AIRCRAFT ACCIDENT REPORT

No. 89-032

BRITTEN NORMAN BN-2A-21
ISLANDER ZK-SFE
Northwest Bay, Pelorus Sound
19 March 1989

Transport Accident Investigation Commission
Wellington · New Zealand

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Transport Accident Investigation Commission
Wellington

Chief Commissioner
Transport Accident Investigation Commission

The attached report summarises the circumstances surrounding the accident involving Britten Norman BN-2A-21 "Islander" aircraft ZK-SFE at Northwest Bay, Pelorus Sound on 19 March 1989 and includes suggested findings.

This report is submitted pursuant to Section 8(2) of the Transport Accident Investigation Act 1990 for the Commission to review the facts and endorse or amend the findings as to the contributing factors and causes of the accident.

4 October 1990

R CHIPPINDALE
Acting Chief Executive

APPROVED FOR RELEASE AS A PUBLIC DOCUMENT

19 November 1990

M F DUNPHY
Chief Commissioner

AIRCRAFT:	Britten Norman BN-2A-21 "Islander"	**OPERATOR:**	Sounds Air
REGISTRATION:	ZK-SFE	**PILOT:**	Mr S.J. Gray
PLACE OF ACCIDENT:	Northwest Bay, Pelorus Sound	**OTHER CREW:**	Nil
DATE AND TIME:	19 March 1989, 1635 hours	**PASSENGERS:**	Five

SYNOPSIS:

The Office of Air Accidents Investigation was notified of this accident at 1715 hours on 19 March 1989. Mr D.V. Zotov was nominated as Investigator in Charge and commenced the investigation next morning. While attempting to land at Tiraora Lodge the pilot was dazzled by low sun and elected to overshoot. The aircraft made a low turn to avoid high ground, struck a telephone wire and descended out of control into the sea. The pilot and five passengers were rescued but suffered varying degrees of injury.

1.1 HISTORY OF THE FLIGHT:
See page 4.

1.2 INJURIES TO PERSONS:
Pilot: 1 Serious
Pax: 3 Serious
2 Minor

1.3 DAMAGE TO AIRCRAFT:
The aircraft was damaged beyond economical repair by water immersion and the subsequent recovery operation.

1.4 OTHER DAMAGE:
One telephone line conductor and an adjacent pole were broken.

1.5 PERSONNEL INFORMATION:
See page 5.

Flight Times

	Last 90 days	Total
All Types	50	2345
On Type	21	28

1.6 AIRCRAFT INFORMATION:
See page 6.

1.7 METEROLOGICAL INFORMATION:
See page 10.

1.8 AIDS TO NAVIGATION:
Not applicable

1.9 COMMUNICATIONS:
Not applicable.

1.10 AERODROME:
See page 11.

1.11 FLIGHT RECORDERS:
Not applicable.

1.12 WRECKAGE AND IMPACT INFORMATION:
See page 12.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION:
Nothing in the pilot's previous medical history suggested anything that might have impaired his ability to make the flight.

1.14 FIRE:
Fire did not occur.

1.15 SURVIVAL ASPECTS:
See page 14.

1.16 TESTS AND RESEARCH:
See page 16

1.17 ADDITIONAL INFORMATION:
See page 16.

1.18 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES:
See page 21.

2. ANALYSIS:
See page 22.

3. FINDINGS:
See page 27.

4. SAFETY RECOMMENDATIONS:
See page 30.

5. REGULATORY:
See page 31.

* All times in this report are NZST

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 The flight was from Koromiko via Tiraora Lodge airstrip to Wellington.

1.1.2 ZK-SFE took off from Koromiko with one pilot and five passengers at about 1620 hours. Three of the passengers were members of the pilot's family. It was intended to make a stop at Tiraora Lodge airstrip to pick up additional passengers before proceeding to Wellington.

1.1.3 Enroute to Tiraora Lodge, the aircraft encountered some turbulence from the westerly wind which was established aloft.

1.1.4 The pilot flew the aircraft on a straight-in approach to Tiraora Lodge airstrip vector 26. Out on the bay wind gusts were disturbing the water but inshore the water was calm. There was no white water in the bay and the pilot assessed the surface windspeed as ten to fifteen knots.

1.1.5 The sun was shining across the top of the ridge of hills which lay beyond the airstrip. As its azimuth was virtually the same as the runway direction the associated glare meant the pilot was unable to see the runway. However, the shadow of the ridge appeared to lie where the runway should have been so the pilot continued the landing approach expecting the aircraft would be in shadow when it was closer to the runway threshold and thus he would be able to see to make the landing.

1.1.6 During the approach the aircraft encountered a downdraught which required the pilot to apply power to maintain the glidepath.

1.1.7 The company's missed approach procedure at Tiraora Lodge was to commence a level turn to the left 200 m from the threshold, the turn being sufficiently steep to be completed over the water. Thus the aircraft would not have to clear the trees, about 130 feet high, which surrounded the Lodge. The position from which the missed approach was to be commenced was not defined in terms of landmarks.

1.1.8 The pilot elected to maintain a height of 200 feet on the approach reasoning that if he was unable to complete the landing, he would be able to turn above the trees which would therefore not be the limiting obstacle.

1.1.9 By this stage, the aircraft's indicated airspeed had been reduced to less than 88 knots and the pilot "toggled" the selector switch with the intention of setting landing flap (56°).

1.1.10 When the pilot was able to see the airstrip he was abeam its lower end, to the right of the runway. The terrain ahead of him was uneven and divided by drainage ditches and deer fences. The overrun area beyond the runway precluded a safe arrival if the aircraft could not be stopped on the runway. A climb straight ahead was not possible due to the steep rise to a ridge at 2500 feet immediately beyond the end of the

runway and high ground also prevented a turn to the right. However, a left turn seemed to offer an escape route as the ground in that direction rose less steeply.

1.1.11 The pilot therefore commenced a missed approach to the left. He applied full power, selected flap towards "TAKE-OFF" and commenced a level turn. He had to descend the aircraft to keep it flying. Although the engines were delivering full power the performance of the aircraft was much less than he expected.

1.1.12 Because he had been having problems with the flap actuation and indication system the pilot thought the flaps might not have retracted from the "LANDING" flap position to the "TAKE-OFF" position properly. On recollection, after the accident, he thought he may not have selected "LANDING" flap correctly during the approach and when he selected "TAKE-OFF" on the go-around the flaps travelled from "TAKE-OFF" to the 6° down position. Although he believed the flap position indicator to be unserviceable he did not check the position of the flaps themselves visually after either selection.

1.1.13 Witnesses on the ground commented that the aircraft seemed to be affected by turbulence on the approach, was flying very slowly as it came level with the runway threshold and that it banked steeply when it commenced its turn.

1.1.14 Although the pilot could not recollect hearing the stall warning horn, the passengers said that it came on and sounded continuously.

1.1.15 During the missed approach the aircraft collided with a telephone line. When the pilot felt the drag of the telephone wire, he closed the throttles. Then, when he found the aircraft was still flying, he applied full power but the aircraft pitched nose up so he reduced the power again.

1.1.16 The aircraft descended into the water at an angle of about 25° and then floated briefly on the surface of the bay. Although the pilot had attempted to flare the aircraft it was in a nose-down attitude on impact.

1.1.17 All of the passengers escaped or were assisted from the aircraft and taken ashore to the Lodge for first aid and dry clothes.

1.1.18 The accident took place in daylight at about 1635 hours NZST. The accident site was Northwest Bay, Pelorus Sound. National Grid Reference 176510 (NZMS1, Sheet S15, "Rai") latitude 41°05'05" south longitude 173°52'00" east.

1.5 Personnel information

1.5.1 The pilot of ZK-SFE, Stephen John Gray, aged 30, held a valid Air Transport Pilot Licence - Aeroplane, number 1280. At the time of the most recent medical examination for renewal of this licence he was assessed as fit. His total flying experience was 2345 hours of which 380 hours was on multi-engine aircraft and 28 hours was on BN2 aircraft. At the time of the accident he held the position of Operations Manager with another passenger service operator.

1.5.2 The pilot's duty day had commenced at about 0700 hours that morning and prior to that he had had 2 days rest. During the previous 90 days he had flown 50 hours, of which 21 hours were on BN-2A aircraft.

1.5.3 The pilot had flown into Tiraora Lodge airstrip on two previous occasions, on 17 February 1989 and 8 March 1989. Both of these flights were on BN-2A aircraft. He had received no dual instruction in operations at Tiraora Lodge but he had made one flight into the airstrip as a passenger, with the owner of Sounds Air flying, in a Cessna 185 aircraft which was not equipped with dual controls. The owner did not demonstrate the missed approach procedure.

1.5.4 The last check of the pilot's competence to conduct air transport operations, as required by Regulation 76, consisted of a flight from Wellington Airport to Paraparaumu Aerodrome and return to Wellington, on 14 December 1988, in a Beech 65 aircraft. This flight was made under instrument flight rules, as were all of the previous Regulation 76 checks recorded in the pilot's logbook.

1.5.5 Since December 1984 the pilot had made a total of 240 flights into airstrips as follows:

145 take-offs and landings at Nopera
51 take-offs and landings at Havelock
(Havelock has nil slope and is 750 m long)
10 take-offs and landings at Port Gore
34 take-offs and landings at 11 other airstrips

Twenty four of these take-offs and landings were in "Islander" aircraft. There was no record in his logbook of any dual instruction in the techniques required to land at airstrips, or any checks of competence at operating into airstrips, as required by Regulation 76 or any demonstrations of competence at any of these airstrips as required by Regulation 77.

1.5.6 According to his log book his conversion to the "Islander" aircraft comprised 3 solo circuits. On the other hand the owner was adamant that the pilot "underwent a full company check-out on the Islander by another operator, concerning all emergency procedures including "baulked approaches", this being completed in (the pilot's) first few hours on type".

1.6 Aircraft information

1.6.2 ZK-SFE was a Britten Norman BN-2A-21 "Islander", serial number 406, a 10 seat twin-engined aircraft designed for short-haul, airstrip operation. It was manufactured in 1974 and imported second-hand into New Zealand in 1988, at which time it had flown 2710 hours.

1.6.2 The Certificate of Airworthiness was non-terminating unless cancelled or suspended. The aircraft was required to be maintained in accordance with the Sounds Air Operator's Maintenance Manual, which provided for maintenance at intervals of 50 hours. These intervals had been exceeded by as much as 14 hours, but at the time of the accident the

aircraft had a valid Maintenance Release. It had then flown approximately 3166 hours.

1.6.3 The only significant defect entered on the Defect Record Card was "Rear Pax Door Handle Broken".

1.6.4 The flap operating mechanism was driven by an electric motor. A toggle switch on the central pedestal had "UP", "OFF" and "DOWN" positions and was spring-loaded to the centre "OFF" position. The flap position indicator was an electric meter mounted above the windscreen. It was marked with white sectors indicating "UP", "TAKE-OFF" (25°) and "LANDING" (56°) flap positions. These sectors were of finite width and momentary deflection of the flap lever would "inch" the flaps over a small range within the sector. This was of particular value in the "UP" position where a 6° range was provided to enable selection of an optimum position which varied with the aircraft's all up weight. When the flap lever was deflected for sufficient time for the flaps to travel beyond one of the white sectors, the flaps would continue to travel after the lever was released, until reaching the start of the next white sector.

1.6.5 The pilot stated that, on ZK-SFE, the flap position indicator was erratic and did not necessarily indicate the true position of the flaps.

1.6.6 Doors which hinged forward and outward were located as shown in Diagram 1. These were also the emergency exits of first resort, although an interlock on the pilot's door prevented operation unless the left engine magnetos were switched off, or an override lever (on the inside of the door) was operated.

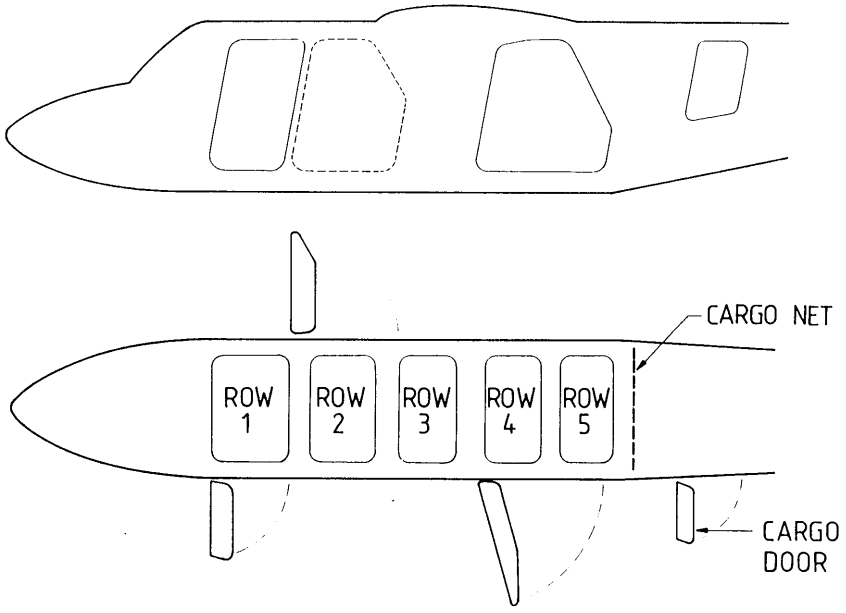

DIAGRAM 1. — SEATING AND DOOR LAYOUT

1.6.7 Because the doors might be difficult to open in an emergency, particularly if the aircraft alighted on water, emergency "pull-in" windows were located in the doors. (See Diagram 2) These windows were mounted in grooves in a rubber moulding. The approved Flight Manual stated, at Section 3 page 10:

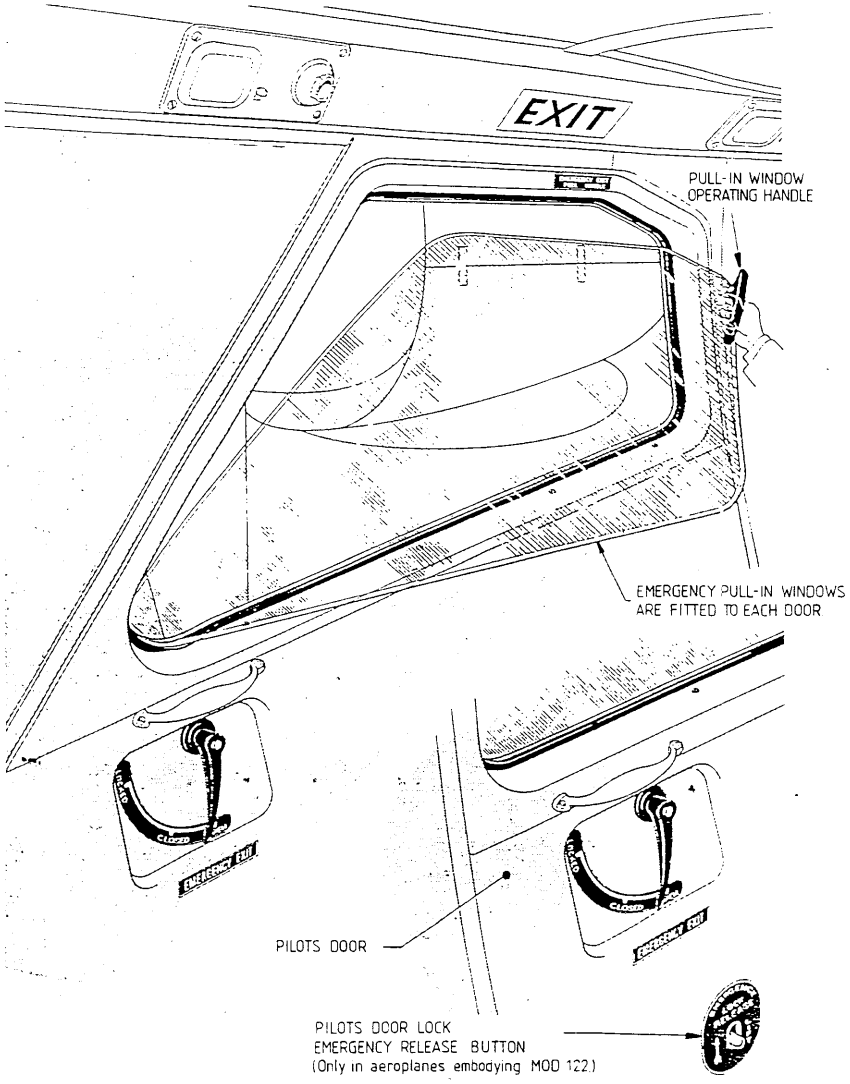

DIAGRAM 2. — EMERGENCY EXITS.

"1. Grip the red handle at the top corner of the cabin door window trimming and pull inwards and rearwards as hard as possible.

2. It is necessary to dislodge the window from its groove in the rubberised moulding and considerable physical effort may be required, especially in cold conditions."

1.6.8 The red handle appeared to have been designed to act as a lever; pulling on the longer side of the asymmetric handle would cause the shorter side to bear on the window surround and thus assist in dislodging the window. However this was not evident either from looking at the handle or from the adjacent instructions which said "Ditching Exit Pull Handle". Diagram 2 appeared in the maintenance documents, not in the approved Flight Manual.

1.6.9 The windows had been sealed against the ingress of rain by use of a polymerising sealant. In subsequent tests a strong man, standing beside a door was unable to remove the window, though he was able to crack the perspex.

1.6.10 According to the aircraft load sheet completed before departure from Koromiko, the aircraft weighed 2470 kg. The maximum authorised take-off mass was 2994 kg. The disposition of the load was such that the centre of gravity was within the approved limits.

1.6.11 The approved Flight Manual stated at Section 4 page 14:

"CHANGES OF TRIM

... Application of Power - large increase in power produces a marked nose up tendency."

1.6.12 The required approach technique was to lower full flap (56°) when the speed had been reduced below 88 knots, and then to progressively reduce the speed to the threshold speed. The appropriate speed for the weight of ZK-SFE was 54 knots.

1.6.13 The handling technique for a baulked landing was detailed in the approved Flight Manual as follows:

"Apply full power ... and establish a positive rate of climb. Select flaps to take-off position and accelerate to 61 knots. Select flaps UP at 200 feet above the ground and climb out at 65 knots. ... Be prepared for nose-up change of trim during application of power and selection of flap from take-off to UP."

1.6.14 The climb performance of a BN-2A, at the weight of ZK-SFE and with the atmospheric conditions prevailing, should have been in excess of 1200 feet per minute. However this performance was predicated on the aircraft having accelerated to the speed for best rate of climb, 65 knots, and with the flaps retracted. After a baulked approach, the expected average climb rate to 200 feet amsl was 1100 feet per minute, provided that the aircraft climbed straight ahead and the flaps were selected to "TAKE-OFF" soon after applying full power.

1.6.15 The climbing performance of the aircraft was substantially reduced by banking the aircraft. The climb rate reductions at a steady indicated airspeed of 55 knots were:

ANGLE OF BANK	CLIMB RATE REDUCTION
30°	144 feet per minute
45°	428 feet per minute
60°	1284 feet per minute

However, if the pilot sought to increase the airspeed while the turn was in progress, the reduction in rate of climb would have been greater.

1.6.16 The power-on indicated stalling speed at 30° of bank to the left, with flaps up, at 2470 kg was 39 knots. The stall warning indicator would have sounded at 51 knots. These speeds would have been higher if the angle of bank was greater than 30°.

1.7 Meteorological information

1.7.1 The General Aviation Weather issued at 0615 hours on 19 March 1989 and valid from 0700 to 1800, included the following information:

WINDS AT 0600 NZST
Paraparaumu Aerodrome: 360°/17 knots at 3000 feet
Nelson Aerodrome: 240°/18 knots at 3000 feet

FORECAST: Winds in Cook Strait 350°/30 knots below 5000 feet
[The New Zealand Meteorological Service advised that this applied to Cook Strait itself, not the Marlborough Sounds]

Winds easing slowly

FORECAST WEATHER

Marlborough and Canterbury: No significant weather apart from few early morning mist patches

Turbulence: Occasional moderate, isolated severe turbulence below 10,000 feet about and east of the ranges south of 45° south.

1.7.2 Before flying from Koromiko to Tiraora Lodge, the pilot telephoned the Lodge and was advised that the wind was light.

1.7.3 At about the time of the accident observers noted the surface wind was 280°/10 to 15 knots.

1.7.4 During the afternoon of 19 March 1989, an anticyclone was centred over the North Tasman Sea and a strong west to south-west airflow covered New Zealand. At the accident site, the New Zealand Meteorological Service estimated that the general airflow at 3300 feet was about 270°, 25 to 30 knots. The wind at 30 feet above the ridgetop was calculated to be 45 knots.

1.7.5 The Meteorological Service made a computer analysis of the airflow over the terrain around Tiraora Lodge. This indicated that, from the point where the aircraft commenced its missed approach, it would have experienced a steadily increasing downdraught up to some 500 feet per minute, together with transient eddies. There would not have been excessive turbulence.

1.7.6 The Meteorological Service commented:

"The weather features on the afternoon of 19 March 1989 do not represent an unusual situation and it seems likely that the wind effects

which may have contributed to the accident were not unusual except perhaps they were a little more intense than the most common situation."

1.7.7 The surface temperature at Tiraora Lodge at the time of the accident was estimated to be about 19°C, dewpoint 11°C, relative humidity 60%.

1.10 Aerodrome information

1.10.1 Tiraora Lodge airstrip was situated beside the Lodge and to the north of it, inland from Tiraora Bay, the north-west corner of Northwest Bay, Pelorus Sound. (See Diagrams 3 and 4) The airstrip was 525 m long, with a general slope of 4°. There was a turning bay at the top and the slope up to the turning bay, for the last 100 m, was about 10°. Beyond the turning bay was a final lip up, then a gut approximately 30 feet deep with a creek in the bottom and then steeply rising walls of a blind gully. Above this, the ridgeline rose to 2500 feet. Seen from the threshold of the airstrip the ridgeline was at an elevation of 19° along the runway axis, with peaks on each side rising to 26°. The runway direction was 08 (take-off)/26 (landing). The magnetic bearing in the landing direction was 257°M.

1.10.2 The airstrip was situated in a valley which sloped down to the shore of Northwest Bay. The surrounding hills rose steeply beside the bay to the north-east of the strip (necessitating a curving approach and precluding an overshoot in that direction). To the south-west the spur, which rose to the ridge, sloped upwards more gently. (See Diagram 3)

1.10.3 The runway threshold was at the beach and comprised a 2 feet high bank of boulders.

1.10.4 One concrete telegraph pole, painted white, lay along each side of the strip at the threshold as threshold markers. The left hand side of the strip was marked by one metre high, 150 mm diameter half-round posts, painted white, with their flat side to the landing direction. The right hand side of the strip was bounded by deer paddocks, the fencing also being mounted on half-round posts.

1.10.5 Beside the upper part of the left hand side of the strip (in the landing direction) the ground fell away to a creek; substantial boulders lay on the slope.

1.10.6 The runway surface was well graded and firm.

1.10.7 The Lodge was beside the lower left-hand side of the strip (in the landing direction). Trees surrounding the Lodge rose to about 130 feet. A telephone line crossed the spur to the south-west of the Lodge; the spur was fenced off into deer paddocks. The elevation of the telephone line from the estimated point at which the aircraft commenced its go-around (See Diagram 4) was about 5°; the wires were concealed (from this point) by trees but were visible from a slightly higher vantage point.

1.10.8 From the spur where the telephone wire crossed, the land sloped down to the bay at an increasing angle, ultimately about 25°.

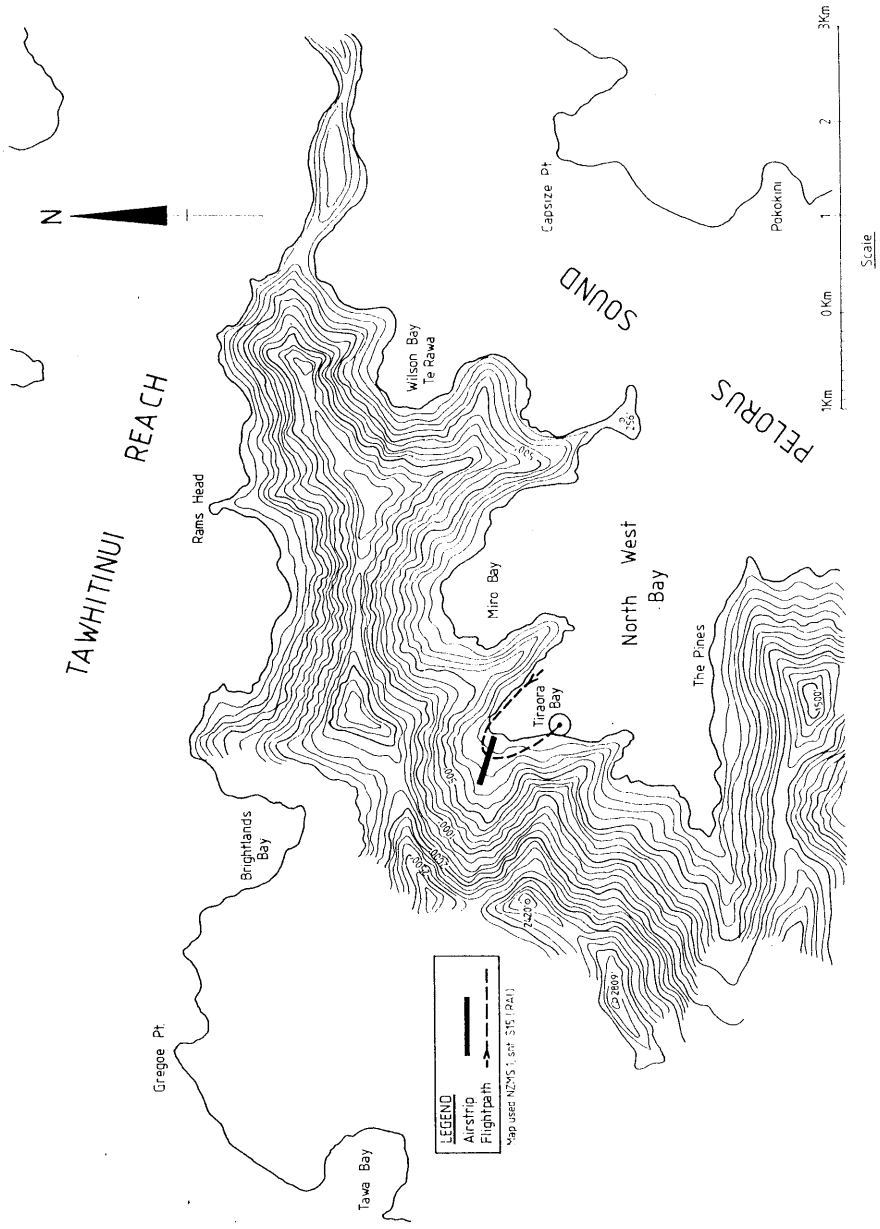

DIAGRAM 3. — TIRAORA AND SURROUNDING TERRAIN.

1.10.9 A windsock was positioned at the right hand side of runway 26, near the threshold.

1.12 Wreckage and impact information

1.12.1 The broken telephone wire lay inside a deer paddock and a number of pieces of fibreglass moulding lay between the line and the

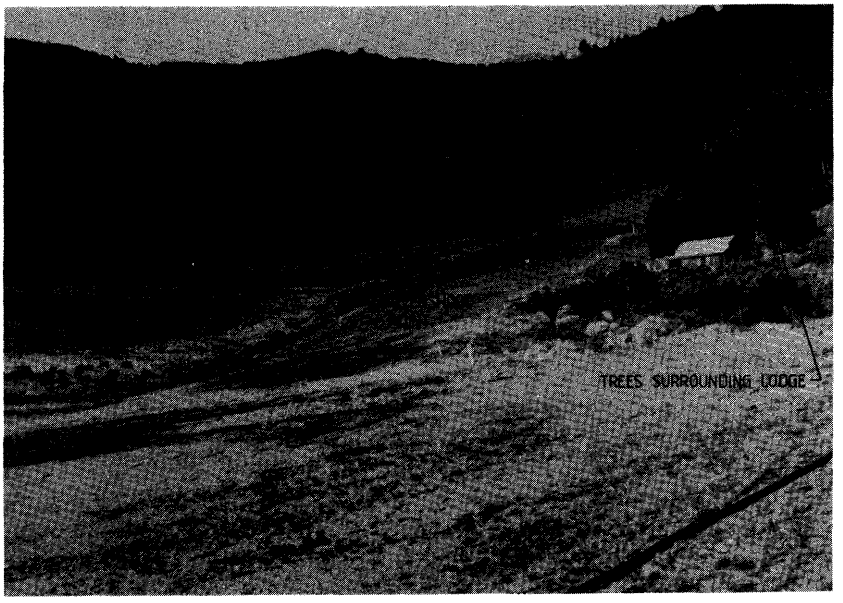

DIAGRAM 4. — AIRSTRIP FROM TURNING BAY.

eastern boundary fence. The broken telephone pole was just outside the fence. The wire had been at 4.7 m above ground level at the pole and would have passed some two metres above the top of the fence. There was no indication of the aircraft having struck either the fence or the pole.

1.12.2 Pieces of fibreglass moulding subsequently identified as part of the left tailplane tip lay to the east of the boundary fence.

1.12.3 The left tailplane lay near the shoreline. It had been cut off as though with a wire, peeled metal showing the direction of cut (forward above, rearward beneath). It lay about 80 m to the left of a direct line joining the broken telephone line to a marker buoy indicating the position in which the aircraft had sunk.

1.12.4 The aircraft's right hand passenger door was found in the bay. (See Diagram 1) Divers advised that this door had been in place and had been disturbed by them during their original investigation of the wreckage. The emergency exit panel was still in place.

1.12.5 The lower half of the pilot's door was also found floating in the bay.

1.12.6 The main wreckage lay on the floor of the bay in 30 feet of water.

1.12.8 When the aircraft was brought to the surface it was defuelled to reduce the strain before placing it aboard a barge. A 44 imperial gallon (200 litre) drum was nearly filled with fuel in the process.

1.12.9 A significant length of wire was found trapped where it had cut into the aluminium fairing of the left main undercarriage leg, just above

the wheels. There were light wire strikes on the left propeller. The propellers showed only minor water impact damage.

1.12.10 Although most of the left tailplane had been cut off, the entire elevator was still present, the left half being bent downward almost through a right angle.

1.12.11 The flaps were depressed to approximately 6°.

1.12.12 The left side passenger door was still in position and could not be moved. The emergency exit was still in place and could not be moved.

1.12.13 The aircraft log and defect summary was recovered.

1.12.14 The aircraft's life jackets were recovered, still in their plastic satchels.

1.15 Survival aspects

1.15.1 Neither of the fare paying passengers had any recollection of a briefing by the pilot on emergency procedures before their departure from Koromiko.

1.15.2 The aircraft's life jackets were in individual sealed plastic satchels, stowed in a bag near the pilot's seat. The passenger seated behind the pilot was aware of this and when it seemed to her that the aircraft might dive into the sea, she passed two of the life jackets to the passengers seated in the row behind her. The writing on the life jacket's satchels did not indicate what the contents were, how to open them, or how to don the life jacket. (See Diagram 5) The recipients, unaware of what they were, discarded them as being of no value in the imminent accident.

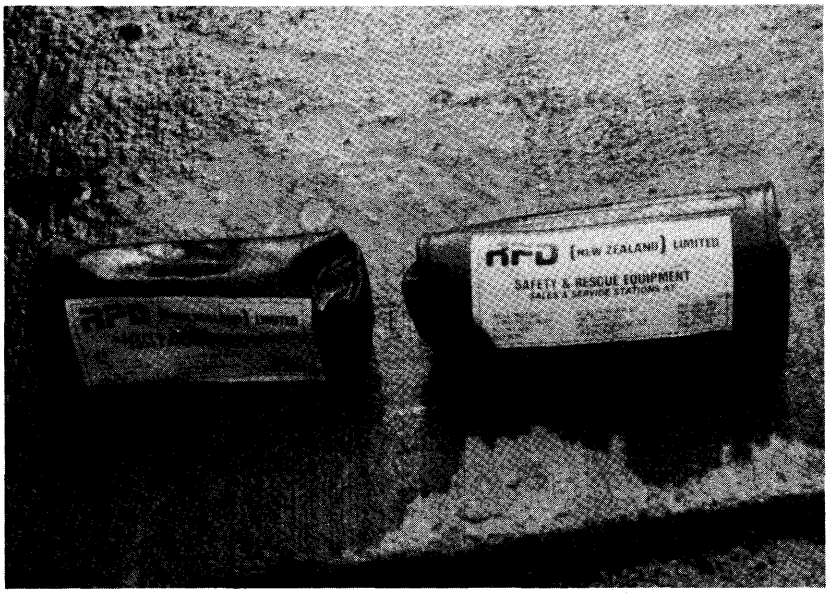

DIAGRAM 5. — LIFEJACKETS IN SATCHELS.

1.15.3 When the aircraft struck the water the pilot and passengers suffered head injuries to varying degrees. The pilot also suffered a back injury; two of the passengers suffered broken legs. The passengers (none of whom had a shoulder harness) had not been shown how to brace for impact.

1.15.4 The pilot's door was torn off in the impact sequence and a child, who was seated in the co-pilot's seat, was able to swim across the pilot's lap and out of the doorway, despite facial injuries and a broken leg.

1.15.5 The passengers were unable to open the passenger doors and those of the associated emergency exit window panels which they tried would not open. (See paragraphs 1.6.7 - 1.6.9)

1.15.6 The luggage compartment was screened from the passenger compartment by means of a fabric net. This came adrift during the impact sequence, so that the male passenger in the rear seat (who suffered a broken leg during the impact sequence) was able to make his way to the luggage door. The luggage door release mechanism had no inner handle but was exposed and guarded by a light metal hoop. When the passenger twisted this hoop it came away in his hand. Abandoning attempts to work the mechanism he braced himself across the fuselage and was able to kick the door open.

1.15.7 The other passenger in the third row recovered to find the cabin filling with water. He was unable to work the emergency exit beside him, but he was aware that the luggage door was open. Although he could not swim he remained in the rapidly filling cabin to extricate the woman and child in the row in front and then made his own way out through the luggage door and onto the roof of the aircraft.

1.15.8 From that position he saw that the pilot was trapped, with his head disappearing below the water from time to time. The passenger removed a piece of metal which had trapped the pilot's neck; then, finding that he was still unable to move the pilot, got into the water, released the pilot's harness and assisted him onto the wing.

1.15.9 Persons on shore who had witnessed the accident had run to two high-speed launches which the Lodge kept at readiness for such a contingency. They arrived at the wreckage about two minutes after the accident. Two of the rescuers boarded the wreckage to assist the survivors aboard the launches. As the last survivors were hauled aboard, the wreckage sank under the rescuers.

1.15.10 The promptness of the rescuers and the actions of the two male passengers probably averted a number of fatalities. For his part in rescuing two female passengers and the pilot, the passenger who remained in the cabin after the accident was awarded the Bronze Medal of the Royal Humane Society.

1.15.11 Medical assistance arrived promptly by helicopter from Blenheim. It was decided to transfer the pilot to Wellington Hospital, so the Wellington-based Rescue helicopter was summoned.

1.15.12 The maps carried by the Wellington based helicopter were different from those used by the Blenheim Police, who were coordinating the rescue. The helicopter's maps did not show Northwest Bay by name, and it was ultimately guided to Tiraora Lodge by the Blenheim-based helicopter, which hovered over the airstrip with its searchlight illuminated to act as a beacon. A delay of about half an hour was incurred because of the differences in the maps.

1.16 Tests and research

1.16.1 A mathematical model of the flow over terrain in various atmospheric conditions was used to determine the probable airflow conditions at Tiraora Lodge at the time of the accident.

1.16.2 Tests on another Britten Norman "Islander" showed that it was impracticable to dislodge the emergency window exits on that aircraft. This was found to be due to the sealant used.

1.16.3 Another "Islander" aircraft was examined and found to have flap indicator deficiencies which the pilot said were similar to those which he noted on ZK-SFE.

1.17 Additional information

1.17.1 The standards of aerodromes within New Zealand were specified in the Aerodrome Standards Manual of the Air Transport Division, and licensed aerodromes were monitored by the Controller of Aerodrome Standards. While international airports were required to conform to the recommendations of the International Civil Aviation Organisation (ICAO) the standards adopted for aerodromes used by smaller aircraft were less stringent than those recommended by ICAO for such aircraft and the consequent reduction in safety standards was accepted.

1.17.2 The lowest standard in the New Zealand Manual was the Authorised Landing Ground (ALG) but some limitations were applied as to obstacles near the airstrip and the maximum all up weight of aircraft (2300 kg or less) that could use it.

1.17.3 The responsibility for ensuring the ALGs were of a suitable standard did not come under the Controller of Aerodrome Standards. Authorisations were issued by General Aviation Inspectors who reported to the Controller of General Aviation Operations.

1.17.4 The Manual of Aerodrome Standards, at Part 1 Section 2, Table 2, limited ALGs to aeroplanes with a maximum all up mass of 2300 kg and below, but paragraph 2.4 stated:

> "Operation of aircraft larger than that specified for a particular aerodrome may be authorised subject to limitations specified by the Director."

Table 3 stipulated, for ALGs, a maximum slope of 15° each side of the runway strip, above which there must be no obstacles, and no obstacles were permitted within a 920 m radius of the strip, above 150 feet above aerodrome level. At paragraph 3.10.1 it stated:

"These obstacle limitation surfaces are necessary to enable aircraft to maintain a satisfactory level of safety while manoeuvring at low altitude in the vicinity of the aerodrome".

1.17.5 Tiraora Lodge airstrip had trees rising to 130 feet immediately beside the airstrip and the ground rose more than 150 feet above the airstrip within 920 m radius of the airstrip.

1.17.6 While the airstrip at Tiraora Lodge was under construction two pilots, experienced in operating in the area, wrote to the Air Transport Division to warn them of the unfavourable wind conditions to be expected there and the lack of overshoot facilities. The Division's General Aviation Inspector (GAI), in reply to these letters, stated they "were well aware of the likely situation" but were "bound by the limits of the regulations" and when issuing Landing Ground Authorisations could only limit specific operations when dangerous conditions occurred. The GAI continued "Therefore when I examine the airstrip with a view to issuing an LGA for it, account will be taken of your comments. If thought necessary appropriate restrictions will be placed on it. It would not necessarily close the airstrip when other conditions apply."

1.17.7 Landing Ground Authorisation number 2399 dated 10 January 1989 authorised operations at Tiraora using Cessna 185 and BN2A aircraft, subject to conditions which included:

"4. Operations not to take place when general wind in Sounds area from W or NW exceeds 30 knots."

1.17.8 The Approved Operations Manual stated:

5-13 TIRA ORA

... Overshoot is possible up to 200 m from the threshold with a left turnout. Strong north-west to west conditions produce gusty winds and downdraughts and preclude operations when above 30 knots in the area."

1.17.9 At 200 m from the runway threshold on a 5° glidepath the aircraft would be at 58 feet above sea level, while on a standard 3° glidepath it would be 34 feet above sea level. The aircraft speed would have to be reducing to target threshold speed, about 55 knots, by this height and at this speed the aircraft would be six seconds from touchdown. At this speed 25° bank would be required to achieve a 200 metre radius turn, while if the speed had been maintained at a normal final approach speed of about 70 knots, the bank angle would need to be 35°.

1.17.10 Sounds Air had been operating into Tiraora Lodge since the end of December 1988. They had made approximately thirty flights, the majority of which were in predominantly (and uncharacteristically) calm conditions before the flight on which the accident occurred.

1.17.11 The Operations Specifications forming part of Air Service Certificate number 350 stated:

"2.9.1 ... The operator shall not permit a pilot to fly ... an aircraft engaged in air transport operations unless:

... (c) he has been checked in full compliance with Regulations 76 and 77 by a person approved to conduct these checks for the operator.

2.10 FLIGHT CREW TRAINING
The operator shall provide facilities for flight crew training and checking in accordance with Regulations 76, 137 and 142 ...

2.11 ROUTE QUALIFICATION
The operator shall ensure the initial and continued route experience and competency of its flight crew members in accordance with Regulation 77."

1.17.12 A pilot engaged in Air Transport operations was required by the Civil Aviation Regulations, Regulation 76, to demonstrate:

"... his technical knowledge, piloting competence, and ability to execute emergency procedures in that category of aircraft in the type of operations to be carried out -

... (b) ... during the period of 12 months prior to the flight."

1.17.13 Regulation 77 prescribed that a pilot in command of an aircraft engaged in an Air Transport operation must have:

"(a) ... Demonstrated to the operator that he has an adequate knowledge of ... the aerodromes which are to be used, including an adequate knowledge of
(i) The terrain ...
(ii) The seasonal meteorological conditions

(c) ... Made an actual approach into each aerodrome of intended landing ... as a member of the flight crew or as an observer on the flight deck accompanied by a pilot who is qualified for the aerodrome."

1.17.14 The approved Operations Manual stated at 1.8.3 Flight Checks:

"(a) Flight Checks ... are to be carried out at least once in every 12 months for pilots engaged in VFR operations. ... Flight checks will be sufficiently comprehensive as to ensure maintenance of pilot skill and continued route experience and competency, in accordance with Regulations 76 and 77 ..."

(b) A record of all flight checks will be kept on file."

and at 1.8.4 Training and Route Checks it stated:

"...(b) Route checks are to be carried out by approved Check Pilots and will include:

... 4. Knowledge of pertinent directives, procedures and techniques."

1.17.15 Regulation 137 stated:

> "Instruction of Personnel - An airline shall ensure that all its personnel are properly instructed concerning their particular duties and responsibilities and the relationship of those duties to the Operations System".

1.17.16 Regulation 142 stated:

> "Training and Checking Organisation - An airline shall provide an approved training and checking organisation to ensure that members of its flight crews maintain their competency."

1.17.17 The owner stated that Sounds Air's pilots were taught that they were to overfly airstrips if for any reason the entire runway, or the windsock was not visible, clearly, throughout the approach. However this was not written in the Operations Manual.

1.17.18 The approved Operations Manual showed, at page 6, that the owner was also the Operations Manager and the Training and Safety Officer. At paragraph 1.3.1 the responsibilities of the Operations Manager were stated to include:

> "(a) The direction and control of flight operations.
>
> ...(d) The reporting of all defects in writing to the Engineering Manager."

1.17.19 The owner was a full-time pilot with Air New Zealand employed on international operations. In consequence he was frequently absent from New Zealand.

1.17.20 The Training Manual, Appendix 3-2 "Type Rating Flight Test", stipulated that a baulked landing be demonstrated for issue of a Type Rating.

1.17.21 The Operations Manual stated, at Appendix 3.4 "Type Conversion":

> "Britten Norman Islander
>
> ... Flight conversion shall consist of no less than 2 hours flight time."

1.17.22 The approved Training Manual stated, under 3 - Check and Training - General:

> "... At annual intervals - Company route/handling check. All checks will be in accordance with [the form at Appendix 1]".
>
> Appendix 1 stipulated that overshoots be demonstrated from landing approaches.

1.17.23 The Manual of Procedures for Operations, Certification and Inspection, ICAO Document 8335, recommended procedures which were followed by airline inspectors in their surveillance of larger airlines. The Manual of General Aviation Supervision (subsequently called the Flight Operations Handbook) laid down similar procedures for use by General

Aviation Inspectors in their surveillance of smaller operators. In general it followed the procedures recommended by Document 8335, although with somewhat relaxed standards. Both manuals required Base Inspections at regular intervals, at which pilots' logbooks and training records would be checked, and both required Route Checks. Document 8335 further recommended that proving flights be undertaken when a new route was being opened up.

1.17.24 The Air Transport Division files relating to Sounds Air disclosed no evidence of any inspections of that operator being carried out.

1.17.25 Although the pilot had been checked while flying for another operator the check related to IFR flights between Wellington and Paraparaumu aerodromes.

1.17.26 Prior to the accident the Ministry of Transport had introduced a policy of "downsizing". This had resulted in there being only two General Aviation Inspectors to supervise some 50 IFR operators in the Wellington region. In consequence, surveillance of VFR operators was, at best, intermittent.

1.17.27 Regulation 74 stated:

> "(2) Every operator of an aircraft shall ensure that prior to take-off passengers are informed of the location and use of ... emergency exits, life jackets and other emergency equipment.
>
> ...(4) In an emergency involving an aircraft the pilot in command thereof shall ensure that passengers are instructed in such emergency action as may be appropriate in the circumstances."

1.17.28 The approved Operations Manual stated, at 3.4 "Passenger Safety Instruction":

> "3.4.1 Prior to the departure of all flights, passengers are to receive instruction on the location and use of life jackets and the means of emergency exit from the aircraft."

1.17.29 Regulation 104 - Basic instruments and equipment stated:

> "Safety devices not less than those specified in this regulation, shall be carried by all New Zealand aircraft...
>
> (v) When engaged in operations over water beyond gliding distance from a safe alighting area - one life jacket for each person on board ... stored in a position easily accessible from the seat ... of the person for whose use it is provided."

1.17.30 The "brace for impact" position, with head forward and arms grasping legs, had been demonstrated in many accidents to reduce the risk of injury or incapacitation significantly .

1.17.31 At 3-14 "Minimum and Unserviceable Equipment", the Operations Manual stated:

"3.14.1 Except where the Director has approved a Minimum Equipment List in accordance with Regulation 108(2) ... all instruments and equipment required by the Regulations ... must be serviceable before departure."

1.17.32 There was no approved Minimum Equipment List for ZK-SFE.

1.17.33 A flap position indicator was required by Regulation 104(p).

1.17.34 There was no record of the flap position indicator being reported as defective to the engineers responsible for the maintenance of ZK-SFE.

1.17.35 The approved Operations Manual stated, at paragraph 1.7 "Post Flight Responsibilities of Pilot in Command":

"(c) A written report detailing any defects is to be furnished to the Operations Manager at the termination of the flight."

1.17.36 Civil Aviation Safety Order (CASO) 12, Part 23 Section 1 Appendix 1 was the approved training syllabus for an Agricultural Pilot Rating. It stipulated that all dual training should be conducted by the holder of an "E" category instructor rating, who must also authorise all solo flying. Initial training for an agricultural rating included not less than 1 hour dual and 1 hour solo of type conversion training, including approach, rejected landing and overshoot, to ensure that the pilot "knew his aeroplane" before proceeding to specialist training. A further period of 20 hours pure flying (of which at least 5 hours was dual) was then required including:

Steep turns
Stalling in steep turns
Circuits at progressively lower levels and downwind landings

Before commencing role training, ground training was required on strip operations, followed by flight instruction on inspecting an airstrip from the air, planning the approach and landing and take-off from strips. The flight training required to reach this stage would be some 23 hours.

1.17.37 A pilot engaged in topdressing might make one strip landing per 3 minutes, or 200 strip landings in a 10 hour working day.

1.18 Useful or Effective Investigation Techniques

1.18.1 The wind-flow analysis was obtained from a computer wind-flow model using representations of the land height and roughness length in the vicinity of Tiraora Bay. The output consisted of a 16 x 16 grid, where the points were separated by 250 m; at these points ground height, mean wind speed and vertical wind at 10 m and 50 m above the surface were available, both in tabular and diagramtic form. The grid was formed from the central part of a 64 x 64 array which was used in the calculations. It was held fixed while the contours of land height and roughness were oriented to the required direction relative to the general wind.

1.18.2 The programme, called MS3DJH/3R was developed by the Atmospheric Environment Service in Canada and was purchased by the New Zealand Meteorological Service under an international wind energy research programme. The NZMS considered the programme was valid for flows over simple terrain features and reasonably accurate in complex situations without very steep slopes.

1.18.3 The programme was designed to accommodate changes of roughness length by factors about 100. At Tiraora it was assumed that the roughness length was .01 m over the sea, 0.15 m over the airstrip and further inland reached 0.5 m. The contours of the land height were obtained by digitisation of the land within about 4 km of Tiraora.

2. ANALYSIS

2.1 The Air Transport Division of the Ministry of Transport was advised of the unsatisfactory features of the airstrip at Northwest Bay while the airstrip was under construction. Notwithstanding that the airstrip did not meet the minimum requirements for an Authorised Landing Ground, no investigation appears to have been made into the airflow characteristics to be expected in normal wind conditions at Tiraora Lodge. Operations by BN2A "Islander" aircraft were authorised although, at 2900 kg, its maximum authorised mass was greater than the normal limit for ALGs (2300 kg). These authorisations were given by a General Aviation Inspector and such authorisations were routinely given at this level.

2.2 The GAI concerned responded to the advice by the experienced pilots by limiting operations from the Tiraora airstrip to situations where the wind did not exceed 30 knots in the Sounds area. Discretion was available to the GAI to allow aircraft which were larger than those normally permitted to operate from ALGs as in this case. However a review by the Meteorological Service such as was performed after the accident may have given grounds for him to refuse this dispensation.

2.3 The wind restriction on the use of Tiraora Lodge "when the general wind in the Sounds area exceeds 30 knots" was amplified in the Operations Manual which spoke of such operations being precluded by the gusts and downdraughts when the wind exceeded 30 knots. However, there was nothing in the forecasts available to the pilot before the flight to suggest that hazardous winds or turbulence might be encountered in the Sounds area; nor could he take any warning from the calm conditions at Tiraora Lodge reported to him by telephone before take-off. On approach to the airstrip he assessed the surface wind as 15 knots or less and this estimate was in line with those of observers on the ground. The pilot considered such turbulence as he encountered was normal in the Sounds and the only warning that adverse conditions might be encountered was the downdraught which he experienced on final approach.

2.5 The Meteorological Service estimated that the wind above the ridgetop was about 45 knots at the time. This should have been sufficient to preclude operations but the pilot had no means of knowing of it. The downdraught conditions encountered during the attempted go-around were

not unusual, however all but one of the 30 previous flights to the airstrip had been in uncharacteristically calm conditions and the pilot himself had made only two of these flights so he could not draw on any background of experience.

2.6 The restriction in the Landing Ground Authorisation was meaningless without a specific means of assessing the wind (such as a remote-reading anemometer mounted on the ridgeline above the airstrip).

2.7 A missed approach might have been needed for a variety of reasons, for example a vehicle moving onto the runway when the aircraft was on final approach. Operations to an airstrip from which a missed approach could not be performed from the runway threshold were inherently less safe than those where such a missed approach was practicable and it should have been a matter for special consideration before deciding such operations were acceptable for the transport of fare-paying passengers.

2.8 When operating into the one-way strip, it was imperative that a go-around point be established beyond which the approach would not be continued unless the pilot was satisfied that the landing could be achieved. The aircraft had to be configured correctly, at the correct speed and attitude, on the correct glidepath, with no factors such as sun, shadow or turbulence which might prejudice the landing and the runway unobstructed. Self-evidently, the runway had to be in sight, clearly, by this point.

2.9 The approved Operations Manual was defective in its guidance to pilots. There was no way in which a pilot could assess when he was 200 m from the threshold. It was normal practice for agricultural pilots (who operated into one-way strips more frequently) to establish some visual feature, such as a gate or fenceline, to use as their go-around point. Such a point should have been established at Tiraora Lodge, detailed in the Operations Manual and brought to the attention of pilots when they were being trained to operate from this airstrip.

2.10 The aircraft performance information for the BN2A gave reason to doubt that a go-around could be performed safely from 200 m on final approach, given the downdraughts and eddies to be expected under normal conditions in Tiraora Bay. In any case, a manoeuvre which might require a steep turn at low speed at 50 feet or less in a relatively large aircraft should not have been countenanced when the Operations Manual was approved.

2.11 Another factor likely to prejudice the safe performance of the missed approach envisaged was the large nose-up trim change with application of power, of which the Flight Manual warned. Even with a clear visual horizon such a trim change was likely to result in an excessive angle of attack in a steep turn, and degraded performance. With the false horizon in Tiraora Bay, any attitude change which was likely to result in an excessive angle of attack would be difficult to detect. It might require an unnatural push force on the control column to achieve the correct angle of attack.

2.12 The pilot should have been required to demonstrate this manoeuvre with the aircraft ballasted to maximum all-up mass during his training at Tiraora Lodge, so that he would be familiar with both the performance of the aircraft and its handling characteristics, in this manoeuvre.

2.13 In fact, the pilot's familiarisation with Tiraora Lodge consisted of one flight as a passenger in a Cessna 185, with the owner flying it. This met the legal requirements of Regulation 77, being a landing "as observer on the flight deck" and would have been sufficient before operating into an ordinary aerodrome. It was inadequate for operation into an airstrip which did not meet the criteria for an authorised landing ground and in an aircraft the maximum authorised mass of which was above the limits for the use of authorised landing grounds.

2.14 The pilot's belief that the clump of trees beside the runway was the controlling factor in making a missed approach and thus that he could fly safely to the runway threshold provided that he stopped the descent at 200 feet, demonstrated his lack of knowledge of the airstrip and surrounding terrain. The spur which he had to overfly in making his turn to the left was higher than the trees, so even in the absence of downdraughts or wind eddies he would have had little clearance to make a level turn.

2.15 The pilot expected the aircraft to climb during the turn, because the aircraft normally would climb in excess of 1200 feet per minute. However, this was the rate of climb to be expected when flying straight ahead, with flaps retracted and stabilised in the climbing attitude at the speed for the best rate and angle of climb. The pilot should have been aware that the overall climb achieved during transition from a baulked approach would be less than this and the rate of climb would be diminished in a climbing turn. It was reasonable to expect an airline pilot, who operated routinely into airstrips where such a manoeuvre might be required, to know the actual performance to be expected during the manoeuvre. That he did not, reflected adversely on the training he had received and on the checks which he had been required to undergo.

2.16 When the aircraft did not perform as the pilot expected, he thought the explanation might be that the flaps had not retracted from the "LANDING" position (56°) to "TAKE-OFF" (25°), possibly because he had not held the toggle-switch against its spring for a sufficient time for the flaps to have travelled out of the "LANDING" arc.

2.17 In fact it was more likely that he had not engaged the toggle switch long enough to set landing flap on the approach so that when he assumed he was selecting the take-off position during the missed approach he was actually retracting the flaps to the 6° setting.

2.18 Selection of the flaps from "TAKE-OFF" to a 6° setting at low speed during the missed approach was likely to be a counter-productive action in terms of loss of lift and increase of stalling speed. It was not surprising therefore that the stall warning came on and stayed on and that the pilot found he had to allow the aircraft to descend in order to maintain control.

2.19 If the pilot believed that the flap position indicator was unreliable, it was incumbent on him to check, by looking at the flaps, that the flap selection had resulted in the required flap position being achieved. This should not have posed a problem when selecting landing flap on approach. It may have been impracticable for him to have done so during the activity required of him by the missed approach manoeuvre.

2.20 If the flap position indicator was unserviceable it was a deficiency of which the pilot was aware and had accepted. Thus it should not have been a significant factor.

2.21 The flap position indicator was an instrument required by regulation to be fitted and in the absence of a Minimum Equipment List providing otherwise, it was required to be serviceable before take-off, for the aircraft to be airworthy.

2.22 Had the pilot been aware of the Regulation pertaining to the flap position indicator and the provisions in the Operations Manual as to requirements for serviceability, he ought not to have accepted the aircraft for the flight. That he was not aware of these items reflects adversely on his conscientiousness as a pilot in command and on the training and checking system.

2.23 Although the pilot believed the flap position indicator to be defective it was not recorded as unserviceable either on the defect record card or the aircraft logbook and the aircraft's maintenance engineers stated that if there was such an unserviceability it was not known to them.

2.24 The Operations Manual required pilots in command to report defects, after flight, to the Operations Manager whose responsibility it was to advise the engineers in writing. This appears never to have been done. With no provision in the Manual for delegation of the Operations Manager's duties such a situation could have been anticipated. In view of the small scale of Sounds Air's operations, it would have been more realistic to require each pilot to notify the engineers of any defects direct.

2.25 The Air Transport Division were aware that the owner's other employment involved his absence overseas at frequent intervals and he could not be on hand, continuously, to give written notice to the engineers of aircraft defects as they arose. The Manual ought not to have been approved with the owner as Operations Manager, without provision for delegation of the Operations Manager's duties.

2.26 The pilot made a straight-in approach to Tiraora Lodge airstrip, without first overflying the airstrip. He stated that this was the company's standard operating procedure. Overflight of the airstrip was desirable; among other reasons it enabled any obstruction on the strip to be seen (important at Tiraora Lodge, where the airstrip was concealed until close in on final approach) and in the circumstance of this accident the shadow of the hill would have made it evident that the sun's glare was close to the ridgeline and the approach should have been delayed for some minutes.

2.27 The owner stated that overflying an airstrip was standard company procedure if the entire runway and/or the windsock were not clearly visible throughout the approach. The owner was both Operations

Manager and Training Officer. The pilot and the owner could not both be right. In such a small company the Operations Manager/ Training Officer should have been able to ensure the pilots were aware of and complied with company operating procedures.

2.28 Regulation 76 required the pilot be checked on his continuing skill and competence. His logbook indicated that all such checks had been made on flights between aerodromes under instrument flight rules while flying for another operator. These checks were of no value in assessing his skill and competence at making visual approaches, landings and missed approaches at one-way airstrips, which formed a major part of his duties. The absence of such checks would have become apparent had the Air Transport Division performed a Base Inspection of Sounds Air's operations, since inspection of the pilot's logbooks was a part of a Base Inspection. There was no record of any Base Inspection having been carried out on Sounds Air's operation.

2.29 Regulation 77 provided that the pilot had to demonstrate to the operator his knowledge of the route, weather, aerodromes, aircraft and appropriate Regulations and documentation. Since the pilot did not appreciate the potential for downdraughts in the vicinity of Tiraora Lodge, was unaware that the trees were not the only significant obstacle in the vicinity of the airstrip, was unaware of the probable performance of the aircraft during the baulked approach manoeuvre and appears to have been unaware of relevant Regulations and provisions in the Operations Manual, such checks cannot have been performed adequately.

2.30 The pilot's lack of instruction for the airstrip operations he was undertaking contrasted unfavourably with the early training provided for agricultural pilots for airstrip operations. The pilot's logbook did not show any training whatever in airstrip operations: he was self-taught. By contrast some 23 hours of dual and solo flying was considered necessary to build up experience at low level operation and airstrip operation, before a pilot was deemed proficient to begin training for agricultural operations from airstrips. This pure flying training was considered necessary for the protection of a pilot engaged on agricultural operations yet no similar training programme was laid down for the protection of the passengers of a pilot flying on air transport operations in a similar environment.

2.31 A greater level of skill should have been required of the air transport pilot, not only because he carried passengers but also because he was required to operate in stronger winds and more adverse weather. He also got less opportunity for reinforcement of technique than was provided by the repetitive circuits flown by pilots on agricultural operations.

2.32 Had a member of the Air Transport Division's staff flown on a route check with the pilot into the airstrips used by Sounds Air, the pilot's lack of training in airstrip operations might have been detected and remedied before the accident occurred.

2.33 When it became apparent that an accident was imminent, the pilot should have called to the passengers to "brace for impact". The "brace for impact" position had been found to reduce the severity of injuries experienced in accidents and thus to increased the probability of

the occupants surviving both the impact and the subsequent evacuation. The passengers were not instructed in the "brace for impact" position prior to take-off, nor did the Operations Manual require it to be done.

2.34 The pilot was required to conduct an emergency briefing before flight, covering the wearing of life jackets and operation of the emergency exits, but neither of the fare paying passengers could recall such a briefing being given before this flight.

2.35 The life jackets had been stowed in a valise near the pilot's seat. The Regulations expressly required them to be stowed within reach of each passenger while seated. It was fortuitous that the passenger seated behind the pilot knew where the life jackets were and started to hand them out, but her efforts were unavailing because the life jackets were contained in satchels which did not indicate what the contents were, let alone how to use them. The lack of available, clearly marked life jackets might have caused fatalities had rescuers not arrived at the wreckage promptly.

2.36 As was to be expected in a ditching, some of the aircraft's doors could not be opened. However the emergency exits would not open either because they were sealed in place to prevent rain water leaking in. It was unlikely that they had ever been tested to see if they could be opened. It was fortunate that the cargo netting between the cabin and the cargo bay had come adrift in the accident and that a strong passenger recovered sufficiently quickly to reach the cargo door and kick it open. This situation indicated the desirability for any door which might be used in an emergency to have a large and obvious handle with which to open it.

2.37 Surveillance in accordance with ICAO Document 8335 should have detected many of the shortcomings which led to this accident and impaired subsequent survivability. Such surveillance should have detected the pilot's lack of training in this type of operation and lack of subsequent checking on his skill and knowledge, allowing these lapses to be rectified. It should have brought to light the specific failures to brief the passengers on emergency procedures and to overfly the airstrip before making an approach and detected the weaknesses in the airline's missed approach procedure at Tiraora Lodge airstrip. It should have detected the improper stowage of life jackets. Because no surveillance was done, the opportunity to interrupt the chain of events which led to this accident was lost.

2.38 The policy of "downsizing" the Air Transport Division, together with an unexpected early retirement of two GAIs, resulted in the remaining staff being unable to cope with the existing workload of surveillance. As a result, scrutiny of the Operations Manual before approval was deficient and surveillance of Sounds Air's operations was non-existent.

3. FINDINGS

3.1 The aircraft had a valid Certificate of Airworthiness and Maintenance Release.

3.2 The pilot stated that the aircraft's flap position indicator was known to be unserviceable before departure.

3.3 If the flap position indicator was unserviceable the aircraft was not airworthy.

3.4 If the flap position indicator was unserviceable it may have misled the pilot as to the position of the flaps.

3.5 The pilot made no attempt to have the flap position indicator repaired before he commenced the flight.

3.6 The pilot configured the aircraft incorrectly, for a baulked approach.

3.7 The pilot did not check the position of the flaps, visually during the approach or the subsequent missed approach.

3.8 The incorrect flap position contributed to the aircraft's loss of height which led to it striking a wire.

3.9 The pilot continued the approach beyond the nominated missed approach point despite being blinded by sun glare.

3.10 The pilot commenced the missed approach from a point which, in the prevailing conditions, did not permit the manoeuvre to be completed safely.

3.11 The pilot flew past the company's missed approach point intentionally.

3.12 The pilot's unfamiliarity with the airstrip and prevailing meteorological conditions led him to the mistaken belief that a missed approach was possible from 200 feet above the runway threshold.

3.13 The pilot had received inadequate training in relation to Tiraora Lodge airstrip.

3.14 The removal of the left tailplane by a telephone line deprived the pilot of control of the aircraft before it dived into the sea.

3.15 The passengers had not received an adequate safety briefing.

3.16 Life jackets were not "easily accessible from the seat" of each of the passengers.

3.17 The aircraft's emergency window exits did not function as intended.

3.18 Fatalities were averted by the valiant actions of two of the passengers and the prompt actions of rescuers.

3.19 The pilot had received no formal training in airstrip operation.

3.20 The pilot was unfamiliar with important provisions in the Regulations and Operations Manual which would have helped to avert this accident.

3.21 It was the pilot's responsibility to be familiar with the Civil Aviation Regulations and the Company's Operations Manual.

3.22 The owner of Sounds Air who was nominated as Operations Manager and Training and Safety Officer was often absent.

3.23 The positions of Operations Manager, Training and Safety Officer were not delegated.

3.24 In the owner's absence the system of control defined in the Operations Manual did not work.

3.25 Prior to the accident the Ministry of Transport had introduced a policy of "downsizing" which resulted in staff shortages.

3.26 The Ministry of Transport's action in "downsizing" its staff of the Air Transport Division , together with the unexpected loss of two GAIs, resulted in inadequate surveillance of VFR air transport operators

3.27 The staff shortages in the Air Transport Division were such that adequate supervision of the Sounds Air operation was impracticable and proper scrutiny could not be given to Operations Manuals.

3.28 Had the recommended surveillance been performed, the factors which led to this accident could have been detected before the accident occurred.

3.29 Tiraora Lodge airstrip did not meet the requirements for an Authorised Landing Ground.

3.30 The BN-2A Islander aircraft exceeded the maximum mass limit for aircraft authorised to operate into an ALG without dispensation.

3.31 Sounds Air had a dispensation to operate their Islander aircraft into the Tiraora Lodge Airstrip.

CONCLUSION

The probable cause of this accident was the pilot's decision to continue to fly the aircraft, at 200 feet amsl, past the point from which a missed approach could be successfully achieved, when he was unable to see the position of the runway, its threshold or the windsock. Other contributory factors were:

The pilot's unfamiliarity with the Tiraora Lodge Airstrip,

The pilot's inadequate training in strip operation and on the aircraft type,

The pilot's failure to check the position of the aircraft's flaps, visually, during the missed approach procedure when he believed the flap position indicator to be unreliable,

The pilot's unfamiliarity with the aircraft's flap operating system,

The lack of a suitable wind measuring device or other information on the local winds in the area and the presence of a substantial downflow in the area of the attempted missed approach,

Obstructions within the obstruction free area prescribed for approved landing grounds, and

The absence of supervision of the airline by the regulatory authority.

4. SAFETY RECOMMENDATIONS

4.1 As a result of the investigation of this accident it was recommended to the General Manager of the Air Transport Division that:

Soundsair be subject to an Audit by the Air Transport Division with a minimum of delay, unless such action had already been taken or the company was no longer operating.

He liaise with with Police to discover what maps they use, and have such maps available for rescue helicopters.

He review the minimum recent experience in airstrip operations required for pilots authorised to operate into the Tiraora Lodge airstrip on air transport operations.

He consider a requirement for escape exits on all air transport aircraft to be operated at regular intervals, on maintenance checks, to prove their operability.

He inspect the various types of aircraft used for air transport operations and identify each door which a passenger might use as an exit in an emergency.

He design and fit suitable handles for opening such doors from the inside in an emergency.

He ensure each emergency exit had a readily identifiable and effective handle on the inside of the aircraft.

He require the (3 above) recommendations as airworthiness requirements for all imported aircraft.

He require the operator to provide some accurate source of windspeed indication at Tiraora Lodge airstrip.

He require the owner to level the threshold of runway 08 at Tiraora Lodge airstrip.

He require operators to produce detailed studies of potential downdraught or wind-eddy situations in the vicinity of airstrips that they use or intend to use for air transport operations in the Marlborough Sounds.

He review wind limitations in the light of these studies, especially in relation to go-around procedures.

The procedure for the issue of Landing Ground Authorisations by Air Transport Division staff be reviewed to ensure that the persons to whom this task was delegated were familiar with the standards required and the implications of granting exemptions.

He require operators to produce for approval a mandatory syllabus of training for pilots intending to engage in air transport operations into confined airstrips and require training for pilots already so engaged.

He require pilots engaged in air transport operations into confined airstrips to demonstrate the missed approach procedure with the aircraft in which they intend to operate ballasted to the authorised mass and most adverse C of G position for that airstrip and require that such demonstration be used for checks in accordance with Regulation 76 and 77.

When the Operations Manual called for a particular missed approach procedure then the Operations Manual identify the physical feature to determine the missed approach point.

He review whether the standards for air transport operations from ALG's where a missed approach could not be performed safely from the runway threshold were acceptable.

He require an examination of the key personnel of airline operators on their knowledge of their regulatory responsibilities and of any special hazards associated with their operation as part of the Quality Audit of Air Transport Operators.

Until such time as the "Quality Audit" system proved to be able to establish the safety of air transport operations, routine inspections in accordance with ICAO Doc 8335 be re-established.

He redraft paragraph 3.3.1 on page MET 3-2 of the Aeronautical Information Publication to clarify whether or not the General Aviation Weather is intended for use by pilots planning VFR air transport operations.

He require the "brace for impact" position to be included as part of the pre-flight passenger briefing by demonstration or by reference to a briefing aid.

4.2 It was recommended to the Manager of the New Zealand Meteorological Service that the provision of Area Forecasts and Aerodrome forecasts to general aviation pilots be reinstated.

5. REGULATORY

5.1 Pursuant to Regulation 15(1) of the Civil Aviation (Accident Investigation) Regulations 1978 the operator, the pilot and the Air Transport Division were invited to avail themselves of the opportunities afforded to them thereunder.

5.2 As a result of representations received from the above parties the report was amended and amplified to clarify some of the points raised.

5.3 The representations made to the undersigned are not to be taken as an admission of liability on the part of the operator, the pilot or the Air

Transport Divison and their statements are without prejudice to their right to act in any way they may consider fit in any proceedings or action which may be based on the events to which this report refers.

M.F. DUNPHY
Chief Commissioner