NO. 93-012

FLETCHER FU24-950M

ZK-BHU

1.5 KM SOUTH-EAST OF TAUWHARE

28 SEPTEMBER 1993

ABSTRACT

On 28 September 1993, ZK-BHU, a Fletcher FU-24 aircraft collided with the terrain during a topdressing sortie. The cause of the accident was not determined.

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

AIRCRAFT ACCIDENT REPORT NO. 93-012

Aircraft Type, Serial Number and Registration:	Fletcher FU24-950M, 22 ZK-BHU
Number and Type of Engines:	One Lycoming IO-720-A1B
Year of Manufacture:	1955
Date and Time:	28 September 1993, 1307 hours*
Location:	1.5 km south-east of Tauwhare, near Hamilton Latitude: 37°47'S Longitude: 175°28'E
Type of Flight:	Aerial Work, Agricultural
Persons on Board:	Crew: 1
Injuries:	Crew: 1 Fatal
Nature of Damage:	Destroyed
Pilot in Command's Licence:	Commercial Pilot Licence (Aeroplane), Agricultural Rating Chemical Rating
Pilot in Command's Age:	39
Pilot in Command's Total Flying Experience:	6584 Hours 6250 On Type
Information Sources:	Transport Accident Investigation Commission Field Investigation
Investigator in Charge:	Mr D G Graham

* All times in this report are NZST (UTC + 12 hours)

1. NARRATIVE

1.1 On 28 September 1993, (the day of the accident) the pilot and loader driver commenced duty at Hamilton Aerodrome, their normal operating base, at about 0800 hours. The loader driver had known the pilot for some 18 years and had worked with him as a loader/driver for the past four years. He reported that the pilot was in his usual good spirits at the commencement of the day's work.

1.2 Arrangements had been made for the pilot to sow 15 tonnes of 'Pasture-mix', a proprietary fertiliser compound, on a farm about 16 km east of Hamilton, near the settlement of Tauwhare. The aircraft would operate from an airstrip on a nearby property, some 4 km to the north from which the pilot and loader driver had completed an unrelated 55-tonne contract on the previous Saturday (25 September), and the loading vehicle was already positioned at the airstrip. On the same day the pilot had inspected the relatively small farm on which a hill block and some flat paddocks were to be topdressed, and had discussed with the farmer his requirements for the distribution of the fertiliser.

1.3 Before departure from Hamilton, the pilot held a telephone conversation with the carrier engaged to transport the fertiliser. It was arranged that he and the loader driver would fly in advance to the airstrip and assist the carrier to unload on the latter's arrival. In the course of the telephone conversation the pilot raised the possibility that, in his assessment of the local weather conditions, a later deterioration might require topdressing operations to be suspended.

1.4 Fletcher FU24 ZK-BHU was the company aircraft allocated to the pilot, and had been flown by him on a regular basis since 1984. The aircraft was kept at Hamilton Aerodrome, and was tied down overnight, and at weekends, in an open area adjacent to the company hangar. The pilot and loader driver had refuelled ZK-BHU to capacity following their return to Hamilton after the completion of topdressing on the Saturday and the aircraft had remained on pickets since that date.

1.5 The pilot carried out a pre-flight inspection, including fuel drain checks which disclosed no water or other contamination. At about 1115 hours he and the loader driver flew from Hamilton to the airstrip. The flight took approximately 5 minutes. The loader driver, who was very familiar with the operation of ZK-BHU, reported that the aircraft appeared to perform normally in all respects. He had not specifically observed the pilot check the contents of the left and right fuel tanks visually during the pre-flight inspection but recalled that both fuel gauges indicated "FULL" during the flight.

1.6 At the airstrip, the bulk load of fertiliser was transferred on to the smooth concrete floor of the covered storage bin. The fertiliser was dry and free-flowing. The bin itself was situated on the crown of a large, rounded hill paddock. The smooth close-cropped grass slopes of the paddock formed the airstrip, providing a steep but effective take-off path towards the south-east.

1.7 Topdressing operations commenced at about mid-day. The aircraft was loaded with one tonne of fertiliser for each sortie. Seven round trips were completed uneventfully. Each round trip took approximately four minutes.

1.8 No communication, either verbal or by other means, took place between the pilot and the loader driver during this period. The aircraft appeared to be operating in an entirely satisfactory manner and the pilot gave no indication to the loader driver of any required variation in the load. The loader driver did not obtain any impression that conditions in the sowing area had changed or were deteriorating to an extent that could have dictated either a temporary break, or cessation of operations for the day.

1.9 The take-off for the eighth sortie was normal. After the aircraft's departure the loader driver drove to the bin and filled the loader bucket in preparation for the next sortie. By the time this was accomplished he expected to see the aircraft on its return flight but on this occasion there was no sign of ZK-BHU. A short time later he observed smoke in the area where the pilot had been operating and used a mobile telephone to alert emergency services.

1.10 A number of ZK-BHU's topdressing runs were watched by local people, including pupils at Tauwhare School, and several farmers. The pilot was well known in the area. Nothing unusual was observed in regard to the pattern flown, the height, or the manoeuvring of the air-

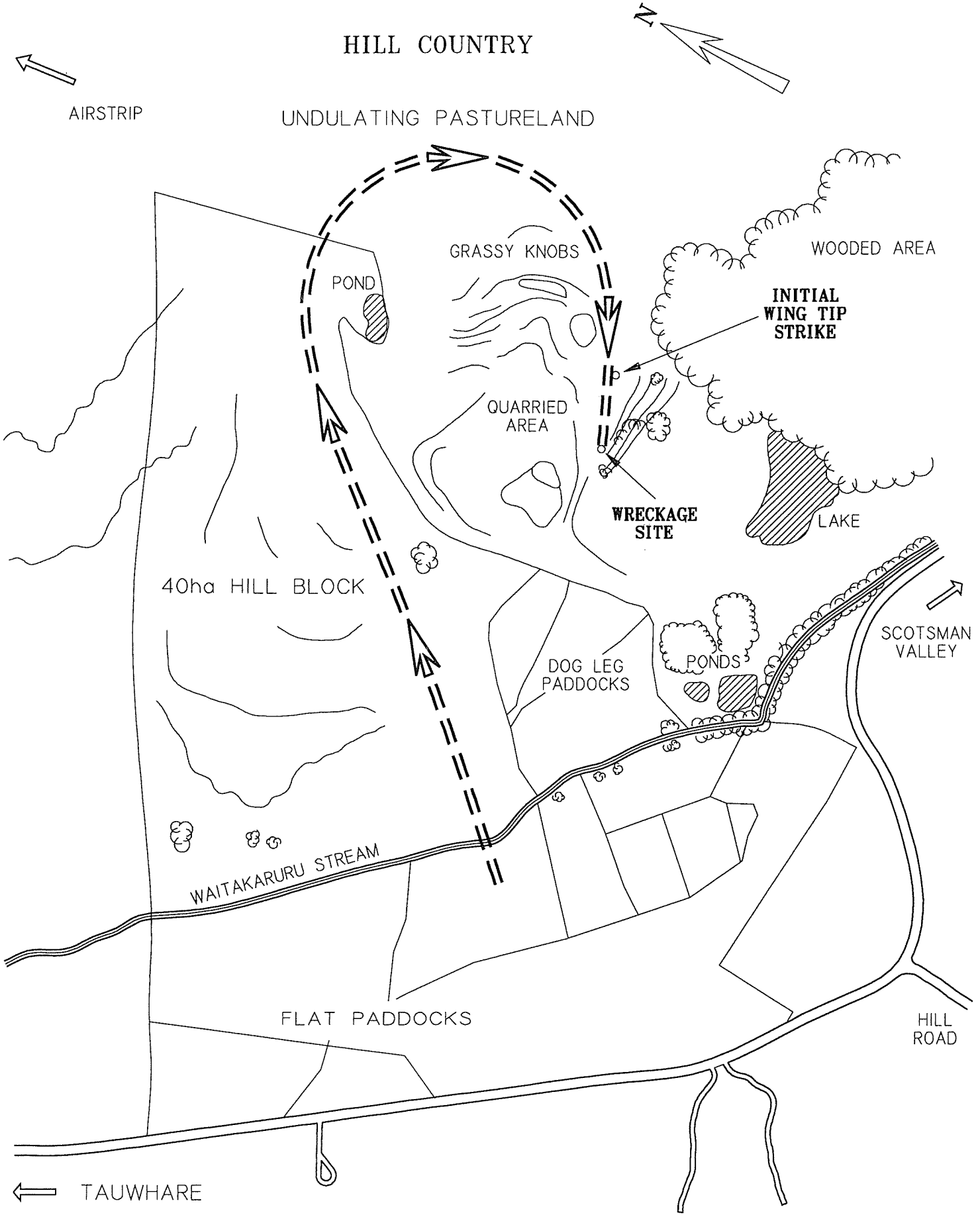

FIGURE 1 **APPROXIMATE FINAL FLIGHTPATH ZK-BHU**

craft. The aircraft was lost to the view of these observers at various stages during the runs due to their location and the intervening hilly terrain.

1.11 A resident of Scotsman Valley Road had watched the aircraft. At about 1300 hours ZK-BHU flew in his direction as the pilot made a sowing run towards the west. He reported that "... the aircraft turned and went back up the gully, dropping another load. At the top of the gully it banked hard to the right and went around the back of the quarry where it disappeared from my sight ... the engine did not miss a beat at all". About five seconds later he heard a "woompf" and saw a small puff of smoke. He immediately arranged for the emergency services to be contacted and proceeded as quickly as possible, by motorcycle, to the site. Others had also made their way to the scene but the wreckage of the aircraft was engulfed in flames and no assistance could be rendered to the pilot.

1.12 The farm covered a total area of 63 hectares, of which 40 hectares were to be topdressed. It was situated on the east side of Scotsman Valley Road about 1 km south-east of Tauwhare, at the edge of the Waikato Plain, and included a number of paddocks at an elevation of about 200 feet amsl. To the east however it comprised gently rolling hill country rising to more than 600 feet amsl. A dog-leg of small flat paddocks bounded by fences and the Waitakaruru Stream lay at the lower level to the south (see Fig. 1).

1.13 The adjacent property on the east side included an abandoned quarry and a narrow gully oriented approximately north-east/south-west which opened towards the lower flat land and the dog-leg area of the property being sown. The required sowing rate was 375 kg to the hectare. Eye witness reports describing the aircraft's flight path, and ground examination to establish the areas which had been covered prior to the accident, suggested that the pilot had followed a sowing pattern corresponding to that shown in Fig. 1.

1.14 The loader driver reported that the weather was clear at the time of the accident. He estimated the wind as 10 to 15 knots from a southerly direction. The aircraft's take-off path on each sortie had been into wind.

1.15 Conditions at Hamilton Aerodrome at 1300 hours were reported as follows:

Wind: 200°/13 knots

Visibility: 70 km

Cloud: 1 octa strato cumulus at 4000 feet

Temperature: 12°C

QNH: 1022hPa

The automatic weather station at the aerodrome recorded the following information at 1300 hours:

Wind: 210°/13 knots (maximum gust in the last 10 minutes 20 knots)

Relative Humidity: 45%

1.16 In a report on the weather at the time of the accident the Director of the Meteorological Service of New Zealand Ltd commented:

> "Situation: On 28 September 1993 an intense anticyclone was centred to the west of the North Island and a southerly airstream flowed over the North Island.
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> Weather: The southerly air flowing over the North Island was very dry and the island was virtually cloud free except for some areas east of the main ranges.
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> Surface Winds: There was a moderate gradient giving winds of about 15 knots close to the ground. The direction over the relatively flat ground of the Waikato plain was probably about 200° or 210° . However in the rolling hill country where the accident occurred the direction was probably more south-westerly and the winds may well have been blowing up the gully down which the aircraft was flying. That is, the aircraft probably had a headwind of the order of 15 knots.
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> Turbulence: There is no radiosonde ascent near to the accident area but the tephigrams from balloon flights at Kaitaia and Paraparaumu released about 1100 hours both showed the atmosphere to be unstable up to about 7000 feet where an inversion stopped any further upward motion. Both ascents show a steep lapse rate, close to the dry adiabatic lapse rate, near the ground which indicates that turbulent mixing was taking place up to 5000 feet at Kaitaia and 7000 feet at Paraparaumu. This instability together with the roughness of the terrain would have caused occasional moderate turbulence at low levels. Temperature: At the time of the accident the surface temperature was about 13°C and the lapse rate close to 3°/1000 feet. The surface dew point was about 1°C".

1.17 It was noted at the accident site, in conditions similar to those existing on the day of the accident, that the wind varied from occasional calm, to gusts and puffs stronger than the prevailing wind over the Waikato plain due to funnelling effects in the narrow valley. The

burned area confirmed that the wind was predominantly blowing up the gully, ie. from a south-westerly quarter, at the time of the accident.

1.18 Ground marks, wingtip damage, and the subsequent wreckage trail showed that the right wing of ZK-BHU had contacted the northern side of the narrow north-east/south-west gully at its upper end at an elevation of about 400 feet amsl. The tussocky grass covered gully sides sloped steeply in the area. The aircraft was on a heading of approximately 225°M at initial contact, and banked about 45° to the right. The tip and adjacent skin sections progressively tore away, and the right outboard panel detached as the aircraft descended along the side of the gully. After about 50 m it struck dense gorse and scrub and cartwheeled, then slid semi-inverted some 20 m to the base of the gully. It had come to rest upright on a northerly heading with the tail assembly in tall gorse part way up the opposite slope.

1.19 The engine separated completely from the airframe and the forward area of the cockpit had broken open. During the cartwheel phase the rudder had separated entirely from the fin assembly, and lay in the gorse upslope of the main wreckage. The rudder torque tube had fractured at its base where it was welded to the control horn, and the rudder had torn away from the upper pivot. One magneto and parts of the exhaust had also detached from the engine, and some fertiliser had been ejected through the hopper entrance, indicative of the disruptive forces acting at that point in the accident sequence.

1.20 The right fuel tank had broken away from the wing leading edge as the aircraft slid downslope. It was likely that exposed fuel lines and the hot exhaust contributed to the immediate outbreak of fire. Apart from the left wing and flap assembly the whole aircraft had been consumed by fire. A quantity of fuel remained in the punctured, but relatively intact, left tank. The fire ignited adjacent scrub, seedling pines, and grass on the southern side of the gully, and burned an area of about two hectares.

1.21 The hopper sowing lever was in the closed position and an estimated three to four hundredweight (150-205kg) of fertiliser remained in the hopper. The propeller was still attached to the engine crankshaft. Continuity and integrity of the elevator, aileron and rudder systems was established as far as practicable, given the ravages of the fire which had generated sufficient heat to melt brass turnbuckles and consume significant portions of the aluminium alloy structure. The aircraft was fitted with an electric trim system. The extension of the stabiliser trim actuator corresponded to a neutral trim setting.

1.22 ZK-BHU was built in 1955 from components produced by the Fletcher Company in the USA. The aircraft had been converted to FU24-950M status in 1979. In 1992, revised wing and aileron fairings and vortex generators had been installed, as a general modification introduced to enhance the handling qualities of the type. At the time of the accident the airframe had accumulated a total of 19077 hours. 1627 hours had been recorded since the last complete overhaul.

1.23 ZK-BHU was maintained in accordance with the Operator's Fletcher FU24-950 series Inspection Schedule. The most recent scheduled maintenance comprised a Check 4, carried out in June 1993. This included inspection of the fin and rudder assembly for condition and security. The aircraft had flown some 84 hours since this inspection. Maintenance work on ZK-BHU since the Check 4 had involved, in August 1993, installation of a 43 cubic foot (1.3 cu metre) hopper, and rebuilding the horizontal stabiliser.

1.24 Lycoming IO-720-A1B Serial Number L1140-54A was installed in ZK-BHU in 1992 and had run a total of 4066 hours, with 1725 hours since overhaul. Hartzell Propeller HC-C3YR-IRF/F-8475R, Hub Serial Number DY1949, had a total of 3255 hours, and 1627 hours since overhaul. There was no indication of pre-impact damage or abnormality in regard to the propeller. The propeller governor functioned normally when tested.

1.25 The severe impact damage to the engine and accessories including a broken crankcase, mount brackets, and the oil filter adapter rendered a test-run impracticable. The engine was bulk stripped at an approved facility. Considerable wear was identified in the cylinder assemblies and four broken compression rings were found. All other engine components were in normal condition, consistent with the engine hours run. The left magneto functioned satisfactorily on bench test. The right magneto could not be test run but strip examination disclosed no pre-impact defect. Fuel was present throughout the engine fuel injection system. No contamination was evident. All components functioned normally when bench tested. Although the cylinder wear and broken piston rings would have resulted in some overall power loss, no significant defect or anomaly was found in the engine or its accessories which

might have contributed to the accident.

1.26 Fire had destroyed portions of the fuselage rear bulkhead, the base of the fin, and the horizontal stabiliser. Sufficient evidence remained, however, to conclude that damage to the left stabiliser bracket and the right stabiliser leading edge had occurred during the ground impact sequence. The rudder torque tube had broken away from the control horn earlier in the wreckage trail (see 1.19). The right arm of the control horn remained in place on the lower pivot mounting. The left arm had been bent downwards before separation. The fin vertical spar had broken just above the rear bulkhead and the fin forward attachment had failed.

1.27 The rudder control horn assembly, and the rudder itself, together with the fin forward fitting and vertical spar were submitted for detailed metallurgical examination. The fin components had fractured in a ductile mode, and it was concluded that ground impact forces resulted in failure of the vertical spar with subsequent failure of the forward fitting.

1.28 Examination of the rudder torque tube and the detached control horn arms indicated that repair of the control horn/torque tube pressed and welded junction had taken place on an earlier occasion. The torque tube was protected externally by several layers of paint but internally it was coated thickly with fertiliser residues and corrosion products. Severe general and pitting corrosion had caused thinning of the torque tube wall, and subsequent weld repairs showed undercut of the wall at the toe of the weld, with a lack of fusion, and hot-tearing, in other areas. Much of the fracture path was through defective weld beads and tube wall. The metallurgical investigation concluded that weakening by these pre-existing defects contributed to the separation of the control horn/torque tube assembly. While it could not be established with certainty when ultimate deformation and overload failure occurred, the available evidence suggested that ground impact forces were more likely to have caused the failure than "in-flight" loads.

1.29 Medical and pathological investigation resulted in the following conclusions:

> "The impact forces were within the survivable range but the intense fire which broke out immediately after impact precluded opportunity for survival.
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> The pilot was wearing a protective helmet and this was retained during the impact. The pilot restraining harness worked satisfactorily during the impact, and it would appear that all aids to survival operated satisfactorily.
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> There was no evidence of pilot incapacitation, although post-mortem examination was restricted by the extensive burns. Nothing from the medical history of the pilot, or pathological examination indicated any probability of impairment of flying performance or risk of sudden incapacitation."

1.30 The pilot was regarded as a very competent topdressing pilot. He had commenced flying training in 1971, and had been employed in the agricultural aviation industry since 1975, initially working as a loader driver. In 1981 he had obtained a Commercial Pilot Licence (Aeroplane), and in 1982, after completing a course of Agricultural Flying Training had begun topdressing under supervision. He had first flown ZK-BHU in 1983, and at the time of the accident had recorded a total of 4420 hours on this aircraft. During the last 90 days he had flown 132 hours of which 76 hours was on ZK-BHU. In the last 29 days he had flown 39 hours, all on ZK-BHU. He had flown a total of about 78 hours on spraying operations. The pilot had spent almost all his flying career engaged in topdressing activity in the Waikato, and had flown the FU24-950 type almost exclusively.

1.31 The loader driver's evidence, and witness descriptions of the aircraft in flight, indicated that topdressing proceeded uneventfully during the first seven sorties. The accident occurred toward the end of the eighth sortie when only a small quantity of fertilizer remained to be sown. The position and heading of the aircraft suggested that the pilot intended to complete the sortie by applying the fertiliser to the dog-leg area of the farm. The narrow gully, in which the accident occurred, opened out towards this area and a descent at an appropriate height following the line of the gully provided a logical lead-in for the sowing run.

1.32 When last observed the pilot of ZK-BHU had entered a turn "banked hard to the right". The aircraft then disappeared from view, hidden behind the hilly terrain. The position of the witness in relation to the terrain indicated that during this turn the pilot was flying ZK-BHU at a low height. At this stage of the sortie the aircraft was lightly laden and the pilot may have elected to follow the descending contours closely, consistent with his probable intention to enter and fly down the gully, then commence

sowing. The layout of the terrain suggested that an angle of bank of about 45° was appropriate to achieve the required radius of turn.

1.33 There were no eye-witnesses to describe the final flight path of ZK-BHU, which culminated in the right wing contacting the northern side of the gully. The orientation and shape of the gully was conducive to fluctuating wind strength and direction in the prevailing conditions, and there was a likelihood of moderate turbulence and possible wind shear at the time. Whether such factors adversely affected a finely judged turn conducted at low level, or whether some event occurred in-flight to distract the pilot, or cause an inadvertent additional loss of height in the course of a more routine positioning turn, could not be established.

1.34 The extensive destruction of the aircraft by fire rendered it impracticable to discount completely an in-flight control malfunction, or structural failure, as a causal factor in the accident. However, no definitive evidence was found to support such a possibility. In the event, the circumstances directly contributing to this accident remained unexplained.

2. FINDINGS

2.1 The pilot in command held a valid Commercial Pilot Licence (Aeroplane), with Agricultural and Chemical Ratings.

2.2 The pilot was experienced in topdressing operations.

2.3 The pilot was experienced in flying FU24-950 series aircraft.

2.4 The pilot was very familiar with the operation of ZK-BHU (the aircraft being flown at the time of the accident).

2.5 Most of the pilot's topdressing flying had taken place in the Waikato.

2.6 The pilot had not previously topdressed the farm near which the accident occurred.

2.7 The pilot had completed half of the topdressing contract uneventfully.

2.8 The topdressing contract required fertiliser to be sown on hilly country and on lower flat terrain.

2.9 The pilot was flying down a gully leading to lower flat paddocks when the accident occurred.

2.10 The aircraft was last observed in a steep turn to the right and disappeared from view behind hilly terrain leading to the gully.

2.11 The aircraft's right wing contacted the side of the gully, the wing collapsed, and the aircraft cartwheeled and came to rest at the bottom of the gully.

2.12 The immediate outbreak of an intense fire prevented rescue attempts and rendered the accident unsurvivable.

2.13 Moderate turbulence, wind shear, and fluctuating wind conditions were likely to have existed in the accident area at the time of the accident.

2.14 Extensive fire damage prevented conclusive determination of the pre-impact integrity of the aircraft structure, control surfaces, and primary control systems.

2.15 Destruction of the aircraft by fire, and the absence of witness observation to describe the aircraft's final flight path combined to preclude a determination of the accident's probable cause.

29 June 1994

M F Dunphy
Chief Commissioner

ABBREVIATIONS COMMONLY USED IN TAIC REPORTS

AD	Airworthiness Directive
ADF	Automatic direction-finding equipment
agl	Above ground level
AI	Attitude indicator
AIC	Aeronautical Information Circular
AIP	Aeronatical Information Publication
amsl	Above mean sea level
ASI	Airspeed indicator
ATA	Actual time of arrival
ATC	Air Traffic Control
ATD	Actual time of departure
ATPL (A or H)	Airline Transport Pilot Licence (Aeroplane or Helicopter)
AUW	All-up weight
C	Celsius
CAA	Civil Aviation Authority
CASO	Civil Aviation Safety Order
CFI	Chief Flying Instructor
CPL (A or H)	Commercial Pilot Licence (Aeroplane or Helicopter)
DME	Distance measuring equipment
E	East
ELT	Emergency location transmitter
ERC	En route chart
ETA	Estimated time of arrival
ETD	Estimated time of departure
F	Fahrenheit
FAA	Federal Aviation Administration (United States)
FL	Flight level
g	Acceleration due to gravity
GPS	Global Positioning System
HF	High frequency
hPa	Hectopascals
IAS	Indicated airspeed
IGE	In ground effect
IFR	Instrument Flight Rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
ins Hg	Inches of mercury
kHz	Kilohertz
KIAS	Knots indicated airspeed
kt	Knot(s)
LF	Low frequency
LLZ	Localiser
M	Mach number (e.g. M1.2)
M	Magnetic

MAANZ	Microlight Aircraft Association of New Zealand
MAP	Manifold absolute pressure (measured in inches of mercury)
MAUW	Maximum all-up weight
METAR	Aviation routine weather report (in aeronautical meteorological code)
MF	Medium frequency
MHz	Megahertz
mph	Miles per hour
N	North
NDB	Non-directional radio beacon
NOTAM	Notice to Airmen
nm	Nautical mile
NZAACA	New Zealand Amateur Aircraft Constructors Association
NZGA	New Zealand Gliding Association
NZHGPA	New Zealand Hang Gliding and Paragliding Association
NZMS	New Zealand Mapping Service map series number
NZDT	New Zealand daylight time (UTC + 13 hours)
NZST	New Zealand standard time (UTC + 12 hours)
NTSB	National Transportation Safety Board (United States)
OGE	Out of ground effect
PAR	Precision approach radar
PIC	Pilot in command
PPL (A or H)	Private Pilot Licence (Aeroplane or Helicopter)
psi	Pounds per square inch
QFE	An altimeter subscale setting to obtain height above aerodrome
QNH	An altimeter subscale setting to obtain elevation above mean sea level
RNZAC	Royal New Zealand Aero Club
RNZAF	Royal New Zealand Air Force
rpm	Revolutions per minute
RTF	Radio telephone or radio telephony
S	South
SAR	Search and Rescue
SSR	Secondary surveillance radar
T	True
TACAN	Tactical Air Navigation aid
TAF	Terminal aerodrome forecast
TAS	True airspeed
UHF	Ultra high frequency
UTC	Coordinated Universal Time
VASIS	Visual approach slope indicator system
VFG	Visual Flight Guide
VFR	Visual flight rules
VHF	Very high frequency
VMC	Visual meteorological conditions
VOR	VHF omnidirectional radio range
VORTAC	VOR and TACAN combined
VTC	Visual terminal chart
W	West