Inquiry 11-006: Britten-Norman BN.2A Mk.III-2, ZK-LGF, runway excursion
Pauanui Beach Aerodrome, 22 October 2011

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Final Report

Aviation inquiry 11-006

Britten-Norman BN.2A Mk.III-2, ZK-LGF

runway excursion

Pauanui Beach Aerodrome

22 October 2011

Approved for publication: February 2014

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (Commission) is an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

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Important notes

Nature of the final report

This final report has not been prepared for the purpose of supporting any criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 makes this final report inadmissible as evidence in any proceedings with the exception of a Coroner's inquest.

Ownership of report

Citations and referencing

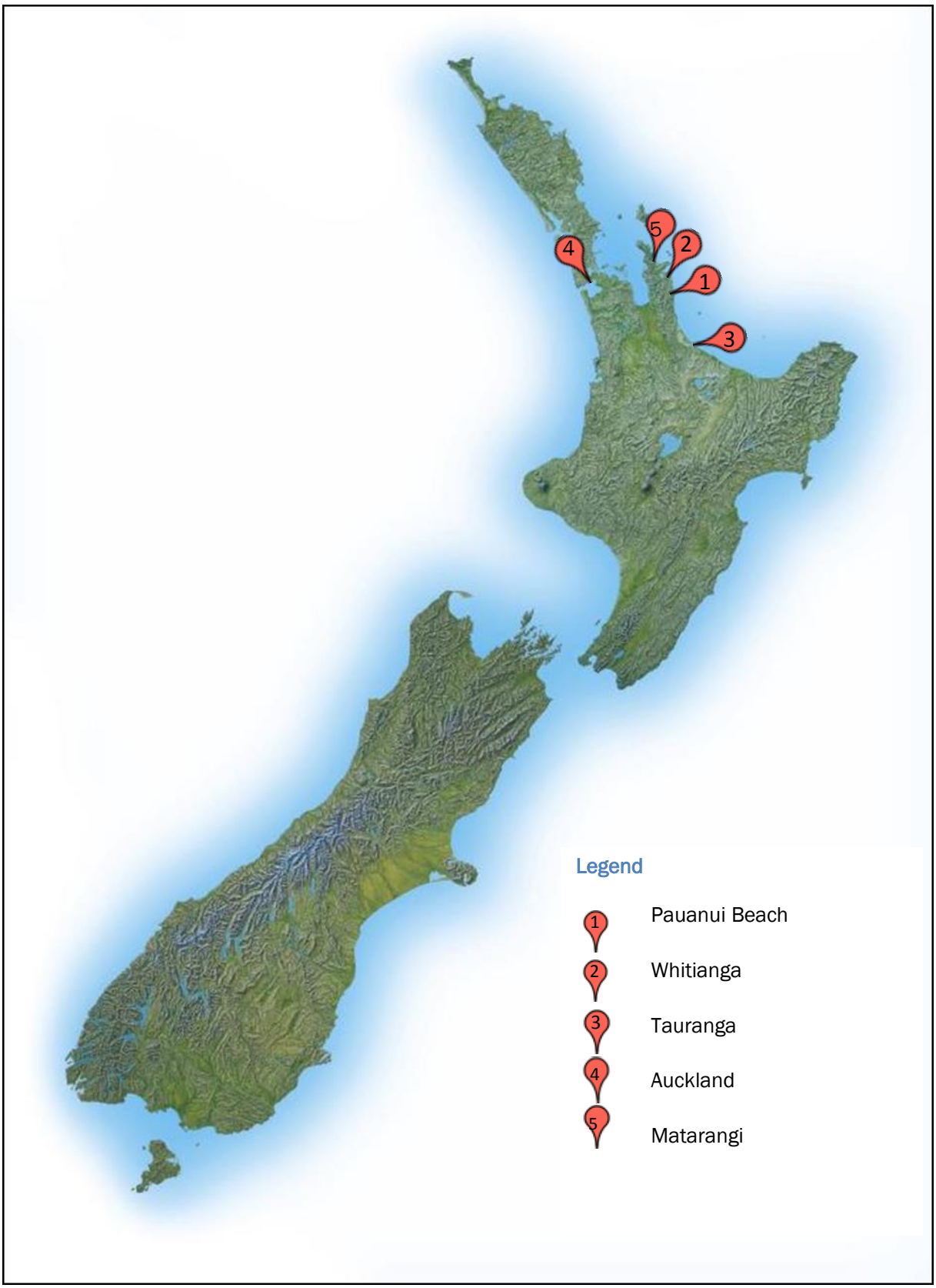
Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1980 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams, pictures

Unless otherwise specified, photographs, diagrams and pictures included in this final report are provided by, and owned by, the Commission.

ZK-LGF after the incident

(photograph taken the following day)



Source: mapsof.net

Location of incident

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Abbreviations

AIP	Aeronautical Information Publication New Zealand
CAA	Civil Aviation Authority of New Zealand
CEO	Chief Executive Officer
Commission	Transport Accident Investigation Commission
Director	the Director of Civil Aviation
ESWL	equivalent single wheel load
kg	kilogram(s)
kt	knot(s)
m	metre(s)
UTC	co-ordinated universal time

Glossary

datum	a reference point, line or plane for some measurement
hectopascal	System International standard unit of pressure
NOTAM	notice to airmen: information concerning the establishment of, condition of or change in any aeronautical facility, service, procedure or hazard, usually of a temporary nature
power-plant	the combination of engine and propeller
rotate	raise the nose of an aeroplane to the take-off attitude
scheduled performance	the expected performance of an aeroplane – particularly for different conditions of weight, altitude and temperature – determined by flight tests and conservatively factored to allow for average pilot ability
take-off distance required	the distance from start of take-off until clearing a notional 50-feet-high obstacle
take-off distance available	the length of a runway declared by the aerodrome operator as available and suitable for an aeroplane taking off, plus the area beyond the departure end of the runway (if any) that is a suitable area over which an aeroplane may make its initial climb to 50 feet
visual flight rules	the rules for flights conducted in visual meteorological conditions
visual meteorological conditions	weather equal to or better than a specified visibility, distance from cloud and cloud ceiling

Data summary

Aircraft particulars

Aircraft registration:	ZL-LGF
Type and serial number:	Britten-Norman BN.2A Mk.III-2 “Trislander”, C1023
Number and type of engines:	3 Lycoming O-540-E4C5 normally aspirated, reciprocating
Year of manufacture:	1976
Operator:	Great Barrier Airlines Limited
Type of flight:	air transport
Persons on board:	13

Crew details

Pilot’s licence:	commercial pilot licence (aeroplane)
Pilot’s age:	27
Pilot’s total flying experience:	1527 hours, including 205 hours on type

Date and time	22 October 2011, 1815[1]
Location	Pauanui Beach Aerodrome
	latitude: 37°01.3´ south
	longitude: 175°51.5´ east
Injuries	nil
Damage	minor

[1] Times in this report are in New Zealand Daylight Time (UTC+13 hours) and expressed in the 24-hour format.

1. Executive summary

1.1. On 22 October 2011 a Britten-Norman BN.2A Mk.III-2 "Trislander" (the aeroplane) was scheduled for a scenic charter flight from Pauanui Beach aerodrome. The aeroplane was operated by Great Barrier Airlines Limited (the airline, or the operator). On board were 13 people – the pilot, another company employee and 11 passengers.

1.2. The pilot applied full power for the take-off but was unable to get the aeroplane airborne, so she abandoned the take-off and applied full braking. The aeroplane did not stop before the end of the runway and went through a low wooden rail marking the end of the runway, stopping with its nose wheel in a garden just 3 metres (m) short of a public footpath. Nobody was injured and damage to the aeroplane was minor.

1.3. The Transport Accident Investigation Commission (Commission) found that the main reason for the aeroplane not getting airborne was that its centre of gravity (balance) was significantly outside the permissible limits. The pilot's take-off technique and, possibly, increased resistance from the wheels of the heavy aeroplane on the runway surface were other factors that contributed to the aeroplane over-running the end of the runway.

1.4. The Commission also found that the required margin for a safe take-off was not met because the aeroplane was too heavy for the available runway length. This was a reason for the aeroplane not stopping before the runway end after the pilot had rejected the take-off.

1.5. The Commission identified the following safety issues:

- the standard of pilot training and supervision of operations at Great Barrier Airlines was below that required
- the Civil Aviation Authority of New Zealand (CAA) had had recurring concerns for the management and standard of operations at Great Barrier Airlines during the 3 years prior to this incident, but the actions taken to address those concerns had been largely ineffective
- the Thames-Coromandel District Council (the council) had not evaluated the effects of a subsurface runway irrigation system on the maximum equivalent single wheel load (ESWL) for the Pauanui Beach runway.

1.6. The Commission has made recommendations to the Director of Civil Aviation (the Director) and the Chief Executive of the council to address these safety issues.

1.7. Key lessons identified during this inquiry were:

- pilots must know the weight and balance of their aircraft before every flight and ensure that both remain within permissible limits. Failure to do so can have serious consequences for flight safety
- when calculating the weight and balance of their aircraft, pilots should use a standard weight for passengers only if it is truly representative of the actual passenger weights for the flights
- it takes more than just good written policies and procedures to achieve an acceptable level of flight safety. Managers need to lead by example and ensure that pilots actually follow the procedures.

2. Conduct of the inquiry

2.1. The Commission was notified by the CAA of the incident shortly after it had occurred. An investigator inspected the site on the morning of 23 October 2011 before the aeroplane was moved and while the aerodrome was still closed.

2.2. The pilot was formally interviewed at Auckland on 23 October 2011 and again by telephone on 7 November 2011. The Chief Executive and the Flight Standards and Training Manager were interviewed formally at other times.

2.3. The incident was discussed with the relevant managers at the CAA. On 16 December 2013 the Commission heard from the Director.

2.4. On 16 December 2013 the Commission approved the draft report for circulation to interested persons for their comment.

2.5. Submissions were received from the airline, the former Quality Assurance Manager of the airline, the CAA, the pilot of the Matarangi flight (see section 3.9, "Previous occurrence") and the Thames-Coromandel District Council.

2.6. On 26 February 2014 the Commission approved the report for publication.

3. Factual information

3.1. Background

3.1.1. A tour company arranged to charter an aeroplane from Great Barrier Airlines on 22 October 2011 to take 11 people on a scenic flight from Pauanui over the Bay of Plenty. The flight was to return to Whitianga aerodrome, 25 kilometres north of Pauanui. The allocated aeroplane was a Britten-Norman BN.2A Mk.III-2 Trislander registered ZK-LGF, which can carry a pilot and up to 17 passengers. The pilot, who was assigned the duty the day before the flight, had been to Pauanui once before, in a light aeroplane in 2003.

3.1.2. The pilot reviewed the Aeronautical Information Publication New Zealand (AIP) information for Pauanui, but was not aware that the airline's Route Guide also had a section on Pauanui.

3.1.3. The pilot did not check the expected aeroplane performance at Pauanui because, she said, the airline's Chief Executive Officer (CEO)[2] had told her that the runway was adequate for the expected take-off weight of 4080 kilograms (kg) on the scenic flight. The pilot had also assumed that the condition of the grass runway at Pauanui would be good, because there had been no rain in the region for some days.

3.2. Narrative

3.2.1. On the day of the charter, the pilot commenced duty at 0900 and flew 3 scheduled return air transport flights in the same aeroplane between Auckland International Airport (Auckland) and Claris aerodrome on Great Barrier Island. She then had a 2-hour break at Auckland, during which she obtained the weather information for the route to Pauanui and confirmed that there was no relevant NOTAM.[3]

3.2.2. The pilot was accompanied on the flight to Pauanui by another staff member who was to provide a commentary for the passengers on the scenic flight. Before landing at Pauanui, the pilot did not listen to the automatic weather information broadcast[4] for the aerodrome because, she said, the weather was good.

3.2.3. The aeroplane landed shortly after 1800 and the passengers, members of a rugby tour group, arrived soon afterwards. The staff member gave them a safety briefing while the pilot checked the fuel. There was sufficient fuel for the flight to Whitianga and the flight back to Auckland.

3.2.4. A combined load sheet and passenger manifest for the scenic flight had been partly completed in Auckland before the passengers' names were known (see Appendix 1). The airline's procedures required the pilot to enter the passengers' names against their seat positions and to leave a copy of the completed form at the departure point. That was not done. The prepared load sheet showed the 2 passenger seats behind the pilot and one seat in the next row unoccupied in order that the aeroplane centre of gravity at take-off would be within the flight manual limits. However, the passengers sat where they chose, with more at the front of the cabin than allowed for on the load sheet. The pilot did not calculate the weight and balance of the aeroplane for the actual seating arrangement.

3.2.5. At about 1815 the pilot taxied the aeroplane for a take-off from runway 23.[5] She said she positioned at the start of the runway and held the aeroplane stationary with the foot brakes until she had set full power. However, independent witnesses and most of the passengers said the aeroplane became lined up with the runway at a position inset from the runway end and the pilot applied full power without the aeroplane stopping.

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[2] References to the airline management appointments are to the incumbents during the periods indicated.

[3] Notices to airmen, NOTAM, provide information concerning the establishment of, condition of or change in any aeronautical facility, service, procedure or hazard.

[4] This service automatically broadcast the current wind speed and direction, and air pressure and temperature, when triggered by radio transmissions made on a frequency given in the AIP. The broadcast data was not recorded.

[5] The runway designation is the magnetic heading in the take-off direction, rounded to the nearest 10 degrees.

3.2.6. The pilot said her take-off technique was to raise the nose wheel just clear of the runway when the airspeed was between 50 knots (kts) and 60 kts and to rotate[6] at 80 kts. Witnesses on the aerodrome and on board said the aeroplane accelerated slowly. The pilot said she had thought the initial acceleration was normal, but that the airspeed had stagnated near 60 kts. She had checked again that full power was set.

3.2.7. The staff member had a pilot licence but was not qualified on the aeroplane type. She said the airspeed had increased to about 70 kts when she saw the pilot pull back fully on the elevator control, but the nose did not rise. The pilot had then closed the throttles and braked hard.

3.2.8. The pilot said she thought that the braking action had been effective and that the wheels had not skidded. The aeroplane turned slightly left of the take-off heading as it slowed, but it did not stop before a low wooden rail that marked the end of the runway strip. The aeroplane went through the rail and stopped with the nose wheel about 3 m from a public footpath and subway. The aeroplane received minor damage to the forward fuselage. Nobody was injured.

3.3. Site examination

3.3.1. When the aeroplane was examined the next day, the wing flaps were at the take-off setting and the elevator trim set at half a unit "nose up". The park brake had been applied and the engine controls were at positions appropriate for the engines having been shut down. The fuel selectors were off; the indicated total fuel on board was 88 United States gallons (about 334 litres).

3.3.2. The runway was dry and firm, except for a 3 m long patch of wet runway surface a little over half-way along the runway in the take-off direction. The aerodrome custodian was not aware of the wet patch until after the incident. There were 2 tyre tracks running through the patch, but they were not parallel, so they could not have been made by the dual wheels of the aeroplane's main landing gear. A small amount of dried mud was on the aft right fuselage of the aeroplane, but there was none on the tyres.

3.4. Personnel information

3.4.1. The pilot had obtained a New Zealand private pilot licence (aeroplane) in August 2003 and a commercial pilot licence (aeroplane) in August 2004. From August 2008 until January 2010 she had been employed as a first officer on Twin Otter turbo-prop aeroplanes in Samoa. During 2010 she had obtained a type rating for the Britten-Norman BN.2 "Islander" after training by the airline's Flight Standards and Training Manager.

3.4.2. The airline had hired the pilot on 1 January 2011 and she gained a type rating for the larger Trislander the same day. The flight test had included a maximum performance, or "short", take-off. Her first 13 flight hours of air transport operations in the Trislander had been supervised. On 17 January 2011 she had been "cleared for unsupervised [visual flight rules] air operations" except for a requirement for 2 more supervised operations from North Shore aerodrome.

3.4.3. The pilot's most recent flight crew competency and line checks had been completed in the aeroplane on 23 May 2011. All of her training and check flights with the airline had been conducted by the Flight Standards and Training Manager. The flight check reports stated that she had completed all of these flights to a very good or high standard.

3.4.4. The pilot had flown the Trislander into 5 other aerodromes in the airline's route network: Auckland, Claris and Okiwi on Great Barrier Island, North Shore and Whangarei, all of which had runways longer than that at Pauanui. Although Pauanui was not on the usual route

[6] To raise the nose of an aeroplane, using the elevator control, to the take-off attitude.

network, the airline exposition[7] did not list any route or aerodrome qualification that had to be met before a pilot could operate there.

3.4.5. The pilot said she had been well rested prior to the duty on 22 October 2011 and considered that she had been fit to fly. The 3 previous days had been free of duty. In the 7 days before 22 October 2011 she had flown 16 hours; in the previous 30 days, 47 hours. Her recent duty periods had averaged 10 hours and 45 minutes long. Her medical certificate was current, with no conditions, restrictions or endorsements.

3.5. Aircraft information

3.5.1. The Trislander was an extended cabin version of the twin-engine, 10-seat Islander, with a third engine in the tail. Both types were manufactured in the United Kingdom. The Trislander was powered by 3 Lycoming O-540-E4C5 engines. The maximum take-off weight was 4536 kg.

3.5.2. Variants of the Trislander have operated in New Zealand since 1989 with Standard Category airworthiness certificates. More information on the certification and regulated performance requirements of the aeroplane operating in New Zealand is given in Appendix 2.

3.5.3. The aeroplane had been imported in February 2010 and owned by Great Barrier Airlines since then. According to the airline's maintenance records, it had been maintained in accordance with the approved maintenance programme. The previous scheduled maintenance had been a 50-hour airframe inspection and 100-hour engine and propeller inspections, carried out on 4 October 2011 at 15 966.4 airframe hours.

3.5.4. No defect had been recorded in the previous 6 months that might have contributed to the incident. At the time of the incident, the aeroplane had accrued 16 006 airframe hours.

3.5.5. The pilot did not have any concerns after the incident that a power-plant had been at less than full power. After satisfactory engine and propeller checks at Pauanui, the aeroplane was flown to the Great Barrier Airlines engineering base for repair.

3.5.6. The aeroplane had been last weighed on 12 February 2010. The relevant data from that weighing was used in the airline's computerised flight planning system.

3.6. Meteorological information

3.6.1. The operator's Route Guide incorrectly stated that no weather information was available for Pauanui and advised pilots to use the Whitianga weather. However, routine weather information was not available for Whitianga either.

3.6.2. The flights to and from Pauanui were conducted under visual flight rules. Witnesses said the sky was overcast and the westerly wind varied from "a pretty light breeze" to "a reasonably stiff breeze". This suggested the speed was between about 4 kts and 16 kts.[8]

3.6.3. The aeroplane altimeter sub-scale was found set to 1017 hectopascals, the air pressure when the aeroplane departed from Auckland. At 1600 on 22 October 2011 the pressure and air temperature at Tauranga Aerodrome, 80 kilometres southeast of Pauanui, were 1015 hectopascals and 19 degrees Celsius respectively.

3.6.4. The most recent rain at Pauanui had been 5 days before the incident, when 18 millimetres were recorded at the local wastewater treatment facility, one kilometre from the aerodrome.

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[7] The exposition, which is required by Civil Aviation Rules Part 119, describes and defines, among other things, the air operator certificate holder's organisation, the scope of its activities and its means for on-going compliance with the Rules.
[8] Wind speeds estimated from the Land Beaufort Wind Scale. See http://metservice.com/help/help-warning.

3.7. Aerodrome information

General

3.7.1. Pauanui aerodrome, established in 1972, was owned and operated by the Thames-Coromandel District Council. Operational control was delegated to a local custodian. The custodian was responsible for notifying changed operational conditions to the Airways Corporation of New Zealand, which would publish a NOTAM or an amendment to the AIP, depending on the permanence of the change. No air traffic service was required or provided.

3.7.2. The grass runway, which was predominantly of compacted sand construction, was level and 19 feet above sea level. The AIP aerodrome diagram gave the declared take-off distance for runway 23 as 782 m, the same as the overall runway length. The Great Barrier Airlines Route Guide at the time showed incorrectly that the runway was 850 m long.[9]

3.7.3. The aerodrome was not certificated under Civil Aviation Rules, nor was it required to be. Even so, the CAA exercised its power under section 15 of the Civil Aviation Act 1990 to conduct periodic inspections of the runway and facilities. Operators of non-certificated aerodromes are not obliged to act on findings and recommendations made during CAA inspections, although, according to the CAA, most do take action.

3.7.4. About 20 m beyond the right end of runway 23, and only 10 m off the runway centreline, was a skateboard park. Inspections by the CAA in 2007 and 2011 had commented on the lack of fencing adjacent to the skateboard park and had recommended corrective action. The council later advised that it had programmed work to erect fences.[10]

Runway strength and condition

3.7.5. CAA aerodrome inspections subjectively assessed runway strength and condition. The most recent inspection had been on 24 August 2011 and, like previous inspections, had found the aerodrome condition to be satisfactory.

3.7.6. On 22 October 2011 at least 12 other aeroplanes, all less than half the maximum weight of a Trislander, had used the Pauanui runway. Those pilots had various descriptions of the runway condition, depending on where on the 54 m wide runway they had landed or taken off.[11] Some, including the Trislander pilot, said the surface had been firm and dry; others that it was soft in places and their take-off performance had been degraded. After the incident, the grass length was measured as 100 millimetres in places, but it was generally shorter.

3.7.7. About 4 hours before the Trislander landed, the pilots of 2 light aeroplanes taxiing along the southern side of runway 23 noticed a wet patch on the runway with at least one tyre track through it. The patch, which was towards the southern edge of the runway, was later found to have been caused by a leaking feeder head in an underground irrigation system (described below). The feeder head and runway surface were repaired the next day.

Aerodrome irrigation system

3.7.8. In 2009 the council had installed an irrigation system beneath the aerodrome to dispose of treated wastewater from the community. The irrigation lines were installed at a depth of about 450 millimetres without disturbing the surface material. The emitter heads were closer to the surface. The AIP noted that the aerodrome was irrigated by a subsurface system, but only in regard to the use of aircraft tie-down pegs being restricted to designated areas.

3.7.9. The irrigation project team had recognised that subsurface saturation could affect aircraft operations. In 2002 tests had shown that the runway surface did not saturate with discharge volumes of up to 300 cubic metres per day. The project engineer advised that saturation was

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[9] The aerodrome diagram was issued 18 November 2010. The previous edition gave the runway length as 850 m, which was reduced because the threshold locations changed. On 4 April 2013 the runway length was amended back to 848 m.

[10] Thames-Coromandel District Council, *Airfields Activity Plan*, 2012-2022 Ten Year Plan, p.42.

[11] Grass aerodromes often had comparatively wide runways. The concrete runway at Auckland was 45 m wide.

unlikely at depths shallower than 350 millimetres. He was unaware of any measurement of the runway strength during the experimental discharges or at any other time.

3.7.10. Although the council had recognised that unspecified "tensions" could arise from the integration of a wastewater infrastructure with aerodrome operations[12], its documents also showed that consent had been sought to increase the daily discharge rate well above the levels tested.

3.7.11. According to the council's project engineer, the consent current at the time of the incident was for discharges of 60 cubic metres per day. However, records showed that an average of 140 cubic metres of effluent had been discharged under the aerodrome each day from 17 October to 19 October 2011.

3.8. Organisational and management information

3.8.1 The airline had been established in 1983 with its main base at Auckland and its associated engineering company at the secondary base at North Shore. The airline held air operator certificates to conduct operations under Civil Aviation Rules Part 135 (small aeroplanes, like the Islander) and Part 125 (medium-sized aeroplanes, such as the Trislander). A mixed fleet of 10 aeroplanes was used for scheduled services between Auckland, North Shore and Great Barrier Island and unscheduled services to other aerodromes.

3.8.2 The CEO was a pilot who had been employed by Great Barrier Airlines since October 2007 and who had been appointed to the CEO role in August 2011. He was rated to fly the Trislander and flew air transport operations occasionally.

3.8.3 The Flight Standards and Training Manager had been in the role for more than 5 years. His primary job as a pilot with a major airline limited the time he could give to Great Barrier Airlines matters.

3.8.4 The Operations Manager was a retired airline pilot with experience in airline management and regulatory roles. The CAA had accepted his appointment in 2008.

3.8.5 CAA records showed that the management of the airline had been a long-term concern to the CAA. During a special investigation of the company by the CAA in July 2008, the main issues identified had been:

- the availability of senior persons and confusion over their responsibilities
- an ineffective internal quality assurance programme
- various cases of non-compliance with the Civil Aviation Rules and the company's exposition.

3.8.6 Similar issues were found during a routine audit conducted by the CAA in October 2010 and during a spot check in September 2011. In late January 2012 the CAA conducted an audit of the management and general operations at the airline and found deficiencies similar to those identified in the September 2011 spot check and during the initial investigation of the Pauanui incident. Finding Notices issued during the September 2011 spot check had not been closed (that is, corrective actions had not been completed) more than 8 months after the agreed due date.[13]

3.8.7 The ownership and management of the airline changed on 1 January 2012. The CEO became Operations Manager and a previous CEO returned to that role.

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[12] Thames-Coromandel District Council, *Airfields Activity Plan*, 2012-2022 Ten Year Plan, p.13.

[13] A finding notice described a non-compliance that had been found, the cause(s) of the non-compliance, and the action agreed by the auditor and operator to correct the non-compliance by a specified date.

3.8.8 Civil Aviation Rule 125.5 stated, in part:

> Each holder of an air operator certificate shall ensure that all persons employed … by the holder … are familiar with the appropriate sections of the Act, Civil Aviation Rules, and procedures specified in the certificate holder's exposition.

In the context of this incident, Great Barrier Airlines was responsible for ensuring that the pilot met all route and aerodrome qualification requirements for making the flight from Pauanui and that she was trained in the policies and procedures applicable to the operation.[14] Each pilot was required to have completed within the immediately preceding 12 months a written or oral test that covered, among many subjects, the performance and content of the flight manual for each aeroplane type normally flown by the pilot. Great Barrier Airlines could not produce records to show what performance knowledge had been tested.

3.9. Previous occurrence

3.9.1 On 20 October 2011, 2 days before the Pauanui incident, a different pilot had flown the same aeroplane to the grass Matarangi aerodrome on Coromandel Peninsula. He said that before the flight he had calculated that the runway length was adequate. He had loaded 9 passengers from a rugby tour group, but not in accordance with the prepared load sheet. The pilot had rejected the take-off because of the aeroplane's poor acceleration on the soft runway. The pilot asked 2 passengers to sit further back in the cabin before he made another take-off attempt, but they opted to travel by car. The pilot then obtained revised weight and balance data from the Auckland base prior to making a safe take-off.

3.9.2 About 3 weeks previously the same pilot had cancelled a flight to Matarangi after the aerodrome operator had advised that the runway was soft. He had not checked the runway condition before the 20 October 2011 flight because the CEO had told him a week beforehand that it was good. The pilot later recalled that heavy rain had affected Auckland on 19 October 2011, and he noted that the rain could have extended to Matarangi. The AIP entry for Matarangi noted "standing water on both sides of runway at mid-point after heavy rain" and "runway floods at mid-point after very heavy rain".[15]

3.10. CAA surveillance and intervention policies

3.10.1 The CAA's "Regulatory Operating Model" (CAA, 2012a) assumed continued effective operation by air operators of the management systems required by the Act and defined in the Rules. The CAA audits and spot checks of operators periodically tested the validity of that assumption. Auditing was one of the surveillance tools described in the CAA's "Use of Regulatory Tools" policy (CAA, 2102b). In the case of a serious risk to safety, the CAA could consider using an administrative tool such as suspension or revocation of the certificate held by the person or organisation.[16]

3.10.2 The preferred (and usual) means by which the CAA addressed a significant risk to public safety was to require some corrective action. Whether the action taken was voluntary or imposed, the policy noted that there was "an understanding that similar non-compliance or failure of risk control measures will not be accepted and could result in the escalation in the severity of the regulatory tool applied."

3.10.3 A finding notice was evidence of non-compliance with legislation or a rule, or some procedure required by a rule. The CAA stated that a document holder continued to be non-compliant until the agreed corrective action was completed (CAA, 2012c). Therefore timely closing of finding notices was necessary for a safe system.

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[14] Civil Aviation Rule 125.503 (a).

[15] AIP page NZAG AD 2-51.1, 22 September 2011.

[16] The CAA introduced its Use of Regulatory Tools policy on 23 September 2011, one month before the Pauanui incident. The Surveillance Policy had been in place since 2006.

3.10.4 The CAA considered the following factors, and others, when deciding what action to take with regard to the use of regulatory tools (CAA, 2013):

- whether an unacceptable safety risk remains that must be mitigated
- the compliance history of the document holder
- whether a non-compliance has given rise to unnecessary danger to persons or property
- whether factors involving the public interest and safety are present, such as the use of aircraft on an air transport operation
- whether the document holder has heeded previous warnings or actions
- the document holder's attitude to safety.

3.10.5 The CAA recognised that it would not be appropriate to continue seeking voluntary compliance by issuing more finding notices if there had been on-going significant non-compliance. In such cases it would consider other methods of regulatory intervention.

4. Analysis

4.1 Introduction

4.1.1 Runway excursions are recognised globally as a major risk to aviation safety. The outcome of an excursion depends on variables such as the aeroplane size and speed, and whether it encounters obstacles when it leaves the runway.

4.1.2 The Pauanui incident occurred after the pilot rejected the take-off because of concern for the aeroplane's take-off performance. The aeroplane was slow to accelerate and the pilot was unable to raise the nose of the aircraft off the runway to take off. As she doubted that the aeroplane would fly, rejecting the take-off was an appropriate action.

4.1.3 The Commission has concluded that the aeroplane had no chance of a successful take-off due to a combination of issues with the aeroplane's weight and balance and possibly the surface condition of the runway. An improper take-off technique was also a factor contributing to the overrun. These issues are first discussed, before considering the following general safety issues that were identified in the inquiry:

- the standard of pilot training and supervision of operations at Great Barrier Airlines was below that required
- the CAA had had recurring concerns for the management and standard of operations at Great Barrier Airlines during the 3 years prior to this incident, but the actions taken to address those concerns had been largely ineffective
- the council had not evaluated the effects of the subsurface runway irrigation system on the maximum ESWL for the Pauanui runway.

4.2 The direct causes of the Pauanui runway excursion

4.2.1 The weather conditions were not a factor. The aeroplane take-off configuration was correct and there was no evidence that any aeroplane technical factor contributed to the incident.

4.2.2 The degraded performance was due to the following factors, which are discussed in turn:

- the aeroplane weight and balance were not as planned
- the take-off distance available was insufficient
- the pilot's take-off technique was inappropriate
- the aeroplane was too heavy for the runway surface.

4.2.3 The pilot was completely unaware of these impediments to a safe take-off because she had not planned adequately for the flight. She did not appreciate the actual weight or calculate the expected performance. Great Barrier Airlines contributed to the incident through its inadequate supervision of operations.

The aeroplane weight and balance

4.2.4 A load sheet shows the amount and distribution of the items that make up the total weight of an aircraft. A load sheet must be completed for every flight to show compliance with weight and balance limits, including that the centre of gravity will remain within the limits during the flight.[17] Adherence to the flight manual centre of gravity limits is critical for safe flight.

4.2.5 The aeroplane's elevators control the pitch attitude of the aeroplane. They are a fixed distance behind the main landing wheels. When the pilot pulls back on the controls to take off (rotates), the elevators are attempting to raise the nose of the aeroplane by pivoting the aeroplane on its main wheels. If the aeroplane's centre of gravity is too far forward ("nose heavy") it will be more difficult to raise the nose. This was the primary reason for the

[17] Civil Aviation Rules 125.305 and 125.307.

unsuccessful take-off. The pilot applied full aft elevator in an attempt to rotate the aeroplane to the take-off attitude, but that control input had no effect.

4.2.6 The load sheet for the Pauanui flight is shown in Appendix 1. The passenger manifest section of the sheet does not show the names of the passengers or where they sat. The pilot should have directed the passengers to seats marked as "occupied" in the pre-planned loading arrangement shown at the bottom left corner of the sheet, and recorded their names against the appropriate seat numbers. The load sheet was partially completed at the operator's base. The load sheet showed that the aeroplane's weight and balance were within permissible limits, but this assumed that the pilot would direct passengers to the designated seats and that the average passenger weight was close to the standard weight of 81 kg.[18] Neither was the case on this flight: the pilot allowed the passengers to sit where they chose and their average weight was later calculated to be 101 kg. The pilot said that she thought the passengers looked "average".

4.2.7 The passengers did not have any significant carry-on baggage. Using the declared passenger weights, the aeroplane weight before take-off was calculated to have been about 4294 kg, which was 214 kg over the pre-planned 4080 kg.

4.2.8 The total aeroplane weight was less than the maximum permitted weight, but the actual weights and seating positions of the passengers put the aeroplane centre of gravity well forward of the allowable range.[19] The allowable range for the Trislander centre of gravity position was very narrow compared with those of other aeroplanes commonly used for air transport (see Appendix 3).

4.2.9 Later calculations using the declared passenger weights showed that even if the seat plan had been followed, the centre of gravity position would have been very dependent on which passenger sat where and could still have been ahead of the forward limit. Had the Pauanui pilot recognised that actual passenger weights should have been used, an acceptable aeroplane weight and balance might have been achieved for that flight.

4.2.10 The load sheet had provision for changes to the load weight, but not for calculating any resultant change in the centre of gravity position. Pilots were required to telephone the Auckland base for that revised data, as the Matarangi pilot did. This system might work most of the time, but as pilots are responsible for ensuring that the weight and balance of their aeroplanes are within the allowable limits, it would have been prudent for the operator to provide them with a ready means to calculate it themselves. The operator later advised that it would provide pilots with a manual weight and balance form.

4.2.11 Great Barrier Airlines' procedures provided for situations when passengers did not appear to be of "standard" weight by requiring that their actual weights be used. The Operations Manual stated that scales were to be taken in the aeroplane when passengers were to be boarded at an aerodrome without check-in scales, unless the passengers' weights had been notified to the company in advance. In this case, the passenger weights were not notified in advance and the airline did not have any portable scales for the pilot to take to Pauanui.[20] Matarangi was another aerodrome without check-in scales, yet the load sheet for the charter flight from there on 20 October 2011 was also prepared using standard weights.[21] Therefore, the use of standard weights appeared to be the airline's normal practice for all load sheets. The operator later advised that it intended to use actual passenger weights on all future flights.

4.2.12 Although the operator had documented weight and balance procedures, in practice they were not all followed by its pilots. In both the Pauanui and Matarangi incidents, the pilots had not seated their passengers in accordance with the planned loading arrangements.

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[18] The standard weight did not include the weight of personal carry-on baggage, which was weighed separately. It came from a survey of passengers' weights conducted by the operator in January 2010 and was approved by the CAA.

[19] The estimated position was 254 millimetres aft of the datum. The forward limit was 500 millimetres aft of the datum

[20] The operator's investigation into the Pauanui incident stated that scales had been purchased to correct this deficiency.

[21] See section 3.9.

Findings:

1. The primary reason for the aeroplane's failure to take off was that its centre of gravity was well forward of the maximum permissible limit.

2. Neither the pilot nor Great Barrier Airlines had calculated the actual weight and balance of the aeroplane prior to the flight.

3. Great Barrier Airlines had not provided the portable scales that were necessary for the pilot to comply with the airline's procedures for determining the aeroplane weight and balance.

The take-off distance available and aeroplane handling technique

4.2.13 Aircraft flight manuals include chapters on "scheduled performance" that contain the data needed to determine the expected performance of the aircraft under stated conditions – for example, the maximum weight for take-off at a given altitude and air temperature; the maximum altitude achievable with a specified weight and temperature; and the take-off distance required.

4.2.14 The flight manual charts or tables for calculating the take-off distance required include corrections for different types of runway surface, typically paved (asphalt or concrete) surfaces and firm, dry grass.[22] On grass or soft runways, such as Pauanui with its sand subsoil, the rolling resistance of the tyres is higher, which increases the take-off ground run. Long or wet grass further increases the distance required, but the effect is too variable for correction factors to be given.

4.2.15 The take-off speed of an aeroplane is directly related to its gross weight. In general, a heavy aeroplane will accelerate more slowly and must reach a higher speed than a lighter aeroplane of the same type before it can take off. The heavy aeroplane therefore needs a longer ground run.

4.2.16 The pilot had operated Trislanders at weights up to the maximum permitted for take-off, but only from longer, paved runways such as North Shore aerodrome. Her expectation that the take-off performance at Pauanui would be similar to what she was used to at North Shore indicated that she did not fully understand the variables of aeroplane performance.

4.2.17 The flight manual stated that the take-off safety speed was the speed at which the pilot should raise the nose to the take-off attitude.[23] The speed varied directly with the aeroplane weight, up to a maximum of 70 kts. The take-off safety speed for the planned take-off weight at Pauanui was 67 kts, but the pilot said she had been aiming to rotate at 80 kts. Her choice was likely influenced by an informal take-off safety speed used within the airline. The CEO said it used 80 kts for all weights and sometimes 90 kts when taking off at Auckland. The Flight Standards and Training Manager said that 90 kts would be unusual, but a higher speed was useful at Auckland when traffic was busy because it gave a better climb rate and allowed an earlier turn after take-off.

4.2.18 The flight manual take-off performance data was based on all engines operating at maximum continuous power (2700 revolutions per minute/full throttle), the wing flaps set to 25 degrees and the aeroplane being "held on the ground until the appropriate take-off safety speed".[24] These conditions implied that, for maximum performance, the engines would be set to maximum power before the brakes were released for the take-off run and the aeroplane nose would be rotated at 70 kts. The Flight Standards and Training Manager stated that this was

[22] The take-off distance required is the distance to take off and climb to 50 feet.
[23] Trislander Flight Manual, p.5.2/b.
[24] Trislander Flight Manual, p.5.5/b.

the method taught and one that the pilot had performed competently on a check flight. However, on the incident flight she performed a rolling take-off.

4.2.19 The assumed conditions for calculating the expected aeroplane performance on take-off were 1015 hectopascals, 18 degrees Celsius and a head wind of 10 kts. Using these values, the take-off distances required from a dry, paved runway were determined to be about 620 m at the planned weight and 680 m at the calculated weight.[25] The flight manual required these distances to be increased by 15% when taking off from "dry grass runways with freshly cut grass and firm subsoil".[26] With that correction, the take-off distances required were approximately 713 m and 782 m respectively. The actual length of the runway was 782 m, so the aeroplane should have been able to take off, provided no other factors degraded its performance (for example, the runway condition or an improper centre of gravity position).

4.2.20 The Great Barrier Airlines standard operating procedures noted the Civil Aviation Rule that the take-off distance required for an air transport flight shall not exceed 85% of the take-off run available.[27] That was 665 m in the case of the 782 m long runway at Pauanui. Therefore the Pauanui runway was not long enough, even at the originally planned take-off weight. The CEO later acknowledged that he had not considered this Rule before telling the pilot that Pauanui would be acceptable for the scenic flight.

4.2.21 In the Matarangi incident, the pilot did determine that the runway would be long enough. However, his calculation of 610 m for the take-off distance required was based on a firm, dry runway with short grass. Although the flight manual did not provide any corrections for wet or long grass, a longer distance would have been required because both factors were present. Therefore it was very likely that the actual take-off distance required would have exceeded 655 m, which was the maximum under the "85% of distance available" requirement.

4.2.22 The similarities between the 2 rejected take-off incidents showed that the airline's pilots, including the CEO, did not have the required understanding of the Civil Aviation Rules or the airline's own policies and procedures in regard to aircraft performance. This indicated inadequate training and supervision of operations within Great Barrier Airlines.

4.2.23 The flight manual noted that "the take-off run required will not exceed, and must be taken as, 61% of the take-off distance [required]". On that basis, the scheduled take-off run at the estimated take-off weight was 477 m. The actual ground run would have been longer because the rolling take-off was commenced at an inset position, rather than at the runway end.

4.2.24 Great Barrier Airlines' Route Guide showed incorrectly that the Pauanui runway was 850 m long (rather than 782 m). That error could have been a factor in the CEO's advising the pilot that the runway would be long enough. No other runway distances were given in the Guide. Although the pilot did not refer to the Guide, an incorrect and partial list of runway data could mislead pilots if they used the Guide for determining performance. For example, the Guide did not show that the take-off distance available (at that time) on runway 05 was only 707 m. The airline later removed any data from the Guide that was already provided in the AIP.

4.2.25 Aeroplane performance was rarely a critical factor at the aerodromes in Great Barrier Airlines' scheduled route network, but it should have been an essential consideration for a non-scheduled flight to a rarely used aerodrome. Assessing the feasibility of a flight, which was no doubt done when the charter flight request was received, was no substitute for the assigned pilot calculating the actual performance using the weight and environmental conditions pertaining on the day.

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[25] Trislander Flight Manual, p.5.5/c. The distance is from start of take-off until the aeroplane reaches a height of 50 feet.

[26] Civil Aviation Rule 125.211 specified an increase of 14% for operations from grass, without specifying the condition. There was no requirement for the greater of this or any corresponding factor in the flight manual to be observed.

[27] Civil Aviation Rule 125.209(a)(2).

Finding:

4. There were 3 factors that contributed to the aeroplane overrunning the end of the runway when the pilot abandoned the take-off:
   - the aeroplane was too heavy for the available length of the Pauanui runway and the safety margin required by Civil Aviation Rules
   - the pilot did not use all of the available runway
   - the pilot did not use the appropriate technique for a successful take-off.

The runway condition

Safety issue – The council had not evaluated the effects of the subsurface runway irrigation system on the maximum equivalent single wheel load for the Pauanui runway.

4.2.26 Reduced acceleration during a take-off roll can result when the aeroplane is too heavy for the runway surface and the tyres "sink" into the surface. Runways can be damaged if aeroplanes are operated at weights above the design limit weights for the runways. Civil Aviation Rule 125.77, Use of Aerodromes, required the holder of an air operator certificate to ensure that the aerodromes it used when performing air transport operations had physical characteristics appropriate to the aeroplanes being used, and that the runways had sufficient strength.

4.2.27 The usual measure of the load imposed by a small or medium aeroplane[28] on a runway is the equivalent single wheel load (ESWL). The ESWL is a simplified way of accounting for the actual weight of the aeroplane and its landing gear configuration. The ESWL for an aeroplane with one wheel per main landing gear leg is fixed at 45% of the actual weight of the aeroplane.[29] Multi-wheel configurations, such as the dual main wheels of the Trislander, have lower ESWLs.

4.2.28 The training syllabi for the various pilot licences did not specify "ESWL" as a knowledge requirement, but the need was implied by the following syllabus items (in this case, taken from the Commercial Pilot Licence syllabus):[30]

> 16.50.4 Describe the publications and their content that provide operational route and aerodrome information.
>
> 16.50.6 Derive operational information from charts and publications that provide route and aerodrome information.
>
> 16.76.10 Interpret information on aerodrome/heliport charts, AIP GEN & AIP Volume 4.

4.2.29 The AIP referred aeroplane operators to the CAA for advice on the ESWLs for specific aeroplane types. The CAA advised that the value for dual main wheels was 80% of that for single wheels; that is, 36% of the actual aeroplane weight.[31]

4.2.30 The pilot in the Pauanui incident said she did not know the Trislander's maximum ESWL or how to calculate it. The flying school where she had completed her pilot training did cover the subject of ESWL, but once a pilot moved to larger aeroplanes and airports there might be few occasions when the information was important. Therefore, the knowledge was soon forgotten.

4.2.31 It was incumbent upon operators to identify and address knowledge and skill gaps applicable to their operations. In this case, Great Barrier Airlines could not show that it had determined the maximum weights for each of its aeroplane types to ensure that aerodrome ESWL limits

[28] Which may be taken to mean aeroplanes having a maximum certificated take-off weight less than 5700 kg.
[29] AIP, p.AD 1.10-2. All AIP references were current on 22 October 2011.
[30] Advisory Circular 61-5, Pilot Licences and Ratings – Commercial Pilot Licence.
[31] The International Civil Aviation Organization Circular 25-AN/22, *Runway design methods for multiple wheel landing gears*, published in 1952, advised that the ESWL for a dual main wheel configuration could be 30% of the actual weight.

were observed. Following this incident, Great Barrier Airlines advised the CAA that it would restrict Trislander operations to paved runways only.

4.2.32 The maximum ESWL for the Pauanui runway was 1140 kg, or 910 kg in wet conditions.[32] Using the figure of 36% of the aeroplane weight, the ESWL of the aeroplane on 22 October 2011 was 1469 kg for the planned take-off and 1546 kg for the attempted take-off. Both values exceeded the maximum ESWL for the Pauanui runway when it was dry.

4.2.33 Similarly, with the previous incident at Matarangi aerodrome, the runway ESWL limit was 910 kg, with no lower "wet" limit. The calculated ESWL for the first take-off attempt on 20 October 2011 was 1452 kg and 1352 kg for the actual take-off. Again the aeroplane exceeded the ESWL for the runway.

4.2.34 The estimated take-off weights in both the Pauanui and Matarangi incidents were less than the maximum certificated take-off weights for the aeroplanes, but they exceeded the more restrictive ESWLs.

4.2.35 Comments from other pilots who had operated light aircraft at Pauanui on 22 October 2011 suggested that the runway strength had not been affected significantly by recent rain or wastewater discharges. However, the Trislander was much heavier than the other aeroplanes, which meant that its wheels were more likely to have experienced increased rolling resistance from the sandy subsoil, thus affecting the aeroplane's acceleration. The wastewater volumes discharged in the preceding week were more than twice the consented daily volumes. However, testing had shown that the rate of discharge would not cause surface saturation. Furthermore, the most recent wastewater discharge had been 3 days before the incident

4.2.36 The council did not know the origin of the published values of maximum ESWL or what effect wastewater discharges would have on the runway bearing strength. As the aerodrome operator, the council was responsible for the accuracy of aerodrome information published in the AIP. Therefore, the council ought to have established accurate values for the ESWL including any reduced bearing strength caused by wastewater discharges under the runway. It also needs to be wary of monitoring and maintaining the irrigation system. As shown in this case, leaks in the irrigation system can affect the runway surface in that area.

4.2.37 The Commission is recommending to the council that it establish accurate values for the ESWLs at the aerodromes it operates and that it determine whether a "wet" ESWL is appropriate at the Pauanui aerodrome while a wastewater discharge is underway and for any period after the discharge has ended.

Findings:

5. The Trislander aeroplane exceeded the equivalent single wheel load for the Pauanui runway. The possibility could not be excluded that the sandy subsoil increased the rolling resistance on the wheels, which would have degraded the take-off acceleration.
6. Great Barrier Airlines had not considered whether its aeroplanes complied with the equivalent single wheel load at the aerodromes it used. An excessive equivalent single wheel load could affect take-off performance and damage runway surfaces.
7. The aerodrome operator did not know the origin of the published maximum equivalent single wheel load values and had not determined the effects of subsurface irrigation on the runway strength. Incorrect or unknown equivalent single wheel load data could affect the safety of aerodrome operations by reducing the take-off performance of aeroplanes using the runway.

[32] AIP, 2011, p.NZUN AD 2-52.1.

4.3 Training and supervision deficiencies

Safety issue: The standard of pilot training and the supervision of operations at Great Barrier Airlines was below that required.

4.3.1 The Pauanui pilot had approximately 1500 flight hours as well as 9 months' service with Great Barrier Airlines. That experience and the airline's training ought to have ensured that she could perform the flight safely, which was her responsibility as the pilot-in-command.

4.3.2 A number of personal knowledge and skill deficiencies were identified that indicated the pilot did not, on the Pauanui flight, meet the standard required of a pilot-in-command of an air transport flight. These included:

- not adequately planning for the flight
- a low understanding of scheduled performance
- not having accurate weight and balance data
- not complying with some of Great Barrier Airlines' policies and procedures.

4.3.3 The pilot did not recognise that the aeroplane weight and aerodrome conditions required her to conduct a maximum-performance take-off or that a successful take-off might be unlikely.

4.3.4 The pilot accepted the CEO's statement that the Pauanui runway would be suitable for the planned flight, and did not check the performance charts for that reason. The more experienced pilot-in-command of the aeroplane at Matarangi also accepted old information about that aerodrome from the CEO. In each case, given that the aerodrome was rarely used by Great Barrier Airlines, the pilot ought to have obtained the current aerodrome information and critically evaluated the expected aeroplane performance before the flight. Pilots-in-command have individual responsibilities to perform that planning[33] and the airline has a responsibility to make the information readily available to its pilots.[34]

4.3.5 The CEO misled both pilots to some degree and overlooked a mandatory performance requirement. It is especially important, given their influence on the organisation's culture and level of compliance, that senior persons in an airline have strong operational knowledge and demonstrate best practice for more junior pilots in their employment.

4.3.6 When the same mistakes and errors are made by different people who work in an airline, it is an indication of systemic deficiencies. The Great Barrier Airlines exposition included the required policies and procedures. Had all of its pilots been complying with its policies and procedures, neither this incident nor that at Matarangi should have occurred. However, the airline management had not ensured, particularly in the case of the Pauanui flight, that the pilot, aeroplane and aerodrome were suitable for the flight.

4.3.7 After the Pauanui incident, Great Barrier Airlines advised the CAA that it had suspended flights into Pauanui and "other marginal airfields" until it was "satisfied that the aircraft and crew [were] suitably qualified to conduct such flights". The CEO said that the "refresher" training session held in early November 2011 in response to the 2 runway incidents emphasised compliance with standard operating procedures. The operator later advised that it would formalise periodic testing of pilots' knowledge of standard operating procedures.

4.3.8 A CAA spot check in September 2011, 5 weeks before the Pauanui incident, had asked the operations manager about the airline's documented procedure for authorising charter flights "to ensure that all new airfields are risk assessed and only appropriately qualified pilots are assigned [to the flight]". The operator did not consider Pauanui to be a "new" aerodrome, even though it was rarely used. Therefore, the Operations Manager had not been involved in authorising the Pauanui charter. The airline said that, following the Pauanui and Matarangi incidents in 2011, it had amended its policy to require every charter flight to be subjected to a

[33] Civil Aviation Rule 91.217, Pre-flight action, refers.
[34] Civil Aviation Rule 125.57, Flight preparation, refers.

risk assessment prior to specific authorisation. However, the January 2012 audit issued a finding notice because the airline had "no apparent process for the authorisation of non-scheduled flights". A proactive operator would have immediately heeded the earlier advice of auditors. This airline did not react promptly, even after a serious incident had occurred.

4.3.9 Following these 2 occurrences the Flight Standards and Training Manager reviewed the pilot training and checking programme, for which he was responsible. He found no issues, yet the occurrences showed that there were safety issues with the way the check and training programme was working. The operator dealt with the matter by restricting future Trislander operations to sealed runways only. While this action might have resolved problems with how the airline's procedures dealt with flight authorisation and planning, it did not resolve the issue of a sub-standard check and training programme for its pilots.

4.3.10 Pauanui and Matarangi were not on the airline's normal route network, but were considered to be included in the general route and aerodrome qualifications of pilots. In spite of that, the airline's report to the CAA on the incident included a finding that the pilot had not been previously checked into Pauanui. On 27 October 2011, without a route check and presumably on the basis of the incident flight, the CEO signed and added a Pauanui aerodrome qualification to the pilot's training file. The operator later instituted an Aerodrome Assessment form to be used in conjunction with flight authorisations for non-scheduled flights.

4.3.11 The holder of an air operator certificate is required to ensure that its pilots have the requisite knowledge, amongst other things, of the route and aerodromes to be used and the operator's policies and procedures appropriate to its air operations.[35] The pilot at Pauanui (and, to a lesser extent, the pilot at Matarangi) demonstrated some knowledge and skill deficiencies that the airline should have identified and corrected.

4.3.12 An effective check and training system, along with an effective internal audit system, should be able to identify and close knowledge and skill gaps like those described.

4.3.13 An inspection of the load sheets for flights by other pilots found that indicated seat allocations and loading arrangements often did not correlate. The operator later explained that seat allocations were only correct when used in conjunction with actual passenger weights. While these discrepancies did not prove that the earlier flights had been incorrectly loaded, they did mean there was no documented proof that those flights had operated within flight manual limits. Great Barrier Airlines later emphasised to its staff the need to seat passengers according to the prepared loading arrangements.

4.3.14 A similar inaccuracy in form use was evident in the Pauanui load sheet incorrectly showing the route as AA (Auckland) to GB (Great Barrier – Claris). The manifest for the Matarangi charter flight had the same error. Although these might seem to be minor errors, internal audits had evidently not identified them and pilots evidently tolerated them. Whether that response is an indicator of tolerance or complacency, the frequent errors of this sort showed that Great Barrier Airlines did not ensure compliance with its published policies and procedures.

4.3.15 More serious was the airline's informal adoption of a "standard" take-off safety speed of 80 kts. While this typically did not jeopardise flight safety, the practice could have an adverse outcome, as happened at Matarangi and Pauanui, if the conditions for its safe use were not fully appreciated by pilots. The airline later said it would formalise the procedure for use where runway length allowed.

4.3.16 Poor supervision of operations was inevitable when there was confusion between management roles and responsibilities. That problem was identified in the routine audit of October 2010 and the spot audit of September 2011, and was evident after the Pauanui incident when managers could not agree who had approved the charter.

4.3.17 Great Barrier Airlines initially assessed the Matarangi rejected take-off as an "acceptable risk". After the Pauanui incident 2 days later, the CEO suspended flights into Pauanui, but only

[35] Civil Aviation Rule 125.557, Initial training for crew members.

because he understood the runway condition was poor. The CEO was not responsible for suspending operations. The airline's exposition stated[36]:

> The Operations Manager is the person responsible to restrict or suspend operations if any condition exists that is a hazard to safe operations.

4.3.18 According to the Operations Manual, the appropriate person to approve flights was also the Operations Manager. However, on 31 October 2011 the airline issued the following Notice to Pilots, which was later incorporated into the Operations Manual:

> Until further notice, all charter flights to/from non-certificated airfields, or any other than Auckland, Great Barrier, North Shore, Whangarei, Kaitaia are not to be quoted or commenced until approval from BOTH the [Quality Assurance Manager and Flight Standards and Training Manager] is sought.

4.3.19 The confusion of management roles was still present when the CAA audited the airline in January 2012.

Findings:

8. Systemic deficiencies within the management of the Great Barrier Airlines operation contributed to the aeroplane overrunning the runway at Pauanui. These deficiencies included:
   - the pilot check and training programme did not ensure that all pilots were appropriately qualified to operate into all aerodromes shown in the airline's exposition
   - there was uncertainty around the allocation of responsibilities between senior managers and pilots in the airline
   - internal audits had failed to identify frequent non-compliance with the airline's standard operating procedures.
9. A culture of acceptance of non-conforming practices existed within the Great Barrier Airlines operation, in spite of external audits in the 3 years preceding the Pauanui incident having indicated that this was a safety issue.

4.4 Regulatory oversight

Safety issue: The CAA had had recurring concerns for the management and standard of operations at Great Barrier Airlines during the 3 years prior to this incident, but the actions taken to address those concerns had been ineffective.

Prior to February 2012

4.4.1 The standard of management and flight operations in Great Barrier Airlines had concerned the CAA for more than 3 years prior to the Pauanui incident, but the necessary improvements had not been forthcoming. Audit reports had identified various, sometimes repeated, deficiencies in the airline's exposition, policies, procedures.

4.4.2 In June 2008 Great Barrier Airlines had been due for a scheduled 5-yearly re-certification ('re-entry').[37] During preliminary meetings with the airline, a CAA flight operations inspector had formed the view that there was "a serious lack of day-to-day management" within the airline. Other major deficiencies had been identified with the airline's compliance with quality assurance requirements and its exposition generally.

[36] Great Barrier Airlines' exposition, paragraph 3.1.16.

[37] Initial certification and re-entry involved checks that the document holder's exposition complied fully with all relevant legislated requirements. Subsequent audits primarily checked that the document holder was acting in compliance with their exposition.

4.4.3 As a result of those observations, the CAA had immediately investigated the airline under section 15A of the Civil Aviation Act 1990. The specific safety concerns stated by the CAA were that:

- the internal quality assurance programme was ineffective
- the airline's policy condoned the non-reporting of in-service aeroplane defects
- the airline management (at that time) did not provide adequate supervision and direction.

The CAA required the airline to complete corrective actions before it renewed the air operator certificate in July 2008 (for 6 months only).

4.4.4 One corrective action had been to restructure the airline's senior management. The CAA had interviewed the operations manager in July 2008 prior to confirming acceptance of his nomination for that role. At that time the CAA noted the manager's aviation experience and apparent strong safety focus, and his commitment to an efficient quality assurance system. However, the CAA's expectation of a turnaround in the conduct of the airline was not fulfilled. Subsequent audits continued to make findings on management issues and quality assurance.

4.4.5 Due to the recurring management issues at the airline the CAA categorised the airline as "high risk". The means used by the CAA to try to force change and improvement at the airline were to issue the air operator certificate for a short term only, and to conduct more frequent routine audits and spot checks.

4.4.6 In late January 2012 the CAA conducted a routine audit of the management and general operations at the airline. At that stage the new management team had been in place for less than a month. Prior to the audit, the CAA had identified some Route Guide and exposition deficiencies that were pertinent to the Pauanui incident. The audit made 22 findings, with some similar to those made in the September 2011 spot check. They included the following:

- the lack of a process for authorising non-scheduled flights
- management reviews were held less frequently than was stipulated in the exposition
- there was no published procedure for risk assessment and no system for aircraft document amendment
- the load sheet passenger manifests did not match the seating allocations used to calculate the centre of gravity for each flight
- the manual load sheet had no provision to re-calculate the centre of gravity
- the Operations Manager was not involved in all relevant operational decisions.

4.4.7 One of the auditors summarised the findings of the January 2012 audit in a routine weekly report to the Manager Flight Operations Airlines, and recommended in that report that the air operator certificate for Great Barrier Airlines be suspended because the airline could not show that it met the statutory requirements of a certificate holder.[38] The auditor sent a copy of his weekly report to the General Manager Operations and Airworthiness.

4.4.8 The auditors' draft audit report included more than a page of explanation for their belief that the airline did not meet the statutory requirements. Although the draft report did not explicitly recommend suspension of the air operator certificate, it included the following statement:

> 'Upon reviewing the audit, the auditors are satisfied that based on the evidence gathered, Great Barrier Airlines fail to meet any of the requirements of Section 12(4) of the Civil Aviation Act 1990.'

4.4.9 The General Manager considered the draft audit report and decided that the recommended action would be disproportionate under the circumstances. The approved final audit report did not refer to the auditors' concerns, but did describe an airline with a new management

[38] As shown in the Civil Aviation Act 1990, section 12(4).

team that did not understand fully its responsibilities, did not have an accurate knowledge of the risks associated with its operations or how they were being performed, and did not act promptly to correct identified deficiencies. The report concluded by noting that the CAA had discussed the deficiencies with the new management team and "reached agreement on how these problems can be addressed".

4.4.10 The CAA made 33 findings regarding the management and flight operations at Great Barrier Airlines during the 3 audits conducted between October 2010 and February 2012.[39] Although the findings were mostly minor and of an administrative nature, taken together they gave an impression of successive airline management teams having been unable to make and sustain the improvements that the CAA required. The CAA recognised that the airline's failure to meet internal quality assurance requirements was a core issue.

4.4.11 The recurring findings of administrative lapses and operational deficiencies confirmed that the airline's corrective actions had been ineffective, or in some cases, had not existed. The CAA had recognised this in May 2012 when it wrote to the Chief Executive of Great Barrier Airlines and stated that the delay in closing the findings from the September 2011 spot check was unacceptable. The letter also noted that some findings from a January 2011 audit had still not been resolved, and indicated that the airline "does not have the systems in place to effectively implement corrective action".

4.4.12 However, the pattern of CAA responses was one of issuing similar corrective actions for repeated findings of the same nature. While the auditors might have found the root causes of many of the airline's earlier management and compliance problems, the agreed corrective actions had generally been ineffective and had not compelled the airline to meet the regulated safety standards. In the meantime, any recurring cases of non-compliance and deficiencies would likely mean that the airline operated on occasions outside the Civil Aviation Rules.

4.4.13 The CAA's safety policy recognised that a key requirement for air safety was to ensure operators had the attitudes and behaviours that reflected acceptance of their responsibility and accountability for actively identifying and effectively managing risks. In the CAA's view, participants could be placed somewhere on the following "safety performance continuum":

- willingly performing to, or exceeding, the required safety standards
- not performing but willing
- wilfully not performing.

4.4.14 The CAA had a range of intervention strategies available for managing unsatisfactory performance by participants. Anyone judged to be "wilfully not performing", which was a very rare situation, risked having their document (certificate or licence) revoked or suspended. A situation where an operator was "not performing but willing" could be complex for the Director to decide, especially if the operator was continually unable to "make the grade". The repetitive issuing of finding notices against Great Barrier Airlines for non-compliances of a generic nature had indicated that the airline was in this performance category at that time, and that had led the January 2012 auditors to recommend a stronger intervention.

4.4.15 For at least 3 years before the Pauanui incident, the CAA had had evidence that the management and standard of operations at Great Barrier Airlines were not fully meeting civil aviation rule requirements. The CAA had grounds to increase the level of regulatory intervention to mitigate or eliminate the risk that substandard airline operations then posed to the travelling public.

4.4.16 One effect of the continued substandard airline performance had been that some cases of non-conformance appeared to have been tolerated and to some extent normalised by the airline and its pilots. The pilots have a personal legal responsibility to conduct flights safely, but the airline's culture at the time may have discouraged them from challenging and correcting obvious deficiencies.

[39] For clarity, a table of selected audits and the number of findings made is shown in Appendix 4.

4.4.17 The airline's failure to authorise and supervise the Pauanui charter flight properly was a deficiency foretold by the CAA spot check only 5 weeks beforehand. It was therefore likely to have been a latent factor in the causation of the runway excursion. More generally, the wide range of cases of non-compliance and deficiencies identified in the preceding 3 years indicated an airline safety culture that likely contributed to the incident. Had the CAA enforced prompt and effective action by the airline to correct previous audit findings, or taken more forceful action against the airline, the incident might not have occurred.

4.4.18 Unreasonable delays and ineffective attempts at corrective actions by air operators prolong the risk that those deficiencies become latent factors in the causation of future incidents. The Commission is recommending to the Director that he apply stricter requirements upon holders of air operator certificates so that prompt and effective actions are taken to correct identified deficiencies.

Finding:

10. The CAA should have taken more decisive action to address the serious safety concerns identified in consecutive audits. Had it done so, and required Great Barrier Airlines to take prompt and effective action to correct audit findings, the Pauanui incident might not have occurred.

After February 2012

4.4.19 Prior to about February 2012, each CAA audit report had included an "audit analysis" section, which expanded on the factual section of the audit report. The analysis sections of some earlier reports on Great Barrier Airlines contained discussions on management and operational practices, which had not necessarily resulted in audit findings. However, since February 2012 the CAA has omitted the audit analysis section. As a result, the views of auditors and any relevant discussions have not been recorded in later reports. The CAA said this was done to align New Zealand practice with that of the European Aviation Safety Authority.

4.4.20 After February 2012 the number and severity of findings made by the CAA during audits of Great Barrier Airlines declined progressively. The airline submitted that the CAA had responded positively to the airline's management changes, which were proving effective, and provided constructive advice to assist it to meet its regulatory obligations.

4.4.21 The airline was next audited in August 2012. The auditors made 10 findings in the area of management and general operations, one of which was considered "major". Two of the minor findings described inadequate aspects of the airline's emergency response plan, which had also been discussed at the January 2012 audit, although no finding had been made then.

4.4.22 In May 2013 an audit was conducted of the airline's training functions. The scope of that audit was decided on the basis of a "Surveillance Risk Assessment" that had been conducted in February 2013. That assessment had considered "only those areas … identified as being medium-to-high risk", but was almost identical to one conducted in July 2012 prior to an audit of management functions. Whereas the July 2012 assessment had determined that the airline's risk level was "high", the February 2013 assessment was "low".

4.4.23 The May 2013 audit made 6 findings, of which 2 were major:

- the airline's pilot authorisations did not identify all individual operational restrictions
- the Operations Manager had operated a flight after the expiry date of the relevant qualification.

4.4.24 By July 2013, the performance and compliance of Great Barrier Airlines had improved and its new management team successfully completed a full re-certification audit.

5. Findings

5.1. The primary reason for the aeroplane's failure to take off was that its centre of gravity was well forward of the maximum permissible limit.

5.2. Neither the pilot nor Great Barrier Airlines had calculated the actual weight and balance of the aeroplane prior to the flight.

5.3. Great Barrier Airlines had not provided the portable scales that were necessary for the pilot to comply with the airline's procedures for determining the aeroplane weight and balance.

5.4. There were 3 factors that contributed to the aeroplane overrunning the end of the runway when the pilot aborted the take-off:

- the aeroplane was too heavy for the available length of the Pauanui runway and the safety margin required by Civil Aviation Rules
- the pilot did not use all of the available runway
- the pilot did not use the appropriate technique for a successful take-off.

5.5. The Trislander aeroplane exceeded the equivalent single wheel load for the Pauanui runway. The possibility could not be excluded that the sandy subsoil increased the rolling resistance on the wheels, which would have degraded the take-off acceleration.

5.6. Great Barrier Airlines had not considered whether its aeroplanes complied with the equivalent single wheel load at the aerodromes it used. An excessive equivalent single wheel load could affect take-off performance and damage runway surfaces.

5.7. The aerodrome operator did not know the origin of the published maximum equivalent single wheel load values and had not determined the effect of subsurface irrigation on the runway strength. Incorrect or unknown equivalent single wheel load data could affect the safety of aerodrome operations by reducing the take-off performance of aeroplanes using the runway.

5.8. Systemic deficiencies within the management of the Great Barrier Airlines operation contributed to the aeroplane overrunning the runway at Pauanui. These deficiencies included:

- the pilot check and training programme did not ensure that all pilots were appropriately qualified to operate into all aerodromes shown in the airline's exposition
- there was uncertainty around the allocation of responsibilities between senior managers and pilots in the airline
- internal audits had failed to identify frequent non-compliance with the airline's standard operating procedures.

5.9. A culture of acceptance of non-conforming practices existed within the Great Barrier Airlines operation, in spite of external audits in the 3 years preceding the Pauanui incident having indicated that this was a safety issue.

5.10. The CAA should have taken more decisive action to address the serious safety concerns identified in consecutive audits. Had it done so, and required Great Barrier Airlines to take prompt and effective action to correct audit findings, the Pauanui incident might not have occurred.

6. Safety actions

General

6.1. The Commission classifies safety actions by 2 types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that might otherwise have resulted in the Commission issuing a recommendation

(b) safety actions taken by the regulator or an operator to address other safety issues that would normally have been unlikely to result in a recommendation.

Safety actions addressing safety issues identified during an inquiry

6.2. (a) In November 2011 Great Barrier Airlines advised the CAA that it had restricted Trislander operations to paved runways only.

Safety actions addressing other safety issues

6.3 None identified.

7. Recommendations

General

7.1. The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector. In this case, recommendations have been issued to the Director of Civil Aviation and to the Chief Executive of the Thames-Coromandel District Council.

7.2. In the interests of transport safety it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

Recommendation 1

7.3. The Pauanui runway excursion drew attention to recurring deficiencies in the operations at Great Barrier Airlines that had been previously identified by CAA audits. For various reasons, corrective actions had been ineffective, with the result that some of these deficiencies contributed to the runway excursion at Pauanui. A delay in correcting identified deficiencies could be a latent factor contributing to future incidents.

7.4. Some of those audits also discussed serious safety issues with the management oversight and general culture of the company, but not all of these issues resulted in audit findings.

7.5. On 26 February 2014 the Commission recommended to the Director of Civil Aviation that he apply stricter requirements upon holders of air operator certificates to take effective action to correct identified deficiencies, and that any serious safety issues that are identified with managerial oversight of airline operations always result in findings. (001/14)

On 5 March 2014, the CAA replied in part:

> The Director accepts the Commission's recommendation and advises that effective action has already been taken to implement its intent. In this respect, it is noteworthy that the focus of the Commission's investigation primarily related to events in late 2011 and early 2013. Since that time the CAA has undergone considerable organizational change: a real focus of which has been to supplement its strong aviation technical expertise with an enhanced regulatory skill set. To this end it has recently invested considerable time and effort in articulating and strengthening its regulatory approach. This work started to take effect at about the same time as the Pauanui Beach runway overrun occurred and has subsequently both gained impetus and been consolidated. Examples of this investment include:
>
> - significant changes to the CAA's existing Surveillance Policy made in Sep 2011. Relevant to the second element of the Commission Recommendation, the following direction was introduced regarding the raising of findings: "*When a document holder's performance falls below the required standard a finding will be raised*";
>
> - new 'CAA Use of Regulatory Tools' policy introduced on 23 Sep 2011. The new policy was created to provide guidance to CAA staff about the use of regulatory tools in discharging their obligations;
>
> - new 'Regulatory Operating Model' adopted and promulgated by the CAA on 17 Feb 2012. The new policy was created to sit above the 'CAA Use of Regulatory Tools" policy and identify, at a high level, the overarching regulatory principles and approach the CAA adopts in discharging its obligations;
>
> - [A consultant] has been engaged to up skill regulatory staff on good regulatory practice and operational risk management (workshops held May 2013 and Feb 2014). All senior regulatory staff, and the majority of all regulatory staff, have attended one of these seminars;

- the addition of Operational Risk Management and Safety Management System skills to the competency framework for regulatory staff. Development and the delivery of such training with the latest element of the training delivery commencing March 2012;

- internal review processes for regulatory functions ensure compliance with proper process and identify learnings that can drive improvement;

- review of the current risk profile 'triggers' for targeting oversight of any operator with action underway to move toward targeting of the upper quartile of the risk profile distribution (as opposed to utilizing fixed trigger 'scores' for this purpose); and

- the introduction of a risk-based approach to regulation that focusses attention on the circumstances of a particular case, the risks posed and the selection of the most appropriate regulatory intervention to provide the required risk mitigation.

> The efforts outlined above constitute a significant strengthening and sharpening of the CAA's regulatory focus in the time since the overrun at Pauanui. While incremental improvement is always possible the CAA has invested considerably in providing its staff with the direction, guidance, skills and tools necessary for them to make sound, evidence-based decisions in the public interest.

Recommendation 2

7.6. The weight of the Trislander that overran the Pauanui aerodrome runway on 22 October 2011 greatly exceeded the published maximum ESWL for the runway. The possibility that the aeroplane's wheels sank into the runway surface and affected its take-off performance could not be excluded. The aerodrome operator did not know the origin of the published values of ESWL nor what effects wastewater discharges under the runway had on the runway bearing strength.

7.7. On 26 February 2014 the Commission recommended to the Chief Executive of the Thames-Coromandel District Council that the council establish accurate values for the ESWLs at the aerodromes it operates and that it determine whether the "wet" ESWL is appropriate at the Pauanui aerodrome while a wastewater discharge is underway and for any period after the discharge has ended. (002/14)

On 12 March 2014, the Thames Coromandel District Council advised the Commission that they:

> ...have engaged [consultants] to undertake the necessary investigation to enable Council to establish the required Equivalent Single Wheel Load.
>
> The results of the assessment and the follow up information will be forwarded to the Commission once completed. Unfortunately at this stage I am unable to provide the Commission with a date by which the assessment will be complete. The results of the ESWL assessment will be published as required.

8. Key lessons

8.1. Pilots must know the weight and balance of their aircraft before every flight and ensure that both remain within permissible limits. Failure to do so can have serious consequences for flight safety.

8.2. When calculating the weight and balance of their aircraft, pilots should use a standard weight for passengers only if it is truly representative of the actual passenger weights for the flights.

8.3. It takes more than just good written policies and procedures to achieve an acceptable level of flight safety. Managers need to lead by example and ensure that pilots actually follow the procedures.

9. Citations

Civil Aviation Authority. (2012a). Regulatory Operating Model. Retrieved 21 November 2013 from http://www.caa.govt.nz/Policy/Regulatory_Op_Model.pdf.

Civil Aviation Authority. (2012b). Use of Regulatory Tools. Retrieved 21 November 2013 from http://www.caa.govt.nz/Policy/Use_Regulatory_Tools.pdf.

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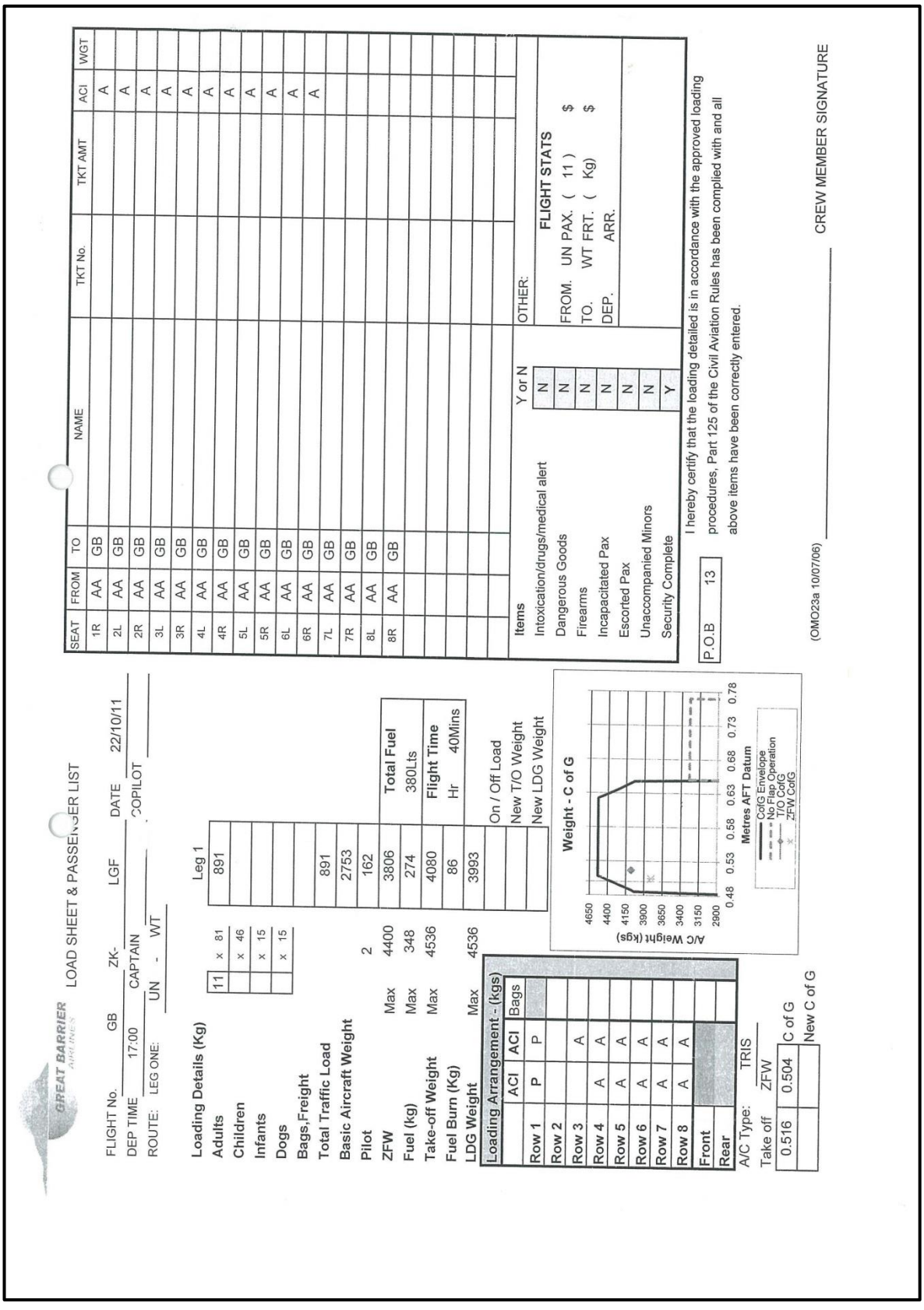
Appendix 1: Load sheet for incident flight



Appendix 2: Certification and regulated performance requirements of Trislander aeroplanes.

The basis for the New Zealand certificate was type certificate number BA6 issued by the United Kingdom Civil Aviation Authority. In 2002, the CAA of New Zealand found that the United Kingdom certification provided an equivalent level of safety to that of certification in the Normal Category of United States Federal Aviation Rule 23, which is the basic certification standard against which the CAA assesses light aircraft. The United States also certificated the Trislander against Federal Aviation Rule 135 Appendix A.

Air transport operations using the Trislander were conducted under Part 125 of the Civil Aviation Rules.[40] Part 125 sub-part D prescribed the performance requirements and limitations, but contained an anomaly for aeroplanes – like the Trislander – that were certificated in the Normal Category of United States Federal Aviation Rule Part 23 and Federal Aviation Rule 135 Appendix A.

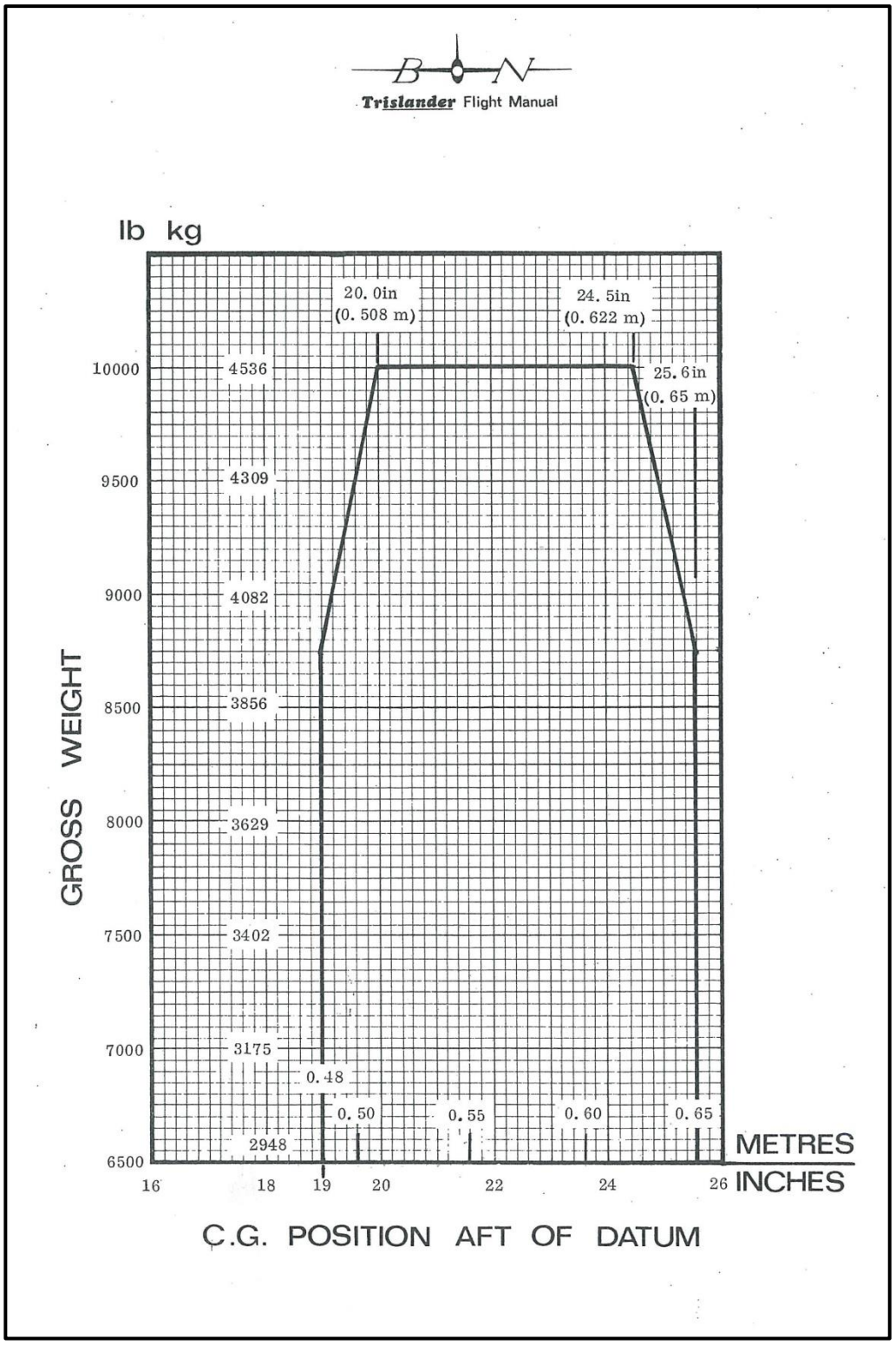
A section of Part 125 sub-part D did not apply to aeroplanes certificated against Federal Aviation Rule Part 23 Normal Category, and another section did not apply to aeroplanes certificated against Federal Aviation Rule 135 Appendix A. Taken together, these exemptions removed many of the requirements for scheduled take-off (and landing) performance data for the Trislander. The CAA advised that the anomaly arose from changes to United States rules since the Trislander was first certificated in the United Kingdom.

The CAA said that the Trislander should be operated under Civil Aviation Rules 125.209 to 125.225.

[40] Part 125, Air operations – medium aeroplanes.

Appendix 3: Trislander centre of gravity envelope.

Source: Trislander Flight Manual, section 6, page 8.



Appendix 4: Great Barrier Airlines selected audits 2010-2013

The recent history of CAA audits of Great Barrier Airlines is summarised in the following table:

Date	Audit number (functional area audited)	Risk profile (%)	Findings (number major)
20 Oct 2010	11/ROUA/47 (Management & General Operations)	n/a	8(1)
16 Sep 2011	12/SPTA/1 (QA & Flight Operations)	n/a	3(2)
31 Jan 2012	12/ROUA/81 (Mgmt & General Ops)	n/a	22(4)
15 Aug 2012	13/ROUA/10 (Mgmt & Flight Ops)	24.29 ("high")	10 (1)
23 Jan 2013	13/SPTA/9 (Mgmt & Flight Ops)	n/a	7(1)
7 May 2013	13/ROUA/241 (Training)	"low"	6(2)
17 July 2013	14/ROUA/27 (en route part 125 and part 135 aircraft)	2 profiles exist: A: 24.41 B: 15.34	none

n/a = not available

Risk profile bands: Low 16% and below; Medium 16.1% – 26%; High 26.1% – 36%; Very High 36.1%+.

Recent Aviation Occurrence Reports published by the Transport Accident Investigation Commission (most recent at top of list)

11-003	In-flight break-up ZK-HMU, Robinson R22, near Mount Aspiring, 27 April 2011
12-001	Hot-air balloon collision with power lines, and in-flight fire, near Carterton, 7 January 2012
11-004	Piper PA31-350 Navajo Chieftain, ZK-MYS, landing without nose landing gear extended, Nelson Aerodrome, 11 May 2011
11-005	Engine compressor surges, 18 September 2011
11-001	Bell Helicopter Textron 206L-3, ZK-ISF, Ditching after engine power decrease, Bream Bay, Northland, 20 January 2011
11-002	Bombardier DHC-8-311, ZK-NEQ, Landing without nose landing gear extended Woodbourne (Blenheim) Aerodrome, 9 February 2011
10-010	Bombardier DHC-8-311, ZK-NEB, landing without nose landing gear extended, Woodbourne (Blenheim) Aerodrome, 30 September 2010
12-001	Interim Factual: Cameron Balloons A210 registration ZK-XXF, collision with power line and in-flight fire, 7 January 2012
10-009	Walter Fletcher FU24, ZK-EUF, loss of control on take-off and impact with terrain, Fox Glacier aerodrome, South Westland, 4 September 2010
10-007	Boeing 737-800, ZK-PBF and Boeing 737-800, VH-VXU airspace incident, near Queenstown Aerodrome, 20 June 2010
10-005	Cessna A152, ZK-NPL and Robinson R22 Beta, ZK-HIE near-collision. New Plymouth Aerodrome, 10 May 2010
10-003	Cessna C208 Caravan ZK-TZR engine fuel leak and forced landing, Nelson, 10 February 2010
10-006	Runway Incursion, Dunedin International Airport, 25 May 2010
10-001	Aerospatiale-Alenia ATR 72-212A, ZK-MCP and ZK-MCJ, severe turbulence encounters, about 50 nautical miles north of Christchurch, 30 December 2009
09-002	ZK-DGZ, Airborne XT-912, 9 February 2009, and commercial microlight aircraft operations

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