
[6] A stall/spin caused by the pilots attempt to regain flying speed prior to the aircraft fully recovering from the initial stall condition.

2.11 The philosophy embodied in the CARs intends constructors of amateur built aircraft such as ZK-JPE to have certain freedom to innovate and develop their aircraft with significantly less specific regulation and financial cost than would be attributed to the construction and certification of a standard category aircraft. However, the CARs still prescribe a managed process by which the constructors prove the integrity of the aircraft, by inspection and testing. The prescription of specific safety enhancements (such as a stall warning system) as mandatory certification criteria for this category of aircraft does not align with the intent of the CARs.

3. Conclusions

3.1 The pilot was appropriately licenced for the flight.

3.2 The aircraft departed from controlled flight, which the pilot probably did not anticipate.

3.3 The pilot did not recover the aircraft from the stall, and a spin ensued.

3.4 The pilot partially recovered the aircraft from the spin; however a secondary stall/spin occurred, from which the pilot was unable to recover in the available altitude.

3.5 The pilot had altered elements of the engine cooling system rendering the aircraft not airworthy. It could not be determined whether this action was a contributory factor in the accident.

3.6 The pilot had a heart disorder (myocarditis). It could not be determined whether this was a contributory factor in the accident.

3.7 The pilot had a low level of experience with the aircraft type.

3.8 The PPL(A) training syllabus and BFR requires the pilot to have knowledge of spin recovery techniques but not demonstrate competency in spin recovery.

4. Safety action

4.1 In December 2008 CAA published a Good Aviation Practice Booklet ‘Spin Avoidance and Recovery’ to help pilots understand the conditions that encourage an aircraft to spin and what to do if an unintentional spin occurs.
http://www.caa.govt.nz/safety_info/GAPs/Spin_Avoidance.pdf

5. Observation

5.1 For high performance Sport and Recreational Category aeroplanes similar to the GP4, which generally provide little forewarning of an impending stall through their flight controls, embodiment of a system, by the constructor or owner, which provides an indication of AOA and/or an audible warning of an impending stall would be a prudent measure.

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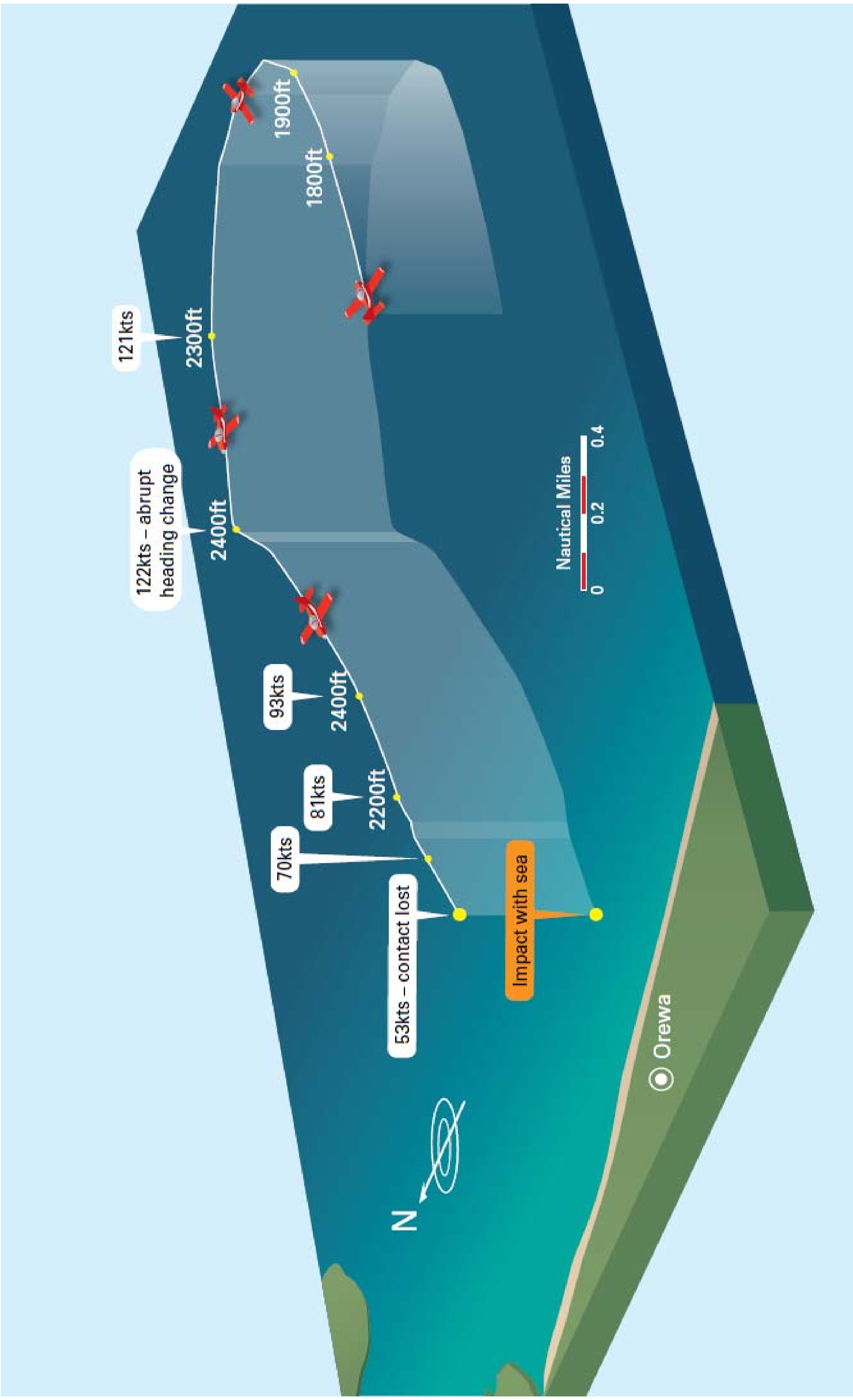

Figure 2. Diagram of Flight Path Derived from Airways Radar Data