FINAL REPORT

AAIU Formal Report No: 2009-003
AAIU File Number: 2007-0062
State File Number: IRL00900927
Published: 20/01/2009

Manufacturer:	Cessna Aircraft Company
Model:	208B
Nationality:	USA
Registration:	N208EC
Location:	Connemara Airport (EICA), Inverin, Co. Galway, Ireland, N53º 13' 49.8" W009º 28' 04.0".
Date/Time (UTC):	5 July 2007 @ 13.49 hrs.

SYNOPSIS

The aircraft was returning on a short flight from Inis Meáin (EIMN), one of the Aran Islands in Galway Bay, to Connemara Airport (EICA), in marginal weather conditions when the accident occurred. There had been a significant wind shift, since the time the aircraft had departed earlier from EICA that morning, of which the Pilot appeared to be unaware. As a result a landing was attempted downwind. At a late stage, a go-around was initiated, at a very low speed and high power setting. The aircraft turned to the left, did not gain altitude and maintained a horizontal trajectory. It hit a mound, left wing first and cartwheeled. The Pilot and one of the passengers were fatally injured. The remaining seven passengers were seriously injured. The aircraft was destroyed but there was no fire.

NOTIFICATION

The Chief Fire Officer, Co. Galway, notified the AAIU of the accident at 14.30 hrs[1] on 5 July 2007. An AAIU "Go-team" consisting of Mr. Paddy Judge, Inspector of Air Accidents, and Mr. Micheál Ryan (AAIU) immediately routed to EICA by an Irish Air Corps helicopter and commenced the Investigation at 17.00 hrs. Mr. Graham Liddy and Mr. Leo Murray, Inspectors of Air Accidents, later augmented this team.

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 6 July 2007, appointed Mr. Paddy Judge as the Investigator-in-Charge (IIC) to conduct a Formal Investigation into this accident. Mr. Graham Liddy and Mr. Micheál Ryan provided technical assistance. Both the Aircraft and Engine Manufacturers sent Accredited Representatives (ACCREPS) to assist the Investigation.

[1] All times in this Report are UTC, or local time less one hour.

1. FACTUAL INFORMATION

1.1 History of the Flight

The purpose of the flight was a demonstration of an aircraft to a group of potential investors and interested parties associated with a proposed airport at Clifden, Co. Galway, some 25 nm to the northwest of EICA. The flight was organised by one of this group who requested the aircraft, a Cessna Caravan registration N208EC, through an Aircraft Services Intermediary (ASI)[2] from the aircraft's beneficial owner. The owner agreed to loan his aircraft and the pilot, to fly the group from EICA to EIMN, (a distance of 9 nm) and back.

The aircraft departed from Weston (EIWT) aerodrome, near Dublin, at 08.20 hrs on the day of the accident. It over flew Galway (EICM) to EICA where it landed and shutdown. There were two persons on board, the Pilot and an Aircraft Maintenance Specialist (AMS). After a short discussion with ground staff, the Pilot and AMS flew a familiarisation flight to EIMN where the aircraft landed and taxied to the terminal. It did not stop or shut down but turned on the ramp and flew back to EICA where it shut down and parked while awaiting the arrival of the group.

The group assembled at EICA, but as there were too many passengers to be accommodated on one aircraft, two flights were proposed with the aircraft returning to pick up the remainder. The aircraft then departed with the first part of the group. On arrival at EIMN, the Pilot contacted those remaining and informed them that he would not be returning for them[3]. This did not cause a problem because an Aer Arran Islander aircraft, with its pilot, was available at EICA to fly the remainder of the group across to EIMN.

Following lunch in a local hotel the AMS made a presentation on behalf of the ASI on the Cessna Caravan, its operation and costing. The Pilot assisted him, answering questions of an operational nature. During the presentation two members of the group, who had a meeting to attend on the mainland, travelled back on the Islander aircraft to EICA. The Islander aircraft subsequently returned to EIMN to assist in transporting the remainder of the group back to EICA.

Following the presentation, those of the group who had not flown outbound on N208EC returned on it. N208EC took off with eight passengers on board and made an approach to Runway (RWY) 05 at EICA, followed by a go-around. During the go-around, it hit the ground in an open field to the north of the runway, just outside the airport boundary fence and close to the terminal building.

The emergency fire service from the airport quickly attended. Later an ambulance, a local doctor and then the Galway Fire Services arrived. A Coastguard Search and Rescue helicopter joined in transporting the injured to hospital. The Gardaí Síochána secured the site pending the arrival of the AAIU Inspectors.

[2] The role of the ASI is detailed in Section 1.17.2.
[3] His reasons for this are reported in Section 1.1.5.4.

1.1.1 Interviews

All surviving passengers were interviewed, as was the relevant airport ground staff. Of particular assistance to the Investigation were the observations of the ground witnesses who saw the accident, the pilot of the Islander aircraft, the passenger seated in the co-pilot's seat and the AMS who was also a passenger. Comments of witnesses regarding the weather have been collectively placed in **Section 1.7 Meteorological Information**.

1.1.1.1 Airport Staff Member who met the Pilot initially

This staff member stated that N208EC arrived into EICA from Dublin between 09.00-09.15 hrs and had called inbound on the VHF radio beforehand. There were two people on board. She spoke to the Pilot, whom she knew as he had been in EICA on a few occasions previously. The Pilot then went on a "*dry run*" or familiarisation flight to Inis Meáin at about 09.40 hrs and was back very quickly. His passengers arrived and he took off at about 10.30 hrs for Inis Meáin. She did not know how many were on board, as airport staff did not partake in boarding the passengers. She did not hear from the aircraft again.

1.1.1.2 Passenger on flight out (EICA-EIMN)

A passenger, who had previously piloted both fixed wing and helicopter aircraft, occupied the co-pilot's seat on the flight out. He commented that the Pilot appeared quite professional and diligently completed cockpit checks prior to departure. There was a significant cross wind during take-off. After becoming airborne the Pilot accurately tracked the extended centreline of the runway. On approach to EIMN the Pilot made a visual turn downwind followed by a turn to finals to land on RWY 15. The passenger commented that runway alignment for landing was accurate and the landing was good, his overall impression of the Pilot being one of competence. The weather was poor and there were two tall cranes close to the extended centre line of the runway, associated with constructing a harbour at the island. He believed that the Pilot was unhappy with such significant obstacles in the vicinity of EIMN in conditions of poor visibility.

1.1.1.3 Witnesses who observed Impact

Two witnesses, who were near the western entrance gate to the airport, observed the impact close by.

1.1.1.3.1 Power Supply Technician (PST)

The PST stated that he and his colleagues had changed a mains transformer close to the entrance gate to the airport that day. They worked through their dinner hour to complete the job, as the weather was poor. When the transformer was operational, the PST moved his lorry into position to take down the old pole. He was getting out of the lorry when he heard the noise of an aircraft coming but did not see it at first. In a few seconds, the aircraft emerged through the cloud and he thought it was very low and that it seemed to be off course. He did not hear a change in the noise of the engine as the aircraft approached but said that the engine was quite loud. He stated that he could see it clearly coming straight towards him as he stood near the pole, very fast, getting lower and too low to clear the terrain. He said, "*at about 30 ft above the ground, or about 30 metres from where it hit the ground, it seemed to shiver, rocking from one side to the other twice*.

It initially hit furze[4] *bushes – there was a mound or a little hill in the field, which it hit with a loud bang and some baggage fell out. It bounced into the air possibly 100 ft and the engine cut out at that stage. It fell down on its left hand side and dropped on softer ground about 50 metres"* from where he was standing. He shouted to his colleagues that an aircraft had just crashed and to get help quickly. He jumped the fence and went into the aircraft. As he was climbing on the aircraft, one man was getting out and he was brought to safety.

He stated that fuel was flowing from each wing of the aircraft onto the ground. He checked for fire or smoke, but there was none and he commenced rescuing the casualties.

He estimated that about an hour after the accident a medical team arrived and took over the situation. Approximately 10-15 min after this, the Galway Fire Service units arrived and lifted the aircraft at the front and got the rest of the casualties out. He believed that initially "*there did not seem to be anyone in charge*" of the rescue effort (see Analysis 2.4).

1.1.1.3.2 Electrician

This witness stated that he was sitting in his truck at the entrance gate to the airport when he heard an aeroplane, which seemed to be approaching. Initially he did not pay attention to it, as he was at an airport, but the noise got very loud. He then looked to his right and saw it but thought it looked *"awfully low"*. It appeared to be approaching the field (beside the terminal) rather than the runway. He described it as gliding in with *"its belly up and left wing down"*. He saw the left wing catch a mound. The aeroplane then "*flipped into a violent spin and cart-wheeled to its left*". It came down violently on its front, which crumpled and bent backwards for about a quarter of the way along the aeroplane. It ended up facing back towards the west. He then went over to the aeroplane.

He stated that the aeroplane had approached from Galway Bay. He first sighted the aeroplane when it was between the runway and the mound. He said he had not noticed a change in engine sound but was not familiar with aeroplane engine noise.

1.1.1.4 Airport Ground Staff at EICA

An airport operations staff member stated that no aircraft was expected as no call had been made on the radio by the Pilot to advise of his pending arrival. He was on the ramp area and heard an aircraft *"engine noise really revving up and then a bang"*. He went around the back of the hangar, saw that an aircraft had crashed and activated the fire alarm.

An aircraft mechanic heard the noise of an engine accelerating or going to full power and then a bang and realised an aircraft had crashed. He also pressed the fire alarm and got dressed into his gear. By the time he got to the site the airport fire tenders were there. He stated that he observed one passenger, fatally injured, who was lying between the seats. He was sure that that passenger was not secured by his seatbelt.

An airport fire crewmember stated that when the crash alarm activated they donned their equipment in the hangar where the fire gear was located and, as they came out of the hangar, they observed the crashed aircraft. They took the fire tender and on arrival at the site they secured the area. They did not lay a foam blanket as there was no fire or smoke and they thought it might affect the casualties on board and hinder the rescue effort.

[4] A shrub of genus *ulex eurpaeus*, which grows to a height of about 2 metres.

The Emergency Plan was put into operation with medical, fire and ambulance services being notified and they endeavoured to evacuate as many casualties as they could without endangering them. Several casualties could not be extracted because of their injuries. The County Galway Fire tenders arrived later, bringing heavy cutting equipment, which assisted in the casualty evacuation.

1.1.1.5 Passengers

All surviving passengers were interviewed.

1.1.1.5.1 Aircraft Maintenance Specialist (AMS)

The AMS was seated in the rearmost right hand seat at the time of the accident. He is a licensed aircraft maintenance engineer and had flown light aircraft some years previously as a pilot. He accompanied the aircraft from EIWT where the flight originated. He said that the purpose of the flight was to give a group of sponsors for a new Airport at Clifden a presentation on, and experience of, the Cessna Caravan aircraft. He did this at short notice on behalf of the ASI and understood that the owner had loaned the aircraft and Pilot to the airport group for a demonstration.

The AMS stated that the Pilot completed a pre-flight at EIWT and that the flight from EIWT to EICA was normal. The weather was deteriorating when they landed at EICA. As far as he could remember they approached from overland and landed on RWY 25. He remembered the Pilot commenting that he preferred to land from the other direction, from over the sea, due to the terrain and that he was not happy with approaching from the land direction. They taxied in and spoke to one of the ground staff. There was a clearance in the weather so they took off and flew a familiarisation flight to EIMN where they landed and taxied to the terminal. They did not stop there but, with engine still running, turned around and returned to EICA where they landed and shutdown. This time they approached from over the sea and landed on RWY 05.

A number of people arrived but there were too many to accommodate on the one aircraft. They decided a number would go on the aircraft and some could go on another flight, either in the Caravan when it returned, or in an Islander aircraft that was available for charter. The AMS was seated in the rear during the flight where he could discuss the aircraft with those around him. Operations were normal but the cloud level was low going across to EIMN. He said that the Pilot decided that, because the weather conditions were very gusty and blustery, he was not prepared to return to EICA to collect the rest of the group. These then came across to the island on the Islander aircraft.

The full group went to a hotel on the island, had a meal and he then gave the presentation. After the meeting, they decided that the people who had missed the flight over on the Cessna Caravan would travel back on it. The Pilot asked him if he would like to sit in the front but he preferred to sit in the back again where he would not distract the Pilot by talking to the passengers about the aircraft. He believed they did not enter cloud during the flight, but the windows had misted over. He could see the surface of the sea and that they were quite low.

The approach was from over the sea and he thought that they might have climbed to land on the runway. The aircraft then dropped, perhaps due to wind shear. The stall warning went off a couple of times, he saw some rocks and felt that one of the wheels might have touched the ground, but was unsure.

He stated that the Pilot applied a lot of power, maybe full power, and went into a go-around with a steep pitch angle. He heard the stall warning going continuously and had a feeling that they were going to stall in. He stated that the engine was going continuously until the impact and that he did not believe the Pilot had reduced power.

As far as he knew all the passengers were strapped in and he himself had tightened his belt fully prior to impact. The AMS commented that there was a torque affect on the aircraft, with the application of power, which he considered could have been a factor.

He considered the Pilot as a competent operator and had confidence in him. He had no involvement with maintenance of the aircraft, which was maintained by a Cessna approved maintenance facility.

The AMS stated that he, not the Pilot, had filled in the logbook on the day of the accident. He said that, due to an oversight on his part, the flight EIWT - EIMN recorded on the log was not the actual route flown by the aircraft. This should have been EIWT - EICA followed by EICA – EIMN. Consequently, there was a sector missing in the log entries. He believed there was about 1,600 lbs of fuel on board the aircraft at the time of the accident.

1.1.1.5.2 Passenger (1R)

This passenger was seated in the co-pilot's or front right hand seat (1R) at the time of the accident and was one of those who travelled out to EIMN on the Islander. He was initially invited by the Organiser[5] of the flight to travel out on the aircraft to EIMN and see what the aircraft was like and was told he would return in time for a meeting of the shareholders of the Clifden Airport Company later that day. He was one of the last to arrive and consequently he was not on the first flight out. Instead of the aircraft coming back for them, after about a half an hour, the Organiser of the group told them that an Islander aircraft would fly them out, as there was some hold up with the aircraft on the island. They were checked in, weighed and a safety briefing conducted after which they flew out to EIMN on the Islander.

He said that there was a well-organised audio-visual presentation by representatives of the ASI on Inis Meáin. As the requirement to purchase an aircraft was not immediate, the presentation was of interest but a number of issues arose regarding the overall commercial package and the operation of the aircraft. The Pilot covered some technical operational questions. He stated "*the Pilot mentioned that he had overshot the runway in EIMN and had to come around to land on the way in, as he did not know the local island winds*". He understood that this had disturbed the Pilot and that was why he had not returned to EICA for the remainder of the passengers earlier. He said the Pilot stated that, although he had come under some pressure to do so, he would *"not be pressurised when it comes to safety"*. Two of the Airport Committee left during the presentation and asked the Pilot of the Islander to return them to EICA, as they had a meeting to attend elsewhere.

The lunch ended and they went to the aircraft, where the group who had not travelled out on the aircraft boarded the Cessna to return to EICA. They examined the plane, which seemed to be very new. He got into the back initially and, when invited by the AMS, got into the right hand front seat or co-pilot's seat where he strapped in. He had no previous experience of sitting in a pilot's seat.

[5] The role of the Organiser is later described in **Section 1.1.1.5.3**

Because of this, he was unable to understand the flight instruments. The Pilot conducted checks[6] prior to strapping in. The weather was wet and damp. Take-off was smooth and they gained height and entered cloud. He heard the Pilot calling on the radio. There was a GPS on the instrument panel on which the Pilot showed him the track to EICA. He believed the autopilot was engaged, because when the Pilot selected 1,000 ft the aircraft climbed up to it. After about 3 to 4 minutes while in cloud, the Pilot said something to the passengers that he could not hear. He heard the Pilot make a radio call, to ATC he presumed, and the Pilot then set 800 ft and told him "*it would bring it down to 800 ft itself*".

The Pilot kept looking out the window and they eventually broke cloud while at 800 ft. At this point they were very close to the mainland but the airstrip was not directly in front of them as he, the passenger, had expected; it was at least 500 metres to the left (of track) and he thought the shoreline was between 1 km and 2 km ahead. He said the Pilot expressed surprise that they were so close to the runway. He could see the ocean and thought they were going very fast. The Pilot, manually flying the aircraft, turned left (to a right base leg for RWY 05) and started to lose height. He then "*swerved right*" to line up with the airstrip. The Passenger stated that "*the Pilot levelled the aircraft to land but they were too fast"*, so the Pilot pulled up about half way down the runway and turned left in a steep turn. When they turned left they "*started to lose height and the left wing came dangerously close to the ground*". There were two levers and he recalled the Pilot "*pushed one forward first and then the second*". He said that *"the Pilot pulled up and the airplane started to climb but did not appear able to do so as it started to level out and drop again. There was a beeping sound"*. – He felt that "*the plane seemed to have no power as it then stopped and started to fall*". He could not remember the impact, but recovered consciousness in a doubled over position and was amazed he was alive. The emergency services peeled the ceiling off the aeroplane using cutters to free him. He was then airlifted to Galway hospital.

During subsequent elaboration of his statement the witness stated that he was sure that the Pilot did not adjust the lever nearest to him (the flap lever) in the go-around. He thought that the Pilot pushed the middle lever up first and he then moved another lever a long way forward. This may have happened when the aeroplane turned left but he was not sure. At the time, the aeroplane was positioned to the left of the runway, the runway being to his, the passenger's, right hand side. The turn to the left was quite sharp with a large bank angle, the nose dropped and they were very close to the ground. The aeroplane was unable to climb with a beeping sound occurring. Following this there may have also been a bank to the right, which was recovered, before the aeroplane hit. He was not sure of the exact sequence or timing of the lever movements but was sure that two levers were pushed fully forward, separately, during the event.

1.1.1.5.3 Organiser

This passenger stated that he was involved in the proposed development of Clifden Airport and stated that the Airport Company was hoping to buy its own aircraft. He contacted the ASI who was in charge of organising the bookings/schedule for the Cessna Caravan, as there was a possibility that they could buy an aircraft like that. The Cessna Caravan was loaned to them, for the day, by the owner and was flown from EIWT to EICA with the ASI producing a presentation on the Caravan and the AMS presenting it.

[6] A Pre Departure Inspection (PDI).

Earlier in the day, the Pilot took off with some of the group to EIMN. The Pilot then rang the Organiser and told him he would not be coming back to collect the remainder of the group as he was not happy with the weather. He then organised the Islander to bring the remainder to EIMN. The Operator of the Islander made them all weigh and sign in for both outward and return flights, as there was a different set of passengers on each. On the return flight, he changed the passengers, as he wanted everyone to have experience of flying in the Caravan.

On the return flight from EIMN to EICA they got on the Caravan, which left before the Islander, and he sat with the window on his left hand side facing aft. There was a lot of southerly wind that day with big waves and they seemed to be travelling with the wind and to be going very fast. The clouds got lower as they progressed. The airplane made an immediate approach to the runway went back up again and back down again, the tail seemed to be wagging before impact. He woke up a couple of hours later.

1.1.1.5.4 Other Passengers' Observations

Passengers' previous flying experience varied from regular flyers to those with little experience in small aircraft.

The passengers said that they were initially told at EICA that the weather was too bad for the Pilot to return for them and they were all to go out to EIMN on an Islander aircraft. They were then weighed by Airport staff and assigned seats. After being taken through the safety features of the aircraft, they boarded and flew out to EIMN.

Following lunch, there was a presentation by both the AMS and the Pilot, which essentially dealt with the commerciality of an operation with the Pilot answering operational questions. During the meeting, the Pilot indicated that he was not comfortable in the area and specifically mentioned cranes on the island and the poor weather. One passenger stated that the Pilot commented over lunch that he did not like flying in the area, as there were no radio aids. Another mentioned that the Pilot did not drink any alcohol during lunch.

Afterwards they walked down to the airport terminal where they were allocated flights. Those on the Caravan walked straight out and boarded while those for the Islander were weighed and were therefore later boarding that aircraft.

An experienced flyer was seated facing aft and could see the sea through his window. He said he thought the airplane was at about 300 ft and, as they got closer to EICA, he thought they got very low, possibly down to about 100'. The plane gave a shudder and he looked over his shoulder. He saw the Pilot struggling with the controls and thought they were in trouble. He remembered a turn to the left.

Some passengers reported seeing rocks and the shore before impact. Those who looked outside said they were going very fast. Most passengers reported hearing a horn or siren (*stall warning*) before impact, initially intermittently and later continuously. Many reported the engine operating at high power.

Two passengers reported a possible initial ground contact some seconds before impact. However the Investigation did not find any evidence of this.

1.1.1.6 Pilot of Islander Aircraft (Islander Pilot)

The Islander Pilot is very experienced with about 4,000 hrs flying the Islander aircraft in this area. He said that before N208EC departed EICA airport staff arranged fire cover for the aircraft on arrival at EIMN, as they were of the opinion that this was needed on arrival due to the passenger numbers involved. N208EC departed at about 10.30 hrs for EIMN. The Islander Pilot understood that the weather deteriorated slightly while N208EC was en-route to EIMN and that the Pilot was not comfortable with the weather situation. As a result, he himself was asked if he would operate and bring out the remainder of the group. As he considered the weather suitable at the time, he departed with the remaining group of passengers, at 11.26 hrs and arrived at 11.37 hrs. There was quite a strong head wind straight down RWY 15 at EIMN during the landing. After they disembarked he overheard one of the group passing a comment aloud to the Pilot that the Islander Pilot *"had managed to get to the island so why couldn't you*". He believed that "*this went down very badly with the Pilot*".

During the lunch, he spoke briefly to the Pilot about runway light operation by VHF and the crane obstructions, associated with a harbour construction on Inis Meáin. He had not had the opportunity to talk to the Pilot about the weather but got the impression that the Pilot *"was not happy with the operation"*. The Islander Pilot was then asked if he could fly two of the group back to EICA, as they had to go to a meeting, to which he agreed.

He waited for the fire crew and, when they arrived, he departed EIMN for EICA at 12.18 hrs. After landing at EICA, he returned to EIMN for the remainder of the passengers and landed at 12.45 hrs.

At EIMN he had his return passengers weighed but the Pilot of N208EC said there was no need to weigh his passengers. At about 13.35 hrs, N208EC departed and took off from RWY 15. He thought the take-off roll of N208EC was very long as, at the end of the runway there is a steep 20-25 ft high sand hill. His last sighting was the aircraft on course for EICA at 500-600 ft. He stated that he did not hear the Pilot make any radio calls to EICA, as if he had done so, the staff at EICA would have advised him whether the weather was suitable and which runway was in use. He waited for some time to allow N208EC to get to EICA and then took off. After take-off he circled and called N208EC on the VHF radio, but it did not reply. The Islander Pilot heard a Rescue Helicopter south of and close to EICA and advised him of both the N208EC traffic and his own aircraft's position and altitude. On contacting EICA he was advised of an accident there so he returned to EIMN and landed.

He stated that when N208E stopped at EICA it landed on RWY 05 and took off on RWY 23, as other aircraft were doing at the time, since the wind was a direct crosswind.

However, by the time the N208EC departed EIMN in the afternoon the wind was blowing directly across the runway at EIMN at a wind speed of 20-25 kts. He believed that would have given N208EC a 20-25 kts tailwind on RWY 05 at EICA.

As there was no ATC, the procedure was to set QNH on the airport apron by reference to airport elevation.

The Islander Pilot stated that in normal conditions he personally used 4 nm to 5 nm to align with the RWY 05 at EICA, but estimated that he would need a minimum of 1.5 to 2 nm.

1.1.1.7 Pilot Rescue Helicopter

The helicopter was returning with a casualty to Galway from a rescue mission to the west of EICA. This pilot stated that the weather deteriorated as they travelled east towards Galway. The pilot did not recall any transmission from N208EC whom he called a number of times. As no TCAS[7] was fitted to the Rescue helicopter they did not know where that aircraft was. He advised the Islander to "go back and to tell the Caravan not to come in" as the weather was poor at the time at EICA. On arrival at Galway, they were told about the accident in EICA. They refuelled and conducted two return ambulance runs from EICA to Galway. The visibility at EICA was about 1 to 1½ nm when they first arrived.

1.2 Injuries To Persons

Injuries	Crew	Passengers	Total in aircraft	Others
Fatal	1	1	2	0
Serious	0	7	7	0
Minor	0	0	0	0
None	0	0	0	0
TOTAL	**1**	**8**	**9**	**0**

The injuries to the Pilot (left hand front seat) and the passenger seated immediately behind him (second row, left hand side) were fatal. The remaining seven passengers were seriously injured and were all hospitalised.

1.3 Damage To Aircraft

The aircraft was destroyed.

1.4 Other Damage

Nil.

1.5 Personnel Information

1.5.1 (Commander)

Personal Details:	Male, aged 59 years
Licence:	FAA Commercial Pilot No. 2414306 Multi-engine; Instrument airplane
Issued:	19 September 2006
Medical Certificate:	10 October 2006
Medical Class:	Second

The Pilot had 9,001 hrs total flying of which 476 were on type. He last flew six days previously on the 29 June 2007.

The Pilot's Second Class medical certificate was valid and was issued by an FAA approved medical examiner. It was dated 19/09/2006 and required him to wear corrective lenses.

[7] Traffic Alert and Collision Avoidance System (TCAS) is an airborne system designed to warn the pilot of the proximity of other aircraft.

Records show that the Pilot had flown N208EC into EICA on seven occasions over the previous twelve months (30 July 2006, 8 December 2006, 25 March 2007, 27 March 2007, 1 June 2007, 4 June 2007 and on the 30 July 2007). There was no record found of the Pilot having flown into EIMN previous to that day.

1.6 Aircraft Information

1.6.1 General Aircraft Information

The Cessna 208B is an all-metal, high wing monoplane equipped with a non-retractable tricycle undercarriage and a turbo-prop engine. This aircraft was also equipped with a cargo pod, which was attached underneath the fuselage and provided additional stowage.

The aircraft equipment included a Garmin 530 GPS. This model does not retain track records after power loss and therefore no recorded navigational information was available to the Investigation from that source.

The interior of this aircraft was fitted with an Oasis Interior kit that was FAA approved, under a Supplemental Type Certificate (STC), for the Cessna Caravan aircraft. This interior is available in a number of configurations, the one on this aircraft being a 10-place configuration (crew included). The kit included a left hand refreshment cabinet and a right hand storage cabinet for pilot's manuals and other items. These cabinets were located behind the pilot seats and in front of the second row of seats (Row 2). All passenger seats faced forward with the exception of the third row, which faced aft.

This aircraft was also equipped with a life raft and lifejackets.

1.6.1.1 Leading Particulars

Aircraft type:	Model 208B Grand Caravan
Manufacturer:	Cessna Aircraft Company
Constructor's number:	208B1153
Year of manufacture:	2005
Certificate of Registration:	26 October 2005
Certificate of Airworthiness:	19 September 2005
Total airframe hours:	320
Total cycles:	275
Engine:	Pratt & Whitney PT6A-114A
Propeller:	McCauley 3GFR34C703-B/106GA-0
Maximum authorised take-off weight:	8,750 lbs
Estimated Actual Take-off weight:	8,943 lbs
Maximum authorised landing weight:	8,500 lbs
Estimated weight at time of accident:	8,793 lbs
Centre of Gravity limits (at accident weight):	33% to 38%
Centre of gravity at time of accident:	34% (calculated by the Investigation)

The Maintenance release, dated 18 May 2007 at 273.7 hrs, was valid and issued for an FAR 91[8] Operator. Its next scheduled maintenance was due on 18 September 2007.

1.6.1.2 General dimensions and Significant Operating Characteristics

Wingspan:		15.9 metres
Length:		11.5 metres
Propeller diameter:		2.7 metres
Wheel Track:		3.6 metres
Maximum operating speed:		175 kts
Maximum Torque:		1,865 ft lbs at 1,900 RPM
Landing Approach	**Flaps Up:**	100-115 kts
	Flaps 30:	75-85 kts
Balked Landing[9]	**Flaps 20:**	80 kts
Max crosswind operating limitation:		20 kts
Stalling speed – Power off, Flaps up:		78 kts
Landing Run – no propeller reversal:		290 metres

The manufacturer stated that stall warning typically occurs at 1.1 times stall speed in terms of calibrated airspeed, the variation being from 1.07 (turning flight) to 1.12 flaps down power off.

1.6.2 Airworthiness

The Licensed Engineer responsible for maintenance was interviewed by the Investigation. He stated that maintenance checks were conducted in the UK by an FAA approved JAR[10] 145 facility, which billed the owner directly. An Inspector of the UK Air Accident Investigation Branch assisted the Investigation by securing the maintenance records of the aircraft from the maintenance facility.

The aircraft was certified airworthy with a valid Maintenance Release. The Maintenance Release for FAR 91 Operation was completed at 273.7 hours on 18 May 2007. The aircraft had undergone its last annual inspection on 2 October 2006, at 203 airframe hours. The last maintenance prior to the accident was an Operations 2 Check, which was performed on 18 May 2007. The next check due was an Operations 3 Check (including an annual inspection) due at 503 airframe hours or by end October 2007, whichever came first. The Investigation found that the aircraft maintenance records were comprehensive and up to date. The only deferred item, which had been duly authorised, was the replacement of an engine fire warning harness, which was awaiting a parts delivery. This was not a factor in the accident.

[8] FAR, or Federal Aviation Regulations in the USA. FAR 91 covers General Aviation. Under the USA FAA system, FAR 91 aircraft do not require renewal of their certificate of airworthiness at periodic intervals.
[9] Go-around.
[10] JARs, Joint Aviation Requirements are used by 42 European countries.

The flight log record was found on the aircraft. Its records were up to date and the total aircraft time was logged at 320 hours. There were no recorded technical defects outstanding.

As previously noted in the interview with the AMS (Section 1.1.5.1), there was a technical log error in recording a flight earlier in the day where the flight EIWT-EIMN should have recorded two sectors; EIWT–EICA followed by EICA–EIMN. This was not a factor in the accident.

1.6.3 Fuel

The fuel used was Jet A1.

During the previous operation of the aircraft on the 29 June 2007, the aircraft flew from EICK (Cork) to EIWT where the Pilot recorded 450 lbs of fuel remaining on arrival. The departure fuel from EIWT was logged as 2,100 lbs but no uplift was shown in the log. Since the logbook incorrectly logged the first flight on the 05/07/2007 as being from EIWT to EIMN the flight time for that sector is inaccurate.

Table 1

Date	From	To	Flight time	Total	Cycles	Fuel Depart	Burn	Fuel Remain	Uplift
29/06/2007	EICK	EIWT	0.8	318.9	272	800	350	450	
05/07/2007	EIWT	EIMN	0.5	319.3	273	2,100	300	1,800	
05/07/2007	EIMN	EICA	0.1	319.4	274	1,800	100	1,700	
05/07/2007	EICA	EIMN	0.1	320.0	275	1,700	150	1,550	

Extract from N208EC's logbook

Note: All fuel weights are in lbs. As mentioned previously the sector EIWT-EIMN did not record a stop in EICA.

Refuelling records from EIWT subsequently showed that 983 litres of this fuel was loaded onto the aircraft on the 29 June 2007. Assuming a specific gravity of 0.8 for Jet A1, this uplift translated to an approximate weight of 1,734 lbs, or a ramp fuel load of 2,184 lbs, which confirmed the fuel load of 2,100 lbs recorded on departure. The Investigation was informed that the Pilot was not present when the fuel was uplifted.

1.6.4 Performance

No load and trim sheet was found for the accident flight. In addition, the Load and Trim Sheets found on the aircraft after the accident did not reflect either the seating configuration or the maximum weights of the aircraft. The Islander Pilot provided the Investigation with the passenger weights, which were recorded on the load sheet of the outbound Islander flight from EICA to EIMN. Consequently, the Investigation calculated the weight of the aircraft and its trim as shown in **Table 2**.

Table 2

	Weight lbs
Aircraft empty weight	5,531
Occupants of pilot seats	299
Occupants of Row 2	387
Occupants of Row 3	399
Occupants of Row 4	361
Occupant of Row 5	240
Baggage weight (estimated)	175
Zero Fuel Weight.	**7,393**
Fuel	1,550
TOW	**8,943**
Estimated burn off/Trip fuel	150
Landing weight	**8,793**
Max Landing Weight.	**8,500**
Estimated Overload	**293**

Load sheet

Note: Equipment and various items from the aircraft, which weighed 175 lbs, were found at the accident site by the Investigation. These consisted of; inter alia, a life raft and life jackets, aircraft handling equipment including a manual tow bar, pilot flight guides and sundry catering equipment. Baggage weight above is listed as estimated since some of the containers, which would probably have held liquids before the accident, were found broken.

Using the Weight and Balance Supplement for the Cessna 208/208B (Doc 2015-STR297) and seat positions moment arm, the trim of the aircraft was calculated. The aircraft was found to be in trim with a moment arm of 34% of the Mean Aerodynamic Chord (Limits 33% to 38%) with at an estimated landing weight of 8,793 lbs.

The aircraft was therefore estimated to be in trim but over its maximum landing weight on final approach into EICA.

1.6.5 Powerplant

1.6.5.1 General

The powerplant consists of both the engine and propeller. The engine, a reverse flow turboprop engine, was equipped with an inertial separator, which allows water particles to be separated from the inlet air.

1.6.5.2 Powerplant controls

Five control levers are mounted on the central pedestal of the Cessna 208B, between the pilots' seats as in **Photo No. 1**. The Flap Lever is mounted on the right hand side of the pedestal and the other four levers control the powerplant. Those levers are from left to right: Emergency Power Lever, Power Lever, Propeller Control and Fuel Condition.

- The Emergency Power Lever (red), which allows power to be restored after failure of the Fuel Control Unit (FCU). It is wire-locked in the Normal position as below.
- The Power Lever (black) controls power from Max (fully forward) to Idle and Beta (fully back). Reverse is selected when in the Beta position.
- The Propeller Control Lever (blue) controls Propeller RPM and has three marked positions: Max (fully forward), Min and Feather.
- The Fuel Condition Lever (red) controls the minimum RPM of the gas turbine and has three positions: Cut-off, Low Idle and High Idle.
- Flap Lever (black), controls the position of the flaps and has three positions: 0, 10 and 20 degrees of flap.

Photo No. 1: Powerplant and flap controls

1.6.6 Procedures

The following relevant checklist items are listed in the Pilot's Operating Handbook.

Before Landing Check

Seat belts Shoulder harness:	Secure
Fuel Tank Selectors:	Left on, Right on
Fuel Condition Level:	High Idle
Propeller Control Lever:	Max (full forward)
Wing Flaps 0-10:	Below 175 KIAS

Landing

Wing Flaps:	Full down
Airspeed:	75-85 KIAS

1.6.7 Ownership

This aircraft was registered in the USA, based in Ireland, flown by pilots who are Irish citizens with addresses in Ireland but holding USA licences. As such, regulation of the aircraft and pilots' licences falls under the jurisdiction of the FAA. As Ireland is the State of Occurrence, it is responsible for investigating the accident, as detailed in Annex 13 of the International Civil Aviation Organisation (ICAO).

FAA registration records at the time of the accident showed the aircraft was owned by a Trustee company; Wells Fargo Bank Northwest, Salt Lake City, Nevada. The Investigation was informed that the Trustor[11] and beneficial owner was Lancton Taverns, a Dublin based company.

The aircraft was operated under FAR 91 (General Aviation) category.

1.7 Meteorological Information

1.7.1 Meteorology General

Met Éireann, the Irish Meteorological Service, was requested to and provided an aftercast for the time of the accident.

Meteorological Situation: A low-pressure circulation was centred very close to the Northwest coast of Co. Mayo (co-ordinates N54º30′ W010º25′). The associated cold front had pushed away East of the accident area. A back-bent occlusion was approaching from the West. The air mass lying over Inverin (EICA) airport was very moist with characteristics similar to a warm sector situation.

Meteorological conditions at time of accident: Following are the conditions most likely to have prevailed over the Inverin area at the time of the accident:

Wind: Gradient wind 240°/30 kts to 35 kts.
Surface wind 220°/15 kts to 20 kts with occasional gusts of 25 to 30 kts

Cloud: Given the humid nature of the airflow and the fact that the location on Inverin is coastal, the likely cloud ceiling would have typically ranged 500–1,000 ft with a risk of patchy lower cloud, possibly to 200 ft.

Visibility: The presence of light rain/drizzle on Radar and at other coastal stations at the time the accident occurred suggests visibility would be quite poor. Values ranging 2,000 m to 5 km would be typical in this situation.

Weather: Occasional light rain or rain and drizzle mixed.

Temperatures: Air temperature 15 deg C.
Dew point temperature: 14.5 deg C.

Freezing Level: Circa 9,000 ft

Pressure: 998 hPa (mean sea level)

[11] Under USA law only USA citizens are permitted to own USA registered general aviation aircraft (N-registered). To comply with this requirement, yet still allow a non-US citizen to own such an aircraft, there is a widespread practice whereby USA citizens sets up a company which is the FAA registered owner of the aircraft, known as the Trustee. The beneficial owner, the non-US citizen, then enters an agreement with the Trustee, and is known as a Trustor.

Additional Comments

- Cumulonimbus clouds were not present, embedded or otherwise. Therefore, turbulence or wind shear associated with convective downdraughts was not present.
- There is no evidence to suggest the presence of turbulent mountain wave motion.

1.7.2 Actual Weather Reports for Nearby Locations

Shannon Airport (EINN) is located 37 nm south of EICA. The METAR (actual weather report) for EINN at 1400 UTC, 10 minutes after the accident, on 5 July 2007 showed a wind from 220º at 18 kts gusting to 28 kts. Good visibility was reported with some cloud at 1,800 ft and further cloud layers at 2,400 ft and 3,000 ft. The temperature was 17ºC with a dew point of 13ºC and an atmospheric pressure of 999 hPa with no significant change expected.

Ireland West Airport Knock (EIKN) is 47 nm north of EICA. The METAR for EIKN 1400 UTC on 5 July 2007 was significantly worse than Shannon; the wind direction varied between 130º and 200º, visibility was 2,000 metres in drizzle and cloud base at 100 ft.

The meteorological sea buoy M1, 63 nm west of EICA, recorded a wind speed of 17 kts gusting to 21 kts with a pressure of 996 hPa at 14.00 hrs.

Galway Airport (EICM) is 20 nm to the east. There was one meteorological report recorded at the airport; however this was almost two hours after the accident. The report showed a wind direction of 230º and a wind speed of 18 kts. The visibility was 7,000 metres with the cloud base at 700 ft. The temperature was 16ºC with a dew point of 16ºC and atmospheric pressure was 996 hPa.

Additional METARs and the Synoptic charts for the 5 July 2007 and 6 July 2007 are included in **Appendix A.**

1.7.3 Witnesses Weather Observations

1.7.3.1 PST Technician

The PST Technician stated that at the time of the accident, the day was particularly dark and misty.

1.7.3.2 EICA Operations Staff Member

An experienced airport operations staff member stated that the weather had been murky and misty with showers during the day. He said that although it was breezy, with possibly a light mist falling at the accident time, he believed meteorological visibility was "*within normal operational limits*" at the time of the accident.

1.7.3.3 AMS

The experienced AMS seated in the rear passenger seat reported that generally the weather was not good but variable. At the time of the accident it was very blustery and rough with low clouds but that he considered the visibility adequate for an approach.

1.7.3.4 Islander Pilot

The Islander Pilot stated that the weather was poor and very variable in the region during the day. Initially that morning the wind was from the southeast but by 13.35 hrs, the time N208EC departed EIMN after the presentation, the wind had veered by almost 90º to southwest. He estimated the wind speed at about 20-25 kts, which was increasing rapidly.

The Islander Pilot observed that, in the morning, the atmospheric pressure was about 1006 hPa and that it dropped to under 1000 hPa in 2½ -3 hrs. In the period 11.26 hrs to 12.28 hrs, pressure was dropping rapidly as his altimeter dropped by 3 hPa[12]. At the time visibility was about 3 miles with the cloud base 500 ft. He remarked that at 12.45 hrs at EIMN the visibility had much improved - the cloud base was then between 500-700 ft and visibility was 4 to 5 miles.

He added that generally, if the weather changed, airport staff would advise the pilot of an expected aircraft, either by radio or by mobile phone. He stated that the weather in the area is extremely variable.

1.7.3.5 Pilot of the Rescue Helicopter

The Pilot of the Rescue helicopter stated that they passed approximately 0.5 nm south of EICA close to the time of the accident and that they descended to 125 ft to keep clear of cloud but they did not see the airport. There was no rain but the winds were southerly up to 20 kts with reduced visibility. He thought the wind direction was between 200º and 220º.

1.8 Aids to Navigation

There are no navigational aids located at EICA.

1.9 Communications

ATC records, from EIWT and EICM, show that the aircraft took off at 08.20 hrs from EIWT and flew west to Galway Airport (EICM), on an IFR[13] flight plan at 4,000 ft, QNH 1009 hPa. The Pilot contacted EICM at 09.01 hrs as the aircraft transited through the EICM Control Zone and it was given the then current EICM QNH of 1006 hPa. It over-flew EICM and continued west to EICA for a VFR[14] approach to the runway. This was normal procedure as there was no ATC facility at EICA and the lower airspace (below 2,500 ft) beyond EICM is Class G airspace, i.e. airspace that is not controlled by ATC.

ATC did not record any further radio contact with the aircraft.

At 13.52 hrs an aircraft 40 nm west-northwest of Shannon reported to Shannon ATC that it was receiving an Emergency Locator Transmitter (ELT) on 121.5 MHz. ATC advised the Coastguard. The Coastguard shortly afterwards advised ATC Shannon of the accident.

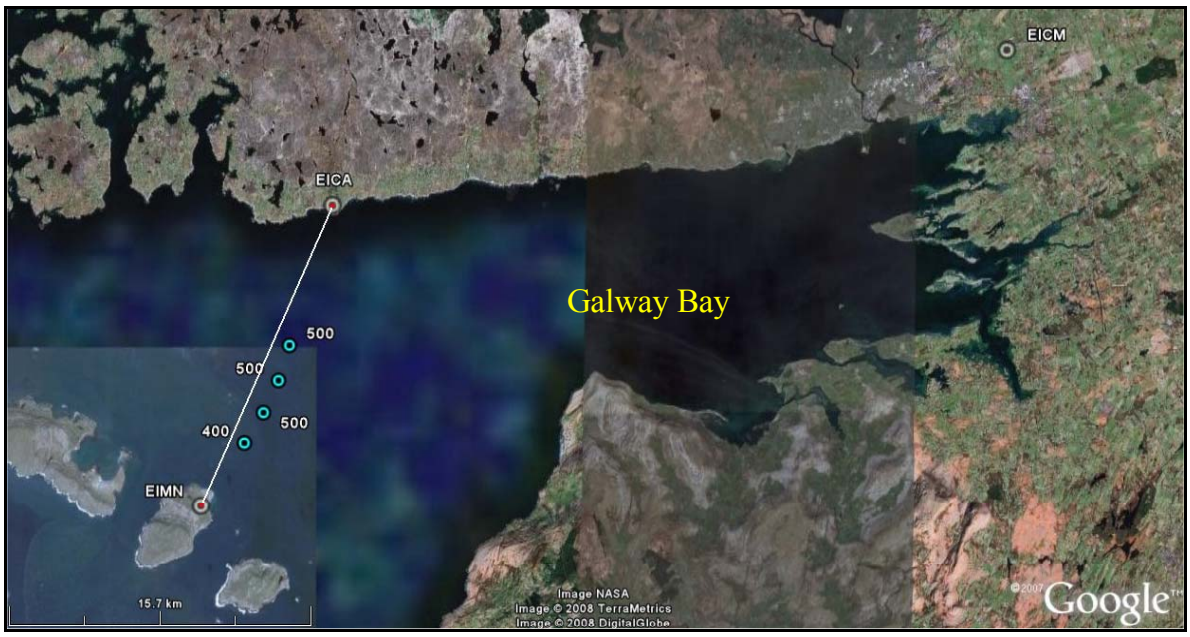
[12] Hectopascal, equal to a millibar and used to measure atmospheric pressure.
[13] Instrument Flight Rules under ATC supervision.
[14] Visual Flight Rules not under ATC supervision.

1.9.1 Radar Records

Shannon ATC radar recorded intermittent returns from the aircraft as it flew between EICA and EIMN. It should be noted that higher terrain in the vicinity masks radar coverage for parts of Galway Bay, especially at low altitudes.

Radar recorded the aircraft on the familiarisation flight at 09.46 hrs when it flew from EICA to EIMN at an altitude of 700 to 800 ft[15]. Signal was lost in the vicinity of EIMN at 09.51 hrs but reappeared travelling back to EICA at 09.56 hrs and disappeared off radar at 09.58 hrs.

Similarly, radar observed the aircraft for a limited part of the accident flight, appearing at 13.45:30 hrs but at a lower height of 500 ft. It disappeared off screen at 13.46:40 hrs. The complete ATC radar positions recorded for the accident flight are provided in **Appendix B**. **Graphic No. 1** was constructed from those readouts.



Graphic No. 1: Radar position and height plot of N208EC between 13.45:30 and 13:46:40 hrs.

Note:

1 Every second radar position has been plotted to provide graphic simplicity, each being displayed with its associated recorded altitude i.e. generally 500 ft. The track recorded was 029º with groundspeed generally at 159 kts.

2 EICM ATC Control Zone extends from EICM to halfway to EICA.

[15] This altitude was recorded from the transponder of the N208EC, which transmitted an altitude based on a standard pressure setting of 1013.2 hPa. This altitude was then corrected by the radar system, which used the then current QNH setting at Shannon, to display the correct altitude of the aircraft above sea level.

1.10 Aerodrome Information

Connemara Airport (EICA) is located at Inverin, 15 nm west of Galway city on the northern shore of Galway Bay. The airport elevation, located at the ramp, is 70 ft. No ATC facilities are provided at the aerodrome. The airport is underneath the Shannon CTA, in Class G airspace, which is not controlled by ATC.

EICA is a Public Licensed Category 2 Aerodrome as defined in IAA Aerodrome Licensing Manual November 2005 (Licensing Requirements for Lower Category Aerodromes). The aerodrome is subject to annual audit inspections; the previous inspection was conducted on 19 September 2006 and the subsequent one on 16/17 August 2007, one month after the accident. No significant non-conformities were recorded.

The single runway RWY 05/23 (magnetic orientation 049º/229º) is bituminous and has a Landing Distance Available of 609 metres. It is 18 metres wide. There are no navigation aids, radio beacons or runway lights. The airport terminal is located half way along the runway on the northern side. It is reached by a short taxiway from the mid point of the runway. EICA layout is shown later in **Section 1.18.2**.

The airport is home to Aer Arann, which operates small twin engine Britten-Norman Islander aircraft between the Aran Islands and the mainland. These flights are of very short duration (circa 7 – 10 minutes) and are very frequent (up to 80 per day) in the summer. The Islander chartered by the Clifden Airport Group was one of those aircraft.

EICA is a VFR aerodrome operated on the basis of Prior Permission Required (PPR). Pilots or aircraft operators are required to obtain permission to use the aerodrome from the Airport Operator in advance. There is no requirement to provide ATC at such an airport. The IAA, through its ongoing oversight of aircraft operations, may mandate the provision of an air traffic service at an aerodrome on safety grounds. The IAA has not seen a requirement for such provision at EICA to date (S.I. 856 of 2004 refers).

Airman's Information Circular (AIC) NR 39/03, published by the IAA, lists a radio frequency 123.00 MHz for Inverin. It states that prior permission to land is required and that the airport is closed outside the times of Aer Arran Islands Operations. Landing and Take-off is prohibited if a pilot is unable to establish radio contact on 123.00 MHz. However, the frequency is not usually manned unless a flight is expected. Procedurally, pilots must call when inbound and ground staff then expect the flight to land in or around its ETA, or in 5 minutes for local flights. The airport fire service, which is operated by trained airport staff, is then alerted.

In general, local pilots operate an inter-pilot information service while flying in or transiting in the area. They call position reports on 123.00 MHz, which they use as a communal inter-pilot frequency. In this way, they keep each other informed of their relative positions and intentions. This procedure is not a published procedure.

Weather reports were not recorded at EICA. As EICA is a VFR aerodrome a windsock was required. This was provided at the centre of the field, beside the ramp taxiway exit to the runway. An anemometer, which could be read by airport staff, was also installed although this was not required. The Investigation was told that that wind information was provided to pilots on request. The nearest airport from which meteorological information was available was EICM.

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

A Cockpit Voice Recorder was not fitted, nor was one required to be.

1.11.2 Flight Data Recorder

A Flight Data Recorder was not fitted, nor was one required to be. The engine was fitted with an engine parameter recorder unit as detailed in **1.18.2**.

1.12 Wreckage and Impact Information

1.12.1 Site

The accident site is located in a field a short distance from the taxiway entrance to the ramp. The taxiway entrance is to the right of the vehicles in **Photo No. 2** below. The field itself is "commonage" or owned collectively by a number of local people. Though generally level, the ground is uneven with a thin cover of soft, peaty soil through which the underlying rock projects. The ground slowly rises in the direction of the debris trail. Initial contact was on the right hand side of a small mound, about three metres high, partially covered by furze (gorse).

Photo No. 2: Chopped path through the furze - heading 012ºT (Looking along the line of impact)

A path some 19 metres in length and 012ºT in direction, was chopped through these shrubs. The path widened as the ground rose in a northerly direction. On the left hand side of this path, where the furze ended, was a large boulder (**Photo No. 3**) on whose flat face were three vertical strike marks (see **Section 1.18**).

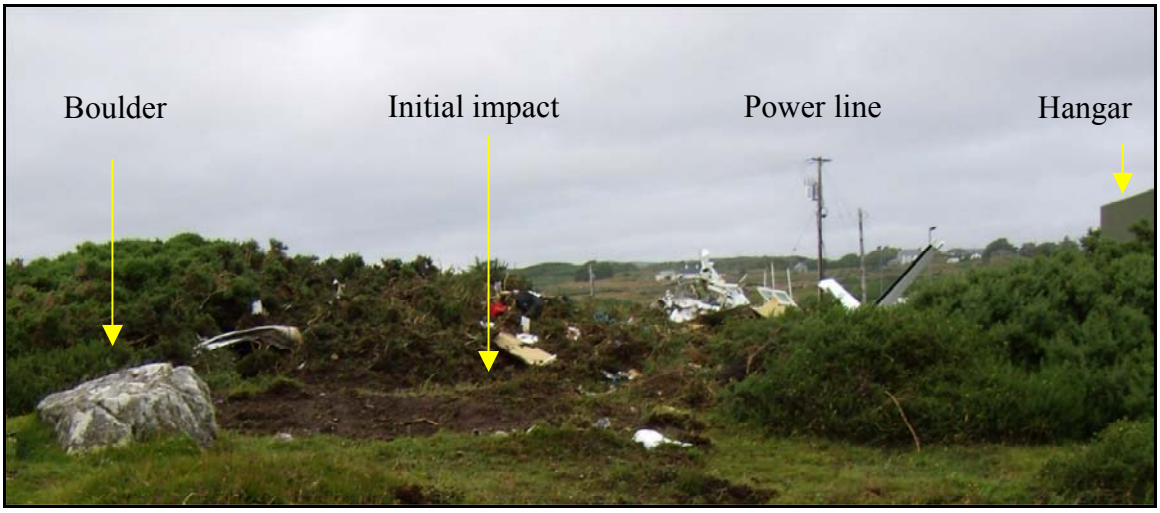


Photo No. 3: Showing boulder, initial impact position, wreckage and power line transformer.

The initial ground impact point was located 3 metres beyond this boulder and there the debris trail commenced. The ground at the initial impact point was soil-covered rock with bare rock to the left in the furze. The impact position was just under the right hand brow of the mound. The main wreckage was located 34 metres beyond this point with the fuselage pointing in the opposite direction to the debris trail. The final impact was in a shallow wet depression, partially filled with water.

The fuel tanks in both wings had ruptured and no fuel remained. However, there was physical evidence of a substantial fuel deposit at the impact site.

After arrival at the site the "Go Team" was informed that the Emergency Locator Transmitter (ELT) was still transmitting on 121.5 MHz. Due to the disruption of the wreckage the beacon was not located or deactivated until the following morning. It was finally located under the rear seats, underneath an integrated module that incorporated a toilet. Although the ELT could theoretically be accessed by removing the rear seats module this was not possible due to distortion of the aft fuselage/tail section. The ELT finally was deactivated after a metal bulkhead was cut through.

1.12.2 Wreckage

1.12.2.1 Fuselage

The aircraft fuselage came to rest on a heading of 230°T banked 55° to the right. The left wing had detached and rested on the right side of the fuselage. Its control cables remained connected. The right wing remained attached by its forward main spar attachment point. The engine had separated and came to rest on the right wing pointing in the direction of flight, which was in the opposite direction to the final heading of the fuselage.

The cabin fuselage section, though deformed, was essentially intact. The nose section was compressed by impact damage and had folded up and backwards over the cockpit area. The overhead section of the cockpit had detached. The left side of the fuselage was substantially crushed at the aft left wing spar attachment point. The tail fuselage section was intact. The right main landing gear leg, though still attached, had pivoted nearly 180° vertically, while the left main landing gear had separated from the aircraft. The nose wheel assembly had also separated.

1.12.2.2 Wings, Tail and Flight Controls

All flight controls surfaces were in place and control cable continuity was confirmed for the ailerons, rudder, and elevators.

The right wing was intact and was connected by the main (forward) spar, although the aft spar attachment had fractured. Mid-span was depressed and crushed where the engine came to rest. The aileron, trim tab actuator and control rods were attached. Both aileron and trim cables were attached and under tension. Wiring looms and tubing were still in place. The flap was attached and was down approximately 10°.

The right elevator was attached to the horizontal stabilizer. The outboard portion of the stabilizer and elevator at mid-span was bent/folded over approximately 100°. The leading edge on the stabilizer had impact damage.

The left wing, though detached, was intact. However, the outer segment of the wing showed significant impact damage and was nearly broken in half at the aileron/flap junction by impact loads. The aileron cables were still attached and under considerable tension as they held up the severed wing root. The left aileron and trim tab rods were attached. The flap was attached and was down approximately 10°.

The flap position indicator in the cockpit showed 10°. This position was subsequently confirmed by a flap actuator extension measurement of 3.2", which equated to 10° of flap.

Subsequent testing established all flight controls continuity although both control columns had severed. Both control columns were in the full aft position when fracture occurred.

1.12.3 Cockpit

1.12.3.1 General

The details of cockpit instrumentation and control positions found during AAIU site inspection post accident can be found in **Appendix C.** The following details are considered relevant by the Investigation.

1.12.3.2 Centre Pedestal Controls

The Power Lever was found at a high power setting, just short of maximum. The Propeller RPM Lever was found approximately 2.5 cm (1 inch) from maximum. The Fuel Condition Lever was noted in the "low idle" position. Since the controls to the fuel control unit had separated the pre-impact lever positions of these levers could not be determined with the exception of the Emergency Power Lever, which was wire locked in the "Normal" position. The Flap Lever position was approximately 10º.

1.12.3.3 Powerplant Instrumentation

The engine torque gauge was found reading 1,600 ft-lbs and the fuel flow gauge indicated a fuel flow of 4,400 lbs per hour. The Hobbs Meter, which recorded engine hours, indicated 320.1 hrs.

1.12.3.4 Flight Instruments

	Pilot	Co-pilot
Altimeter subscale in hPa	1006	1006

1.12.3.5 Selectors and Switches

Fuel Shutoff: On
Emergency Locator Transmitter: Arm
Seat Belt: On

1.13 Medical and Pathological Information

The Pilot was required, in accordance with his FAA medical, to wear corrective lenses. These were found in the cockpit at the accident site.

The Pathologist reported that the deaths of the Pilot and the passenger were caused by massive trauma induced by impact forces. In addition, the toxicology examination showed no trace of alcohol, illicit or prescribed drugs being detected in either person.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The Oasis interior kit is equipped with seats designed to withstand an impact of 25g. The catering units were mounted on the seat rail tracks, and located between the pilots' seats and Row 2. These units detached during the impact, one where the seat rail clasps pulled through the base floor and the other where the complete floor separated.

The pilot seats were equipped with five-point harness systems, the shoulder straps being an inverted Y system with an inertial recoil mechanism mounted in the seat back. All passenger seats were equipped with a lap strap and a single shoulder strap attached to the seatbelt buckle. An inertial reel mounted on the side of the aircraft secured the top of the shoulder strap. Therefore, this strap came over different shoulders depending on the location and orientation of the passenger seat. All seatbelts were intact following the impact with the exception of seat 2L. The shoulder strap of Seat 2 L was severed. The passenger in this seat was fatally injured.

All seatbelts, buckles and attachment points were otherwise in good condition.

In general, injury distribution was most severe at front left and least serious at rear right. The passenger in 4L stated that his seat was not locked in the fore/aft position and was free to swivel during the flight. He had not been shown how to lock it and did not discover how to during the flight. Most passengers suffered back problems among their other injuries.

1.16 Tests and Research

1.16.1 Engine Teardown

The engine was dismantled by personnel with type approval and a representative of the engine manufacturer under the supervision of an AAIU Inspector. The engine displayed moderate impact damage. The compressor 1st stage blades and shroud, the compressor turbine guide vane ring, the compressor turbine, the power turbine guide vane ring, the power turbine shroud, and the power turbine displayed circumferential rubbing and scoring due to making contact with their adjacent components under impact loads and external housing deformation. The reduction gearbox 1st stage coupling was fractured in torsion due to impact loads. There were no indications of any pre-impact distress or operational dysfunction of any of the engine components examined.

The conclusions of the engine breakdown were that the engine displayed contact signatures to its internal components characteristic of the engine producing power in a mid to high power range at the time of impact. The engine displayed no indications of any pre-impact anomalies or distress that would have precluded normal operation prior to impact.

The engine internal indications showed that the engine was under a substantial amount of power when impact occurred. Further evidence of this was that the impact fractured the spur gear drive to the propeller.

Although the fuel pump inlet screen (10 micron wire mesh) appeared to be clean, the fuel pump outlet filter (10 micron fibre filter) displayed fine dark brown organic debris and was discoloured. The fluid was dark in colour and appeared to have high water content. The filter and fluid contained in the filter housing was retained by the AAIU for analysis.

1.16.2 Filter Analysis

The contaminated filter and fluid contained in the fuel pump, outlet filter was sent by the Investigation to a specialist facility for analysis. The facility reported that a medium amount of material was present, mostly very fine organic material, possible iron based corrosion products and siliceous dust with some aluminium based metal particles. Hydrocarbon material, probably originating from Jet A1 fuel, was also present.

1.16.3 Propeller Teardown

The propeller was sent to its manufacturers where a propeller teardown was conducted under the supervision of an AAIU Inspector.

The propeller hub was fractured into multiple pieces, indicative of impact at high power. The propeller hub's cylinder was bent and deformed. The hub's bottom seal plate was partially pulled from the cylinder. The propeller spinner, the inboard section of Blade 1 and portions of the hub remained partially attached to the engine. Blade 1 exhibited forward bending and leading edge damage near the separation at mid-span. Blade 2 exhibited aft bending, twisting and leading/trailing edge damage and was missing a section of the tip. Blade 3 exhibited S-bending, curling and leading edge damage with aft bending. According to the manufacturer representative, the extent of propeller damage prevented determining blade pitch setting at impact. All fractures were of sudden overload failure type with no indications of fatigue.

The teardown concluded that propeller damage was the result of impact. There was no indication of any type of propeller failure prior to impact. The propeller was rotating at impact and was operating under conditions of high power at the time, but the precise power could not be determined.

1.16.4 Flight Test

Concerns had been raised regarding the handling/performance of the subject aircraft at maximum weight, at low speed and high power setting. In particular, the possibility that a torque roll may have been a factor was raised by the AMS in his interview and by another pilot who regularly flew the aircraft.

In a torque roll, when engine power is abruptly applied, the aerodynamic forces available from the flight controls are insufficient to counteract the accelerating rotation of the propeller mass. The aircraft then rotates about its longitudinal axis in the opposite direction to propeller rotation. This can be a significant characteristic of a single engine aircraft with a powerful engine and a large propeller. Recovery requires the pilot to immediately close the throttle to regain control, which is problematic if the aircraft is at a slow speed and close to the ground.

The Manufacturer informed the Investigation that the alignment of the engine on the aircraft is canted down and to the left in order to reduce the affect of torque roll and p factor[16] during power application at low speeds.

Accordingly, the Investigation needed to establish if there was a handling problem with the aircraft in this flight regime and requested Cessna to test this part of the performance envelope of the Cessna 208B. Initial indications from Cessna were that this would not be a problem. However, this permission was later revoked. The AAIU therefore hired a Cessna 208B with a cargo pod to complete a test flight under the supervision of an AAIU Inspector.

The flight test schedule is detailed in **Appendix D**.

The result of Test No. 10, where no corrective control was applied, was noteworthy.

Test 10 *Reduce to Vsw[17] –5 kts and apply full power maintaining aileron or rudder position without change: -* ***Result:*** *Bank 30° to the left initially and then increasing, yaw 20° left, initial bank was followed by a nose drop, descent and then stall buffet as g[18] loading increased.*

Note: It was not possible to exactly replicate the accident event because:

- N208EC was operating in ground affect[19] and was therefore capable of flying at a lower speed than could be achieved by the flight test, which was conducted at a safe altitude.
- The Pilot on N208EC used greater than the maximum torque allowed during the overshoot. This is only allowed for emergency purposes and results in an engine overhaul. Consequently, it was not appropriate to use this setting during the test.

[16] p factor: Asymmetric propeller disk loading due to a high angle of attack.
[17] Stall warning speed.
[18] Acceleration due to gravity.
[19] Ground effect occurs when a wing comes close to the ground i.e. less than a wingspan. It manifests itself as a cushioning effect or increase in lift probably caused by increased air pressure beneath the wing.

Although torque roll resulted from the application of full power and maximum RPM at the same time, it was controllable by a pilot who was experienced on type. It is noteworthy that the first application of both power and RPM at the same time produced an inadvertent roll reaction, even though the test pilot was expecting it.

1.17 Organizational and Management Information

1.17.1 Owner Interview

The owner stated that the aircraft was purchased through the Irish Cessna Agent who arranged the fit-out of the aircraft. Some months prior to delivery he met the ASI and discussed an arrangement with him relative to record keeping, maintenance and sourcing a suitably qualified pilot. He interviewed the Pilot, who was experienced, and employed him, paying him a retainer fee with a further payment per flight. Another pilot was also interviewed but did not have the requisite hours for command of the aircraft. This pilot later flew frequently with the Pilot. Both pilots were trained on the Caravan in the USA and the aircraft was ferried to Ireland.

Thereafter, the owner stated that the ASI kept all the maintenance records, as he himself did not have expertise in this area. A third party was employed to service the aircraft and this person billed the owner directly for his services. Both maintenance and hangar costs were paid directly by the owner.

The owner had received a request through the ASI to operate this flight, which he understood was for the directors of a proposed airport in the West. He agreed to loan his aircraft and the pilot, at no charge, to fly the group. He had spoken to the Pilot the day beforehand about the flight. The owner regarded the Pilot as safe and cautious.

The owner stated that the aircraft had been kept on the USA registry as he had been advised that this was common practice.

1.17.2 Aviation Services Intermediary (ASI)

The ASI stated that he specialised in keeping records and bookings on a variety of privately owned aircraft. The agency provided a range of services depending on the particular contract it had with each individual owner. These contracts ranged from acting as a full service provider, for owners who might have little or no knowledge of aviation, to an on-occasion specialist facilitator for owners who preferred a more direct involvement in the running of their aircraft.

Whereas some owners might own a helicopter, that is useful for short flights and for operations that are not airfield dependant, others might own a fixed wing aircraft, which would be useful for longer distance airport operations. The owners, through the services of the intermediary ASI who kept a pool of hours, could then exchange the aircraft together with their pilots depending on task requirements and the suitability of each aircraft for the intended task. The ASI stated that the owner had not used N208EC for commercial operations.

The ASI had an ongoing contract with the owner regarding aircraft record keeping and managing bookings for which it charged a monthly fee. The ASI had organised a third party to perform usual daily maintenance and repair and had arranged for overhaul and mandatory checks with a Maintenance facility in the UK.

The ASI stated that the maintenance of the aircraft was directly contracted between the owner of the aircraft and the Maintenance facility with line or daily maintenance being carried out by an aircraft maintenance person who was employed directly by the owner. The owner was charged for costs directly by the maintenance providers and insurers.

The ASI received a request for an aircraft to conduct a demonstration flight from a member of the Airport Committee who was known to him. The ASI relayed the request to the owner of N208EC and a presentation was put together on the aircraft's suitability with operating costs for the Airport Committee. The ASI stated that the subsequent organisation of the flight was between the Pilot and the airport committee member and that he had no further input into its operation.

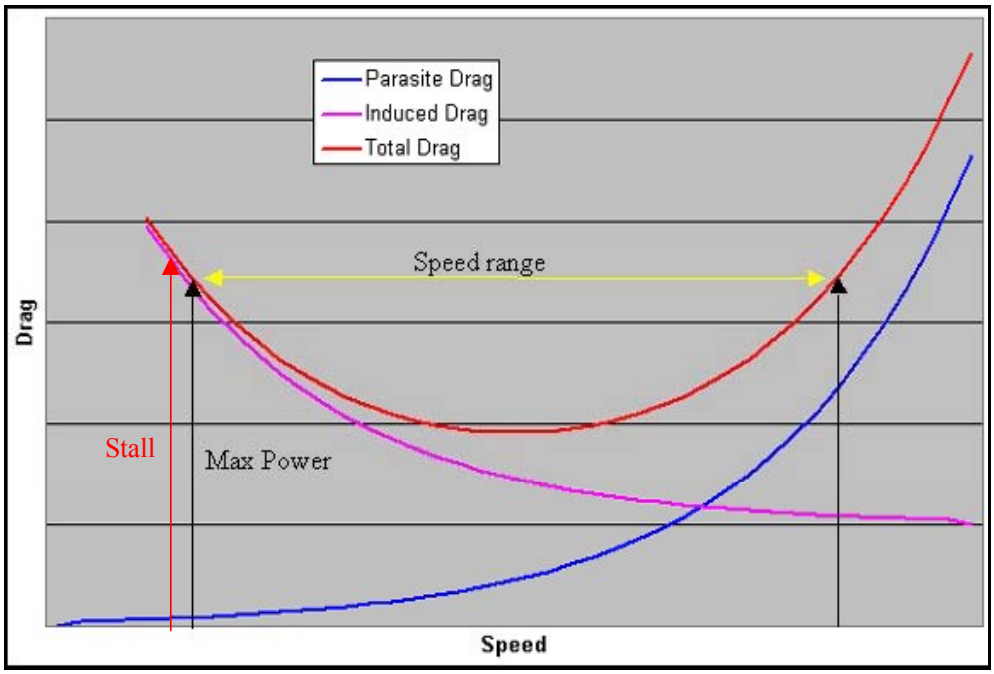
The AMS and Pilot conducted the presentation for the Airport Committee, as the ASI was not available at the time.

The ASI stated that there was an advantage in keeping the aircraft under United States Registration, as the complexity of the Cessna Caravan would possibly require an Air Operator's Certificate (AOC) under JARs[20]. He said that it would therefore be more expensive to operate the aircraft under Irish registry.

1.18 Additional Information

1.18.1 Aircraft Speed and Drag relationships

Note: Graphic No. 2 illustrates general principles of flight. It does not represent any particular aircraft, as the drag curves for each aircraft depend on many factors including aircraft shape, wing design, weight and configuration.



Graphic No. 2: Drag-Speed Relationships in flight

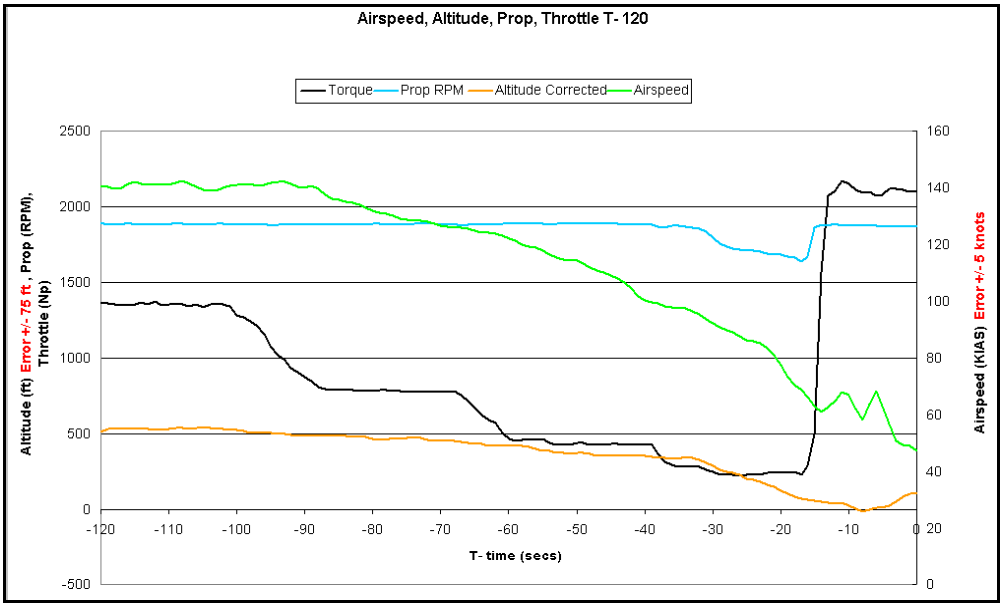
[20] JARs or Joint Aviation Regulations, to which Ireland subscribes, are published by the Joint Aviation Authority which represents the civil aviation regulatory authorities of a number of European States who have agreed to co-operate in developing and implementing common safety regulatory standards and procedures.

Drag on an aircraft is a combination of two elements: Parasite and Induced drag. Essentially, Parasite drag is caused by resistance to the movement of a body through the air, whereas Induced drag is the result of generation of lift for flight. Parasite drag increases with velocity whereas induced drag is inversely proportional to velocity squared and directly proportional to weight squared; consequently there is a significant penalty for carrying extra weight as if weight doubles induced drag quadruples. In a turn, induced drag increases as the apparent weight increases due to the g force increasing in a turn; the sharper the turn the more significant the effect.

In stable and level flight total drag is equal to the power output of the engine. It follows therefore that, as an engine has a maximum power output, there is a maximum amount of total drag that can be overcome both at high speed and at low speed. Between these two points the speed of the aircraft can be controlled, outside these points the aircraft decelerates. Whereas on the right side of the graph the speed decelerates into a controllable speed range, on the left hand side it decelerates towards a stall. The aircraft can only be flown out of this latter area by lowering the nose and accelerating by diving the aircraft. This cannot be done close to the ground. The left hand side of the Total Drag curve is commonly referred to as the "back of the drag curve" or the "back of the power curve" as the slower the aircraft's speed, counter intuitively, the more power is needed to hold that speed until ultimately there is no power reserve left and deceleration continues.

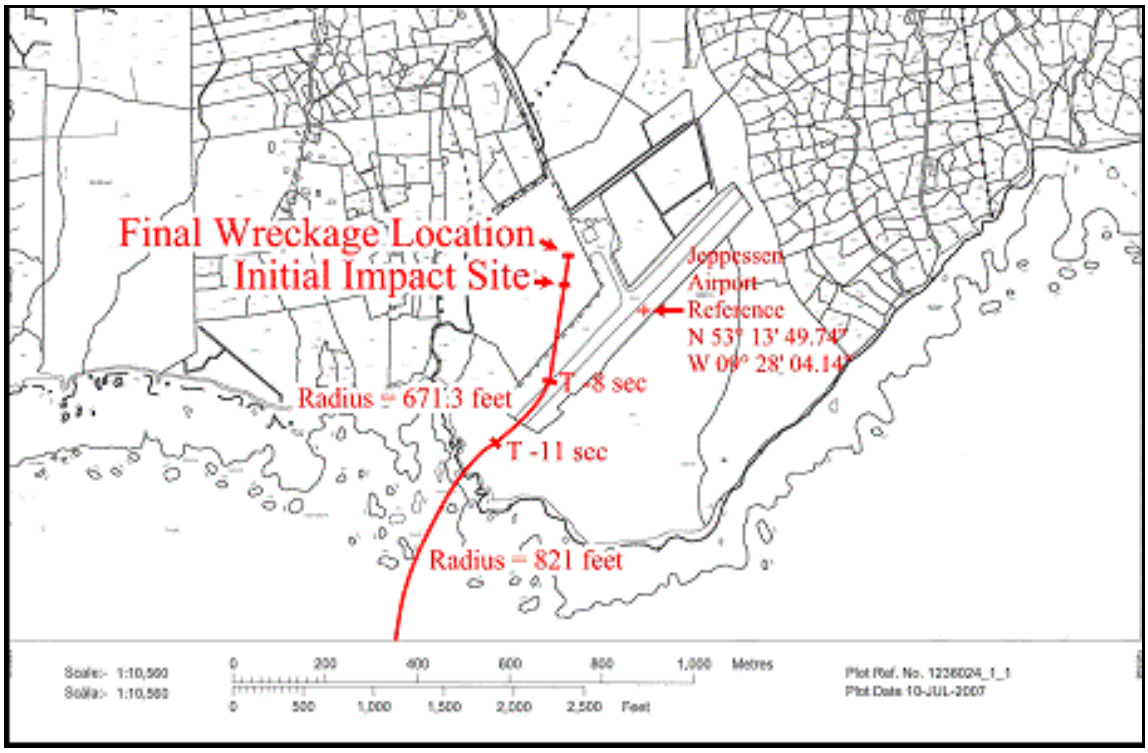
1.18.2 Aircraft Data Acquisition Unit

An Aircraft Data Acquisition Unit (ADAS) Model EMU-A-010-3, which monitors engine parameters, was fitted to the engine. This was recovered from the wreckage and, although substantially damaged, Altair the manufacturer successfully downloaded and read its data. It should be noted that the ADAS was designed to monitor engine parameters and not as a flight recorder. It therefore does not, nor is it required to, have the same level of accuracy or sampling rates as a flight recorder. **Graphic No. 3** below has been derived from the ADAS data for the last 120 seconds of the flight. The data in this graphic has been mathematically smoothed and corrected for pressure altitude deviation from standard at the accident time. The final 25 seconds of the amplified raw ADAS data, from T-25 to 0, is given in **Appendix E**.



Graphic No. 3: Smoothed final 120 Seconds of ADAS recording

The ADAS data was corrected for wind velocity and groundspeeds and drift angles were derived. Using ATC radar records during cruise, the observations of ground witnesses and the passengers, the probable final track of the aircraft was calculated yielding turn radii, bank angles, distances and G loading. This is shown in **Graphic No. 4**. The maximum bank angle was estimated at 35º with a g loading of 1.57g.



Graphic No. 4: Calculated plot of the final track of N28EC

1.18.3 Airport Security Cameras

The airport was equipped with security cameras, which recorded low-resolution colour images in a timed sequence. These were examined by the Investigation. The accident was detectable on the edge of coverage of one of the cameras which overlooking the entrance to the airport. The following information was derived from the security cameras.

Table 3

13.48:55	**Impact**
13.51:21	**Airport Fire tender** crosses ramp through ramp/car-park gate
13.56:41	**First casualty** is assisted by a fireman across the car park to terminal door
13.58:49	**Second casualty** is helped by a fireman to the terminal but appears to be able to walk unassisted
14.03:40	**First Ambulance** arrives
14.18:34	**Doctor** arrives
14.27:28	**First Local Authority Fire Appliance** arrives
14.28:25	**Second Fire Appliance** arrives followed immediately by **third appliance**
14.37:22	**Second Ambulance** arrives

Airport Security Camera Timings

The recordings showed raindrops falling on some of the exterior camera lenses shortly after the accident.

1.18.4 Galway Fire Services Report

Records were requested from the Galway Fire Station. The Chief Fire Officer's Report stated that the accident was reported to ambulance control at 14:51 hrs local (13:51 UTC) or 2 minutes after the accident. Three appliances were mobilised, two were from the eastern side of Galway city, and these arrived at the accident scene at 15:27 hrs (14:27 UTC) or 38 minutes after the accident. The fire fighters used hydraulic extrication equipment to release the trapped casualties. The Report stated that this very difficult extraction took over an hour to complete successfully.

1.18.5 Visual Flight Rules (VFR)

VFR and IFR flights are permitted in Class G airspace. Irish Regulations regarding VFR are published in Statutory Instrument 72 of 2004, Rules of the Air -

Part II, Rule 3 states the minimum heights an aircraft can be flown at. This states that the aircraft shall not be flown:

(i) closer than 150 metres, (500 ft) to any person, vehicle, vessel or structure, or
(ii) at a height less than 150 metres (500 ft) above the ground or water,

Part III, Section 34 states that in Class G airspace VFR requires that an aircraft flown at and below 300 metres (1,000 ft) above terrain, whichever is the higher, must remain clear of cloud and in sight of the surface. Normally an in flight visibility of 5 km is required. This visibility distance can however be reduced to:

(a) 3 kms. Flight Visibility for aircraft operated at an indicated airspeed of 140 kts or less;
(b) lower flight visibilities to a minimum of 1500m may be permitted for aircraft operating:

(1) at speeds that, in the prevailing visibility will give adequate opportunity to observe other traffic or any obstacles in time to avoid collision, or
(2) in circumstances in which the probability of encounters with other traffic would normally be low,
e.g. in areas of low volume traffic and for aerial work at low level;

1.19 Useful or Effective Investigation Techniques

1.19.1 Propeller strike marks

A large boulder or rock was situated on the outcrop slightly to the left of the flight path, approximately four metres before the initial impact. Three score marks were visible on the rock face as shown in **Photo No. 4**. The rock surface was an irregular plane whose alignment was not parallel to the direction of flight, but angled towards it. These score marks were regularly but not evenly spaced along the surface. The score marks shapes indicated that the propeller blades were not feathered. A small piece of propeller blade tip was found buried underneath the rock directly below the third score mark. The Investigation determined that the marks were caused by the rotating propeller striking the rock immediately before impact.

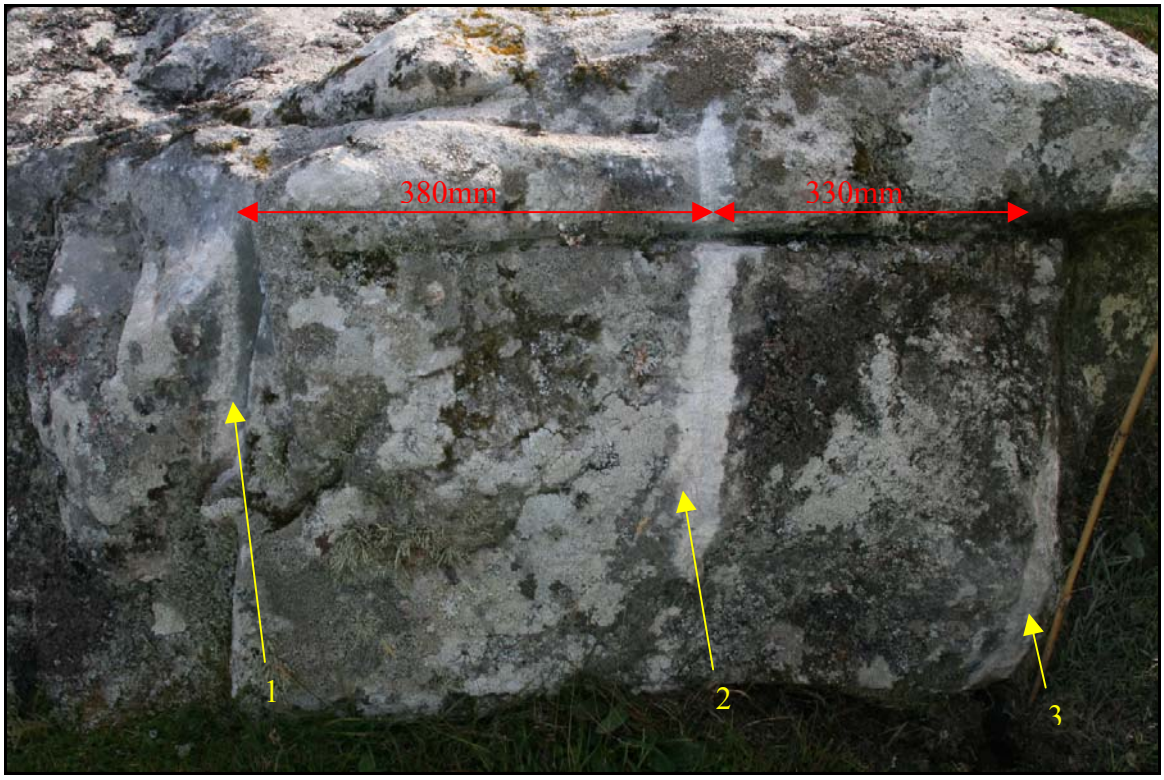


Photo No. 4: Rock with propeller strike marks

The Cessna Caravan has a three-bladed, constant speed, McCauley propeller. In one complete 360º revolution of the propeller would produce four strike marks (three spaces), as the first blade rotates to strike a second time on completion of the revolution. Therefore the three score marks (two spaces) indicate two thirds of a revolution of the propeller. Propeller RPM was 1,868 before impact, as recorded by the ADAS data (see **Section 1.18.2**). This RPM was then used in calculating the ground speed of the aircraft immediately prior to impact.

The distance between score-marks one and two was 380mm and between score-marks two and three was 330mm. These were added and the overall distance travelled by the aircraft during the two-thirds revolution of the propeller was 0.71 meters.

2. ANALYSIS

2.1 General

The normal role for this aircraft and its Pilot, who was employed by the owner, was to fly the owner and his family or associates to specific locations privately. This particular flight was somewhat different. The information provided to the Investigation indicates that a representative of the Clifden Airport Committee requested the aircraft from the owner and that the subsequent details of the flight were organised between the representative and the Pilot. The owner informed the Investigation that the aircraft was provided free of charge and it was therefore being operated in the General Aviation Class under FAR 91.

The Pilot flew to EICA early in the day and sensibly flew a reconnaissance flight with the empty aircraft out to EIMN and back. The Pilot later took the first part of his passengers out but refused to come back as he was apparently uncomfortable with the weather.

According to the meteorological aftercast that assessment was correct as the weather situation was complex.

A passenger on the flight from EICA to EIMN, who was an ex-pilot seated in the co-pilot's seat, observed a careful flight that was accurately flown by the Pilot. This passenger did not observe that the Pilot "*had overshot the runway at EIMN*... as Passenger 1R said the Pilot mentioned, but instead saw two orderly turns, one onto downwind and then one onto final.

However the return flight resulted in a fatal impact. The analysis therefore evaluates the information gathered from the impact site and the underlying factors behind the accident.

2.2 Overview

The Pilot flew from EIMN at low level. He, according to witness 1R, finally saw the runway close too and to the side of track. At that point he made an S turn to align the aircraft with the runway. At low level, in relatively poor weather, with a substantial tailwind and a heavy aircraft he made an attempt to land. Witness 1R stated he was "*too fast*" so a go-around was commenced. At that point the aircraft turned over 30º to the left, towards the terminal building and towards rising ground but did not gain height.

2.3 Impact Trail

The propeller contacted the furze bushes initially, cutting an increasingly wide arc as the ground rose. Analysis of the path (see **Photo No. 2**) indicated that the aircraft was flying approximately level when it contacted the furze. The propeller subsequently struck the boulder immediately before impact. Impact was initially on the outboard segment of the left wing, which imparted an anti-clockwise rotation to the aircraft. This initial impact probably severed the left wing spar attachment points, the wing remaining attached solely by the control cables.

The subsequent and main impact resulted in the propeller hub fragmenting, the engine severing with the aircraft entering a ballistic bounce and cartwheel as described by the ground witness. The aircraft then fell to the ground with little horizontal momentum and came to rest pointing almost in the opposite direction of flight, having horizontally rotated through 142º, with the flailing left wing crossing the fuselage to fall on the right hand side. Subsequently, the severed engine, which had entered a higher ballistic bounce, dropped on the right wing crushing it. There is no evidence of any horizontal motion in the crushed indentation. The Investigation is of the opinion that the final impact of the engine was essentially vertical in nature.

2.4 Powerplant

The damage to the powerplant was consistent with a glancing low speed impact. The powerplant breakdown did not reveal any previous defect and indicated the engine was operating at a high power prior to impact. Witnesses also related hearing the engine at high power. The analysis of the deposits found in the fuel outlet filter revealed that the cause of this contamination was post accident, possibly by stagnant water at the accident site that contained organic material (peat). Therefore it was not a factor in the accident.

Although the distance between the consecutive propeller strike marks decrease slightly, this is probably due to the shape and orientation of the rock together with gyroscopic precession/distortion of the propeller disc, due to the impact forces, rather than any real deceleration of the aircraft.

Two propeller blades were recovered from the immediate vicinity of the rock. This indicated that the propeller blades had sufficient energy to detach from the hub, which was shattered on impact. The propeller manufacturer stated that the fact that the hub itself shattered indicated high energy levels in the propeller, in turn the result of a high engine power setting.

High power was also indicated by the ADAS engine parameters recorded. These showed the engine at a very high power setting (113% of Maximum Torque) with fuel flow and other parameters to match.

Two engine instruments survived. The torque gauge showed 1,600 ft/lbs and the fuel flow 4,400 lbs/hr, which also indicated high power settings. It should be noted that readings from instruments post impact can be unreliable due to the inertial loads on the internal instrument components during impact. However, when these readings are used in conjunction with the other evidence; the results of the engine breakdown, the statements of the witnesses both on the grounds and in the air, it substantiates a high power setting scenario. In addition, in view of the ADAS data the Investigation is of the opinion that the engine was operating in excess of full rated power at impact.

2.5 Speed

Passengers on board the aircraft reported the sound of the stall warning horn or a beeping sound, which became continuous. The stall warning operates at approximately 1.1 times the stalling speed and the sounds reported by the passengers indicate a gradual loss of airspeed. Another passenger reported the aircraft to "shudder", which is symptomatic of stall buffet or the onset of the stall itself where airflow over the wings begins to detach.

The Propeller strike marks on the boulder were analysed. If deceleration caused the variation in strike distance the force required would need to be of the order of –5g. There are, however, no witness marks at the location that would cause such a deceleration.

Assuming constant velocity during the revolution, the aircraft would travel 1.065 metres (0.71 x 1.5) per revolution of the propeller. During the 1,868 revolutions of the propeller in each minute, the aircraft would travel 1.98942 km (1,868 x 1.065), which converts into a groundspeed of 65 kts at impact. If the component affect of a wind of 220º/15 is applied the result is an airspeed of approximately 51 kts immediately prior to impact. This is below the normal stall speed of this aircraft. (Note: The stalling speed for a similar aircraft at maximum weight and full power on the Test Flight was 60 kts).

There is a difference in the spacing of the impact marks, the difference results in an approximate ground speed difference of 4 kts. The spacing of the impact marks; wind speeds and TAS are further evaluated in **Appendix F** where the airspeed range of the aircraft is estimated at between 46-55 kts.

This low speed is corroborated by a final ADAS recording of 46 kts (accuracy +/- 5 kts). The AMS on board the aircraft also commented that the aircraft was at an abnormally high nose up pitch attitude.

This scenario, a low speed and a high pitch angle, is symptomatic of an aircraft hovering at the back of the drag curve where the power output of the engine was incapable of accelerating the aircraft out of the high drag regime. Despite being equipped with quite a powerful engine, the power available, even above rated power, was not enough to provide a flight path that cleared terrain.

At such a slow speed it is very probable that other factors, such as stall/wing drop and lateral control issues, were also aerodynamically significant thus radically increasing the Pilot's control problems. This may have resulted in the impression of the Pilot struggling with the controls, as reported by the passenger and the "shiver" or lateral rocking of the aircraft as reported by the ground witness.

2.6 Final Track Direction

The final track was 012º True or 019º Magnetic. There is a difference of 31º in heading between RWY 05 (049ºM) and the final track 018ºM. It is considered unlikely that the Pilot would willingly turn away from an overshoot path that was clear of obstacles i.e. the clearway the runway offered straight ahead and the open sea to the right and south. Yet the aircraft turned to the left towards rising ground and buildings a short time before impact.

The AMS stated in his interview that the torque affect on the aircraft could have been a factor. Consideration was therefore given to the possibility that the abrupt application of power applied at an abnormally low airspeed resulted in a "torque roll".

Accordingly a Test Flight was conducted to evaluate the torque roll characteristics of the aircraft. As a result of the test flight, the Investigation is satisfied that there are no significant handling problems when the aircraft is at maximum landing weight and MAX Power is applied at speeds down to the stall. However, the aircraft operational procedures and checklists are designed to separate the simultaneous application of power and RPM. Accordingly, the Propeller Control Lever is required to be positioned full forward, or at maximum RPM in the approach or Before Landing Check. However, this does not appeared to have happened in the accident flight, according to the witness who saw the Pilot move two levers forward during the go-around. This is also confirmed by the ADAS data.

The pre-landing checklist items includes: **Propeller RPM Control lever:** Max (full - forward). The purpose of this requirement is to avoid the lateral control problems associated with accelerating the rotating mass of the propeller while simultaneously applying significant power/torque during a go-around. However, Passenger 1R was sure that the Pilot operated two levers in short succession during the go-around. It is likely these were the propeller RPM and Power. This is confirmed by the ADAS data, which recorded engine torque going from 376 to 2,060 ft lbs and propeller RPM from 75% to 100%, all within 2 seconds. At that time, a speed close to the stall of 63 – 61 kts was recorded by the ADAS. Therefore it is probable that the pre-landing checklist item, Propeller RPM Control Lever to Max, was not completed.

The results of the Test Flight must now be considered where the abrupt application of both power and propeller RPM, without pilot control correction, at speeds close to the stall, caused a 30º increasing left bank with a 20º yaw to the left followed by a nose drop, descent and then stall buffet. The descent and stall buffet being caused by the increased g loading as the bank developed.

The fact that N208EC's speed was 10 kts slower than the stall speed recorded during the Test Flight and that greater than maximum rated power was used amplified the above characteristics. This resulted in increased control difficulties in dealing with the torque reaction, as lower aerodynamic forces were available from the flight controls. This slower speed capability of N208EC was due to it operating in ground effect at the time of the accident.

This scenario is in line with the recollection of Passenger 1R, although his impression was that the bank might have occurred first and then power applied, but he was not sure. The Investigation however, is of the opinion that it is more probable that the aircraft turned to the left, during the go-around, as a result of a rapid and almost simultaneous application of very high Power and RPM at a speed close to the stall. Geometric calculations of alignment and turns based on ADAS data co-relate with this.

2.7 Height

The aircraft, when over flying EICM early that morning, was given a QNH of 1006 hPa by Galway ATC. It is noteworthy that both altimeter subscale settings on the aircraft were found still set to 1006 hPa following the accident. This indicates that the Pilot had not reset his altimeters though the pressure was dropping rapidly over the period. The custom in such operations, in the absence of ATC, is to reset the altimeter subscale on an aerodrome ramp where the reference altitude is known. Because this was not done the altimeters misread the height by 224 ft. Therefore while the Pilot was flying an indicated altitude of 800 ft he was in fact much lower, less than 600 ft. As altimeter errors are +/-50 ft this reconciles the observations of the Passenger and ATC radar records - the passenger who observed 800 ft for most of the flight and the radar that recorded it at 500 ft (**Section 1.9**), since the radar system automatically corrected the altimeter pressure setting.

If the Pilot believed he was at 800 ft during the flight he would have expected to initially see the runway when it was further away. As it was, the runway was much closer than expected when it came into view, as he indicated to the passenger in the right hand seat, possibly due to low cloud and the prevailing visibility. Thus he had little time to evaluate the suitability of the runway for landing in the prevailing tail wind conditions.

2.8 Weight

No prepared Load and Trim Sheet was found at the accident site and the blank forms found on the aircraft were for an aircraft with a different seating arrangement. The passengers were not individually weighed and it is therefore unlikely that a Load and Trim sheet was prepared. Subsequent calculations by the Investigation showed that the aircraft was over maximum landing weight at the time of the accident. However, it is probable that the Pilot was not aware that the aircraft was over maximum landing weight since no load sheet was prepared and the passengers were not weighed.

In addition, the flaps were found in the Flap 10º position. It would appear that approaches and landings were frequently conducted using this flap position. Nonetheless, it might have been prudent for the Pilot to use a greater flap setting to reduce groundspeed and shorten the landing run, as the heavier the aircraft the longer it takes to stop.

The Investigation is of the opinion that the heavy landing weight of the aircraft, with slow deceleration during the attempted landing and a subsequent slow acceleration during the go-around due to inertia, was a contributory factor in the accident.

2.9 Weather

EICA is a VFR airport where adequate visual reference is required in order to take-off and land safely. Weather information, both meteorological aftercast and the witnesses' reports, indicate that the weather was very mixed and variable on the day with a possibility of gusts up to 30 kts and a cloud base as low as 200 ft. The pilot of the Coastguard Rescue helicopter reported having to descend to 150 ft, to keep clear of cloud, and poor visibility a half mile south of the airport close to the time of the accident. Yet the experienced AMS on board the aircraft and the ground based operations staff member believed that visibility, at the airport, was within operational limits at the time of the accident. The visibility limits, according to the Rules of the Air, are a minimum height of 500 ft with a minimum flight visibility of 1.5 kilometres. The corrected ADAS data showed that the flight was operated at 500 ft until the approach was commenced. Passenger 1R stated that the aircraft had descended out of cloud and the AMS reported low cloud. It is probable therefore that the flight was operated in marginal VFR conditions.

Although prior permission to land was required, the Pilot, though he may have attempted to do so, did not communicate his imminent arrival to EICA staff and so lost the opportunity of being informed of the changed wind direction. Passenger 1R reported the Pilot making a radio call. If he called EICA he was not heard. However, it is possible that the radio there was unattended at the time, as they were not expecting any aircraft. In addition, the Rescue helicopter reported that he did not hear N208EC on frequency. The Investigation has been unable to establish whom the Pilot called.

It is probable that the aircraft passed through a rain shower on the way to EICA, as evidenced by the fact that raindrops showed shortly afterwards on the airfield's security cameras. The aircraft had approached the runway from upwind, the direction the rain shower was coming from, so it is therefore likely that rain restricted the visibility during the approach. This would also have impaired the Pilot's ability to evaluate wind direction and strength.

The windsock, which indicates the direction of the wind, is located at the entrance to the ramp at EICA, about half way down the runway. However, even if he had seen the windsock it is likely that the Pilot would have had difficulty in interpreting the wind direction as he was approaching from directly upwind with the windsock streaming away from his line of vision. In such conditions it is difficult to determine whether the windsock is pointing directly away or towards the observer, especially with poor visibility and with such limited time available, as was the case.

The Investigation is of the opinion that the Pilot made a quick decision, on seeing the runway, to make an approach onto his preferred runway unaware that the wind had veered from a crosswind to a substantial tailwind while he was at EIMN. He would have only discovered this tailwind when, having already reduced power and flared for landing, the high groundspeed and weight of the aircraft were such that the aircraft, if landed, could not be stopped on the runway. This resulted in a decision to initiate a go-around.

2.10 Go-Around

ADAS data confirmed that airspeed decay had by then become excessive and that the overshoot was commenced at an abnormally low airspeed. The consequent torque reaction to the application of maximum power and RPM, about the same time, probably resulted in the aircraft inadvertently turning left towards rising ground and the terminal buildings. Due to rising terrain, the heavy weight of the aircraft and increased apparent weight[21] in the turn, the resulting drag and lack of altitude did not allow the aircraft to accelerate. This resulted in a semi-stalled condition with the stall warning sounding before impact, as the passengers reported. As the aircraft's speed was on the back of the drag curve and with no altitude available to descend and accelerate, ground impact became inevitable.

2.11 Additional Factors

In addition, the pressure of a demonstration flight, the Pilot's lack of familiarity with island operations and the fact that the flight was only 7 minutes in duration would have significantly affected the Pilot by reducing his situational awareness and ability to assess the situation. It is also probable that the earlier critical comments of a passenger at EIMN added to his stress in an operation in which he was manifestly uncomfortable, according to a number of witnesses.

The Pilot put himself under significant pressure by operating a flight that was in essence a demonstration flight, in environmental conditions he was uncomfortable with (marginal VFR conditions) and he probably did not want to disappoint by diverting to a more suitably equipped airport.

These factors and the desire to successfully complete the flight probably contributed to a rushed decision to land on his preferred RWY 05, a landing that, unknown to the Pilot, was downwind.

2.12 Pre-Departure Briefing

A passenger stated that his seat was not locked and was free to swivel during the flight. He reported that he had not been shown how to lock it and did not discover how to during the flight. There appears to have been no pre-departure briefing by the Pilot, even though the single engine flight was operated over water and the aircraft was equipped with lifejackets and a life raft. This is symptomatic of an operation for which the Pilot was not adequately prepared, since he should have briefed his passengers on the use of safety equipment because in the event of a failure of the single engine the aircraft would have inevitably had to ditch in the sea.

2.13 Emergency Locator Transmitter (ELT)

This ELT activated on impact, transmitting on 121.5 MHz. Although there was an arm/disarm switch on the pilot's instrument panel this was inoperative following impact damage. In addition, due to the disruption of the fuselage, it was not clear where the ELT was located. Subsequent examination found a small decal on carpeting indicating that the ELT was behind a partial bulkhead supporting the rear seats. However, the location was inaccessible other than by using cutting equipment.

[21] Apparent weight, in this context, is the sum of the actual weight of the aircraft plus the increase caused by centrifugal force acting on it during a turn.

The consequence of this ELT transmission was that the Search and Rescue VHF radio channel on the west coast of Ireland was blocked for an extended period. Neither was any information available to the Investigation team or first responders regarding the location of the ELT or how it could be disarmed after an accident.

The Investigation is of the opinion that position of the ELT transmitter should be appropriately identified by a decal on the exterior of the fuselage, or so positioned so as to provide easier access to deactivating it following an accident, and a Safety Recommendation is issued accordingly. In addition, this information should also be contained in a supplement to the Flight Manual.

2.14 Fire Services Response

One of the ground witnesses, who observed the accident, stated in his interview that a medical team arrived about an hour after the accident and that the County Galway Fire Services arrived approximately 10-15 min afterwards or one hour and ten minutes later.

Examination of the airport security tapes showed vapour, generated by the impact, being registered between 14.48:55 hrs and 14.49:09 hrs lasting 14 seconds. Thirty seconds later the first person was recorded moving towards the accident site followed, twenty seconds later, by two others. The Airport Fire Tender is recorded crossing the ramp, after 2 minutes and 26 seconds, and reached the site almost a minute later, but did not discharge foam. As there was no fire this was prudent practice not to exhaust foam stocks, as there would have been nothing left if fire broke out subsequently. In addition, such a discharge would have affected the seriously injured passengers still trapped in the fuselage.

A doctor is shown arriving after 20 minutes and three county fire service tenders arriving after 40 minutes at 15.27 hrs, which was also the arrival time recorded by the Galway Fire Services Report.

The Galway Fire Station received notification within 2 minutes of the accident from EICA staff. This was a speedy response to an unforeseen emergency by airport staff, as they were not aware that an aircraft was on approach. In addition, it would have taken some time for crash information to be relayed, since the accident site was off the airport and not visible from the operations or terminal area.

Although the distance for the county fire services to travel was only 18 miles this road is very busy in the summer, narrow and with limited opportunity for overtaking. As the tenders were coming from the eastern side of Galway city, the Investigation is of the opinion that the response time of the County Galway Fire Services was reasonable in the circumstances. However the accident does demonstrate that the distance induced delay of local emergency services results in a situation where a successful response to an immediate post crash fire can only be achieved by the airport's own fire services.

3. CONCLUSIONS

(a) Findings

1. The aircraft was properly maintained and had a valid Certificate of Airworthiness.

2. The Maintenance Release for the aircraft was valid and the Investigation found no technical fault with the aircraft.

3. The Pilot was properly licensed by the United States FAA.

4. The Pilot's medical was properly issued by an approved FAA medical examiner.

5. EICA is licensed as a VFR airport by the IAA. Landing and Take-off is prohibited if a pilot is unable to establish radio contact. The Pilot did not establish contact with EICA prior to the attempted landing, though he may have attempted to do so.

6. The flight was operated as a General Aviation flight under VFR rules. Evidence suggests that marginal VFR conditions existed at the time of the accident.

7. As a result the runway was only seen at a late stage thus requiring a significant low-level manoeuvre to align the aircraft for landing.

8. The Pilot was unaware of a major change in wind direction from approximately 150º to 220º with a probable wind speed of 15 to 20 kts. This resulted in a significant tailwind component on landing, which caused the Pilot to initiate a late go-around.

9. During the go-around control was lost, resulting in the aircraft making an un-commanded left turn at high power and at an abnormally low speed.

10. It is probable that a torque roll resulting from the sudden and simultaneous application of Power and RPM caused this un-commanded turn.

11. Witnesses reported hearing an initially intermittent stall warning that subsequently became continuous.

12. The aircraft subsequently impacted a mound, as it was unable to gain height.

13. The Pilot and a passenger were fatally injured and 7 passengers were seriously injured as a result of the accident.

14. Airport Emergency Services quickly attended the accident site. County Galway Fire Services subsequently arrived from Galway City. The Coastguard Rescue helicopter and ambulances brought the seriously injured passengers to hospital.

15. The Investigation determined that the aircraft was over maximum landing weight during its approach thus increasing; the landing distance required, stalling speed and drag.

16. The aircraft altimeters under read by approximately 224 ft, as the QNH had not been reset.

17. The ELT operated correctly but difficulties were experienced in disarming the unit due to its unknown and hidden location.

(b) <u>Cause</u>

The Pilot attempted to land downwind in marginal weather conditions. This resulted in a late go-around during which control was lost due to inadequate airspeed.

(c) Contributory Factors

1. Communications were not established between the Pilot and EICA thus denying the Pilot the opportunity of being informed of the changed wind conditions and the runway in use.

2. The aircraft was over maximum landing weight.

3. The altimeters were under-reading due to incorrect QNH settings.

4. The additional stress on the Pilot associated with the conduct of a demonstration flight.

4. SAFETY RECOMMENDATIONS

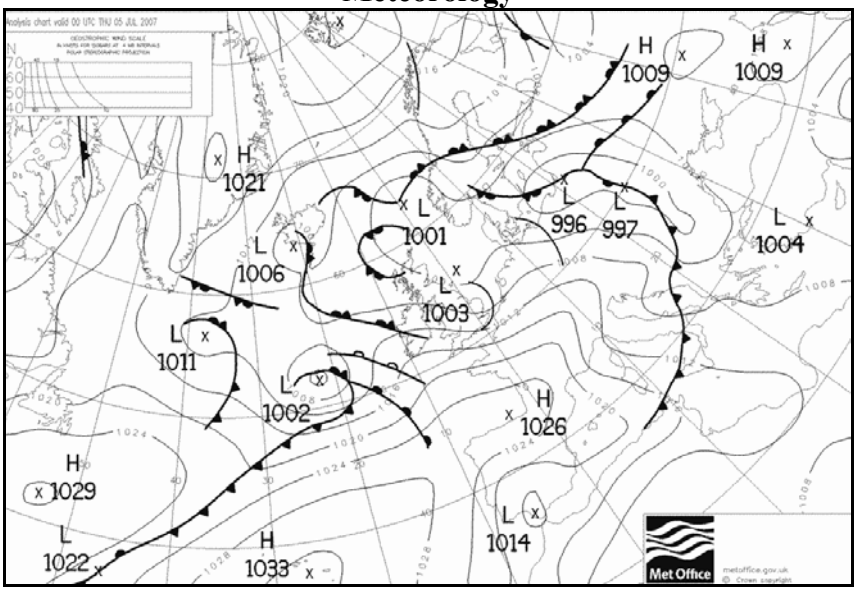
It is recommended that:

1. Yingling Aviation, when fitting the Oasis kit in a Cessna Caravan, should place a placard on the exterior of the fuselage of the aircraft indicating the location of the Emergency Locator Transmitter. **(SR 01 of 2009)**

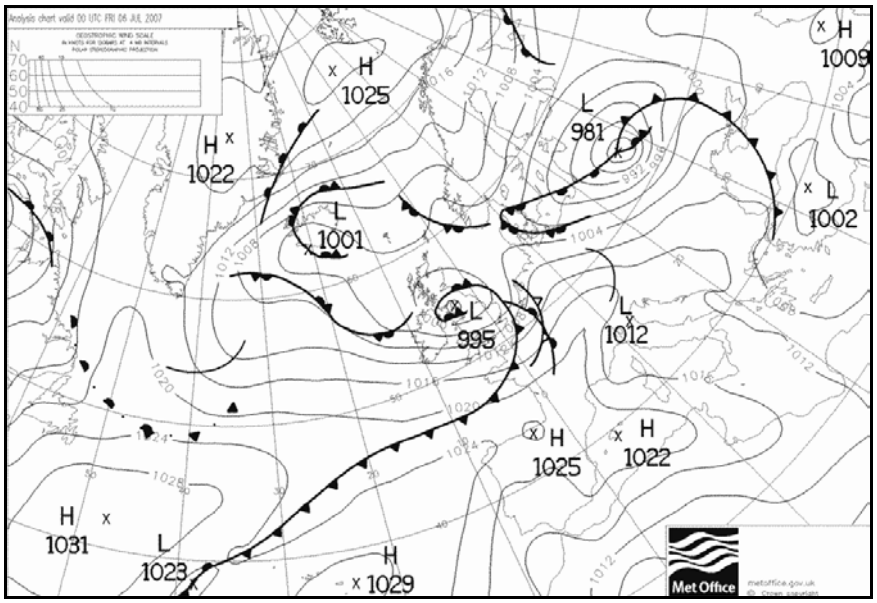
2. That the FAA and the European Aviation Safety Agency (EASA) should require that Flight Manuals, or STC supplements to Flight Manuals, should contain information on the location and de-activation of ELTs fitted to an aircraft. **(SR 02 of 2009)**

Appendix A

Meteorology



Synoptic Chart for 5 July 2007 at 00.00 UTC



Synoptic Chart for 6 July 2007 at 00.00 UTC

METAR EINN 051300Z 21013KT 9999 FEW010 SCT016 BKN022 17/14 Q1000 NOSIG=
METAR EIKN 051300Z 14014KT 1200 -DZ BKN001 BKN003 12/12 Q0998 NOSIG=
METAR EINN 051330Z 22018KT 9999 BKN012 BKN026 BKN036 17/13 Q1000 NOSIG=
METAR EIKN 051330Z 15013KT 110V190 2000 -DZ BKN001 BKN004 12/12 Q0998 TEMPO 1500 BKN001=
METAR EINN 051400Z 22018G28KT 9999 FEW018 SCT024 BKN030 17/13 Q0999 NOSIG=

METAR EIKN 051400Z 16012KT 130V200 2000 -DZ BKN001 BKN004 13/13 Q0997 NOSIG=
METAR EINN 051430Z 22019KT 9999 FEW018 SCT027 BKN040 17/12 Q0999 NOSIG=
METAR EIKN 051430Z 18013KT 140V230 5000 -RA FEW004 BKN007 BKN011 14/14 Q0996 NOSIG=

Appendix B

ATC Records

Time	*ATC and Radar Records*
08.23:48	N208 EC contacts Dublin on 124.65 climbing to 4,000’ on QNH 1009
08.24:40	N208EC out of 1,700' for 4,000' Transponder code A2651, estimate for EICA 09.14 Flight to 4,000' to EICM for a cloud break
09.06.00	Diverted to EICA. (Weather at EINN was 120/14 QNH 1006)
09.46:20	A2651 appears on radar out of EICA at 114 kts
09.49:00	2 returns near Inishmann: A2651 at 700' and 129 Kts, A7000 @ 500' and 69 kts
09.51:00	A2651 disappears off screen at Island
09.55:50	A2651 appears off Inishmann @ 700' and 137 kts
09.57.40	A2651 disappears into EICA
13.45:30	Radar target on screen out of Inishmann
13.45:35	A7000, 400' 159 kts N53 07.35 W009 32.12
13.45:50	A7000, 500' 160 kts N53 07.45 W009 31.3 H029
13.46:00	A7000, 500' 152 kts N53 08.18 W009 31.23 H029
13.46:10	A7000, 500' 158 kts N53 08.44 W009 31.08 H029
13.46:20	A7000, 500' 159 kts N53 09.06 W009 30.53 H029
13.46:30	A7000, 500' 159 kts N53 09.34 W009 30.41 H029
13.46:40	A7000, 500' 159 kts N53 10.02 W009 30.02 H029
13.46:00	Signal lost
13.49:40	A7000 400' 58 kts - Aircraft airborne from Inishmann (Islander) and orbits general area
13.53	British Airways reports an ELT beacon on 121.5 MHz
13.55:10	Islander returns to Inish Mean - signal lost

Appendix C

Cockpit Controls and Instruments

The following are the positions recorded for the various cockpit controls and instruments at the accident site.

Flight Instruments

	Pilot	**Co-pilot**
Heading	321º	128º
Airspeed	0	0
Horizon	60º Left, -Off scale - down	Level, -20 º Down
Altimeter	+585	-490
Altimeter subscale in HPa	1006	1006
VSI		+100 ft/min
Radio Altimeter	Electrical zero, MDA 145 ft	
Turn Coordinator	Level, right slip	Full right, full right slip

Engine Instruments

Engine Torque	1,600 ft lbs
Propeller RPM	Electrical zero
Engine Fuel Flow	4,400 PPH
Oil pressure & Quantity	Electrical zero
Ng % RPM	150
Hobbs	320.1 hrs

Centre Pedestal Controls

Emergency Power Lever:	Normal
Power Lever:	High ~80%
Propeller RPM Lever:	Maximum
Idle Condition Lever:	Low Idle
Flap Lever:	10º
Elevator Trim Indicator:	Centre
Aileron Trim Indicator:	Slightly right of centre
Rudder Trim Indicator:	¾ RIGHT

Selectors and Switches

Fuel Shutoff:	On
Inertial Separator:	Normal
Cabin heat Firewall SOV:	On
Left landing light:	On
Right Landing Light:	On
Nav lights:	On
Strobe Lights:	On
Beacon:	Off
Emergency Locator Transmitter:	Arm
Seat Belt:	On
No Smoking:	Off

Pitot static heater:	Off
Stall heater:	Off
Voltage selector:	Battery
Voltage indication:	Zero
De-ice Anti-ice w/s Primary:	Off
De-ice Anti-ice w/s Secondary:	Off
Alternate Static:	Off

Appendix D

Flight Test Report

Type: **Cessna Grand Caravan 208B**

Date: **23 September 2007**

Preamble:

This aircraft was fuelled and ballast loaded to the same weight as the accident aircraft. The aircraft was trimmed aft to the limit of the normal C of G trim. In view of the weight of ballast required all passenger seats except one were removed to facilitate access and tie down of ballast. The one seat was positioned behind the F/O position to facilitate video recording of the test flight.

Flying conditions were a broken cloud up to 5,000 ft with VFR conditions above. The majority of the test was conducted between 5,000 and 6,500 ft. The test was conducted at Flap 10º, the position in which N208EC was found.

Note:

1. The exact parameters could not be replicated as the test flight was conducted at a safe altitude and the engine was not operated outside its normal torque range.
2. During the exercise opening the throttle fully produced just full torque due to altitude, therefore the possibility of exceeding the maximum rating of the engine was eliminated.
3. Readings were taken from the left hand IAS.
4. It was noted that the first practice lead in to test No.10 below resulted in an inadvertent yaw and roll, both of approximately 10º, even though the pilot was expecting them. Nevertheless the event was subsequently easily controlled.

Test Schedule

Conditions: Climb to 5-6,000 ft in VMC, Class G airspace, Flaps 10, straight and level attitude.

1. Practice power applications from idle to maximum torque within 2.5 seconds at:
   100 kts
   90 kts
   80 kts

2. Reduction to Vsw[22]: 78 kts

3. Reduction to Vs[23]: 70 kts. Stall warning intermittent initially and then constant as speed reduced.

[22] Stall warning speed.
[23] Stall speed.

4. Reduction to Vsw with power.

5. Reduction to Vs with power.

6. Reduction to Vsw and apply full power while normal co-ordination of controls:
   Bank 0, Yaw 10 left, ROC/D zero.

7. Reduce to Vsw –5 kts and apply full power:
   Bank 0, Yaw 0, ROC/D initial descent, levelled, acceleration at +1.5 kts/sec.

8. Reduce to Vsw –5 kts and apply full power without rudder change but with co-ordinated aileron:
   Bank 0, Yaw 10-15 left, IAS 70, ROC/D initial descent, levelled, then very slow acceleration as per 7.

9. Reduce to Vsw –5 kts and apply full power without aileron change but with co-ordinated rudder:
   Bank 15 left, Yaw 10-15 left, IAS 70 kts, ROC/D level, acceleration rate < 1 kts/sec.

10. Reduce to Vsw –5 kts with RPM at Min and Power at Idle. Apply full power and Max RPM without aileron or rudder position change:
    Bank 30 left increasing, Yaw 20 left, IAS 70, ROC/D initial bank was followed by a nose drop, descent and then stall buffet as G loading increased.

11. Reduce to Vsw –5 kts and apply full power then climb at 200 ft/min with co-ordinated controls:
    Bank 0, Yaw 0, IAS 70 kts, ROC/D – 6 seconds to accelerate to climb.

12. Reduce to Vsw –5 kts and apply full power then climb at 400 ft/min with co-ordinated controls:
    Bank 0, Yaw 0, IAS 70 kts, ROC/D – no acceleration.

13. A final check was made on stall speeds at 5,500 ft from straight and level flight:

Vsw, power off	79 kts
Vs, power off	65 kts
Vsw with power	75 kts
Vs with power	60 kts

Conclusion

Following completion of the test flight the Investigation was of the opinion that the aircraft was fully controllable, at maximum landing weight and Flap 10º, when full power was applied at low speeds down to the stall.

Appendix E

ADAS Data Recording

The following relevant extract was recovered from the Aircraft Data Acquisition Unit (ADAS), Model EMU-A-010-3, Serial No. 0641, recorder by its manufacturers.

It should be noted that there is a +8 minute time error in the ADAS recording due to an internal ADAS clock error. This clock is within the processor and supplies ADAS time. It had its own 10-year battery and has no outside time reference. Therefore clock time drift is not compensated for. After examination of the previous sequence of flights, as recorded by the ADAS, the Investigation is satisfied that the recording terminated at impact, ADAS time value 07/05/2007 13:56:43.66. The extract below shows the final 25 seconds before the recording terminated.

ADAS flight data is accurate to:
Altitude +/- 70 ft
Airspeed +/-5 kts

The aircraft was operating in ground affect and at a reported high pitch angle. This could have affected local pressure readings in the vicinity of the ADAS unit. Whereas the airspeed can be confirmed by the propeller strike marks the affect on static pressure (i.e. altitude recorded) accuracy cannot be determined.

The headings on the readout are translated as follows:

Torque	Engine power output
Engine Ng	N2 or high pressure compressor rotation speed
Engine Np	Propeller speed
Engine Wf	Fuel Flow
IAS	Indicated Airspeed
ALT	Altitude

ADAS Serial No. 0641, Readout

Time Actual	*Torque*	*EngNg*	*EngNp*	*EngWf*	*IAS*	*ALT*
'07/05/2007 13:56:18.26	231	69	1709	149	86	568
'07/05/2007 13:56:18.75	232	69	1711	149	86	549
'07/05/2007 13:56:19.24	237	69	1710	144	86	556
'07/05/2007 13:56:19.73	236	69	1708	151	85	537
'07/05/2007 13:56:20.22	232	69	1703	145	85	547
'07/05/2007 13:56:20.70	239	69	1697	145	83	520
'07/05/2007 13:56:21.19	240	69	1690	161	83	528
'07/05/2007 13:56:21.68	242	69	1690	161	81	503
'07/05/2007 13:56:22.17	245	69	1687	161	80	505
'07/05/2007 13:56:22.66	247	69	1684	151	77	480
'07/05/2007 13:56:23.15	246	69	1682	145	76	486
'07/05/2007 13:56:23.63	245	69	1678	156	73	459
'07/05/2007 13:56:24.12	246	69	1674	182	72	461
'07/05/2007 13:56:24.61	251	69	1673	183	71	440
'07/05/2007 13:56:25.10	247	69	1665	161	70	444
'07/05/2007 13:56:25.59	230	69	1656	160	69	425
'07/05/2007 13:56:26.08	230	68	1639	149	69	435

'07/05/2007 13:56:26.57	257	69	1637	202	66	417
'07/05/2007 13:56:27.05	289	72	1668	233	66	429
'07/05/2007 13:56:27.54	376	75	1717	322	63	416
'07/05/2007 13:56:28.03	498	83	1864	404	62	427
'07/05/2007 13:56:28.52	999	89	1917	511	61	406
'07/05/2007 13:56:29.01	1567	97	1879	541	62	416
'07/05/2007 13:56:29.50	2060	100	1879	527	61	391
'07/05/2007 13:56:29.99	2077	101	1877	499	63	398
'07/05/2007 13:56:30.47	2070	100	1872	500	64	381
'07/05/2007 13:56:30.96	2070	101	1880	501	65	395
'07/05/2007 13:56:31.45	2102	101	1886	501	66	379
'07/05/2007 13:56:31.94	2132	101	1885	504	68	400
'07/05/2007 13:56:32.43	2169	101	1874	506	68	381
'07/05/2007 13:56:32.92	2170	101	1871	508	67	383
'07/05/2007 13:56:33.40	2149	101	1874	507	65	357
'07/05/2007 13:56:33.89	2136	101	1876	506	62	358
'07/05/2007 13:56:34.38	2113	101	1875	504	58	328
'07/05/2007 13:56:34.87	2106	101	1874	501	58	341
'07/05/2007 13:56:35.36	2094	101	1872	500	61	332
'07/05/2007 13:56:35.85	2089	101	1873	498	64	355
'07/05/2007 13:56:36.34	2096	101	1876	497	66	349
'07/05/2007 13:56:36.82	2085	101	1879	499	68	368
'07/05/2007 13:56:37.31	2071	101	1877	501	66	351
'07/05/2007 13:56:37.80	2076	101	1869	503	63	366
'07/05/2007 13:56:38.29	2078	101	1869	504	60	357
'07/05/2007 13:56:38.78	2100	101	1872	504	57	379
'07/05/2007 13:56:39.27	2117	101	1872	503	52	376
'07/05/2007 13:56:39.76	2121	101	1871	501	51	408
'07/05/2007 13:56:40.24	2120	101	1871	499	50	412
'07/05/2007 13:56:40.73	2118	101	1872	497	50	440
'07/05/2007 13:56:41.22	2111	101	1867	496	48	437
'07/05/2007 13:56:41.71	2098	101	1864	496	49	461
'07/05/2007 13:56:42.20	2100	101	1868	497	48	32'
'07/05/2007 13:56:42.69	2101	101	1871	497	47	459
'07/05/2007 13:56:43.17	2103	101	1871	498	46	440
'07/05/2007 13:56:43.66	2099	101	1874	501	46	442

The altitude recorded above is based on standard pressure altitude 1013 hPa or 29.92 inches. However, at the time of the accident the pressure at EICA was, according to the meteorological aftercast, probably 998 hPa, which results into a pressure altitude differential of 420 ft (28'x15). This when added to the airfield elevation of 70 ft should have resulted in the ADAS recording an altitude of approximately 490 ft on impact and not the final 442 recorded, a difference of 48 ft. However, this deviation is well within the ADAS altitude tolerance of +/- 70 ft.

The aircraft was operating at a torque setting above maximum and probably at a high nose up angle while in ground affect at the time. These factors would have affected static pressure and therefore the individual altitude reading and, to some extent, airspeed values recorded by the ADAS would have been affected and consequently should not be absolutely relied on. However, it is probable that the trends recorded in these parameters display an accurate picture of what was happening immediately before the impact.

It should be noted that the final groundspeed recorded was 46 kts whereas the value calculated by the Investigation from the propeller strike marks on the boulder was 51 kts, the difference falling within the +/- 5 knot variation allowed in ADAS calibration.

It should be noted that the stall speed recorded by the Investigation on its test flight in a 10º flap configuration at full power and at 5,500 ft altitude was 60 kts. However, the aircraft at the time of the accident was flown at a power setting above maximum (+10%) and in ground affect, thus permitting it to fly at a lower speed.

Appendix F

Rock Strike Mark Evaluation

	A	**B**
Strike 1-2 distance mm	380	380
Strike 2-3 distance mm	330	380
Distance in 2/3 Revolution mm	710	760
Distance in a full Revolution metres	1.065	1.14
Engine RPM	1874	1874
Distance in 1 minute metres	1996	2136
Speed (distance in 1 hour) km	120	128
Converted to kts	65	69
TAS for wind component 14 TWC	51	55
TAS for wind component 18 TWC	47	51

The above columns show the evaluation for the strike distances as recorded (**A**) and what the outcome would be had both strike distances been 380 mms (**B**). This evaluation has been done to establish the variation in the airspeed if the difference in distances was due to a significant distortion in the plane of rotation of the propeller because of the rock strike.

True Airspeed (TAS) is the Ground Speed less the tangential component of the wind vector. The aircraft's track before impact was 012º True. The wind direction and speed was reported as 220º/15-20 kts True. Therefore, the tangential component equates to 14-18 kts (15 x Cosine 23 = 14). Subtracting these values from the aircraft's ground speed gave a possible TAS of 47-55 kts immediately prior to impact. At the aircraft's accident pressure altitude, the True Airspeed and the Indicated Airspeed are similar.

The ADAS recording showed a speed of 46 kts at impact. If a calibration error of +5 kts is added to the ADAS recording then it indicates a possible air speed of the aircraft of about 51 kts. It should be noted that these speeds are significantly below the 60 kts stall speed recorded on the C208B test flight at flaps 10 and maximum landing weight.

Appendix G

Glossary

A/P	Autopilot
AAIU	Air Accident Investigation Unit - Ireland
ACCREP	Accredited Representative to an air accident investigation
ADAS	Aircraft Data Acquisition Unit
AIC	Airman's Information Circular
AIP	Aeronautical Information Publication, published by the State
AMS	Aircraft Maintenance Specialist
AMSL	Above Mean Sea Level
AOC	Air Operator's Certificate
ASI	Aircraft Services Intermediary
ATC	Air Traffic Control
ATS	Air Traffic Services
EASA	European Aviation Safety Agency - EU
EICA	Connemara Airport, Inverin, Co. Galway, Ireland
EICK	Cork Airport
EICM	Galway Airport
EIDW	Dublin Airport
EIKN	Ireland West Airport, Knock
EIMN	Inis Meáin Airport, Inis Meáin Island, Co. Galway, Ireland
EINN	Shannon Airport
EIWT	Weston Airport, near Dublin
ELT	Emergency Locator Transmitter
EU	European Union
FAA	Federal Aviation Administration - USA
FAR	Federal Aviation Regulations - USA
FCU	Fuel Control Unit
FDR	Flight Data Recorder
GS	Groundspeed
GPS	Global Positioning System
IAA	Irish Aviation Authority
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IIC	Investigator-in-Charge
Islander Pilot	The Pilot of the Islander Aircraft
JAA	Joint Aviation Authority
JAR(s)	JAA Requirement(s)
METAR	Meteorological Actual Report
Navaid	A ground based RF transmitter
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board - USA
PPR	Prior Permission Required
PST	Power Supply Technician
QNH	An altimeter barometric setting that displays altitude above sea level

RF	Radio Fix
RPM	Revolutions Per Minute
RWY	Runway
SR	Safety Recommendation
STC	Supplemental Type Certificate
TAS	True Airspeed
UTC	Universal Time Coordinated (a standard time zone for aviation)
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

– END –