PB86-910408

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

BAR HARBOR AIRLINES FLIGHT 1808
BEECH BE-99, N300WP
AUBURN-LEWISTON MUNICIPAL AIRPORT
AUBURN, MAINE
AUGUST 25, 1985

NTSB/AAR-86/06

UNITED STATES GOVERNMENT

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16. Abstract

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The National Transportation Safety Board determines that the probable cause of the accident was the captain's continuation of an unstabilized approach which resulted in a descent below glideslope. Contributing to the unstabilized approach was the radar controller's issuance and the captain's acceptance of a nonstandard air traffic control radar vector resulting in an excessive intercept with the localizer.

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Adopted: September 30, 1986

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SYNOPSIS

About 2205 e.d.t. on August 25, 1985, Bar Harbor Airlines Flight 1808, a Beech Aircraft Corporation Model 99 crashed about 1 mile southwest of the Auburn-Lewiston Municipal Airport at Auburn, Maine, while making an instrument landing system (ILS) approach to runway 4. The weather was indefinite 300-foot ceiling, sky obscured visibility 1 mile in light drizzle and fog. The flight was a regularly scheduled commuter flight between the Boston-Logan International Airport and Bangor, Maine, with intermediate stops at Auburn, Augusta, and Waterville, Maine. All six passengers and the two flightcrew members were killed in the accident. The airplane was destroyed by impact forces and postcrash fire.

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1. FACTUAL INFORMATION

1.1 History of the Flight

About 1400 1/ on Sunday, August 25, 1985, the relief flightcrew for N300WP, a Beech Model 99, reported for duty at the Bar Harbor Airlines' operations department in Bangor, Maine. They were scheduled to make four trips between Bangor and Boston, Massachusetts, with en route stops at Auburn (Auburn-Lewiston), Augusta, and Waterville, Maine. The flightcrew that had flown four trips with N300WP earlier that day had a brief discussion with the relief flightcrew in the operations office. Reportedly, the relief crew was in good spirits and did not express any problems or concerns.

The off-duty crew reported that their flights had been routine and that there were no discrepancies with the airplane. The captain said that he considered N300WP to be one of the better airplanes in the airline's fleet. He also said that the two instrument landing systems (ILS) on board the airplane ". . . cross checked well . . ." and that the two altimeters were within 20 feet of each other. The first officer remembered that they had encountered some "pretty good showers en route to Boston." At that time, the weather at Boston was 4,500 feet overcast and 10 miles visibility.

1/ All times herein are eastern daylight, based on the 24-hour clock.

N300WP departed Bangor as flight 1793 at 1530, 15 minutes late, for Boston. The airplane flew in continually deteriorating weather conditions throughout the afternoon and early evening. The crew returned to Bangor about 1824, 25 minutes late.

N300WP was scheduled to depart for Augusta at 1815 as flight 1755. The airline flight follower on duty explained to the captain by telephone that there would be a change in the schedule because of air traffic control (ATC) delays and that at Boston, the return trip would be designated as flight 1808 instead of flight 1788. Flight 1788, normally was scheduled to depart Boston at 2015 and arrive in Bangor at 2150 on Sunday only. Flight 1808 is normally scheduled to depart Boston at 2040, arrive at Augusta at 2140, arrive at Waterville at 2159, and arrive at Bangor at 2235 only on Sunday. The company added a passenger stop at Auburn-Lewiston.

About 1840, the airplane departed Bangor as flight 1755 and arrived at Augusta at 1905, 39 minutes late. At 1915, it departed Augusta and arrived in Boston at 2015, 25 minutes late. While in Boston, the flight follower contacted the captain and told him that, although there were ticketed passengers for each scheduled stop, he could overfly any stops if the passengers did not show up for those destinations because there were no passengers scheduled to be picked up at those airports. Six passengers boarded the airplane along with 10 passenger bags and two mail pouches; two passengers were scheduled to be taken to Auburn-Lewiston, three to Augusta and one to Waterville. Originally, there were eight passengers, but two were transferred to a non-stop company flight to Bangor.

At 2100, the weather at Auburn-Lewiston was indefinite ceiling, 300 feet obscured; visibility--1 mile in light drizzle and fog; altimeter--30.24 inHg. The Augusta weather was: indefinite ceiling, 100 feet obscured; visibility--3/4 mile in light rain and fog, altimeter--30.27 inHg. At Waterville, it was indefinite ceiling, 400 feet obscured, visibility--1 mile in light rain and fog, altimeter--30.25 inHg.

The airline ramp agent used a ground power unit to assist in starting the airplane. At 2117:06, the captain contacted Boston Clearance Delivery and advised that they were en route to Auburn-Lewiston. The clearance delivery controller replied, "I show you going to Augusta, is that correct?" The captain replied, "It's totally changed, first ah we'll take the one to Augusta and change it en route." The controller gave the flight the following clearance: ". . . Augusta Logan three, Pease [PSN VOR] as filed, seven thousand will be the final, squawk 5374 . . ." The crew was advised that there would be about a 25-minute delay, but at 2126:27, ground control cleared the flight to taxi to runway 4L; the airline ramp agent described the departure as routine. The altimeter setting given by ground control was 30.19 inHg. At 2130:10, flight 1808 was cleared for takeoff and instructed to turn left to 360° The first officer acknowledged the instructions. At 2131:33, radar contact with the flight was established, and it was cleared to 5,000 feet mean sea level (m.s.l.). 2/ Flight 1808 was instructed to proceed direct to Pease VOR and to climb and maintain 7,000 feet.

At 2137:24, the first officer contacted Pease Approach Control while the airplane was passing through 5,500 feet and requested to go direct to the Kennebunk (ENE) VOR. The altimeter setting given was 30.21 inHg. Approach Control initially cleared the flight to Augusta, but the captain requested that his destination be changed to Auburn-Lewiston and requested ENE 036 radial transition to intercept the localizer to runway 4. About 2142, approach control cleared the flight to Auburn-Lewiston via direct Kennebunk at 7,000 feet and told the flight to contact Portland Approach Control. The captain acknowledged the transmission. (See figure 1.)

2/ All altitudes herein will be m.s.l. unless otherwise noted.

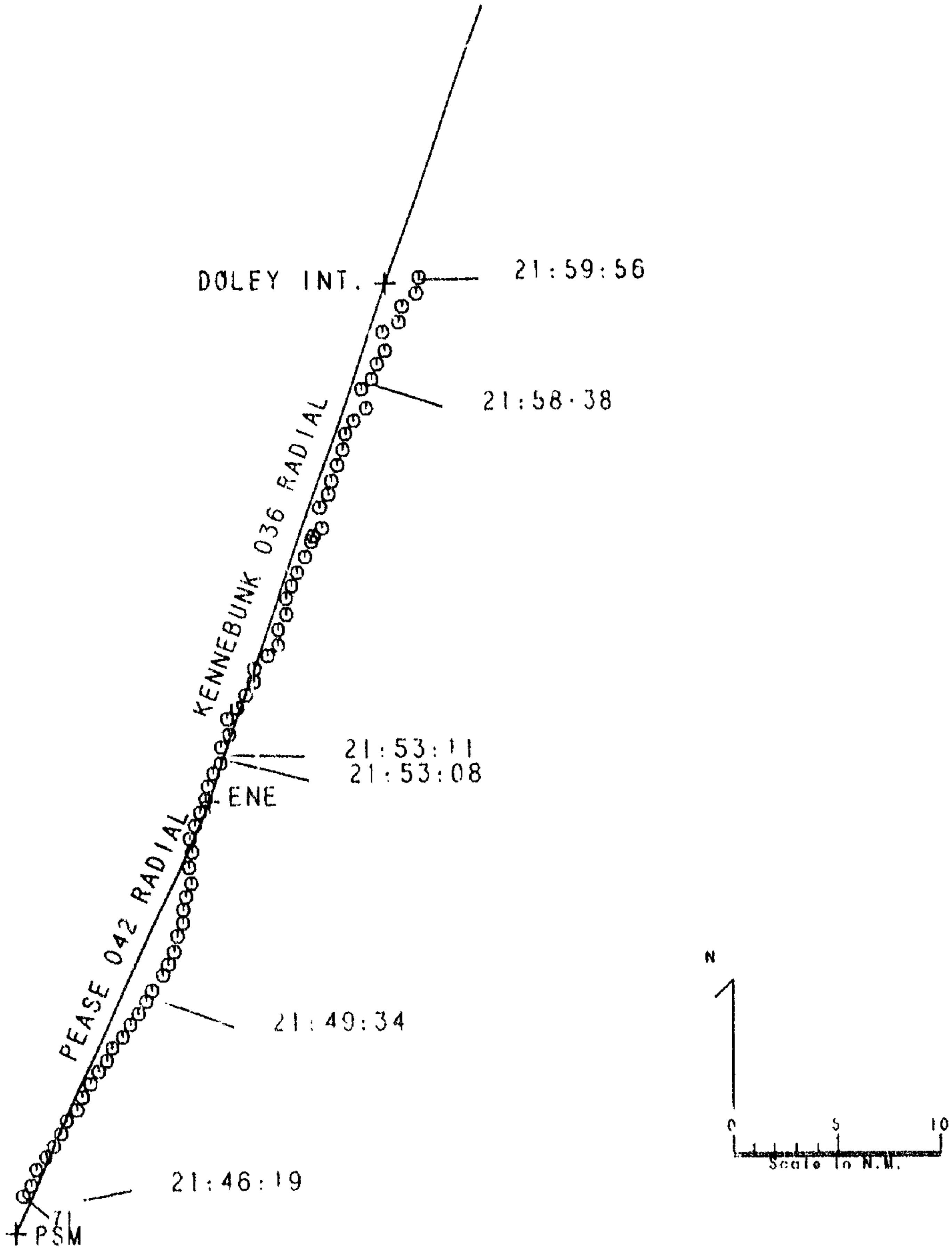


Figure 1.—Radar flight track.

At 2149:34, flight 1808 contacted Portland Approach Control, and reported level at 7,000 feet; the airplane was given an altimeter setting of 30.26 inHg, which the first officer repeated. Three minutes later, the first officer requested a lower altitude and was told to descend and maintain 5,000 feet. After the captain clarified their destination with Portland Approach Control and confirmed that he was on the ENE 036° radial, he was instructed to descend and maintain 3,000 feet and was provided the following Portland weather at 2153:50: Measured ceiling—200 feet overcast; visibility—1 3/4 mile, light rain and fog; winds—090° at 5 knots.

At 2158:38, Portland transmitted, "... one two miles south of Lewie (final approach fix), cleared ILS runway 4 approach, maintain three thousand until crossing Doley (intersection)." The first officer acknowledged the clearance. (See figure 2.) According to the controller the flight appeared on course and he then turned his attention to other traffic he was working in the area of Portland and Navy Brunswick.

The radar controller who handled flight 1808 was working the north and south radar positions combined. He had been working the 1500 to 2300 shift and had been working for about 30 minutes after taking a break before working the flight. At the time the controller was working flight 1808, he was also handling three other airplanes approaching Portland for ILS approaches and a fourth airplane transiting the area: People Express (PEX) Flight 391, a Navajo N791, a Bar Harbor Flight 796, and another Bar Harbor Flight 202 going to Navy Brunswick.

The controller had PEX 391 on a heading of 060° at 4,000 feet for an intercept to the ILS final approach course (112°) to runway 11 at Portland. He had the Navajo cleared to 3,000 feet on a 360° heading to intercept the final approach course and had told the pilot he was No. 2 to land behind PEX 391 (B727). The controller then told PEX 391 to keep his speed up as much as feasible and that it was number one to land. Next, he instructed the Navajo to turn right to a heading of 090° and to descend and maintain 1,800 feet until established on the localizer; he told the pilot he was 7 miles from the outer marker and cleared him for the ILS approach. Then the controller instructed PEX 391 that it was 5 miles from the outer marker, told him to maintain his present heading and 3,000 feet until established on the localizer, and cleared it for the ILS approach. Thirty-five seconds later, the Navajo was descending through 2,400 feet and the controller asked the pilot to reduce his speed. The controller further advised PEX 391 to maintain 3,000 feet. Because he needed to separate PEX 391 and the Navajo by 3 miles when he only had a 2-mile separation, he held PEX 391 at 3,000 feet longer than normal. As a result, the flightcrew of PEX 391 told the controller that they had a full scale downward deflection of the glideslope indicator needle and that they would have to make a 360° turn in order to make another attempt at the ILS approach. At that point, they were about 1 mile from the outer marker; the published crossing altitude at the marker is 1,800 feet. However, the controller told them that they could start their descent at that time. PEX 391 declined and obtained clearance for a 360° turn before beginning its final approach.

About 2200, according to the Bar Harbor station agent (weather observer) located in the terminal building at the Auburn-Lewiston Airport, flight 1808 called him and obtained the following Auburn-Lewiston weather: Indefinite ceiling—300 feet obscured; visibility—1 mile, light drizzle; wind--020° at 4 knots; altimeter--30.24 inHg.

At 2201:33, after noticing flight 1808 was east of course, the Portland Approach controller asked the flight if it was receiving the Lewiston localizer. The captain replied, "Not yet we haven't intercepted." The approach controller stated,

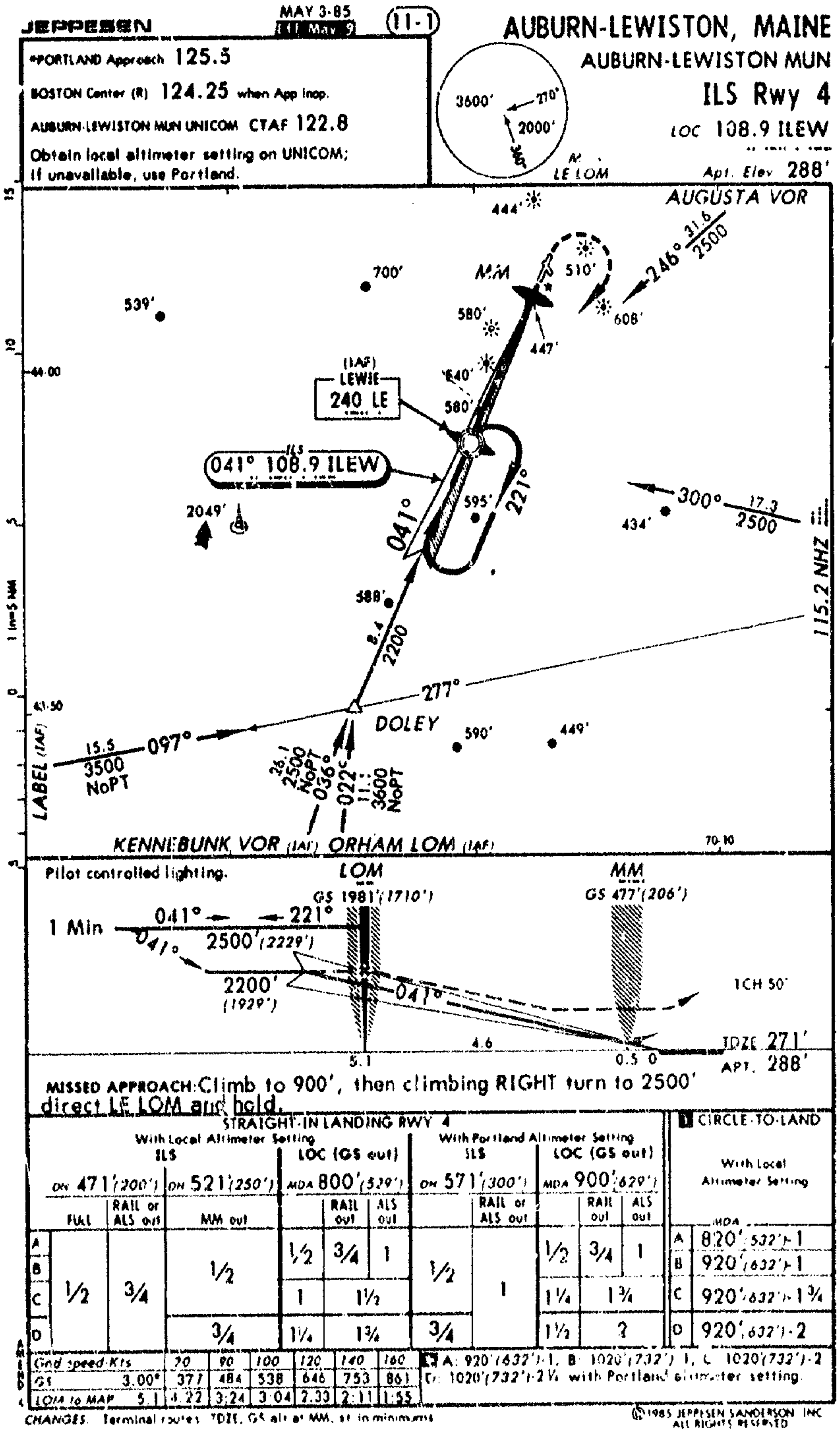


Figure 2.—Instrument approach chart.
(Not for navigational purposes.)

"Roger, turn left heading three four zero, show you slightly right of it." The captain replied, "Okay." Forty-five seconds later, the controller stated, ". . . You're over Lewie now you receiving it?" The first officer said, "Affirmative." The controller then stated, ". . . radar service terminated contact Lewie Unicom for advisories report missed approach this frequency or on the ground 124.05." The first officer acknowledged the instructions, and that was the last transmission from the flight. At 2213, Augusta Flight Service Station called Portland Approach and advised the controller that, about 2205, there had been an aircraft accident about a mile southwest of the Auburn-Lewiston Airport.

At the time of the accident, two witnesses were driving north, generally perpendicular to the airplane's flightpath to the runway. The passenger stated that she observed a cluster of red lights and "suddenly the plane dropped very quickly as a helicopter would do. . . ." She stated that the airplane then flew level and disappeared from her view. Within a few seconds she saw two "explosions," which the driver described as, ". . . like napalm. . . ." The witnesses said there was occasional light mist in the air, but they were able to see the airplane lights clearly. The driver said he could see the airport beacon clearly when he was about 1 1/4 miles south of the airport.

Other witnesses stated that the airplane was not on the normal flightpath to the runway and described the engine noise as louder than normal. They said that there were two separate explosions. The station agent at Auburn-Lewiston estimated that at 2207, the runway lights came on. He stated that he did not hear or see the airplane nor did he hear the crash. He observed emergency vehicles in the area of the crash site about 2215. Witnesses close to the runway observed that the approach lights were on at the time of the accident.

The airplane crashed 4,007 feet from the approach end of runway 4 and 440 feet to the right of the extended centerline of the runway at coordinates 44°02'22" N latitude, 70°17'30" W longitude. (See figure 3.)

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others	Total
Fatal	2	6	0	8
Serious	0	0	0	0
Minor/None	0	0	0	0
Total	2	6	0	8

1.3 Damage to Aircraft

The airplane was destroyed by impact forces and postcrash fire.

1.4 Other Damage

Tree and ground damage.

1.5 Personnel Information

The flightcrew was qualified to conduct the flight. The captain was employed by Bar Harbor Airlines on April 6, 1984. He held an Airline Transport Pilot certificate and was qualified as pilot-in-command in the Beech 99 on June 3, 1985. He had an

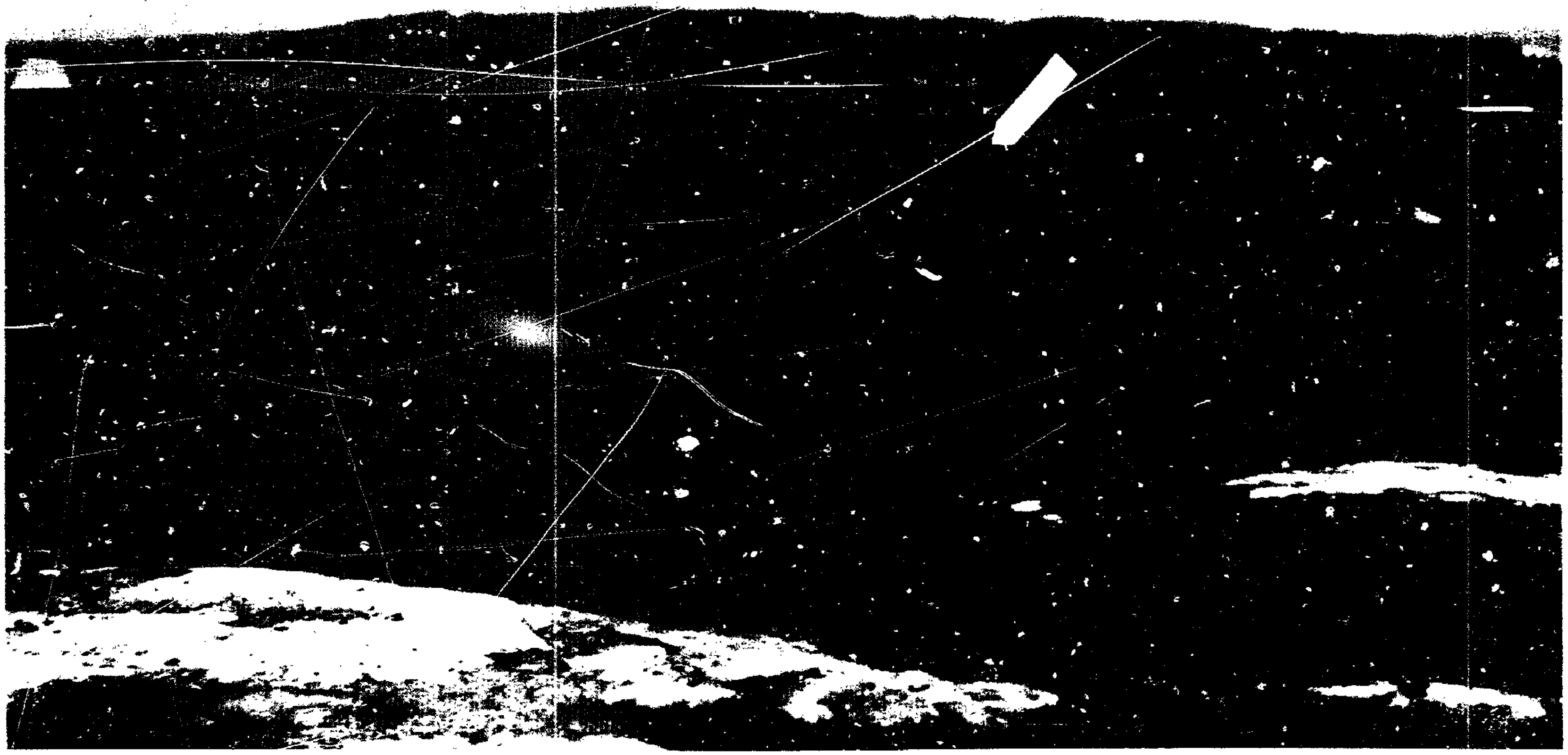


Figure 3.—View of approach end of runway 4.
Arrow shows location of initial tree impact site.

estimated 5,153 hours of total flight time, 504 hours of which were logged in the Beech 99. His total pilot-in-command time in the Beech 99 was 212 hours. His first class medical certificate was current and contained the limitation that lenses must be worn to correct for distant vision.

The first officer was employed by the airline on May 28, 1985. He held a commercial pilot certificate and a flight instructor certificate with instrument ratings. He received his first and only proficiency check in the Beech 99 on June 21, 1985. He had an estimated 1,453 hours of total flight time, about 153 hours of which were logged in the Beech 99. His first class medical certificate was current and contained no limitations.

In the 90 days preceding the accident, the captain had worked 53 days, 14 of which were worked in the preceding 30 days. He had been on vacation with his family from July 31 to August 8. He and the first officer flew another Beech 99 together on August 16 into Auburn-Lewiston. There was no adverse weather conditions on that day. The captain had been on duty from 0625 to 0905 the day before the accident.

The first officer had been on duty 36 of the 66 days since he started flight training. He had worked 15 days in the preceding 30 days. He had been on duty for about 13 hours on Friday, 2 days before the accident. He had called the company and requested sick leave on Saturday. Leave was requested because of an ear problem, but this was not known to the company. No information was available regarding the degree of pain/discomfort he was suffering. (See chart below.)

Duty Time Schedule
August 18-24, 1985

	Captain			First Officer		
Date	On	Off	Hours	On	Off	Hours
8/18	1255	2159	9.1	0905	1525	6.4
8/19		OFF		1215	1525	3.2
8/20	1445	2250	8.1		OFF	
8/21	1900	2126	2.5		OFF	
8/22	0625	0905	2.7		OFF	
	1900	2126	2.5			
8/23	0625	0905	2.7	0805	2039	12.6
	1900	2126	2.5			
8/24	0625	0905	2.7		SICK	
		Total	32.8		Total	22.2

The Portland Approach controller who handled flight 1808 was employed by the Federal Aviation Administration (FAA) and assigned to the Portland control tower on April 19, 1982. He was designated a full performance controller on May 22, 1984. He held a current medical certificate. He had gained previous radar approach control experience with the United States Air Force from 1974 to 1978.

Bar Harbor's station agent in Auburn-Lewiston held a current certificate issued by the National Weather Service (NWS) on March 8, 1982, to take surface weather observations. (See appendix B.)

1.6 Aircraft Information

Beech Aircraft Model 99, N300WP, powered by twin Pratt & Whitney PT-6 turbopropeller engines, was a 15-passenger, nonpressurized commuter airplane first type certificated in May 1968. Its maximum allowable takeoff gross weight was 10,400 lbs. with a center of gravity range from 179.0 to 195.0 inches aft of the datum line located at the nosewheel. Its maximum landing gross weight was 10,400 lbs. It had accumulated about 30,335 operating hours at the time of the accident.

1.6.1 Weight and Balance

According to Bar Harbor Airlines' procedures, the first officer enters the weights of the airplane, crew, passengers, cargo, and fuel on an approved airline weight and balance form. The airline uses an FAA approved average weight for passengers (165 lbs.) and baggage (23.5 lbs.) for this purpose. The captain calculates the center of gravity (c.g.) and signs the form as does the station agent on duty. The flightcrew keeps the original which is to be returned to the operations department at the end of their flight duty, and a copy is given to the ramp agent before the start of any particular flight.

Neither the copy nor the original weight and balance form for flight 1808 was found. The airline speculated that the copy was returned to the captain for revision when two passengers were transferred to the nonstop flight to Bangor and that he forgot to return the copy to the ramp agent. The weight of the payload and fuel for the return trip to Bangor would not have exceeded the takeoff weight limit of the airplane. In an attempt to determine the most probable weight and the c.g. of the airplane at takeoff and at the time of the accident, the Safety Board performed worst case forward and aft c.g. calculations.

The weight of the airplane was computed to be 9,280 lbs. at takeoff and 8,880 lbs. at the time of the accident. The worst case forward c.g. was at 178.0 and at 177.3 inches for takeoff and landing, respectively. The worst case aft c.g. was at 192.5 and at 192.4 inches for takeoff and landing, respectively. The most probable c.g. was computed at 185.67 and at 185.24 inches for takeoff and landing based on a random placement of the passengers in seat rows 2, 4, and 7. In either case, the center of gravity was within the c.g. envelope of the airplane.

1.6.2 Maintenance Discrepancies

The airplane was maintained under a Continuous Airworthiness Maintenance Inspection Program approved by the FAA. The program consists of a preflight inspection, a 60-hour inspection, and a detailed progressive inspection every 500 hours. It also includes on-condition or hard time repairs or overhauls of components or appliances. Avionics equipment and system checks are required to be accomplished every 12 months. The engines were under a slightly different inspection interval and in accordance with manufacturer recommendations.

Safety Board investigators reviewed maintenance records covering a 1-year period from August 1984 to August 1985. The review showed a trend of navigation/communication equipment discrepancies involving N300WP from September 1984 to August 1985. The No. 1 navigation/communication (NAV/COMM) transceiver was replaced on eight different occasions during the 12-month period: once in September, October, November, May, August (the day before the accident) and three times in June. The No. 2 NAV/COMM was replaced once in September and twice in June.

Also, during this period, there were three discrepancies concerning water leakage through the windshield seal. According to the maintenance log, the windshield was last resealed on May 21, 1985. On June 5, a pilot believed that water leakage through the windshield seal caused the No. 1 NAV/COMM to malfunction, and it was replaced. Only a visual inspection of the windshield seal was made. Water was not used to check for additional leaks through the windshield. The next day the No. 1 NAV/COMM was reported inoperative and replaced; however, water was not sighted as the cause. On June 26, there was the following writeup "after rain had unbearable static over radios. No. 2 NAV unusable en route. No. 2 NAV/COMM replaced and both NAV/COMM connections cleaned."

The No. 1 NAV/COMM had been installed since June 6, 1985, but was replaced the day before the accident because it was reported that it would not transmit. However, it was determined that the problem was due to a faulty microphone. The No. 1 NAV/COMM was later examined at the airline's maintenance facility. There was no evidence of water contamination in any part of the radio. It was subsequently returned to service. During this 12-month period, the airplane flew a total of 1,436 hours, averaging 120 hours per month.

Spot checks were made of records before March 1985 to determine the airline's compliance with its maintenance program. Overall, the maintenance records system for controlling maintenance and inspections was adequate. On May 16, 1983, Bar Harbor Airlines recorded compliance with its "fleet campaign" directive to repair waterleaks at the windshield area of all 10 of its Beech 99s, which included the accident airplane. The last repairs made to reseal the windshield seal were made on May 10 and May 21, 1985.

1.7 Meteorological Information

On the day of the accident, there was an east-west oriented warm front through northern Connecticut and southeastern Massachusetts. North of the front, including the areas of southern New Hampshire and southern Maine, the conditions were characterized by low overcast skies with visibility restricted by rain, drizzle, and fog. Winds were light from north through northeast.

The 2100 area forecast for Maine showed flight precautions because of instrument meteorological conditions and obscured mountains. No significant turbulence or icing conditions were expected outside convective activity. The significant clouds and weather portion of the forecast called for widespread ceilings below 1,000 feet with broken to overcast layers to 30,000 feet and visibility below 3 miles in moderate rain, light rain, and fog. There would be occasional 2,000- to 3,000-foot overcast skies with 3 to 5 miles visibility in fog.

The flightcrew briefed themselves at Boston on the weather conditions for the return flight to Bangor from teletype information provided by the airline flight follower. The weather information included the current en route surface weather observations, terminal forecasts, forecast winds and temperatures aloft for the New England area from the surface to 18,000 feet, and pertinent Notices to Airmen (NOTAMS).

The surface weather for the times and locations were as follows:

Boston - 2052: Ceiling—partial obscuration, measured 300 feet overcast; visibility—1 1/4 miles, light rain and fog; temperature—66° F; dew point—65° F; wind—040° at 4 knots; altimeter—30.17 inHg; remarks—fog obscuring 1/10 sky, drizzle ended, rain began 2023.

Portland - 2052: Ceiling—measured 200 feet overcast; visibility—1 mile, light rain and fog; temperature—63° F; dew point—60° F; wind—100° at 5 knots; altimeter—30.24 i. Hg.

Auburn-Lewiston - 2150: Special, ceiling—indefinite 300 feet obscured; visibility—1 mile, light drizzle and fog; temperature—60° F; dew point—missing; wind—020° at 4 knots; altimeter—30.24 inHg; remarks—last observation.

Augusta - 2052: Ceiling- indefinite 200 feet obscured; visibility—1 mile, light rain and fog temperature—59° F; dew point—59° F; wind—100° at 6 knots; altimeter—30.25 inHg.

Waterville - 2145: Special, ceiling--indefinite 400 feet obscured; visibility—1 mile, light rain and fog; temperature—58° F; dew point—missing; wind--020° at 2 knots; altimeter--30.25 inHg.

The current terminal forecasts were as follows:

Portland: Ceiling--400 feet overcast; visibility--1 mile in light rain and fog; wind--090° at 10 knots, occasionally 500 feet scattered; ceiling--1,100 feet overcast; visibility--6 miles in fog.

Augusta: Ceiling--600 feet broken, 2,000 feet overcast; visibility--3 miles in light rain and fog; wind--120° at 10 knots, occasionally 600 feet scattered; ceiling--2,000 feet overcast; visibility--6 miles in fog. After 2000: ceiling--600 feet overcast; visibility--3 miles in light rain and fog, occasionally ceiling 300 feet obscured; visibility--1 mile in light drizzle and fog.

The 2000 observed winds aloft at Portland were as follows:

Altitude	Direction (degrees true)	Speed (knots)
Surface (66 feet)	165	5
1,000	170	6
2,000	199	7
3,000	200	11
5,000	225	19
7,000	225	20

There was no Airman Meteorological Information (AIRMET) or Significant Meteorological Information (SIGMET) 3/ pertinent to flight 1808's route of flight. A Center Weather Advisory, issued by the Boston Air Route Traffic Control Center and valid from 2025 on August 25 to 0700 the next day, called for patchy ceilings at or below 500 feet and/or visibility below 1 mile in fog, light rain, and/or drizzle.

Bar Harbor operates a Supplemental Aviation Weather Reporting Station (SAWRS) at the Auburn-Lewiston Airport. Observations are taken as required in support of the airlines operations and are transmitted to flights by radio or made available on the ground through the airline's computer system. The facility was found unsatisfactory during an NWS inspection on April 11, 1983. Chapter 14, Part B, of the NWS Operations Manual requires that the NWS inspect SAWRS at least twice each year and monitor its observations regularly. The station at Auburn-Lewiston should have been inspected by personnel from the NWS Meteorological Observatory at the Portland International Jetport, Portland, Maine. There was no record that the inspection had been performed in accordance with the NWS manual.

The NWS, along with the Safety Board's investigator, inspected the SAWRS facility 2 days after the accident and found it satisfactory after changes were made as a result of the previous inspection. The station did not have any equipment to observe dew point or station barometric pressure, but it was not required to have the equipment. The two altimeters used to determine the current altimeter setting were checked with a standard aneroid barometer. One altimeter showed an average correction factor of +0.029 and the other +0.012 inHg. When two altimeters are used to determine an altimeter setting, the altimeter with the lowest barometric pressure reading is used. The maximum allowable barometric pressure difference between two altimeters is 0.05 inHg.

The airline's station agent reported that there were no lights to determine visibility at night in the area of the approach end of runway 4. The station agent stated that this area tended to become foggy before other areas around the airport. However, lights were available to determine the visibility for the area at the opposite end of runway 4.

1.8 Aids to Navigation

The six navigational aids associated with the ILS approach to runway 4 were ground checked on the day following the accident by FAA Airways Facilities personnel. The meter readings and other key performance parameters were within established standards and tolerances. The certification check of the self-monitoring feature of the ILS was found normal and showed no evidence that the system had failed previously.

An FAA flight inspection, initiated on the day after the accident, found that the initial approach segment (from the Kennebunk (ENE) VOR to the Doley intersection), the intermediate approach segment (from Doley to the Lewie nondirectional beacon (NDB)), locator outer marker (LOM), radar coverage, and the approach and runway lights were aligned properly and performed within established standards. The ENE VOR was misaligned by a degree, and there was a 2.5° bend in the 036° radial at 20 miles. These errors are within FAA tolerances.

3/ AIRMETs are inflight weather advisories and are issued only to amend the area forecasts which are of interest to all pilots and which are potentially hazardous for aircraft with limited capabilities. SIGMETs concern weather significant to the safety of all aircraft.

A pilot, who had made the ILS approach to runway 4 at 2030 on the evening of the accident, stated that he did not have any difficulties with the approach nor with any of the navigation aids. He had been between layers at 7,000 feet and was vectored by Portland Approach Control to intercept the localizer. He entered cloud tops just west of ENE and was cleared to cross Doley at 2,500 feet. He activated the approach lights just outside the LOM and executed the approach. He reported that there were some breaks in the clouds at 2,200 feet and that the air was smooth. He sighted the approach lights while still in the clouds and broke out in light drizzle before reaching decision height (DH). The visibility was unrestricted. In his comments on executing a night approach to runway 4, the pilot stated that the lack of lights in the runway environment, "... allows the approach lights to stand out even more because it's rather dark down there . . ."

1.9 Communications

There were no reported problems with communications.

1.10 Aerodrome Information

The Auburn-Lewiston Municipal Airport holds a limited certification under 14 CFR 139, normally operates 24 hours per day, but is attended only from 0900 to dusk. It incorporates two intersecting asphalt runways, runway 17-35 and runway 4-22. Runway 4-22 is the instrument landing runway and is 5,000 feet long and 75 feet wide. It is served by an ILS with a 3° slideslope, medium intensity approach and runway alignment lighting, and high intensity runway lights. The ILS LOM is 5.1 miles from the threshold, and the middle marker is 1/2 mile from the threshold. The threshold touchdown zone elevation is 271 feet m.s.l., and the airport elevation is 288 feet m.s.l. Runway 4 also is equipped with a Visual Approach Slope Indicator (VASI), which is maintained by the airport. It operates from dusk to dawn and anytime runway 4-22 is active. All runway and approach lighting is pilot-activated by clicking the microphone on UNICOM frequency 122.8 MHz. The lighting intensity can be varied by clicking the microphone 7 (high), 5 (medium), and 3 (low) times. The lighting remains on for 15 minutes.

The landing weather minimum for the straight-in ILS approach to runway 4 was published as 1/2 mile visibility. (See figure 2.) When the Auburn-Lewiston altimeter setting is available, the decision height is reduced from 300 to 200 feet a.g.l. The lowest altitude to which a pilot can descend if he does not see the runway environment during the approach is 471 feet, if the local altimeter setting is available. When the runway environment is not sighted, the pilot is required to execute an immediate climb from 471 to 900 feet, execute a climbing right turn to 2,500 feet, and then proceed direct to the LOM and hold for further clearance. The pilot also is required to declare to ATC that he is making a missed approach.

The Safety Board learned that, at the time of the accident, the visibility minimum had been inadvertently reduced from 3/4 to 1/2 mile because of an oversight related to obstacle clearance plane criteria (34:1 slopes). The error was corrected within a few days after the accident.

1.11 Flight Recorders

No flight recorders were installed in the airplane, nor were any required by regulation.

1.12 Wreckage and Impact Information

The airplane initially struck trees between 28 and 35 feet a.g.l., 4,007 feet from the approach end of runway 4 and 440 feet to the right of the extended centerline of the runway. The elevations of the breaks of the trees were 342 and 345 feet and about 180 feet below the centerline of the slideslope. The airplane traveled about 737 feet before striking level ground in nearly an inverted attitude and skidded about 188 feet before coming to rest at the bottom of a ravine, oriented on a magnetic heading of 150°. Except for the vertical stabilizer and rudder, the airplane was destroyed by impact forces and a severe postcrash fire. The vertical stabilizer and rudder remained relatively intact.

The outer panels of the wings and outboard portions of the ailerons separated at initial tree impact. The airframe and tree damage indicated that the airplane was in a near wings level attitude. Several tree limbs in the area were cut clean by the propellers. There was a pronounced propeller ground scar about 53 feet beyond the point of initial ground impact. Part of the right engine propeller blade was embedded in a piece of wood 25 feet from the initial ground impact point. This evidence indicated that the engine had been developing substantial power at the time of the accident. Broken branches from two trees behind the initial ground impact site indicated that the airplane's flightpath angle to the ground was about 23°.

The landing gear sustained only fire damage. The actuators showed that all three landing gears were fully extended at the time the airplane came to rest. The landing gear handle in the cockpit was in the down position.

There was continuity in the primary flight control cable system. Two wing flap actuators, found in the main wreckage, indicated that they were fully retracted at the time the airplane came to rest. The horizontal stabilizer trim actuator was extended 5 1/2 inches. This correlated to slightly over a 1/4° of stabilizer leading edge up, or nosedown trim. At this position with the flaps up and landing gear down, the trim speed is 157 knots. According to the airplane manufacturer, with an approach flap setting and landing gear down, the airplane will be within trim from 120 to 130 knots. The change in control yoke pressure from an approach flap setting to a flaps up position with the stabilizer in this position would only have been about 18 lbs. of pull force. The time required for the flaps to retract from the approach setting is about 2.5 seconds.

1.13 Medical and Pathological Information

Postmortem examinations of the eight occupants disclosed that all died from severe impact trauma as a result of ground impact forces. The degree and extent of the injuries were consistent with the airplane striking the ground with substantial forward speed and in a near inverted attitude.

The examinations of the flightcrew and a review of their recent airman medical records revealed no evidence of any medical problems that might have affected their performance. Toxicological analyses showed no acidic, neutral, or basic drugs; no carbon monoxide; and insignificant amounts of alcohol. Also, blood samples showed no evidence of cannabinoids.

As a result of a report that the captain had suffered a previous head injury, the Safety Board researched his medical history. In 1969, the captain was involved in an automobile accident in which he sustained a scalp laceration and brain concussion. He was hospitalized for 3 days. Medical personnel were not able to determined if he actually lost consciousness in the accident, but they indicated in his hospital records that he had been very disoriented, did not know how the accident happened, and had repeatedly asked the same questions after they had been answered. His discharge summary report showed "He is now active, alert and able to remember everything before and after the accident, but not the accident itself."

As a result of the finding and Safety Board consultations with the State medical examiner, a neurological pathologist performed a postmortem examination on the brain of the captain. He found that the captain was neurologically intact and without neurological symptoms at the time of the accident.

In June 1975, the captain had been involved in a motorcycle accident and was hospitalized for 2 days. He sustained bruises in the lower lumbar and thorax area. No treatment was required. A followup visit showed no complications.

On October 15, 1984, the captain was treated for pain and swelling of the right knee. He had been experiencing mild, sporadic, pain for about a year. There was no known injury. The condition began after the captain began jogging. Therapy consisted of massage and exercise.

According to associates, the first officer had complained about an ear problem. He had telephoned his parents the day before the accident and told them he had experienced trouble clearing his ear the day before. He said it was not an earache, that it bothered him only when the airplane was descending and that it did not give him any trouble on the ground. On the day of the accident, he telephoned his parents again and told them that his ear was "perfectly fine." He did not specify in which ear he had had the problem, but according to another company pilot, it was his left ear. The first officer did not have a history of chronic earaches. There was no remark in the autopsy report about the condition of the first officer's ears.

1.14 Fire

There was no evidence of fire along the wreckage path except in the area of the main impact site.

Witnesses near the crash site used the 911 emergency telephone number to notify the Auburn Fire Department at 2206. The crash site was within the city limits, but about 5 miles from the fire department. An officer with the Auburn Police Department was the first official to arrive on-scene. The Auburn Fire Department arrived on scene at 2212 with 12 firefighters, 5 pumper engines, 1 ladder truck, and 1 rescue truck. Firefighters said that they saw the fire as they approached the scene and that they did not experience any difficulty geting to the scene. Also, the New Gloucester Fire Department responded with 10 firemen and two fire trucks. The Lewiston Fire Department responded with a crash truck equipped with a generator and high intensity lights.

One engine pumper and three firemen extinguished the fire in 1 minute with two 1 1/2-inch hoses using 36 gallons of AFFF/ATC foam. All occupants were removed from the wreckage under the direction of the State Medical Examiner with the aid of an FAA Aviation Medical Examiner. The occupants were taken to a temporary morgue set up at the airport.

1.15. Survival Aspects

The relatively steep flightpath angle and the attitude and speed of the airplane at ground impact precluded the occupants from surviving the accident. Safety Board investigators determined that the captain was in the left crew seat and that the first officer was in the right. Both seats were subjected to fire, and no seatbelt restraints were found. The captain's control yoke was melted in the fire, but the first officer's was not melted, and it was not broken. The locations of the passengers within the cabin could not be determined because of the airplane's attitude at impact, the manner in which it came to rest in the ravine, and the ground fire damage. The airplane was equipped with 15 passenger seats. All were found in the main wreckage site, but their original locations in the cabin could not be identified. The damage to the seats were consistent with the airplane's attitude at impact and how it came to rest.

1.16 Tests and Research

1.16.1 Navigation and Communication Equipment

Several components from the airplane were extracted from the main wreckage for further examination. These included flight instrumentation and navigational equipment, light bulbs, and flap system components. (See figure 4.) The following is a description and the results of those examinations:

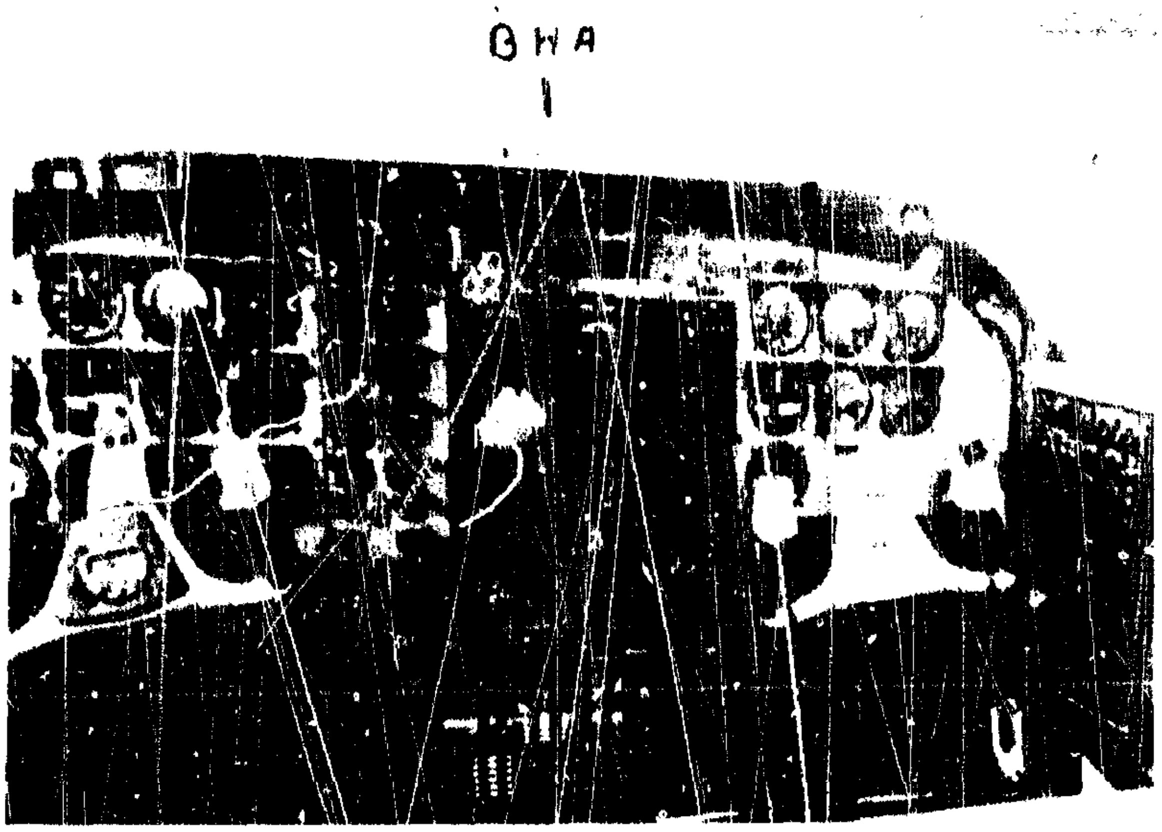


Figure 4.—Cockpit instrument panel and right controls.

Flight Instruments--Examination of some of the captain's flight instruments showed no evidence of a failure or malfunction of the electrically driven attitude gyro. His airspeed indicator indicated a speed of 115 knots. The Kollsman Alti-Coder II altimeter showed a barometric setting of 30.42 inHg. The barometric setting knob could not be moved by hand. All three components were damaged by impact and fire.

No meaningful information could be obtained from the first officer's vacuum driven artificial horizon. His directional gyro was indicating 228°, but the dial could easily be moved with finger pressure. The airspeed indicator was indicating 242 knots. The turn-and-bank indicator did not reveal any useful information. The Kollsman altimeter was indicating a barometric pressure of 30.12 inHg. The setting knob and shaft had sheared from the bezel. All of the components sustained impact and fire damage.

Examination of the No. 1 NAV/COMM (King KX175B), using a new KX175B at the manufacturer's facility to compare the switch rotor positions of the two units, showed the damage unit was set at a frequency of 108.90 MHz. The communication frequency could not be determined because of the extent of the damage to this side of the transceiver. The limited, available evidence indicated that there were 16 possible communication frequencies ranging from 119.200 to 129.775 MHz.

The No. 2 NAV/COMM sustained substantial impact damage. Visual inspection showed a frequency of 108.9 MHz for navigation and 122.8 MHz for communication. Both transceivers are installed side by side in the center of the instrument panel. Frequency 108.9 is the correct frequency for the ILS, and 122.8 is the UNICOM frequency at the Auburn-Lewiston Airport.

A King KI-214, VOR/LOC Converter Indicator with glideslope, installed in the lower left-hand corner of the first officer's instrument panel, sustained damage to both the front and rear sides of the unit. (See figure 5.) The heading selector was set at 040. Although the VOR/LOC needle was stopped at 1 1/2 dots left of center and the glideslope (GS) needle was stopped at 1 1/2 dots below center, the manufacturer believed that both needles may have been displaced from their original positions and captured by broken glass and a distorted bezel. No meaningful information could be obtained from a similar unit installed in the lower left-hand corner of the captain's instrument panel. The "repeater" indicator installed to the right side of the captain's ILS indicator, and remoted to the No. 2 NAV, was not located. (See figure 6.)

A King KR-85 ADF receiver, installed in the lower right-hand corner of the captain's instrument panel, showed a frequency of 240 KHz. The associated indicator, installed in the left center of the panel, disclosed no meaningful information. The frequency was correct for the LOM.

A NARCO DME-190 receiver, which was installed in the lower part of the center panel, sustained substantial impact and internal heat damage. It disclosed no useful information. (See figure 4.)

Light Bulbs.--The Safety Board's scanning electron microscopic examination of filaments from the four landing lights disclosed fracture surface characteristics indicative of brittle separations. There was no evidence of heat associated with the fractures which would have indicated that the landing lights were illuminated at the time the outboard portions of the wings were subjected to impact forces.

Flap Control System.--Most of the components from the flap control system were destroyed in the accident. The flap motor housing sustained excessive heat and the gearbox housing was melted. A teardown inspection of the flap motor at Beech Aircraft revealed no evidence of a preimpact failure or malfunction of the motor.

Figure 5.—First officer's instrument panel.

1.16.2 Kollsman Altimeter Examinations

The captain's and first officer's altimeters were examined by the Safety Board's System Group at Kollsman's facility in New Hampshire on October 1, 1985. Since the barometric settings of both altimeters were inconsistent with the barometric setting reported by the station agent in Auburn-Lewiston, the Safety Board attempted to determine whether the settings had changed as a result of the accident or were set by the crew as found after the accident.

An examination by Kollsman revealed:

> Extensive fire damage to the captain's altimeter. There was no evidence of barometric setting, gear system derangement and the gear train was in good condition despite the fire damage and moisture contamination found upon disassembly. There was no damage to the front end pressure gear train pivots and gears. The barometric setting adjustment knob shaft (steel) was bent and the case was melted against the shaft input gear which prevented the shaft from rotating. (See figure 7.) There were no broken pivots or jewels within the altimeter pressure mechanism. The primary damage to the altimeter was due to heat and moisture. There was no apparent indication of altimeter malfunction prior to impact and fire damage.

Figure 8.--Captain's instrument panel.

The first officer's altimeter showed little external fire damage, but extensive moisture and foam (white powdery substance) damage. The barometric adjustment knob was broken off at the flange and missing. (See figure 8.) Rotation of the case showed that the 1000-foot per turn needle was free to rotate, indicating that the shaft was broken. Disassembly revealed that the shaft was broken, but there was no apparent indication of derangement of the barometric setting gears as a result of the accident. There were several broken parts in the pressure mechanism and the intermediate gear shaft pivots as a result of impact forces.

Maintenance records showed that the altimeters and the pitot static system were inspected in accordance with 14 CFR 91.170. The altimeter system check requires a barometric pressure and scale error inspection and provides for certain tolerances in accordance with 14 CFR 43, Appendix E. The maximum pressure scale error is +/-20 feet near sea level. The maximum barometric scale error is +/-25 feet. Thus, the total maximum error of each altimeter in the airplane could have been +/-45 feet based on allowable errors. However, statistically the most likely error in the altimeters is +/-32 feet root sum square (R.S.S.) 4/ The actual errors in both altimeters are unknown.

4/ The R.S.S. is the square root of the sum of the individual errors squared and defines the effective error when the individual sets of errors are additive, when they are random or independent, and when they have a frequency distribution.

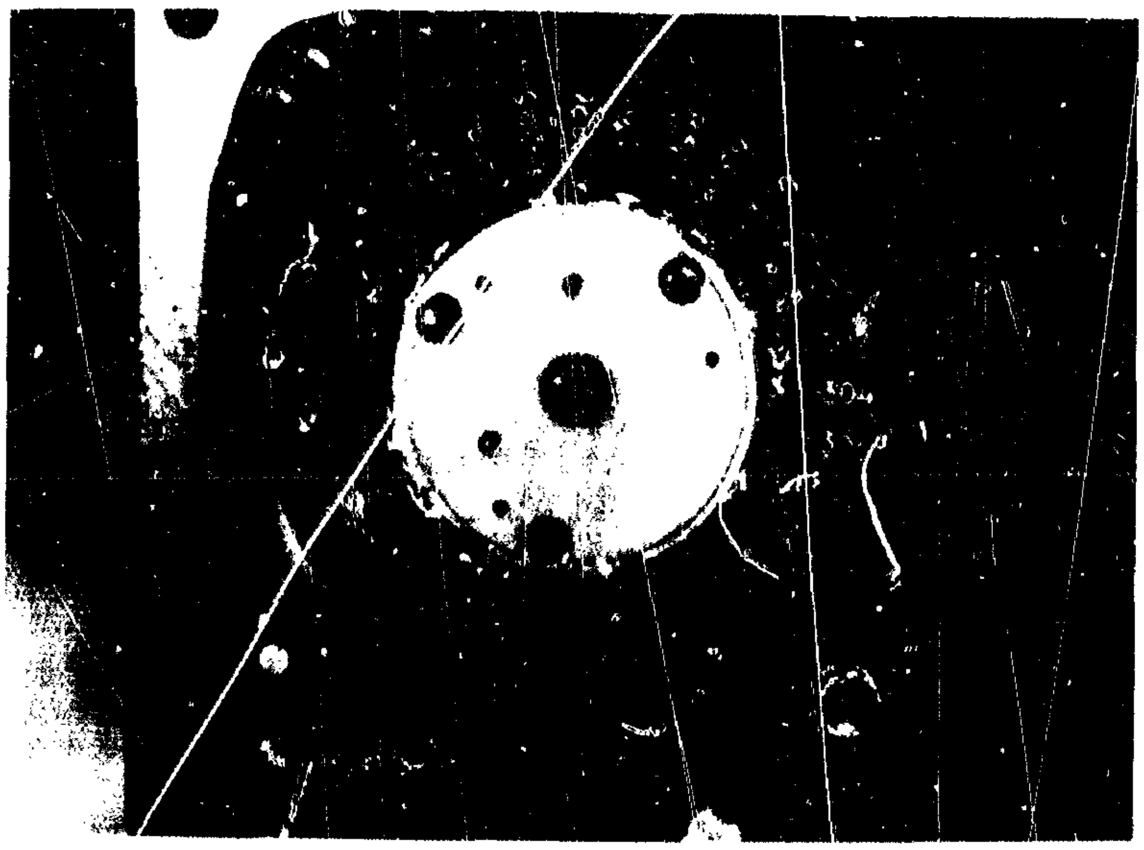


Figure 7.—Top view: Captain's Kollsman Alti-Coder II altimeter.
Bottom view: Position of the barometric dial showing the front end gear train and adjustment knob shaft at lower left-hand corner.

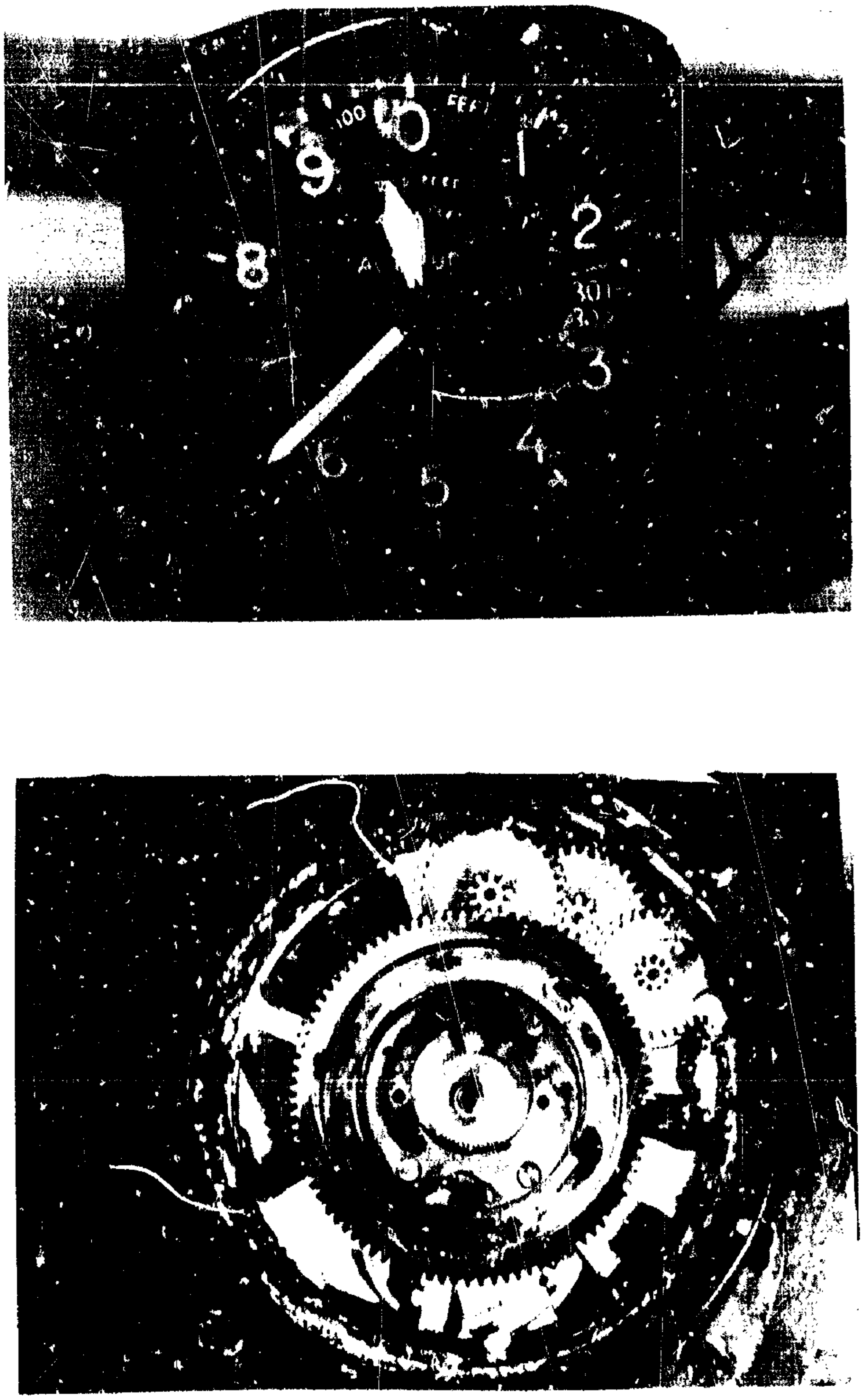


Figure 8.—First officer's altimeter.

At standard sea level conditions, 1/10 inHg equals about 93 feet. When the barometer is 30.24 inHg, the m.s.l. indication of an altimeter setting of 30.42 inHg, would theoretically be +167 feet and with a setting of 30.12 inHg, it would be -112 feet, based on standard correction factors. Therefore, the most likely error range of the captain's altimeter would have been between 135 and 199 feet above m.s.l., and the error range of the first officer's altimeter would have been between -80 to -144 feet below m.s.l. Thus, if the altimeters were set as found at the time the airplane struck trees at the initial impact elevation of 345 feet, the captain's altimeter would have been indicating anywhere from 480 to 544 feet. The first officer's altimeter would have been indicating anywhere from 201 to 265 feet.

1.17 Additional Information

1.17.1 Radar Information and Airplane Performance

Since the airplane was not equipped with a flight data recorder (FDR) its flightpath was reconstructed using recorded radar data. Digitized radar data was available from the Boston Air Route Traffic Control Center (ARTCC) in the National Track Analysis Program format. This data provided time, altitude, latitude, and longitude of the airplane's track every 12 seconds. The radar coverage began shortly after the airplane departed Boston. However, the ARTCC lost radar contact with the flight during its descent in the vicinity of Lewie.

Additional radar data was available from the Brunswick Naval Air Station. This data was recorded by a TPX-42 radar site which provided a radar target about every 5 seconds. The data could be viewed only on a radarscope, so a video recording was made of the playback. The locations of the Doley Intersection, Lewie, and the end of runway 4 was displayed on the scope with a line connecting all three points, representing the 041° final instrument approach course. The elapsed time was superimposed on the video recording with the zero time reference point beginning when the flight passed Doley. The encoded altitude also was displayed during the re-recording.

The Air Route Traffic Control Center (ARTCC) data were used to review the airplane's track from Boston to determine if there were any irregularities in navigation that might help explain why the airplane was slightly off course outside the Doley Intersection. (See figure 1.)

The TPX-42 radar data were used to review the airplane's track inside Doley. Measurements of the data were made from the video monitor and converted to nautical miles to align the ARTCC data with the TPX-42 data and to provide a complete radar flight track from Boston to Lewiston. Also, the raw and smoothed TPX-42 data were used for input into a National Aeronautics and Space Administration (NASA) program which estimates performance parameters, such as airspeed, ground speed, roll angles, and acceleration loads. It must be noted that the program calculates "long term" motion parameters of the airplane. "Short term" maneuvers, such as abrupt attitude changes cannot be derived using this program. However, in the following discussion, the "short term" maneuvers were defined more accurately by using the radar data in a manner similar to the computer program, but additional information, such as airplane performance limits and radar data limits, were incorporated into the calculations. The plan view and profile view of the airplane's flightpath are shown in figures 9 and 10.

Review of the radar data indicated that after departing Boston, the airplane turned north and then established itself on the 215° radial of the PSN VOR for 5 minutes before the flight was given a clearance to proceed direct to Augusta via the ENE VOR at

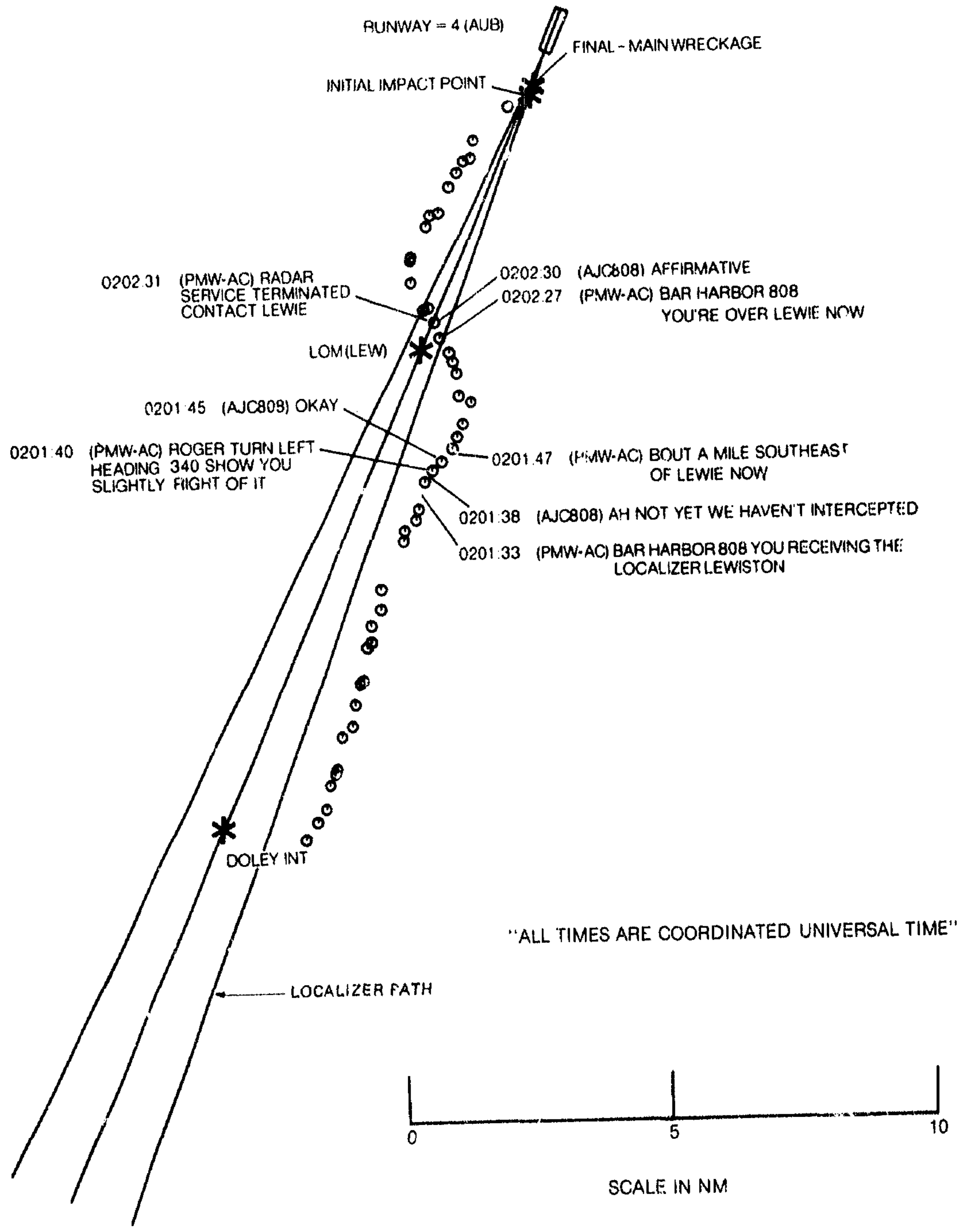
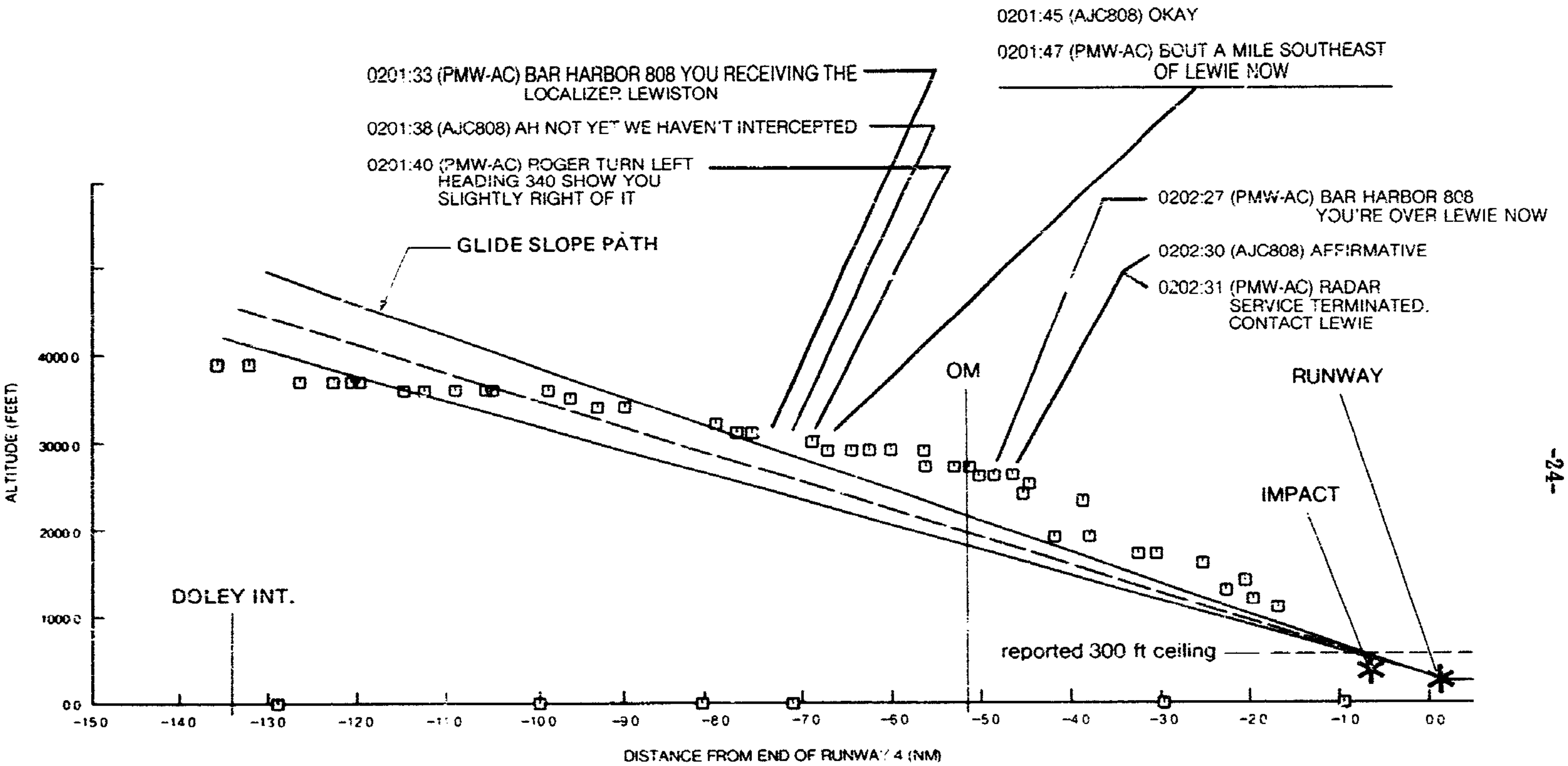


Figure 9.—Radar data reconstructed plan view of the flight track.



"ALL TIMES HEREIN ARE COORDINATED UNIVERSAL TIME"

Figure 10.—Radar data reconstruction of profile view of the flightpath.

2139:47. At 2140:41, the clearance was changed to Lewiston via the ENE VOR. About 4 minutes later, the flight passed slightly to the left of PSN with an approximate ground track of 049°. The 049° track resulted in the flight diverging 1.5 miles to the right of a direct course (042°) between PSN and the ENE VOR. About 5 minutes after passing PSN, the airplane started a 33° turn to the left to apparently intercept and establish a brief track on the 042° radial. At 2153:08, the flightcrew confirmed that they were joining the ENE 036° radial, and the airplane started a descent from 7,000 feet with an airspeed of 205 knots indicated airspeed (KIAS). The airplane appeared to be tracking on the 038° to 039° radial.

At 2158:38, the flight was cleared for the ILS approach while it was about 5 miles south of Doley at 4,800 feet. The average rate of descent from 7,000 to 4,800 feet was 400 feet per minute. The crew was instructed to maintain 3,000 feet or above until crossing Doley. At this time, the rate of descent increased to 800 feet per minute and the airspeed began to increase. The ground track also changed 6° to the right, to a heading of 044° for about a minute. At 2159:50, the airplane passed 1.3 miles to the right of Doley at 4,000 feet descending at the rate of about 800 feet per minute at about 210 knots.

About 2200, 10 seconds after passing Doley, the ground track changed 10° to the left, to 034°. The rate of descent decreased to about 200 feet per minute and the airspeed dropped from about 210 knots to 190 knots over a 1-minute period, and it continued to drop at a nominal rate of 20 knots per minute until near the time of the accident. The localizer needle of the ILS indicator should have shown a full left deflection and the glideslope needle should have shown a full up deflection, indicating that the airplane was right of the localizer course and below the glideslope. At 2200:17, the glideslope needle should have started moving down and it should have been centered 21 seconds later while the airplane remained at 190 knots. It would have taken the needle an additional 28 seconds to move to full down. At 2201:26, the airplane started a right turn. Seven seconds later, the controller asked if the flight was receiving the localizer signal. The right turn was stopped on a heading of 061,° and the captain reported that they had not intercepted. When the crew was given the left turn to 340° at 2201:40, the rate of descent was arrested, and a left turn was initiated to a heading of 354° at 2201:46--a standard rate turn of 3° per second. The left turn stopped on a 47° intercept angle to the 041 final approach course.

At 2202:22, the airplane was outside the right side limit of the localizer as it passed abeam Lewie at about 165 knots at an altitude of 2,600 feet. It had crossed the the right side limit of the localizer course at 2202:25. About this time, the controller stated that the airplane was over Lewie and asked if the flight was receiving it. The first officer replied, "Affirmative," and the rate of descent started to increase. The 354° track was maintained while the controller continued talking. The airplane exited the left side limit of the localizer at 2202:38. Two seconds later, the controller finished talking and the airplane turned right to 049°. Also, from 2,400 feet, the descent rate suddenly increased. The airplane lost about 500 feet of altitude in about 10 seconds, and it leveled off at 1,900 feet. Seven seconds later, the airplane climbed to 2,300 feet, and 10 seconds later, the next radar return showed the airplane descended to 1,700 feet where it had leveled off for 13 seconds. The transponder reported altitude is presented in 100 foot increments with a ± 50 foot tolerance. Therefore, the airplane could have descended from 2,250 to 1,750 feet in 10 seconds. The minimum rate of descent for this short period is about 3,000 feet per minute. Thereafter, it appeared that the rate of descent averaged about 1,300 feet per minute up to the time of initial impact. The airspeed continued to decrease to about 130 knots.

At 2203:46, a right turn to 070° or greater was initiated. Based on the average rate of descent, the airplane would have descended through the upper limit of the glideslope at 2204:02 at an altitude of 650 feet and descended through the lower limit of the glideslope between 2204:08 and 2204:10. At this time, the airplane was at the left edge of the localizer. The airplane then passed to the right of the peak of Christian Hill at about 130 knots and struck trees 875 feet beyond. The lowest ground elevation that it could have passed over Christian Hill is from 390 to 400 feet m.s.l. Since the elevation of the initial tree impact site was 345 feet m.s.l., the airplane had to have been at a minimum rate of descent of 700 feet per minute. The impact occurred between 2204:16 and 2204:21 while the airplane was at the right edge of the localizer limit on a ground track of 045°.

In an attempt to determine how well previous instrument approaches were flown by the flightcrew, the Safety Board reviewed the recorded radar data of the two approaches made before the accident flight: the localizer runway 17 approach at Augusta at 1904 and the ILS runway 4 approach at Boston at 2051 (flights 1755). Both radar flight traces showed that the airplane was on course and showed no evidence of difficulty.

1.17.2 Operator Information

Bar Harbor Airlines began operations as an air taxi in 1968 with a Cessna 206 flying between Bangor and Bar Harbor. Air taxi operations were upgraded to twin-engine airplanes in 1971, and the company purchased its first Beech 99 in 1976. It began operations as an air carrier (Part 121) in 1979 with a Convair 600. At the time of the accident, Bar Harbor Airlines operated 12 Beech 99s, 10 Beech 1900s, 7 Cessna 402s, and 4 Convair 600s, all of which performed 244 takeoffs and landings per day. A total of 134 pilots and 110 maintenance personnel were employed by the company.

Seasonal variations in passenger load factors has had a direct bearing on the company's pilot work force, varying from high in the summer to low in the winter. As is apparently the case with most regional air carriers, the stability of the pilot work force is further affected by the attraction of higher paying positions with the major air carriers. A 4-year history of Bar Harbor's pilot work force follows:

	1982	1983	1984	1985 (8 mos.)
No. of Pilots - High*	88	91	121	134
No. of Pilots - Low*	77	85	88	98
Flight hours - Low	1,100	800 5/	1,100	1,040
*Flight hours - High	3,500	10,700	10,533	6,250
Flight hours - Mean	2,635	3,652	2,688	2,143
Furloughed	0	0	5	4
Terminated	2	2	1	3
Resigned	10	11	23	22

* Total flight hours

5/ Denotes a pilot who was a mechanic and inspector for the company in excess of 3 years. **Note:** There were two pilots on probation who were terminated in 1982; one was on probation in 1983, one in 1984, and three in 1985. The figures are from January to September 1985.

The airline's Beech 99 fleet is equipped with ILS equipment from King, Narco, and Collins. Most of the fleet is equipped with either King KI 214 or KI 204 indicators. According to the manufacturer, differences exist in the display being presented to the pilot of the earlier manufactured KI 214 indicator and the currently manufactured KI 204 indicator. The KI 214 indicator was designed approximately 20 years ago using general aviation accepted practices of that time. The KI 204 indicator, which was designed more recently, followed more currently accepted practices.

The KI 214 uses a "windshield wiper" movement. In this display, the localizer needle pivots about the top of the instrument moving left and right and the glideslope needle pivots about the left side of the instrument moving up and down. The KI 204, on the other hand, uses a rectilinear movement whereby the complete localizer and glideslope deviation needles move horizontally and vertically with respect to the center ("bullseye") of the instrument.

The KI 214 indicator has five dots on each side of the center of the instrument for use in measuring the amount of localizer deviation. In a similar manner, it has two dots above and below the center of the instrument for measuring the amount of glideslope deviation. The KI 204 indicator, on the other hand, has five dots on each side and above and below the center of the instrument for measuring the amount of localizer and glideslope deviation. However, the overall needle travel in both indicators is approximately the same.

Bar Harbor Airline's Beech 99 fleet was not equipped with an interphone system, nor was such a system required by Federal regulation.

Airline policy and standard operating procedures affecting flight operations are delineated in 10 volumes of the company's General Operations Manual (GOM), issued June 1, 1979, and updated with revision No. 18 on January 1985. Volume 1 covers General Operations; Volume 2, the Training Program; and Volume 7, the Beech 99 Aircraft Operating Manual. The maintenance and inspection program is included in Volumes MM-1 through -9. The GOM was prepared to comply with FAA regulations and its policies and procedures can be enforced by the FAA.

The GOM manual states, in part:

Flightcrew Qualifications

1. Captains will possess at least a current airline transport pilot certificate with the appropriate ratings for the type of flight duties assigned and a current first class medical certificate.

2. First Officers will possess at least a current commercial pilot certificate with the appropriate ratings for the type of flight duties assigned and a current second class medical certificate.

3. Pilots are required to meet the experience requirements of 14 CFR, Parts 61 and 135 before assignment to flight duty. All ground and flight training must be completed satisfactorily in accordance with the training manual. Captains must have a minimum of 1,500 hours of total flight time, 500 hours of cross country, 100 hours of night cross country, 20 night takeoffs and landings, 75 hours of instrument time, and a total of 50 hours in the

type of aircraft to be flown. First Officers must meet the minimum requirements of 14 CFR, Part 135.245 (Commercial pilot certificate, multi-engine land rating, instrument rating and meet the recent instrument experience requirements of Part 61.57).

Flight Time Limitations

1. Flight time is scheduled so that it is evenly distributed among crewmembers with consideration to individual training and proficiency requirements and in accordance with Part 135.261 - 10 hours for a crew of two within any 24 consecutive hours with at least a 10 hour scheduled rest period prior to flight assignment.

2. Duty time is normally computed from one hour prior to the first scheduled flight to block-in time of the last flight. The 30 minute period after the last flight is not considered duty time nor is it considered part of any rest period.

Crew Briefings

1. The captain will conduct a briefing with the first officer on the flight plan route and alternate, current and forecast weather, fuel requirements, and on any information necessary for the safe planning and execution of the flight.

2. The captain will conduct a cockpit briefing with the first officer covering work load distribution in standard and non-standard situations. When the copilot is familiar with the captain's method of operation, the captain may simply state: "Standard Cockpit Briefing."

Preflight and Inspection

1. The captain will determine that the requirements for weather, flight plan, and weight and balance are met before departure.

2. The Aircraft Trip (flight) Log will be completed for each flight and duty period. The avionics check section of the log will be completed prior to the first flight of the day or as soon as possible - VOR checks will be made on the first leg of any flight with consideration to standard bearing tolerance errors. Altimeters will be cross-checked against each other when initially set to field barometric pressure prior to takeoff and any substantial discrepancy will be noted on the flight log for correction.

Flight Profile

1. The first officer will normally handle all two-way radio contacts with air traffic control and other ground facilities, monitor and cross check flight and engine instruments, participate in accomplishing checklist items, maintain the flight plan and flight log, and maintain a traffic watch.

2. Checklists will be used with the "challenge and response" method. Crew coordination is essential in order to meet maximum safety requirements.

3. Captains cannot allow first officers to make takeoffs and landings unless captains have logged at least 100 hours as a captain in type. First officers can fly the airplane at the captain's discretion; however, they will be restricted from flying in marginal weather conditions. (An approach to landing weather minimums.)

4. When first officers are flying, captains will keep their feet in a normal position on the rudder pedals and closely monitor all controls during the critical phases of the flight. Captains can take control of the airplane at anytime. Captains will perform first officer duties, except where they are prohibited by the physical location of switches and controls.

5. First officers will advise captains when descending through 1,000 feet above the last assigned altitude. The crew will obtain current altimeter settings when at their lowest usable flight level or transition level as appropriate and for landing. They will insure that altimeters are properly set by having the first officer advise the captain of the current altimeter setting and by each pilot cross-checking each other's altimeters with his own.

6. Navigational aids will normally be set and checked by the pilot executing the approach. Both pilots will cross-check with each other to be positive there is a clear understanding as to the correct aids to use, that they are set properly and identified. (According to the Director of Training, if he were flying the ILS approach into Auburn-Lewiston as captain, he would tune the NAV's to the ENE [No. 1] and the Navy Brunswick [No. 2] VOR's and set the 036 and the 277 degree radials on the respective VOR indicators. As soon as the 277 degree radial "becomes alive" he would tune in the ILS on the appropriate NAV [No. 1]. Well clear of Doley, the first officer could tune the No. 2 NAV to the ILS and cross check each others displays. The ADF would also be tuned to the LOM at this point.).

7. Prior to starting an instrument approach, both pilots shall review the approach chart. Both pilots will determine the correct landing minimums with the appropriate altimeter settings. The first officer will call out the touchdown zone and field elevations as appropriate, the decision height or minimum descent altitude and the missed approach point.

8. During an instrument approach, the captain will call out the outer fix. The first officer will state, "flags checked," indicating that he has checked each pilot's panel. If the captain forgets to announce the outer fix, the first officer will do so. The first officer will call out "localizer alive" and "slideslope alive" whenever their associated needles start to move from full deflection. He will also call out "localizer" or "slideslope" if the needle deflection exceeds one dot throughout the approach.

9. The pre-landing checklist will normally be started after initial flap extension and prior to final fix and/or gear extension. Prior to gear extension, the checklist will be completed up to the point where the captain calls, "Complete the Checklist." After gear extension, the first officer will respond by reading each item aloud. The landing gear will normally be extended at the final approach fix inbound or on intercepting the slideslope. Altimeters will be checked at the outer marker (final approach fix) for agreement with published slideslope interception altitude.

10. The airplane must not continue descent below 500 feet on any approach unless it is in the landing configuration, stabilized on final approach airspeed and sink rate and in a position to touch down in the touchdown zone. If these conditions are not met at any time below 500 feet, a go-around is mandatory.

11. On all approaches, the first officer will call out actual airspeed in knots and sink rate in feet per minute as the airplane passes through 500 feet. After this call, he will call out sink rates in excess of 1,000 feet per minute throughout the remainder of the approach. He will also call out visual cues as they appear, such as, sequence flashers, approach lights, runway lights, etc. At 100 feet above minimums, the captain shall call out, "One hundred feet to go." The first officer will call, "One hundred feet," when the airplane is 100 feet above the terrain, airport or touchdown zone elevations. Unless such visual cues are clearly visible on reaching minimums, the first officer shall call out, "Minimums, no runway," and a missed approach shall be executed. Pilots must not descend below DH or MDA unless visual cues associated with the runway are clearly established.

12. Unless the captain has authorized otherwise, and has determined in advance who will initiate a missed approach whenever one is necessary, the captain will assume full control of the airplane immediately.

The Beech Model 99 Aircraft Operating Manual, states, in part:

1. During a ground check of the altimeters, the maximum allowable difference from field elevation is -40 and +30 feet. The maximum allowable difference between the two on-board altimeters is 70 feet on the ground and in the air from sea level to 2,000 feet.

2. The company requires that approach (30%) flaps not be set at a speed greater than 150 knots - the Approved Flight Manual limitation is 174 knots. The maximum speed at which the landing gear is to be extended is 130 knots -the AFM limitation is 156 knots.

1.17.3 Flightcrew Training and Standardization

The airline's training program consists of standard initial and recurrent training which includes upgrade, transition, and differences training. Initial training is given to all new hires without 14 CFR 135 experience and without experience or currency in the type of airplane to be flown. Initial training is comprised of ground training and flight training. The use of procedural trainers or simulators was not a part of the airline's training program.

There are five phases in initial training: basic indoctrination, Beech 99 ground school, emergency training and drills, flight training, and operating experience. Captains and first officers receive 24 hours of indoctrination, 23 hours of ground school, and 2 hours of emergency training. Captains receive 3 hours and first officers 2 hours of flight training. Captains are given 20 hours of operating experience. First officers are not given the experience training, and they are not required to receive such training by regulation. Flight followers also are given 24 hours of indoctrination and 16 hours of the appropriate airplane ground school. To be eligible for upgrade to captain, first officers must complete 12 hours of classroom instruction; there is no minimum number of hours of flight training. A comprehensive closed book examination is given at the end of ground school. Pilots are trained to proficiency during flight training; proficiency is determined by the individual instructor pilot. The proficiency standards are determined and monitored by the Chief Pilot and governed by the appropriate sections in Part 61, Appendix A, and Part 121, Appendix E.

Preflight briefings and debriefings are held for each training flight. An instrument hood is used during maneuvers, such as basic instrument work, instrument takeoffs, engine out work, holding, approaches, and missed approaches. The following flight parameter tolerances are listed in the training manual:

Altitude	-	+/-100 feet (+50, -0 feet on approaches to minimums)
Heading	-	+/-5 degrees (F/O, +/-10 degrees)
Airspeed	-	+/-5 knots (F/O, +/-10 knots)
Localizer	-	1 dot deviation
Glideslope	-	1 dot deviation above, 0 below
Landing	-	+/-500 feet of the 1,000-foot touchdown zone

According to the Director of Training, the company's established standards for performing ILS approaches, without making corrections to the centerline, are one dot above glideslope and none below. Also, one dot left or right of the localizer centerline is acceptable.

The Director of Training reported that during checkrides, pilots are required only to meet the specified standards in the appropriate FAA Advisory Circular for candidates for the airline transport pilot certificate. However, the airlines' unwritten standards, which are given to check airman during their training, are more stringent. The standards are as follows:

Localizer - If more than one dot left or right of course and no correction is being taken, execute a missed approach.

Glideslope - Slightly below glideslope temporarily is acceptable. If more that one dot above glideslope without corrections, execute a missed approach.

The captain received the ground training as prescribed for upgrade to captain on the Beech 99 on May 7 and 8, 1985. He received 1.8 hours of flight training and his checkride took 1.5 hours. He gained his required operations experience on June 1, 1985, with 6.5 hours and 9 takeoffs and landings and on June 3 with 4.8 hours and 7 takeoffs and landings. His operating experience was allowed to be reduced from 20 to 11 hours because of the number of takeoffs and landings performed in accordance with 14 CFR Part 135.244(b)(4).

The first officer received the prescribed training and obtained a minimum passing score on the written examination. His flight training was administered on June 20, 1985, with 1.3 hours flying and on June 21 with 4.7 hours of observation. His checkride took 1.3 hours. The first officer received some previous experience with an air taxi operator, which included 36 hours of ground training and 5.5 hours of flight instruction for qualification as a copilot of a Britten-Norman Trislander. His checkride was administered in 30 minutes.

According to pilot associates, both pilots normally wore personally owned headsets with boom microphones.

1.17.4 Behaviorial and Operational Factors Affecting the Flightcrew

Eight company pilots, including five captains and three first officers were interviewed regarding behavorial and operational factors of the captain and first officer as well as company flight procedures. Both the captain and first officer were considered knowledgeable pilots by their peers as well as by their supervisors.

The captain reportedly had an even disposition and was receptive to inputs from his first officers. The first officers said he was "... friendly ... easy to get along with ... a good pilot ... very professional ... by-the-book person ..." One said the captain would not be adverse to making a missed approach. Another, who had flown 8 to 10 times with the captain, agreed and said that during instrument approaches into Lewiston the captain stayed 1 1/2 dots above the glideslope because of Christian Hill. He also said that the captain did not demand a challenge and response to the nonessential items of the checklist. The other first officer, who had flown flew 3 or 4 times with the captain, said that he never had to bring a deviation to the captain's attention.

Of the three captains who had flown with the deceased captain, one said that he was very knowledgeable, another said that he did not fly below minimums and used hand signals for altitude call-outs. The use of hand signals is a routine practice used by Bar Harbor pilots. The other pilot said that he was decisive and was receptive to assistance offered by first officers.

According to one captain, the first officer was likeable, conscientious, and demonstrated an awareness of "... what was going on ahead of time ..." during flight. It was said that he would point out deviations to captains. A check airman, who flew with the first officer on his check ride, said that the first officer did not have to repeat any maneuvers during the check ride. Another captain stated that he would put the first officer in the middle of his class and said that he was "... relatively green compared to the first officers who had been with the company for six months."

In interviews with the captain's family it was learned that he had no known personal, family, or health problems which would have affected his performance. He and his family had returned from a 10-day vacation about 2 weeks before the accident.

The first officer was single and shared an apartment in Bangor with another company first officer. According to his associates and family, he had no known personal, financial, or health problems, other than the previously mentioned ear problem, which would have affected his performance.

Immediately after the Safety Board concluded its on-scene investigation, it received a letter dated 3 days after the accident from an anonymous and alledged Bar Harbor Airlines pilot. The letter set forth several allegations about management pressure, dispatcher pressure, and the quality of maintenance within the company. The letter contained a list 16 names of former company pilots and urged that they be contacted to verify the allegations.

The Board was able to contact seven of the sixteen former company pilots. Six were captains and one was a former first officer. All but one of the pilots had worked for Bar Harbor over 3 years. There was general agreement about some of the allegations between five of the former captains. The two other pilots disagreed.

Most of the captains qualified some of the allegations by saying that they were not asked to do anything that was contrary to regulations and that they were generally satisfied with their employment. They also said that maintenance overall was performed satisfactorily. Some said that a couple of dispatchers tried to intimidate flightcrews to take flights and not ground airplanes and that as long as the crews stood firm, nothing further ever came of the episodes. They agreed that newer pilots would have felt intimidated. Reportedly two pilots received disciplinary action for grounding an airplane. There was a consensus that the company indeed worked its pilots hard when required in the busy summer months and when there was a pilot shortage, but that they did not fly contrary to regulations. One stated, "As far as commuters go, Bar Harbor is a pretty safe operation."

One captain remembered that N300WP had a history of water leakage on the avionics system resulting in erroneous glideslope readings, warning flags on the ILS display, and static on the radios. He also experienced similar problems in other Beech 99s as well. He and another captain reported that, on one occasion when they "slapped down" the flap lever in the Beech 99, the lever remained down, but the flaps retracted. One believed that perhaps it was due to overtravel of the flap position drum; because the components from the flap system of N300WP were not available, the Safety Board was not able to investigate the possibility.

At the Safety Board's public hearing, several Bar Harbor pilots were asked if they had had a similar experience in the Beech 99. Only one pilot reported having the same experience. The others reported having been made aware of the potential problem during ground and flight training. The Director of Training stated that it was brought to his attention and that he wanted to be sure that all pilots were made aware of the possibility. He could not recall any specific communication to the maintenance department about this problem and what, if any, specific actions were taken.

Beech Aircraft had no record of reported flap system incidences of this type. Its evaluation of the flap control system disclosed some failure conditions that could possibly have caused the reported malfunction. There were two possible conditions, both of which could have resulted from several mechanical causes that normal maintenance and inspection procedures should have prevented. Two different types of electrical shorts are possible causes which might not be prevented under normal maintenance practice. According to Beech Aircraft, their Beech 99 service history ". . . does not indicate a high frequency of shorting failures of the micro-positioner or flap dynamic brake relay." The manufacturer believed that the production preventive measures taken on the component terminals and the service reliability of the respective components indicate that the probability of these types of faults are remote. Beech Aircraft concluded that a properly calibrated and maintained flap control system would not operate in the manner described by the Bar Harbor Airlines' pilots.

1.17.5 Air Traffic Control Procedures

Portland Approach Control had IFR jurisdiction of the airspace surrounding the Auburn-Lewiston Airport. It is a level III facility based upon a traffic density factor of about 25 aircraft per hour. A level V facility has the highest number of operations per hour. There is no conflict alert or minimum safe altitude warning feature with the Automated Radar Terminal System (ARTS) II radar equipment in the control tower.

Air Traffic Control Handbook 7110.65D, paragraph 5-121, Final Approach Course Interception, Section 9, Radar Arrivals, in Chapter 5, instructs the controller to "assign headings that will permit final approach course interception on a track that does not exceed the interception angles specified in the Table." The table states that if the distance from interception point to the approach gate 6/ is less than 2 miles, the maximum intercept angle is 20°; if the distance from interception point to the approach gate is 2 miles or more, the maximum interception angle is 30°.

Chapter 6, Non-Radar, of the handbook contains procedures for separating aircraft in a nonradar environment. There are no procedures in this chapter for nonradar arrivals, and the term nonradar arrival is not used.

Appendix A, Pilot/Controller Glossary, of the handbook states:

> Radar Arrival - An arriving aircraft which is being vectored to the final approach course for an instrument approach or toward the airport for a visual approach.
>
> Non-Radar Arrival - An arriving aircraft that is not being vectored to the final approach course for an instrument approach or towards the airport for a visual approach. The aircraft may or may not be receiving radar separation, radar monitoring or other services provided by ATC.

In addition, Section 7, Arrival Procedures, of Chapter 4, does not contain references to the phrases "radar arrival" and "non-radar arrival." Also, there are no procedures in the handbook for assisting an aircraft to return to a localizer course if a deviation from course is noted.

1.17.6 FAA Surveillance

The FAA Flight Standards District Office (FSDO-65) in Portland, Maine, is responsible for certification and surveillance of Bar Harbor Airlines. The FSDO had issued the company an Air Carrier Operating Certificate on August 3, 1965. This certificate, along with two separately approved Operating Specifications, authorized the company to operate under both 14 CFR Parts 121 and 135 in both VFR and IFR operations throughout the continental United States.

6/ Approach Gate--The point on the final approach course which is 1 mile from the final approach fix on the side away from the airport or 5 miles from landing threshold, whichever is farther from the landing threshold. This is an imaginary point used within ATC as a basis for final approach course interception for aircraft being vectored to the final approach course.

The Principal Operations Inspector (POI) had been assigned to the carrier at the end of April 1985 and was serving in a temporary capacity until a permanent POI could be assigned. The previous POI had been assigned from 1981 to March 1985 at which time he was reassigned to Washington, D.C. His workload at that time included 21 certificate holders, two Part 121 air carriers, three Part 135 commuters, and several on-demand air taxi operators, pilot examiners and Part 141 flight schools. Between 1981 and 1984, he had been assigned to only one certificate holder, Bar Harbor Airlines, in addition to accident investigation work and enforcement cases. At that time, he was able to devote almost 100 percent of his time to surveillance of Bar Harbor. However, when the POI was promoted, he was assigned 20 other certificates.

According to the temporary POI, six or seven of the complex certificate holders had been transferred to him when he already carried a substantial workload. He stated that he did not have time to develop an effective plan to conduct surveillance of the operators. He said, ". . . my job was more as a fireman, to put out where the fires were burning . . ." He stated that between 1981 and April 1985 the staff of operations inspectors had dwindled from eight to three, with him being the only POI in the office. Furthermore, the workload had increased instead of decreasing during this period. He was not satisfied with his ability to conduct the surveillance that was required. He did not know why the work force was allowed to decrease. (GAO had reported a decrease in the FAA inspector workforce from 2,200 in 1978 to 1,332 in 1983. There had been a decline of about 17 percent in field inspectors in recent years. In 1983, the FAA Administrator reported to Congress that he had a plan for program and system changes that would permit a decrease in the number of surveillance inspectors while at the same time increase the quality and quantity of inspections by the FAA.) At the time of the accident, a permanent POI had been assigned to the office, but she had not yet been assigned POI responsibilities for Bar Harbor Airlines.

The temporary POI said that since April 1985, he had made only a few trips to Bar Harbors' headquarters, and that he had discussed primarily its operation with management. He did not observe any initial or upgrade training and did not perform any proficiency checks in the Beech 99. He did not recall any of the airlines personnel bringing any particular problems to his attention nor was he aware of any significant problems based on his meetings with the airline. He recalled performing a couple of en route inspections, one of which was done in a Beech 99.

The Principal Maintenance Inspector (PMI) was assigned to Bar Harbor in 1981. He was responsible for about 80 certificate holders which are comprised of major air carriers, commuters, on-demand air taxis, turbojet general aviation operators, repair stations, aerial applicators, and pilot and mechanics schools. He reported that he did not have sufficient time to perform all of his responsibilities. He stated that Bar Harbor Airlines had taken about 75 percent of his time during the 6-month period before the accident. He said that if he had more time he would increase his overall surveillance activities of the carrier. Except for a maintenance supervisor who had authority to act as a PMI and a Principal Avionics Inspector, he was the only PMI assigned to the office, and he was the only maintenance inspector assigned to the geographical area in which his assigned certificate holders were located. Two maintenance inspectors in the airworthiness department had died and their vacancies had not been filled. One other inspector had just been with the FAA a year, and a trainee (GS-7) had just recently been assigned to the office.

In March 1984, the FAA conducted a National Air Transportation Inspection (NATI I) which was designed to determine the status of the air carrier industry's compliance with Federal regulations. Seventy-seven inspections of Bar Harbor were performed by the NATI team, which included some inspectors from FSDO-65. Of the 42 inspections performed in the area of operations, all were found satisfactory. The other 35 inspections concerned airworthiness; 9 of those inspections were unsatisfactory and involved problems primarily related to maintenance documentation and recordkeeping practices. Bar Harbor received an overall satisfactory rating and was not required to submit to a followup inspection (NATI II). According to the temporary POI, he relied on the results of the inspection which found no significant problems with the carrier's operation.

From August 1984 to June 1985, FSDO-65 conducted 76 operational, airworthiness, and en route inspections with the assistance of the FAA's New England Region and another FSDO. These inspections were conducted in various types of airplanes, but only five were conducted in the Beech 99; discrepancies found in two of the flights were related to weight and balance problems and the other three disclosed some mechanical problems relating to an autofeather system, a left fuel indicator, and a door warning light. Inspectors also conducted 14 ramp inspections, 17 spot inspections, and 3 procedures and flightcrew records inspections. The only substantive observation noted during the ramp and spot inspections involved a flight diversion due to a mechanical problem. There were 43 other contacts between inspectors and the company involving its operations specifications, manuals, minimum equipment lists, and maintenance conducted either by personal visits, correspondence, or telephone. FAA inspectors also administered 13 flight checks; 7 were performed in the Beech 99 and 6 in the Beech 1900. A check performed by an inspector on March 1, 1985, resulted in an unsatisfactory rating because a captain had difficulty executing normal ILS and automatic direction finding (ADF) approaches.

During the same period, the carrier experienced three separate incidents which were reported to the FSDO: a wingtip strike with another airplane while taxiing, a landing gear problem due to overtravel of the nosewheel turning limits, and smoke and sparks behind the fuel gage panel in N300WP on September 11, 1984. The smoke and sparks was caused by a short in the panel lighting wire. The problem was corrected and the airplane was returned to service.

The New England Region has jurisdiction over FSDO-65. In June 1985, a regional audit team comprised of an experienced operations inspector and an airworthiness inspector performed an in-depth inspection of Bar Harbor. The inspection took 7 days, from May 29 to June 6. The operations inspector performed station facility, records, and en route inspections. The airworthiness inspector performed station facility, records, aircraft spot, ramp, and en route inspections. In all, 28 areas were reviewed which included areas pertaining to both the air carrier's Parts 121 and 135 operations. Some significant areas noted as a result of the audit were:

- o Lack of the use of departure, en route, and approach charts during both VFR and IFR conditions by flightcrews;
- o Flightcrews not planning for immediate landing after departure (they do not have instrument departure and approach charts immediately available for takeoff);
- o During an actual IFR ILS approach, there was no instrument approach briefing and the first officer flew the approach without reference to the approach chart;

- Some long intervals between discrepancy writeups in the maintenance flight log (some aircraft may go several days with no writeups and then the discrepancies get written up after the last flight of the day);
- Aircraft have an excessive number of minimum equipment list (MEL) deferred maintenance items (possible incorrect troubleshooting and inappropriate placarding and releasing per the MEL);
- MEL procedures are a low priority with the carrier;
- Inadequate supply of spare parts;
- Maintenance manual needs updating;
- Required inspection item (RII) procedures and documentation needs updating;
- Maintenance training records incomplete; and
- The PMI is not spending enough time with the carrier (the PMI had over 50 certificate holders to cover and was not able to devote the time he needs to the carrier).

On June 14, 1985, the audit team debriefed Bar Harbor and FSDO personnel on their findings and made several recommendations to correct the deficiencies.

From June 18, 1985, to August 22, 1985, 16 operations and airworthiness en route inspections, 3 ramp inspections, an MEL inspection, and 4 other surveillance activities were performed primarily by FSDO-65. All were found satisfactory, but several resulted in some comments. As a result of the en route inspections, there were some minor discrepancies about weight and balance procedures, a comment about an inoperative power steering MEL item in the Beech 1900 which had existed since May 8, 1985, and a malfunctioning door warning light which had not been recorded in the maintenance flight log. One ramp inspection showed that the forward cargo compartment in a Convair 600 was not sealed in three places because of worn tape. The other four activities concerned those aircraft incidents involving mechanical malfunctions and items involving Convair 600 maintenance.

2. ANALYSIS

2.1 General

The flightcrew of flight 1808 was certificated and qualified for the flight in accordance with Federal regulations and company policy and procedures. The airplane was maintained and inspected in accordance with Federal regulation and the approved maintenance program of the airline.

2.2 Medical and Psychological Factors Affecting Flightcrew

The autopsies performed on the crew revealed no evidence of disease or other medical factors which could have had a bearing on the accident. Although small amounts of ethyl alcohol were found in blood samples of the crew, it is believed that the small amounts of alcohol found were a result of postmortem putrefaction rather than from the physical ingestion of alcohol. The specimens were taken more than 24 hours after the accident. Both crewmen had been exposed to fire and had exhibited extensive internal organ injuries. Also, cultures of the blood samples produced heavy growth of mixed organisms.

Based on the flightcrew's flight and duty time records and information provided by family members and associates, there was no evidence that either crewmember was suffering from chronic or acute fatigue of the crew. Therefore, aside from the ear problem the first officer had experienced 2 days before the accident, there was no evidence to suggest the flightcrew's physical ability to operate the airplane might have been adversely affected.

The first officer had no known history of ear problems and apparently he did not have a cold. The evidence does not permit a determination that the first officer suffered from the affects of aerotitus media (the inability of the middle ear to ventilate itself) resulting in inflammation of the membrane and surrounding tissue. Since knowledge of the first officer's complaint was learned after the autopsy was performed, the Safety Board was not able to request the medical examiner to specifically investigate this possibility. Nevertheless, a dormant infection or other latent cause of tissue swelling cannot be dismissed entirely. This condition conceivably could have caused a sudden onset of severe pain in the ear resulting in a distraction to the first officer and a disruption in crew coordination and in the overall performance of the flight.

2.3 Airplane Maintenance

The investigation found no evidence of a failure or malfunction of the airplane, its systems, or its components. The history of problems with the NAV/COMM equipment was considered as a potential factor in the accident. Water leaks could have affected the NAV/COMMs and could have caused erroneous navigation displays resulting in an unstabilized flightpath. Although the No. 1 NAV/COMM removed from the airplane the day before the accident showed no evidence of water contamination, and there was no further writeup concerning water leaks, it could be concluded that the water leak problem had been corrected when the windshield was last repaired on May 21, 1985. However, another NAV/COMM discrepancy due to a water leak through the windshield about 2 weeks later shows that the last repair did not correct the water leak problem in N300WP. The discrepancy and corrective action history shows there was continuous problems with the NAV/COMM. Thus, a remote possibility of some form of malfunction remains because of the location of the avionics and other electrical components in the nose compartment of the airplane adjacent to the windshield, and because the airplane had been flying through light rain at the time of the accident.

2.4 Weather Reporting System

The SAWRS facility at the Auburn-Lewiston Airport was found unsatisfactory during an inspection on April 11, 1983; however, a reinspection of the facility 2 days after the accident showed that the previous discrepancies had been corrected and that it was in satisfactory condition at the time of the accident.

As a result of its investigation of an accident involving a Beechcraft Queenair on February 4, 1985, at Soldotna Airport, Alaska, 7/ the Safety Board recommended that the NWS:

7/ Aircraft Accident/Incident Summary Report—"North Pacific Airlines, Flight 1802 Beechcraft, BE-65-08A, N50NP, Soldotna, Alaska, February 4, 1985 (NTSB/AAR-86/01/SUM).

A-85-19

> Determine whether Supplementary Aviation Weather Reporting Stations outside the Alaska Region have been inspected and monitored in accordance with the National Weather Service Manual, Chapter 14, Part B, and require an immediate inspection where one is overdue and corrective action is indicated.

On August 13, 1985, the NWS responded that it was initiating a program to bring the inspection of all SAWRS stations up to date and that the program would be completed in October 1985. The Safety Board was subsequently informed that all SAWRS stations had been inspected. Safety Recommendation A-85-19 was classified as "Closed--Acceptable Action."

The company station agent at Lewiston was a qualified weather observer. There was no evidence that he contributed in any way to the accident.

Weather observations in the vicinity of Auburn-Lewiston and witness reports about the weather conditions confirmed that the 2150 observation made by the Bar Harbor station agent at Auburn-Lewiston was substantially correct. The terminal forecast for Portland was substantially correct. The conditions at Portland are believed to be similar to those existing at Auburn-Lewiston at the time of the accident, even though a terminal forecast was not available for Lewiston.

2.5 Visibility Markers

The Safety Board remains concerned about the adequacy of markers used around airports to determine surface visibility. Even though witness statements indicated that the visibility was consistent with the station agent's report, the Board cannot assume these reports represent the actual flight visibility existing in the runway environment at the time of the accident since the observations were not made from the runway. Furthermore, the Auburn-Lewiston station agent stated that the approach end of runway 4 tended to become foggy before other areas around the airport. Insofar as the accuracy of the visibility may be in question, the 1/2-mile visibility error listed on the approach chart may have permitted an approach when one would not have been performed if the visibility had actually been less than 3/4 miles.

Because runway 4 is the main instrument runway at Auburn-Lewiston, the Safety Board finds it is significant that the approach end of the runway does not have available lights to determine the visibility especially when the opposite end of the runway has available lights. As a result of an accident on May 30, 1979, involving a deHavilland DHC-6-200 in Rockland, Maine, 8/ the Safety Board recommended that the FAA:

A-80-23

> Establish guidelines on the location and number of visibility markers necessary at airports to assure representative surface visibility values for airport runways and the airport runway environment.

8/ Aircraft Accident Report--"Downeast Airlines, Inc., deHavilland, DHC-6-200, N68DE, Rockland, Maine, May 30, 1979" (NTSB-AAR-80-75).

On October 25, 1982, the FAA responded that it believed existing requirements to be adequate and that it did not believe the addition of visibility lights over and above that provided by runway lighting would improve aviation safety. Consequently, Safety Recommendation A-80-23 was placed in a "Closed--Unacceptable Action" status. However, in view of the accident, the tempo of airline activity, and competition brought about by deregulation in the aviation industry, air carriers and flightcrews should have the best information possible regarding the weather. In view of the fact that the initiation of an instrument approach is dependent on observed or measured visibility by Federal regulation, the traveling public deserves the extra margin of safety that visibility markers would provide.

2.8 Air Traffic Control

The radar controller was a qualified full performance controller (FPL) with 15 months of experience as an FPL with the FAA. His actions up to and including the approach clearance given at 2158:38 and those of the other controllers handling flight 1808 were timely and in accordance with ATC procedures and other standard operating practices.

The controller's instruction to the flightcrew to turn to a 340° heading was given considerable attention during the investigation because it would have put the airplane on a 60° intercept angle to the final approach course when the airplane was 1 mile from the LOM. During the Safety Board's public hearing on the accident, the controller stated, ". . . this was just a turn, a correction to assist the pilot to intercept Lewie, south of, outside of Lewie." The Board noted that, although the flight was in radar contact with Portland Approach, it had not been given radar vectors to the final approach course nor were they required. Instead, based on their previous clearance, the flightcrew was providing their own navigation to the final approach course by way of the transition depicted by the navigational aids on the instrument approach chart. The controller's supervisor testified that the radar arrival section of the ATC Handbook (7110.65D) did not apply to flight 1808 because the flight was a nonradar arrival and the intercept angle limits specified in the radar arrival section did not apply to N300WP. The nonradar chapter of the handbook did not contain any criteria for handling aircraft in radar contact. The intent of paragraph 5-121, Section 9, "Radar Arrivals" is to provide a smooth transition for an aircraft from a radar vector to a final approach course without overshooting. However, it did not provide guidance to controllers for use in assisting a flight when it deviates from a final approach course. In addition, the key distinction between a radar arrival and a nonradar arrival as presently defined, is whether or not an aircraft is given radar vectors. The term nonradar arrival is confusing because an aircraft would never be given radar vectors in a nonradar environment.

In an accident involving Trans World Airlines at Berryville, Virginia, on December 1, 1974, 9/ the controller issued an approach clearance without an altitude restriction and the airplane struck a hill during its descent while the crew was on their own navigation. FAA maintained that a pilot on final approach or transition to final approach, providing his own navigation while in radar contact, but not given radar vectors, was a nonradar arrival. (At that time, the radar arrival section, in the ATC Handbook (7110.8D), addressed the procedures of radar control for arriving aircraft, but the handbook did not define the term "radar arrival." The term, "non-radar arrival" did not exist in the manual at that time.)

9/ Aircraft Accident Report--"Trans World Airlines, Inc., Boeing 727-231, N54328, Berryville, Virginia, December 1, 1974" (NTSB-AAR-75-16).

In its final report on the Berryville, Virginia, accident, the Safety Board stated that the flight should have been classified and handled as a radar arrival. ATC had radar contact with the flight, and there were no procedures in the manual on how to handle the flight using nonradar procedures when, in fact, the airplane was in radar contact. The Board recommended on July 24, 1975, that the FAA:

A-75-58

> Define the term "radar arrival" and assign an equal weight of controller responsibility to all arrivals receiving radar service, regardless of the kind of radar service.

The FAA responded on August 18, 1975, that it concurred with the recommendation, that the recommendation was part of a study to review terms and phrases used in the ATC system for the purpose of determining whether they needed to be defined, and that it would take whatever corrective action would be needed. As a result, the FAA included the pilot/controller glossary of ATC terms in both the ATC handbook and the Airman's Information Manual.

The Safety Board believes, however, that the definitions are confusing and somewhat inconsistent with the environment under which an aircraft may be operating. The Board believes that a standard should exist for intercept angles regardless of whether or not an aircraft is receiving radar vectors and that appropriate material should be included in the handbook that addresses the situation when an aircraft deviates from its course in a radar environment. If the aircraft cannot be returned to course using the standard criteria for an intercept, then the pilot should be informed that he appears to be too far right or left of course for a safe approach, and asked his intentions. An aircraft in radar contact should not be handled under a chapter of the handbook that was designed and intended for nonradar operations.

In the case of flight 1808, the off-course flightpath was identified by using radar, the correction issued to the pilot was based on radar information, and the position report given to the crew with respect to Lewie was accomplished using radar. Therefore, the Safety Board believes that the flight should have been treated as a radar arrival. The procedures for handling flights should be those governing radar operations and not those governing nonradar operations. To accomplish this, the definition for radar arrivals should be amended to include all IFR arrivals under radar contact, and the definition of nonradar arrivals should be amended to include only arrival aircraft not in radar contact. If deviations are noted, the procedures for assisting a flight to return to course using radar should be added to the radar arrival section in the chapter titled, "Radar."

2.7 The Flightpath

A review of all available data pertaining to the navigational aids and the radar track of the airplane disclosed a possible explanation for the slight off-course track after flight 1808 passed ENE. The ENE VOR was misaligned by 1° to the right and the 036° radial had a 2.5° right bend at 20 miles. If the airplane was tracking outbound on the 036° radial at 26 miles, it actually would have been about 0.7 mile to the right of the desired course. At 2159:50, flight 1808 was actually 1.3 miles to the right of the 036° radial at Doley, about 26 miles away. The 0.6-mile difference between the flight's position and the 036° radial would have resulted in a course deviation indicator (CDI) needle deflection of only seven-tenths of a dot to the left (fly left indication). The CDI would have indicated that the airplane was nearly on the 036° radial. At that time, the airplane made a 10° heading change to the left.

The remainder of the approach to the Doley intersection, where the 041 localizer course would have been intercepted, was flown erratically. A constant rate of descent was not established to cross Doley at the desired 3,000 feet. The crew should have realized that in 26 miles from ENE to Doley, they had to lose 4,000 feet which, at an airspeed of 200 to 210 KIAS, would require a rate of descent of 550 to 600 feet per minute. Instead, the airplane was initially established at a rate of descent of 500 feet per minute and then was allowed to decay to 350 feet per minute. The rate of descent then increased to 800 feet per minute when the crew was told that they were 12 miles south of Lewie and cleared for the ILS approach. It is not known why, at this point, the airplane began a ground track 6° to the right, away from the track that would have permitted intercepting the final approach course. It could be attributed to inattention or misinterpretation of displayed navigational information. Also, a signal anomally, malfunction, or incorrect setting of the NAV equipment could all be possible explanations for the turn away from Doley and the final approach course.

If the NAV equipment had been properly tuned to and receiving the ILS frequency after passing Doley, the GS needle should have started moving downward toward the "bullseye." The distance measuring equipment (DME) reading from ENE should have indicated about 30 miles at this location, in addition to the CDI needle movement if one NAV had been tuned to Navy Brunswick. This should have indicated to the crew that they had passed Doley and that a descent could be made to the next minimum altitude of 2,200 feet. However, the airplane then appeared to level off at 3,600 feet, a minimum en route altitude depicted on the approach chart from the Orham Initial Approach Fix to the Doley intersection, for about 1 minute. The momentary level off at 3,600 feet may have occurred because the crew may have thought initially that the instruction on the chart applied to their route and attempted to comply. It is also the minimum safe altitude for the area in which they were flying. However, it is believed that the airplane most likely was leveled off to slow it down.

About 2200:17, because the localizer needle would have been displaced by more than one dot, the first officer should have been calling, "glide slope alive" and "localizer." The airspeed should have been 120 to 130 knots instead of 190 knots, approach flaps should have been set at a speed not greater than 150 knots, and the prelanding checklist should have been complete up to the point of extending the landing gear. Thereafter, the rate of descent increased to at least 800 feet per minute and was maintained, but it was insufficient to maintain the GS. Since the radar data shows that the airplane was following the glideslope path for 15 seconds, the Safety Board believes that the crew was correctly receiving glideslope information at that time.

At 2201:26, the airplane started to go above the upper limit of the GS and immediately began another right turn away from the final approach course. Seven seconds later, the controller asked if the flight was receiving the LOC and the turn stopped immediately to a ground track of 061°. When the captain reported they had not yet intercepted, the controller issued the turn to 340° at 2201:40. It could be surmised that before the controller made the inquiry the captain may have decided to make a second attempt and was turning to the right to do so but changed his mind when the controller observed that the flight was having difficulty intercepting the LOC and offered assistance. The turn to the right would have been correct with respect to the position of the holding pattern. Also, the crew could have been making an "S" turn to slow down and lose altitude. Although the airplane started to make a left standard rate turn 8 seconds later, it was outside the right side limit of the LOC signal (full needle deflection) as it passed the LOM and was inside the LOM when it crossed the centerline of the LOC course on an intercept angle of about 45°. The crew had 15 seconds lead time from the time the turn was stopped on the 354° ground track until the airplane intercepted the right side limit of the LOC. It took 13 seconds for the airplane to traverse the width of the LOC course. When the first officer acknowledged "Affirmative" to the controller's question, ". . . are you receiving it," the controller began informing the crew of the termination of radar service and the missed approach instructions and did not finish talking until 2 seconds after the airplane had exited the left side limit of the LOC, at which time the right turn to 049 was initiated in an attempt to reintercept the ILS. This transmission by the controller could have distracted the flying pilot which may have interrupted a timely turn onto the final approach course.

As the airplane flew through the LOC course and started the right turn back to intercept the LOC, it lost 400 to 500 feet of altitude in 10 seconds, from 2,400 feet down to 1,900 feet. The sudden climb to 2,300 feet and the descent to 1,700 feet is within the capability of the airplane, but would have required a +1.5 load factor for 6 to 8 seconds followed by a +0.5 load factor for 8 to 10 seconds. In an attempt to arrest a high rate of descent, the pilot might have made a slight climb as a result of overcontrolling the airplane and then a slight push-over because the initial correction was too great and it would be necessary to continue the descent to intercept the GS. However, in this case, the maneuver appeared excessive.

From this point on, the rate of descent stabilized around an average 1,300 feet per minute until the initial tree impact. The airplane had descended below the lower limit of the GS and had passed to the right side of Christian Hill, just inside the right side limit of the LOC signal before it struck the trees. At the point of impact, the airplane was 180 feet below the center of and about 156 feet below the lower limit of the GS. The initial impact site was only about 70 feet short of the middle marker and 126 feet below DH.

The flightcrew executed an unstabilized approach contrary to company procedures and safe operating practices. It is possible that the crew may not have realized how close they were to the LOM before the controller advised them of their position. Station passage would have been indicated by the swing of the ADF needle, the blinking marker beacon light, and associated audible tone if it were selected on. The radar track and marker beacon signal pattern indicates that the crew should have received the marker beacon signal. However, it appears the airplane may have already been inside the LOM and the ADF would not have indicated station passage. At this point the airplane was 500 feet above the GS intercept altitude at 165 KIAS, 15 knots above the company recommended flap extension speed and 35 knots above the company recommended landing gear extension speed, and the rate of descent had increased to 2,200 feet per minute.

Under these circumstances, it is conceivable that the crew would have been late in configuring the airplane for landing and would have been behind in accomplishing the checklist. Late extension of approach flaps and landing gear could have contributed to the climb to 2,300 feet and rapid descent to 1,700 feet before the airplane was stabilized at a descent rate of about 1,300 feet per minute. These events would contribute to a high workload on the flightcrew at a critical time in the approach. They might have had a tendency to focus or concentrate only on certain data to the exclusion of other information that also may have been equally important and failed to make the required call-outs. Such behavior is termed "selective attention" in psychological terms. That is, as workload increases and the resultant level of stress on the pilot increases, the normal scanning and cross-checking techniques and crew coordination break down. The pilot(s) therefore might focus or concentrate on certain instruments or controls to the exclusion of others. As a result, the airplane was never stabilized on the ILS. It is evident that the crew continued the approach and crossed the localizer from left to right descending below the GS at about 600 feet. A witness observed the airplane level off. However, the physical evidence shows that the airplane was in an average 6° descent path before and after initial tree impact. The airplane would have had to turn at least 20° to 30° to the left to have completed the approach. When it hit the trees, the airplane was correcting back to the runway and had obtained a ground track of 045°. It is possible that the crew saw the approach lights when they descended below the GS. The physical evidence indicates that the landing lights were off, which otherwise could have obscured their vision in fog.

Based on the foregoing sequence of events, the Safety Board believes that the flightcrew may not have been completely aware of their position with respect to the LOM until the controller attempted to assist the flight with the 340° heading.

Although, the airplane only turned 47° to the left instead of 60°, the turn given by the controller may have contributed to the unstabilized approach. The flight was off course to such an extent that a 60° turn was required to put the airplane on a track to the LOM and a nonstandard procedure was required to achieve this objective. In view of this fact, the Safety Board believes that the controller used poor judgment and technique in his attempt to assist the flight. He also exercised poor judgment and technique in his subsequent handling of PEX 391 while it was on an ILS approach near the final approach fix. He kept PEX 391 too high and on a 52° intercept heading, which resulted in the airplane flying above the glideslope path. Since the crew was without glidepath guidance, they had to request a turn in order to position the airplane on course and on glidepath before commencing their final approach. The correct course of action in the case of flight 1808 would have been for the controller to have asked the pilot his intentions after providing the position report and then offered to provide radar vectors. Such action by the controller probably would have provided the captain with an easy alternative. Acceptance of radar vector assistance would have alleviated his predicament and would have provided the crew an opportunity to establish a stabilized approach. However, the Safety Board must point out that the opportunity for the captain to have asked for radar vectors was always available. Instead, the approach was continued and the airplane was never established on the localizer or GS.

Although the crew might have been able to make a landing, it would have been unsafe. In darkness and under the existing weather conditions, it would have been difficult for the flightcrew to have recognized an excessive rate of descent until the airplane was very low. In addition, the flightcrew probably was susceptible to visual illusions because there were no other ground lights for reference in the approach zone, there was water on the windshield, and there was a slight upslope to the runway. These conditions would have combined to produce a perception that the airplane was higher than it actually was in relation to the runway.

To make a visual approach, a pilot must constantly interpret the changing visual scene to remain oriented on the proper glidepath to the runway. Pilots must judge height, speed, distance, and glidepath based on perceived movement of external objects, their brightness, and their apparent size as well as their relationship to the horizon and with other objects, and with respect to the airplane's orientation in space or its angular relationship with the runway. Thus, visual perception is a decision-making process based on a multitude of visual cues.

At night, because visual cues are reduced and are further degraded by weather and sloping terrain, pilots must rely to a greater extent on flight and navigation instruments to reach the runway safely. The reduced number of visual cues, such as the runway and approach lights, may well provide images that can be interpreted inaccurately, causing pilots to make inappropriate decisions. In this instance, flight 1808 could have become visual at about 1 to 1 1/2 miles from the airport. Therefore, the crewmembers would only have seen the 3,000-foot long approach light system and perhaps the runway threshold. Without further foveal or peripheral visual cues, an illusion would be created that the airplane was too high in relation to the expected visual light scene, i.e., 3,000 feet of approach lights plus 5,000 feet of runway lights. An additional visual illusion would have been created by the featureless and unlit terrain surrounding and preceding the approach lighting system. This is called the "black-hole approach" and concerns approach to a lighted runway (or in this case to the approach lighting system) over dark featureless terrain beyond which the horizon is not discernible. Simulated tests of both visual conditions have shown that a pilot tends to descend along the arc of a circle, the circumference of which touches the ground short of the runway lights. The fact that flight 1808 had water on the windshield and that the airplane was manuevering and was not aligned with the runway and approach lights center line aggravated the situation. 10/

Therefore, the Safety Board believes that the captain used poor judgment by not making a missed approach in the vicinity of the LOM. Once he decided to continue and attempted to "salvage" the approach, the crew had difficulty because the airplane was not only unstabilized on the ILS, but it was outside the LOC and GS limits. This degraded significantly their ability to determine the airplane's correct angular relationship to the runway when the runway environment came into view. The Safety Board believes that the visual and meteorological conditions could have contributed to the pilot flying too low. Even with the VASI installed, the crew probably did not see it and if they did, the system does not indicate how far an airplane is above or below the proper glidepath.

On site examination showed that the landing gear was extended with the flaps retracted instead of at the approach or full down position. There are four possible explanations. The crew may have accidentally hit the flap lever after the airplane struck the trees, they may have failed to extend the flaps because they were hurried, or they may have failed to complete or properly coordinate a missed approach procedure. If they attempted to execute a missed approach, the proper procedure in the Beech 99 requires first arresting the rate of descent by increasing the pitch attitude and adding full power, and after a positive rate of climb has been established, retracting the landing gear, and then retracting the flaps. The captain must raise the landing gear, and the first officer raises the flaps. If the crew had attempted a missed approach, the change in control yoke pressure should not have been significant if the airplane had been trimmed at a speed between 120 and 130 knots. The position of the stabilizer actuator suggests that this would have been the case. About 130 knots, the airplane has the capability of generating sufficient additional lift in a 2 G pullup to arrest the 1,300 fpm rate of descent within about 10 feet. Also, at this speed the different flap position effect is negligible. Therefore, based on a 3-second recognition and response time and a 1-second aircraft response time, the pilot could have arrested the rate of descent in about 80 feet.

Although remote, a fourth possibility is a mechanical malfunction or electrical short in the system. However, such a failure or malfunction should not have caused any control difficulty.

10/ For further information on visual illusions read, "Fundamentals of Aerospace Medicine," Dettart, Roy L., editor, published by Lea Febiger, Philadelphia, 1985.

2.8 Flightcrew Coordination

The absence of a CVR precluded the Safety Board from determining the circumstances that may have existed in the cockpit at the time of the accident and how effective the crew may have worked together. The available evidence was insufficient to determine who was flying the airplane during the approach and seconds before the accident. Also, it is not known whether or not the crew used the checklist and made the required call outs in accordance with standard operating procedures. Based on the training provided the crew by the company, they should have been aware of the required procedures.

The Board believes that the flightcrew was familiar which each other and the flight schedule. Testimonies from associates indicated that the captain had good piloting skills and good attitudes toward fellow crewmen, and used good judgment. Also, the captain was known to accept constructive criticism without reacting adversely. Accordingly, there should have been no apprehension on the part of the first officer to inform the captain about any unwarranted deviations in company procedures. However, both the captain and the first officer were relatively inexperienced in their respective positions and the division of cockpit duties between the flying and nonflying pilot may not have been performed as effectively as it might have had one or both been more experienced.

While crew coordination was professed to be taught by the company, no specific crew coordination program on cockpit resource management or assertiveness training was taught. There is evidence that crew coordination was not consistently practiced among crewmembers during routine operations. A first officer, who had flown frequently with the captain, said that the captain did not demand a challenge and response use of the checklist. Although, the pilot retracted that statement during the Safety Board's public hearing, he testified that only essential items were called out. Another pilot corroborated that statement. Testimony was obtained in an attempt to clarify which items of the checklist were essential and which were nonessential. According to one pilot, examples of nonessential items were the passenger sign, the autofeather switch, and the altimeter because these items were readily visible and ". . . the copilot can take care of it himself."

The Beech-99 was designed to be operated by a single pilot. It is, therefore, conceivable that in view of the noncomplexity of the airplane and the brevity and simplicity of the checklist, checklist items probably were performed silently by the nonflying pilot. Performing checklist items in this manner in a single pilot operation is obvious, but carrying such habits over into a two-pilot air carrier operation fosters apathy, negates the safety aspect of crew redundancy, defeats the purpose of the crew concept, and invites mistakes that go unnoticed. Consequently, the Safety Board believes that a lack of crew coordination could explain, in part, the operational discrepancies in this accident. The ATC tape of communications revealed that both the captain and first officer were making the radio transmissions, contrary to company procedures. In part, for this reason, the Board was unable to determine who was flying the airplane. The evidence of how the radio communications were handled by the crew is indicative of poor crew coordination technique and could have resulted in a distraction to the flying pilot. Therefore, the FAA must use caution in its certification and surveillance of commuter airlines to ensure that crew coordination is practiced and it should emphasize the problems that can develop with airplanes that are designed for the single pilot.

One such unnoticed mistake that could have evolved from the unchallenged checklist use, is a mis-set altimeter. Both altimeters were found set at pressure settings that were different than what was provided by the station agent. The captain's altimeter was set at 30.42 and the first officer's was set at 30.12. The station agent stated that he had provided the crew with an altimeter setting of 30.24. The last altimeter setting provided by Portland Approach was 30.26 which was acknowledged and repeated by the first officer.

Based on the manufacturer's examinations, the captain's altimeter setting could have been significant since its reading would have been indicating an altitude close to DH when the airplane struck the trees. This would have misled the captain to believe that the airplane was higher than its actual altitude. However, the copilot's altimeter setting was mis-set in the opposite direction. It is possible that the disparate altimeter settings were caused by ground impact and subsequent destruction of the cockpit. However, it only remains a possibility since the altimeters showed no evidence of barometric gear system derangement or impact marks to fix the position of the altimeter settings at the time of the accident.

From a human performance standpoint, it is possible that the captain may have mentally transposed the last two digits of the altimeter setting when he heard the transmission and transferred 30.42 instead of 30.24 to his altimeter. This would require 1 3/4 turns with the thumb and forefinger. Since this is a considerable and unusually large pressure change, the captain would have been expected to question such a change. It is difficult to believe that the first officer would have ignored the altimeter settings he was provided.

Since the recorded radar data of the airplane's flight track at 7,000 feet is consistent with altitude instructions provided to the crew by ATC, the Safety Board concludes that until the airplane began its descent from 7,000 feet, the captain's altimeter was set correctly. However, once the descent was begun, the airplane's flightpath for the remainder of the flight precluded using the radar data to verify the altimeter setting. If the altimeter was mis-set, it would have been mis-set after leaving 7,000 feet. The Board believes that the transposition of the settings is too coincidental to disregard conclusively this event as a factor in the accident. Another possibility that could have accounted for the captain's setting is the station agent giving the setting of 30.42. However, he would not have remembered transposing the numbers and there was no record of the conversation.

Although the Safety Board does not have conclusive evidence that the level of noise in the cockpit actually had an adverse impact on flightcrew performance, previous investigation experience suggests that it probably was a factor. During its investigation of an accident involving a Beech-99 on January 20, 1981, 11/ cockpit noise levels were measured at 97 decibels db(A) 12/ which equals a speech interference level (SIL) of 85.5 db. At these noise levels face-to-face communications become difficult and shouting is required to communicate effectively. Therefore, these noise levels can discourage cockpit communication and, in effect, reduce crew effectiveness and coordination.

As a result of the January 20, 1981, accident, the Safety Board recommended that the FAA:

11/ Aircraft Accident Report-- "Cascade Airways, Inc., BE-99A, N390CA, Spokane, Washington, January 20, 1981" (NTSB/AAR-81-11).
12/ Quantitative noise level measurement.

A-81-75

> Establish for aircraft used in commercial operation the maximum cockpit noise levels which will permit adequate direct voice communication between flight crewmembers under all operating conditions.

A-81-76

> Require the installation and use of crew interphone systems in the cockpits of those aircraft in which noise levels reach or exceed the maximum level established for adequate direct voice communication between flight crewmembers under all operating conditions.

In its response to Safety Recommendations A-81-75 and -76, the FAA said that it has performed an engineering study which showed that there are aircraft that have noise levels high enough to interfere with verbal crew communications. However, it believed that an economic burden would be placed on the aviation community by requiring interphone systems. As an alternate action, the FAA advised that, it would develop an advisory circular which would provide guidance on cockpit noise measurements and noise levels above which communication aids would be desirable as well as remedies that could be used when high noise levels are encountered. Subsequently, both safety recommendations were placed in an "Open—Acceptable Alternate Action" status. The advisory circular was scheduled for May 1986, but has not yet become available and there have been no steps taken by the FAA to implement the retrofitting of airplanes with interphones which exceed allowable noise levels. Therefore, the Safety Board has classified Safety Recommendations A-81-75 and A-81-76, "Closed-Unacceptable Action/Superseded" and it has issued two new recommendations to the FAA based on the maximum cockpit noise level of 78 PSIL recommended in the FAA contract report.

The Safety Board believes that interphone systems in high noise level cockpits are necessary. Since Bar Harbor Airlines was operating under the flightcrew concept rather than conducting a single pilot operation, the Board believes the airline should have installed such a system in order to ensure that its flightcrews could communicate effectively and thereby increase its margin of safety. To counteract the noise environment, flightcrews had developed a practice of using hand signals to identify restrictions and heights above the DH. While the use of hand signals is not an uncommon practice among pilots, the Board believes that such practices should be developed as standard and controlled by the air carrier and included in the flightcrew training program.

High noise level cockpits should not be allowed to interfere with the safe operation of an airplane since relatively inexpensive steps could be taken to mitigate its adverse effects. While it is not possible to assess the quality of the crew's communication in the absence of CVR information, an interphone system certainly would have enhanced their ability to communicate, the lack of which may have been a factor in the accident.

2.9 Training and Experience

The training provided by the company met the standards required by Federal regulations. However, a problem confronted by many commuter air carriers is the high turnover rate among pilots because of the attraction of employment by larger air carriers flying more sophisticated equipment with better working conditions. As a result, the experience level is lower in smaller air carrier companies. For example, in 1984 and 1985, 23 and 22 pilots, respectively, resigned from Bar Harbor compared to 10 in 1982 and 11 in 1983. Similarly, the high flying experience level in 1983 was 10,700 hours, and in 1984 it was 10,533 hours while the 1985 high experience level was only 6,250 hours. The number of pilots employed increased from 88 pilots in 1982 to 134 in 1985.

One problem with a high pilot turnover rate is that selection can be difficult. It also causes lower-time pilots to be upgraded to captains without first becoming seasoned first officers. In effect, new inexperienced captains must fly with even less experienced first officers. When he was hired, the first officer, who had been on the job only 3 months before the accident, had logged 1,300 hours of total time, of which 100 hours were multiengine time. While the captain had considerably more flying experience, he had been with the company only 1 1/2 years, and this was his first experience with a scheduled air carrier. Therefore, while ground and flight training was in conformance with the regulations, and in some cases exceeded these minimum requirements, the operational training of the pilot work force appears to have been accelerated by necessity.

2.10 Company Standards and Management

The Safety Board obtained considerable testimony at the public hearing regarding the standards set forth by the company for both training flights and operational flying. Although the training program does not appear to be an issue, the operational practices of its pilots and their supervision by the company is of concern to the Board.

There was considerable confusion in the testimony from management personnel, training captains, and operational flightcrews regarding the company's standards for an ILS approach and the ILS approach training. The director of training testified that ILS tolerances were established for training and check ride purposes but that there were no tolerances set for daily operations. A first officer stated that the ILS tolerance standards were at the pilot's discretion. A training captain felt that a pilot should execute a missed approach when the deviation needles are deflected one dot. Other personnel believed that a three-dot deviation of the localizer needle was acceptable when 500 or more feet above DH. The former POI testified that, "The standards which are set into the training program would be standards I would expect a line captain to adhere to . . . the carrier, they write the training program, they submit it the FAA for our approval." He stated that if the airline requires performance standards that are more strict than the guidelines (AC 61-77, Airline Transport Pilot Flight Test Guide) for an airline transport pilot certificate, they would be approved.

Although the foregoing represents only one example of the latitude allowed pilots in daily operations, it reflects the lack of adequate guidance and supervision. Further, from a human performance viewpoint, this kind of situation fosters a lack of appreciation for precise flight operations which could lead flightcrews to develop poor flight and crew coordination procedures and habits.

Additionally, nonstandardization in cockpit and equipment instrumentation can have an adverse affect on flightcrew performance. Indeed, the different VOR/ILS indicators installed in Bar Harbor's fleet, with their slightly different displays and operation could have contributed somewhat to flightcrew confusion surrounding the ILS deviation limits. The displacements of their needles are not comparable, that is, a one-dot GS deviation on the KI 214 indicator does not represent the same displacement from glideslope centerline as a one-dot GS deviation of the KI 204 indicator.

The flight operations and safety departments of major air carrier operations, pilot groups, and aircraft manufacturers have been aware of the problem of nonstandardization of cockpit display and equipment and have taken steps to meet the needs of the pilots in this area. However, although emphasis has been placed on achieving standardized cockpits throughout major air carrier fleets, standardization remains a problem. This situation is even more difficult for many commuter air carriers who often are confronted with the difficult task of purchasing adequate aircraft for their operation. The problem of achieving standardization becomes particularly pronounced when the fleet is comprised of aircraft certificated under 14 CFR 23 from different manufacturers and purchased from different operators. While the Board recognizes that this situation is gradually improving with the introduction of new and better aircraft in commuter airline fleets, the need for cockpit standardization will remain and must be emphasized within the growing commuter airline industry.

2.11 FAA Surveillance

From the testimony received at the public hearing, it is evident that the availability of surveillance and assistance by the FSDO was severely curtailed. This situation occurred at a critical time in Bar Harbor's operation because of the increased activity in the commuter industry, the increased pilot turnover rate, and the seasonal increase in passenger travel. The temporary POI could not manage the increased workload, nor did he have time or the resources to carry out his tasks effectively. As he pointed out, he was able only to deal with urgent or critical situations. The PMI was in the same position. It is apparent that surveillance activities were being performed by the FSDO, but the depth and quality of these activities were curtailed by the limited manpower available. The Board believes that the New England Region team performed an excellent audit of the carrier and identified areas which required immediate attention in order to correct deficient trends in the carriers operation and to ensure compliance with the requirements and spirit of the regulation and adherence to good operating practices. It is evident that an immediate and an aggressive response was required of the FSDO. However, the Safety Board believes that due to insufficient inspector workforce at the FSDO, an aggressive program was not established which prolonged the time to accomplish the recommended changes. As a result, there was not enough emphasis by the company to improve its supervision over its operational practices and to correct the occasional failure of its flightcrews to adhere to company standards and procedures.

The Safety Board is continually concerned about the effectiveness of the FAA's certification and surveillance of commuter air carriers. The Board has maintained that a sufficient margin of safety in a commuter operation can only be achieved through sustained and discerning surveillance by the FAA, which in this air carrier operation, was deficient. This certainly had an adverse impact on the carrier's performance and may have contributed, indirectly, to the accident.

The Safety Board recognizes the latest FAA efforts to alleviate substandard surveillance. In February 1984, the FAA embarked on an in-depth review of the flight standards inspection program. The project, entitled SAFE (Safety Activity Functional Evaluation), is a program management and project planning system designed to identify and correct problems in the flights standards program. The project addresses the findings from the National Air Transportation Inspections (NATI I and II), the General Aviation Safety Audit (GASA), and an evaluation of existing regulations, directives, programs, flight standards inspection programs. The elements of the flight standards system which received critical appraisal included: regulations, directives, work programs, program management information, industry safety findings, evaluation programs, budget, resources, position descriptions, classifications, hiring practices, career development, training, and supervisory evaluation. Deficiencies identified by project SAFE have been addressed in an implementation plan with a blueprint for short-term and long-range changes. The implementation plan will update each part of the flight standards program by fiscal year (FY) 1988; by FY 1989, it will standardize and integrate the parts into an automated, interactive system for updating and documenting FAA performance. However, the SAFE program is in its infancy and will require a period of validation before measurable benefits can be derived. The Safety Board believes that the continued dynamic growth of the commuter industry and these latest accident findings warrant more timely interim measures through the development of procedures and guidelines to provide for the needed surveillance of commuter air carriers during periods when the POI is unable to fulfill those duties because of other work demands.

2.12 Cockpit Voice Recorder and Flight Data Recorder

The Safety Board believes that the facts and circumstances of this accident further illustrate the need for a requirement that FDRs and CVRs be installed in multiengine, turbine-powered, fixed-winged airplanes. Recorded flight parameters and CVR conversation would have provided significant factual information regarding the cause of this accident and, thus, provide the means for determining the proper remedial action needed to prevent recurrence.

As a result of its investigation of a number of other accidents dating back to 1976, 13/ and its investigation of an airplane crash at Felt, Oklahoma, on October 1, 1981, 14/ and the Safety Board recommended that the FAA:

A-78-28

> Draft specifications and fund research and development for a low cost FDR, CVR, and composite recorder which can be used on complex general aviation aircraft. Establish guidelines for these recorders, such as maximum cost, compatible with the cost of the airplane on which they will be installed and with the use for which the airplane is intended.

13/ Aircraft Accident Reports—"Columbia Pacific Airlines, Beech 99, Richland, Washington, February 10, 1978" (NTSB-AAR-78/15); "Champion Home Builders Company, Gates Learjet 25B, N994HG, Sanford, North Carolina, September 8, 1977" (NTSB-AAR-79-15); "Inlet Marine, Inc., Gates Learjet 25C, Anchorage Alaska, December 4, 1978" (NTSB-AAR-79-18); "Massey-Ferguson, Inc., Gates Learjet 25D, N137GL, Detroit, Michigan, January 19, 1979" (NTSB-AAR-80-4); "Downeast Airlines, Inc., deHavilland DHC-6-200, N68DE, Rockland, Maine, May 30, 1979" (NTSB-AAR-80-5); "Cascade Airways, Inc., Beechcraft 99A, N390CA, Spokane, Washington, January 20, 1981" (NTSB-AAR-81-11); "Texasgulf Aviation, Inc., Lockheed Jetstar, N520S, White Plains, New York, February 11, 1981" (NTSB-AAR-81-13); and "Northeast Jet Company, Gates Learjet 25D, N125NE, Gulf of Mexico, May 19, 1980" (NTSB-AAR-81-15); and Special Study—"Commuter Airline Safety 1970-1979" (NTSB-AAS-80-1).

14/ Aircraft Accident Report—"Sky Train Air, Inc., Gates Learjet 24, N44CJ, Felt, Oklahoma, October 1, 1981" (NTSB/AAR-82/4).

A-82-107

Require that all multiengine, turbine-powered, fixed-wing aircraft certificated to carry six or more passengers manufactured on or after a specified date, in any type of operation not currently required by 14 CFR 121.343, 122.359, and 135.151 to have a cockpit voice recorder and/or a flight data recorder, be prewired to accept a "general aviation" cockpit voice recorder (if also certificated for two-pilot operation) with at least one channel for voice communications transmitted from or received in the aircraft by radio, and one channel for audio signals from a cockpit area microphone, and a "general aviation" flight data recorder to record sufficient data parameters to determine the information in Table I as a function of time.

A-82-109

Require that "general aviation" cockpit voice recorders (on aircraft certificated for two-pilot operation) and flight data recorders be installed when they become commercially available as standard equipment in all multiengine, turbine-powered fixed-wing aircraft and rotorcraft certificated to carry six or more passengers manufactured on or after a specified date, in any type of operation not currently required by 14 CFR 121.343, 121.359, 135.151, and 127.127 to have a cockpit voice recorder and/or a flight data recorder.

A-82-110

Require that "general aviation" cockpit voice recorders be installed as soon as they are commercially available in all multiengine, turbine-powered aircraft (both airplanes and rotorcraft), which are currently in service, which are certificated to carry six or more passengers and which are required by their certificate to have two pilots, in any type of operation not currently required by 14 CFR 121.359, 135.151, and 127.127 to have a cockpit voice recorder. The cockpit voice recorders should have at least one channel reserved for voice communications transmitted from or received in the aircraft by radio, and one channel reserved for audio signals from a cockpit area microphone.

A-82-111

Require that "general aviation" flight data recorders be installed as soon as they are commercially available in all multiengine, turbojet airplanes which are currently in service, which are certificated to carry six or more passengers in any type of operation not currently required by 14 CFR 121.343 to have a flight data recorder. Require recording of sufficient parameters to determine the following information as a function of time for ranges, accuracies, etc.):

altitude
indicated airspeed
magnetic heading
radio transmitter keying
pitch attitude
roll attitude
vertical acceleration
longitudinal acceleration
stabilizer trim position
or pitch control position.

Although the Safety Board is encouraged by the FAA's notice of proposed rule making (NPRM) concerning CVRs on newly manufactured multiengine, turbine-powered, fixed-wing aircraft operating under 14 CFR 135, it is concerned that a final rule has yet to be issued. Therefore, the Safety Board urges the FAA to expedite its implementation. Further, the Safety Board believes that the matter of prewiring newly manufactured aircraft, as defined in Safety Recommendation A-82-107, for eventual acceptance of a general aviation flight data and cockpit voice recorder retrofit, has been neglected. The Safety Board also reiterates Safety Recommendations A-82-109 through -111 on recorders for all multiengine, turbine-powered, aircraft. Until further action is taken, those recommendations are being held in an "Open—Unacceptable Action" status.

The Safety Board believes that a CVR not only would have been a valuable tool in analyzing the August 25, 1985, accident to determine why it occurred, but that it would be a positive force in developing measures to prevent similar accidents in the future. Until the FAA requires the installation, or airlines voluntarily install CVRs, similar accidents may occur and important preventive measures will go undetected.

2.13 Ground Proximity Warning System

As a result of this and two other approach phase accidents involving scheduled domestic passenger commuter flights operating under 14 CFR 135, which occurred between August 1985 and March 1986, and in which 30 persons were fatally injured, 15/ the Safety Board believes that the time has come for the FAA and the commuter airline industry to address the installation of ground proximity warning systems (GPWS) aboard those aircraft commonly used by the commuter airlines for the commercial transport of 30 or fewer passengers. An advisory type of system to monitor height above the ground probably would have been sufficient to direct the flightcrews' attention to the possibility of ground contact in time to avoid an accident.

A GPWS or similar device requires the installation of a radio altimeter, a transceiver, an indicator, an antenna, and a voice box. Presently, there is no requirement for a radio altimeter in airplanes carrying 30 or fewer passengers. Although installation costs were previously prohibitive for both the radio altimeter and the GPWS on small airplanes, the state-of-the-art has progressed to the point that newly manufactured airplanes used in the commuter industry should be required to have such equipment, and consideration should be given to retrofitting older airplanes on a priority basis. The Regional Airline Association (RAA) documented fewer than 1,500 older airplanes in the entire commuter fleet in 1985; consequently, a retrofit would not place a massive production requirement of an appropriate device on the GPWS industry. The equipment and installation of a GPWS is estimated at under $10,000.

15/ Aircraft Accident Reports—"Henson Airlines, Flight 1517, Beech B99, N339HA, Grottoes, Virginia, September 23, 1985," (NTSB/AAR-86/07); and "Simmons Airlines, Embraer EMB-110P1, N1356P, Alpena, Michigan, March 13, 1986 (still under investigation).

3. CONCLUSIONS

3.1 Findings

1. The flightcrew was certificated and qualified for the flight in accordance with company procedures and Federal regulations.

2. There was no evidence that either crewmember was sufferin from chronic or acute fatigue.

3. There was no evidence of medical factors which would have detracted adversely from the physical ability of the captain to fly th e airplane.

4. The first officer may have suffered from a dormant ear infection which could have detracted from his overall ability to perform his duties. Otherwise, there was no evidence of medical factors which would have detracted adversely from his physical ability to fly the airplane.

5. The airplane was airworthy and maintained in accordance with the company's approved maintenance program.

6. There was no evidence of a failure or malfunction of the airplane, its systems, or its components. However, there was insufficient evidence to discard the possibility of a failure, malfunction or mis-setting of a component of the navigation equipment.

7. The surface weather reports and forecasts were current and substantially correct.

8. The SAWRS facility at the Auburn-Lewiston Airport had not received a current inspection by the NWS at the time of the accident.

9. The company's station agent was qualified to make weather observations and the SAWRS facility was in satisfactory condition at the time of the accident.

10. The approach end of runway 4 lacked lights or other aids to more accurately determine the visibility.

11. The visibility minimum on the instrument approach chart was published incorrectly.

12. The ground-based navigational aids and approach light system were functioning properly and within acceptable tolerances.

13. The combination of a shallow descent at high airspeed resulted in the airplane intercepting the glideslope sooner than the flightcrew expected and passing through glidepath.

14. The flightcrew may not have realized how close they were to the final approach fix and failed to configure the airplane for the approach in a timely manner and failed to follow established company procedures.

15. The radar controller used poor judgment and technique when he attempted to assist the flight in intercepting the final approach course.

16. The captain's acceptance of the large heading change issued by the radar controller contributed to the unstabilized approach.

17. The captain attempted to complete an unstabilized approach and allowed the airplane to descend below the GS.

18. The altimeters may have been mis-set at the time the airplane passed the final approach fix and the captain's altimeter could have been a factor in premature descent below DH.

19. During the final seconds of the approach, the flightcrew was probably influenced by visual illusions caused by the weather, sloping terrain, high rate of descent, and darkness which contributed to a premature descent below DH.

20. The cockpit noise level in the Beech 99 probably was a factor in the flightcrew's ability to communicate with each other.

21. Company management failed to insure that flightcrews were adhering to company standards and operating procedures.

22. FAA surveillance was affected adversely by inadequate manpower and failed to insure that operational standards within the company were maintained.

23. The airline's pilot turnover rate was sufficient to have reduced the overall experience level of the pilot workforce within the company.

24. The accident was not survivable.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the captain's continuation of an unstabilized approach which resulted in a descent below glideslope. Contributing to the unstabilized approach was the radar controller's issuance and the captain's acceptance of a nonstandard air traffic control radar vector resulting in an excessive intercept with the localizer.

4. RECOMMENDATIONS

As a result of its investigation, the Safety Board reiterated the following recommendations to the Federal Aviation Administration:

> Establish for aircraft used in commercial operation the maximum cockpit noise levels which will permit adequate direct voice communication between flight crewmembers under all operating conditions. (Class II, Priority Action) (A-81-75)

Require the installation and use of crew interphone systems in the cockpits of those aircraft in which noise levels reach or exceed the maximum level established for adequate direct voice communication between flight crewmembers under all operating conditions. (Class II, Priority Action) (A-81-76)

Require that all multiengine, turbine-powered, fixed-wing aircraft certificated to carry six or more passengers manufactured on or after a specified date, in any type of operation not currently required by 14 CFR 121.343, 122.359, and 135.151 to have a cockpit voice recorder and/or a flight data recorder, be prewired to accept a "general aviation" cockpit voice recorder (if also certificated for two-pilot operation) with at least one channel for voice communications transmitted from or received in the aircraft by radio, and one channel for audio signals from a cockpit area microphone, and a "general aviation" flight data recorder to record sufficient data parameters to determine the information in Table I as a function of time. (A-82-107)

Require that "general aviation" cockpit voice recorders (on aircraft certificated for two-pilot operation) and flight data recorders be installed when they become commercially available as standard equipment in all multiengine, turbine-powered fixed-wing aircraft and rotorcraft certificated to carry six or more passengers manufactured on or after a specified date, in any type of operation not currently required by 14 CFR 121.343, 121.359, 135.151, and 127.127 to have a cockpit voice recorder and/or a flight data recorder. (A-82-109)

Require that "general aviation" cockpit voice recorders be installed as soon as they are commercially available in all multiengine, turbine-powered aircraft (both airplanes and rotorcraft), which are currently in service, which are certificated to carry six or more passengers and which are required by their certificate to have two pilots, in any type of operation not currently required by 14 CFR 121.359, 135.151, and 127.127 to have a cockpit voice recorder. The cockpit voice recorders should have at least one channel reserved for voice communications transmitted from or received in the aircraft by radio, and one channel reserved for audio signals from a cockpit area microphone. (A-82-110)

Require that "general aviation" flight data recorders be installed as soon as they are commercially available in all multiengine, turbojet airplanes which are currently in service, which are certificated to carry six or more passengers in any type of operation not currently required by 14 CFR 121.343 to have a flight data recorder. Require recording of sufficient parameters to determine the following information as a function of time for ranges, accuracies, etc.):

altitude
indicated airspeed
magnetic heading
radio transmitter keying
pitch attitude
roll attitude

vertical acceleration
longitudinal acceleration
stabilizer trim position
or pitch control position.
(A-82-111)

Also, the Safety Board made the following recommendations:

—to the Federal Aviation Administration:

Amend 14 CFR 135 to require periodic instrument proficiency checks for all Second in Command pilots required in commuter air carrier operations. (Class II, Priority Action) (A-86-98)

Issue an Air Carrier Operations Bulletin-Part 135 directing all Principal Operations Inspectors to require that Pilots in Command, as well as Second in Command pilots, be tested and be required to demonstrate proficiency in flying instrument approach procedures to the standards that are commensurate with the pilot certificate required for their respective pilot positions. (Class II, Priority Action) (A-86-99)

Issue an Air Carrier Operations Bulletin-Part 135 directing all Principal Operations Inspectors to require commuter air carrier operators to delineate in their Operations and Training Manuals missed approach procedures commensurate with Pilot in Command standards. (Class II, Priority Action) (A-86-100)

Revise Paragraph 72 of the Air Carrier Operations Inspector's Handbook Part 135 (8430.1D) to include guidance to Principal Operations Inspectors regarding the standards and level of precision to which Pilots in Command and Second in Command pilots should be tested during instrument proficiency checks. (Class II, Priority Action) (A-86-101)

Issue an Air Carrier Operations Bulletin-Part 135 to verify that commuter air carrier operators use appropriate vision-restricting devices for their pilots during initial and recurrent flight instrument training. (Class II, Priority Action) (A-86-102)

Expedite the program which proposes standards for the use and evaluation of aircraft flight simulator devices to be used in training programs of 14 CFR 135 operators and, in cooperation with the Regional Airline Association, encourage and assist operators to acquire flight simulator devices. (Class II, Priority Action) (A-86-103)

Issue an Air Carrier Maintenance Bulletin-Part 135 directing all Principal Maintenance Inspectors (PMI) to be alert to significant deviations in cockpit instrumentation and equipment installations of commuter air carriers. The maintenance bulletin should provide guidance with respect to the human engineering principles which are desirable in achieving cockpit standardization and which would tend to eliminate pilot errors in the interpretation of cockpit instruments and the operation of equipment. The bulletin should direct PMIs to encourage commuter operators to provide standardization of cockpit instrumentation and equipment in their airplane fleet to the greatest extent possible. (Class II, Priority Action) (A-86-104)

Issue an Air Carrier Operations Bulletin-Part 135 directing Principal Operations Inspectors to ensure that commuter air carrier training programs specifically emphasize the differences existing in cockpit instrumentation and equipment in the fleet of their commuter operators and that these training programs cover the human engineering aspects of these differences and the human performance problems associated with these differences. (Class II, Priority Action) (A-86-105)

Amend 14 CFR 135.83 to require that all required crewmembers have access to and use their own set of pertinent instrument approach charts. (Class II, Priority Action) (A-86-106)

Issue an Air Carrier Operations Bulletin-Part 135 directing all Principal Operations Inspectors to caution commuter air carrier operators that have instrument flight rules authorization not to schedule on the same flight crewmembers with limited experience in their respective positions. (Class II, Priority Action) (A-86-107)

Issue an Air Carrier Operations Bulletin-Part 135 requesting Principal Operations Inspectors to put special emphasis on their check airmen program to assure that company pilots are evaluated properly and that check airmen apply the training and check ride standards in a strict and standardized manner. (Class II, Priority Action) (A-86-108)

Amend 14 CFR 135.153 to require after a specified date the installation and use of ground proximity warning devices in all multiengine, turbine-powered fixed wing airplanes, certificated to carry 10 or more passengers. (Class II, Priority Action) (A-86-109)

Until the objectives and goals of the Safety Activity Functional Evaluation program are fully realized, establish and require, as an interim measure, a minimum level of direct surveillance, in terms of required tasks as well as personnel levels, to adequately oversee commuter air carrier operations. (Class II, Priority Action) (A-86-110)

Develop and issue guidelines to Air Carrier District Offices to provide for a minimum level of continued direct surveillance of commuter air carrier operators when the Principal Operations Inspector is occupied with other duties for extended periods of time. (Class II, Priority Action) (A-86-111)

Conduct noise measurement surveys of all makes and models of aircraft used in 14 CFR 135 passenger-carrying operations which are now not equipped with functioning crew interphone systems. (Class II, Priority Action) (A-86-112)

Require the installation and use of crew interphone systems in the cockpits of those aircraft which are used in 14 CFR 135 passenger-carrying operations and in which the noise levels exceed a preferred frequency speech interference level of 78 at any power setting and flight condition, and remove the crew interphone system as an item on the Master Minimum Equipment List. (Class II, Priority Action) (A-86-113)

Establish specific requirements for the placement of nighttime visibility markers at airports where preexisting markers are not available and transmissometers are not utilized with special consideration for accurately measuring the surface visibility in the vicinity of the approach end of instrument runways to assure that the published visibility minimums for an airport are met. (Class II, Priority Action) (A-86-114)

Amend the definition of radar arrival in Air Traffic Control Handbook 7110.65D to include all instrument flight rules arrivals under radar contract. (Class II, Priority Action) (A-86-115)

Amend the definition of nonradar arrival in Air Traffic Control Handbook 7110.65D to include only arrival aircraft that are not in radar contact. (Class II, Priority Action) (A-86-116)

Amend Section 9, Radar Arrivals, of Air Traffic Control Handbook 7110.65D to require that, when deviations from the localizer course by instrument flight rules arrivals are noted and the controller elects to vector the aircraft back to the localizer course, the intercept criteria of paragraph 5-121 be applied. (Class II, Priority Action) (A-86-117)

Amend Section 9, Radar Arrivals, of Air Traffic Control Handbook 7110.65D, to require that when a deviation occurs from the localizer course by an instrument flight rules arrivals and the aircraft cannot be vectored back on course within the parameters of paragraph 5-121, the pilot be informed that he appears to be too far off course for a safe approach and be asked his intentions. (Class II, Priority Action) (A-86-118)

—to the Regional Airline Association:

In cooperation with the Federal Aviation Administration, develop comprehensive industry standards for initial and recurrent pilot training programs. (Class II, Priority Action) (A-86-119)

Work with its membership to encourage the use of flight simulators or Advanced Training Devices in the pilot training programs of commuter airlines. (Class III, Longer-Term Action) (A-86-120)

Encourage its membership to provide, to the greatest extent possible, standardization of instrumentation and equipment in the cockpits of their airplane fleets. (Class II, Priority Action) (A-86-121)

Encourage its membership to institute a policy of pilot scheduling which would prevent the scheduling on the same flight of cockpit crewmembers with limited experience in their respective positions. (Class II, Priority Action) (A-86-122)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Member

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

JIM BURNETT, Chairman, filed the following additional views:

While the probable cause is correct as far as it goes, it should have included the following:

> Additional factors which contributed to the accident were poor crew coordination due to the high ambient cockpit noise levels and to inadequate training, ineffective supervision by company management, and the lack of adequate FAA surveillance over flightcrew adherence to approved operational standards and procedures.

/s/ JIM BURNETT
Chairman

September 30, 1986

5. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified of the accident at 2310 on August 25, 1985. An investigation team was dispatched from Washington, D.C., the following morning and arrived on scene about 1300. An organizational meeting was held and investigative groups were established for operations, air traffic control, meteorology, structures and systems, powerplants, survival factors, and human performance.

Parties to the investigation were the Federal Aviation Administration, Bar Harbor Airlines, Beech Aircraft Corporation, Pratt & Whitney Aircraft, Airwork Corporation, Hartzell-Propeller Products Division, Auburn-Lewiston Municipal Airport, and the Maine State Aeronautics Commission.

2. Public Hearing

A 2-day public hearing was held in Portland, Maine, beginning on January 28, 1986. Parties participating at the hearing were the Federal Aviation Administration, Bar Harbor Airlines, and the Beech Aircraft Corporation.

APPENDIX B

PERSONNEL INFORMATION

Roy W. Fraunhoger

Captain Roy W. Fraunhofer, 37, was employed by Bar Harbor Airlines on April 6, 1984. He held Airline Transport Pilot certificate No. 1768315, issued on March 20, 1981, with an airplane multiengine land rating and type ratings in the Westwind Jet Commander and Douglas DC-3. He held commercial privileges for airplane single engine land and sea, and airplane multiengine sea. He held a flight instructor certificate for single engine airplanes issued on March 11, 1974, and for instruments (CFII) issued on April 9, 1974.

Captain Fraunhofer held a first class medical certificate issued on February 20, 1985, which required that he wear lenses that correct for distant vision when flying. At that time, his near vision was 20/20 each eye; and distant vision, 20/200 corrected to 20/15 each eye. His most recent Statement of Demonstrated Ability, No. 40GD7615, issued December 7, 1976, stated: "Must wear corrective lenses: extra pair must be available. Physical defect: Defective distant vision, 20/200 corrected to 20/15 bilaterally. Basis for issuance: Special examination." Statements from six company pilots who had flown with the captain, stated the he wore eyeglasses while flying.

Captain Fraunhofer began his Bar Harbor Airlines training in April 1984 which included basic indoctrination and initial systems training in the Cessna 402 (C-402) and BE-99. Captain and operating experience flight training and a check ride in the C-402 was accomplished in April along with first officer flight training and a check ride in the Beech-99. He received first officer BE-1900 ground transition training and flight training and a check ride in July and August 1984, respectively. In October 1984, he received a pilot-in-command flight check, and in December he obtained training on the changes to basic indoctrination training.

Captain Fraunhofer received recurrent ground training in the C-402 and a pilot-in-command flight check in April 1985. On May 7 and 8, 1985, he received BE-99 upgrade ground training, which consisted of 12 hours. On May 29, he received 1.5 hours of pilot-in-command flight training and a 1.8-hour check ride in the BE-99. His initial operations experience (IOE) flights were made on June 1 (6.5 hours, 9 landings) and on June 3 (4.8 hours, 7 landings). His logbook was recovered from the wreckage, but it was burned. The last flight time entry in his log was made on August 23, 1985. It further revealed that he had logged abut 29 hours of actual instrument time from May 29, 1985, to July 16, 1985, and did not log any further instrument time. It showed that he flew the Cessna 402 as pilot-in-command for 57 hours for the period from about May 28, 1985, until about August 12, 1985. He flew N300WP on five occasions of which the last time before the accident was on July 18, 1986. It revealed the following flight time breakdown:

Flight Time	Total Time	PIC	Category	Totals
All A/C	5,153	2,999	X/C	4,467
MEL	3,991	UNK	Night	825
MES	6	UNK	Actual IFR	375
SEL	819	UNK	Simulated	154
SES	329			
Instructing	546			

David C. Owen

First Officer David C. Owen, 24, was hired by Bar Harbor Airlines on May 28, 1985. He held Commercial Pilot certificate No. 26540810 with airplane single and multiengine land and instrument ratings. He held a flight instructor certificate with ratings for airplane single engine and instrument airplane issued on December 10, 1983. He also held a first class medical certificate issued on October 26, 1984, with no limitations.

First Officer Owen received 24 hours of basic indoctrination ground instruction between May 28 and June 7, 1985, which included C-402 and BE-99 systems. However, he was not qualified in the C-402. For company convenience, the C-402 and BE-99 systems training is given during the basic indoctrination course when all the students are together.

The first officer's flight training was accomplished on June 20 after 1.3 hours of flying and 4.7 hours of observation with two other students aboard. He received his checkride on June 21 which took 1.3 hours.

Training records from the first officer's previous employer, an air taxi operator, showed that he had received 36 hours of ground instruction and 5.5 hours of flight instruction for qualification as a second-in-command of a Britton-Norman, BN-2 Trislander. His check ride was administered on April 10, 1985, after 0.5 hour.

The company estimated that he had a total of 1,453 hours, 153 of which were in the BE-99.

Richard P. Benton

Radar controller Richard P. Benton, 31, was employed by the FAA on April 19, 1982. His recent "tape talk" was conducted on May 2, 1985. He was designated a full performance controller on May 22, 1984. He had gained previous radar approach control experience with the United States Air Force at Patrick Air Force Base in Florida from 1974 to 1978. He had obtained a degree in air traffic control management from Embry-Riddle in December 1981. He also held a first class medical certificate.

Armand J. Malinowski

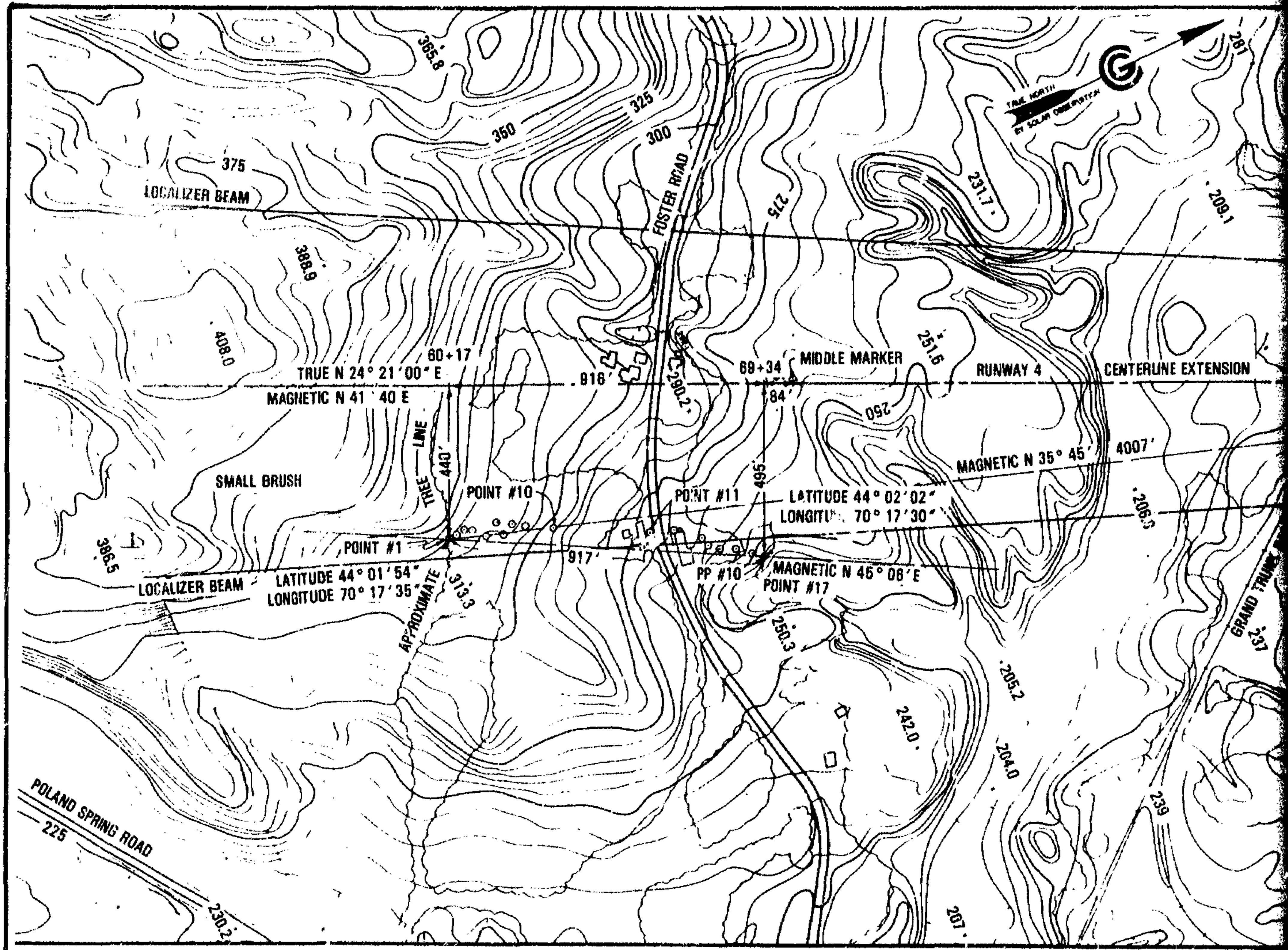
Station agent Armand Malinowski, was employed by Bar Harbor Airlines on January 2, 1982. He was issued as certificate by the National Weather Service on March 8, 1982, to take surface weather observations.

APPENDIX C

AIRCRAFT INFORMATION

Beech Aircraft Corporation, BE-99 Airliner, was first certificated in May 1968 as an 18-passenger turbopeller airplane N300WP, serial number U-22. It received a standard Airworthiness Certificate in the normal category on July 12, 1968. The airplane was registered to Bar Harbor on July 6, 1983.

The airplane had accrued a total time of 30,335 hours. Its maximum certificated takeoff gross weight was 10,400 lbs. It was equipped with two Pratt & Whitney PT6A-20 engines and with two Hartzell, model HC-B3TN-3B propellers. The left engine had a total of 8,755 hours and 11,743 cycles. Total time since overhaul (TSO) was 6,257 hours. The right engine had a total of 21,270 hours and 28,705 cycles. Total TSO was 5,648 hours.



POINT DESCRIPTIONS:

POINT DESCRIPTION	STATION	OFFSET	ELEV	REMARKS
1 INITIAL AIRBORNE COLLISION WITH 8″ POPLAR	60+17	440′	313.0 348 363	GRADE POINT TREE WAS SEVERED CANOPY
2 INITIAL AIRBORNE COLLISION WITH 9″ OAK	60+39	427′	314.5 342 357	GRADE POINT TREE WAS SEVERED CANOPY
3 RIGHT AILERON	60+63	414′	312.2	GRADE
4 RIGHT OUTBOARD WING PANEL AND TIP	60+64	416′	309.5	GRADE
5 LEFT AILERON OUTBOARD SECTION	61+25	433′	310.1	GRADE
6 LEFT OUTBOARD WING SECTION AND TIP	61+54	394′	311.9	GRADE
7 FUEL CAP	61+78	428′	312.6	GRADE
8 OIL COOLER SCOOP	62+02	398′	318.5 358	GRADE CANOPY
9 LEFT AILERON INBOARD SECTION	62+39	405′	307.0	GRADE
10 RIGHT INBOARD LEADING EDGE	63+23	411′	294.6 355	GRADE CANOPY
11 BROKEN LIMBS IN TOP OF 20″ PINE TREE NEXT TO FOSTER ROAD	66+02	419′	269.6 327 338	GRADE APPROXIMATE POINT OF IMPACT CANOPY
12 BROKEN LIMBS IN 14″ MAPLE NEXT TO HOUSE	66+71	422′	266.8 297 312	GRADE APPROXIMATE POINT OF IMPACT CANOPY
13 INITIAL GROUND IMPACT	67+54	441′	260.3	GRADE
14 VOR ANTENNA	68+08	471′	257.1	GRADE
15 ENGINE COWL	68+54	473′	255.6	GRADE
16 RADAR ANTENNA	69+00	482′	249.9	GRADE
17 MAIN WRECKAGE	69+34	495′	238.2	GRADE
18 PP #10 PROPELLER TIP IN WOOD	67+74	455′	258.2	GRADE
MIDDLE MARKER	70+18	-	262.8	GRADE
END OF RUNWAY	100+100	0	270.7	GRADE

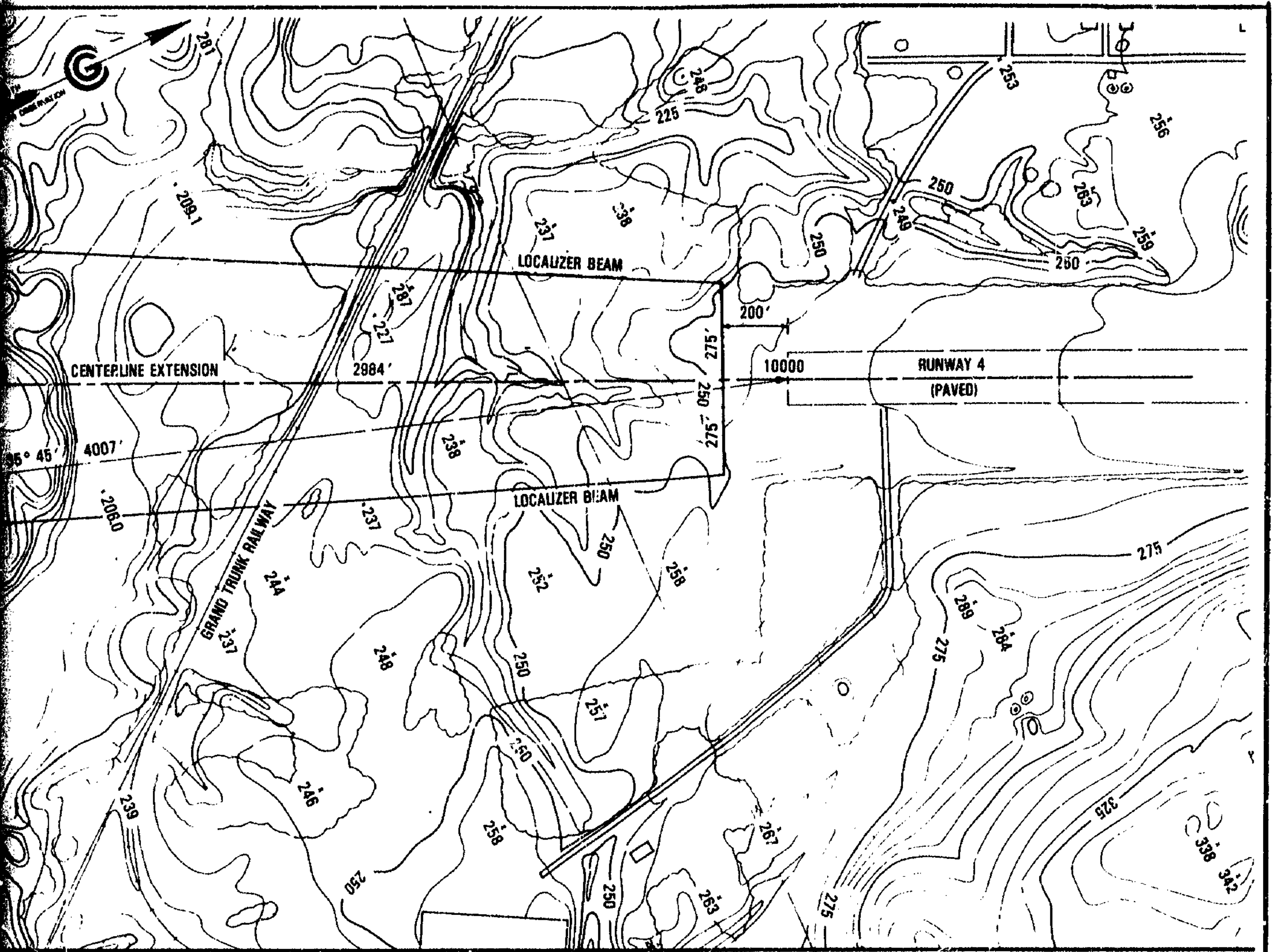
NOTES:

1) TRUE BEARINGS BASED ON THE AVERAGE OF SOLAR OBSERVATIONS ALONG THE CENTERLINE OF RUNWAY 4 EXTENSION. MAGNETIC BEARINGS CALCULATED FROM TRUE BEARINGS UTILIZING A WEST DECLINATION OF 17°19′ BASED ON A SURVEY OF RUNWAY 17-35 BY COURBRON GOTTO ASSOCIATES, INC DATED JUNE 1983.

2) TOPOGRAPHIC INFORMATION TAKEN FROM CITY OF AUBURN TOPOGRAPHIC MAPS COMPILED FROM PHOTOS PREPARED BY AVIS AIRMAP, INC, SCALE 1″=200′ WITH 5′ CONTOURS (U.S.G.S. DATUM) AND IS SHOWN FOR SCHEMATIC PURPOSES ONLY.

3) BENCH MARK: U.S.G.S. BENCH MARK DISK SET VERTICALLY IN THE NORTHEAST FACE NEAR THE NORTH CORNER OF THE LEWISTON AUBURN MUNICIPAL AIRPORT BUILDING. ELEVATION=250.36′ (U.S.G.S. DATUM).

4) LATITUDE AND LONGITUDE SHOWN WERE SCALED FROM U.S.G.S. 7.5 MINUTE SERIES MINOT QUADRANGLE.

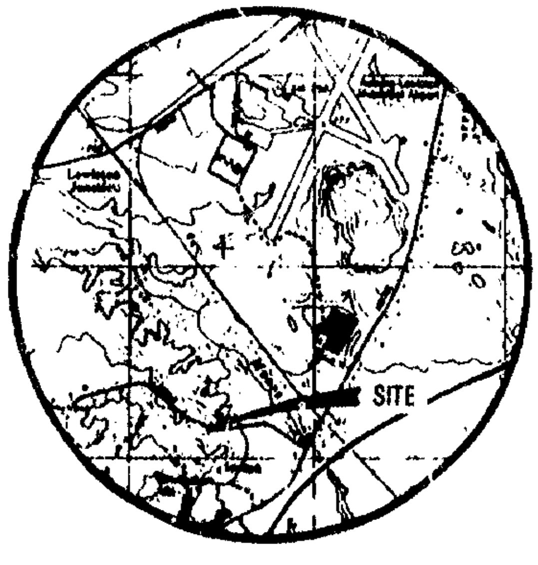


OBSERVATIONS ALONG THE
BEARINGS CALCULATED FROM
17°19' BASED ON A SURVEY
TES, INC DATED JUNE 1983.

AUBURN TOPOGRAPHIC MAPS
INC, SCALE 1" = 200' WITH
SCHEMATIC PURPOSES ONLY.

TICALLY IN THE NORTHEAST
AUBURN MUNICIPAL AIRPORT

ROM U.S.G.S. 7.5 MINUTE



LOCATION MAP

WRECKAGE DISTRIBUTION CHART

(DCA-85-A-A035)

AIRCRAFT ACCIDENT AUGUST 25, 1985

BAR HARBOR AIRLINES FLIGHT 1808
BEECH 99 N 300 WP

AUBURN-LEWISTON AIRPORT
AUBURN, MAINE

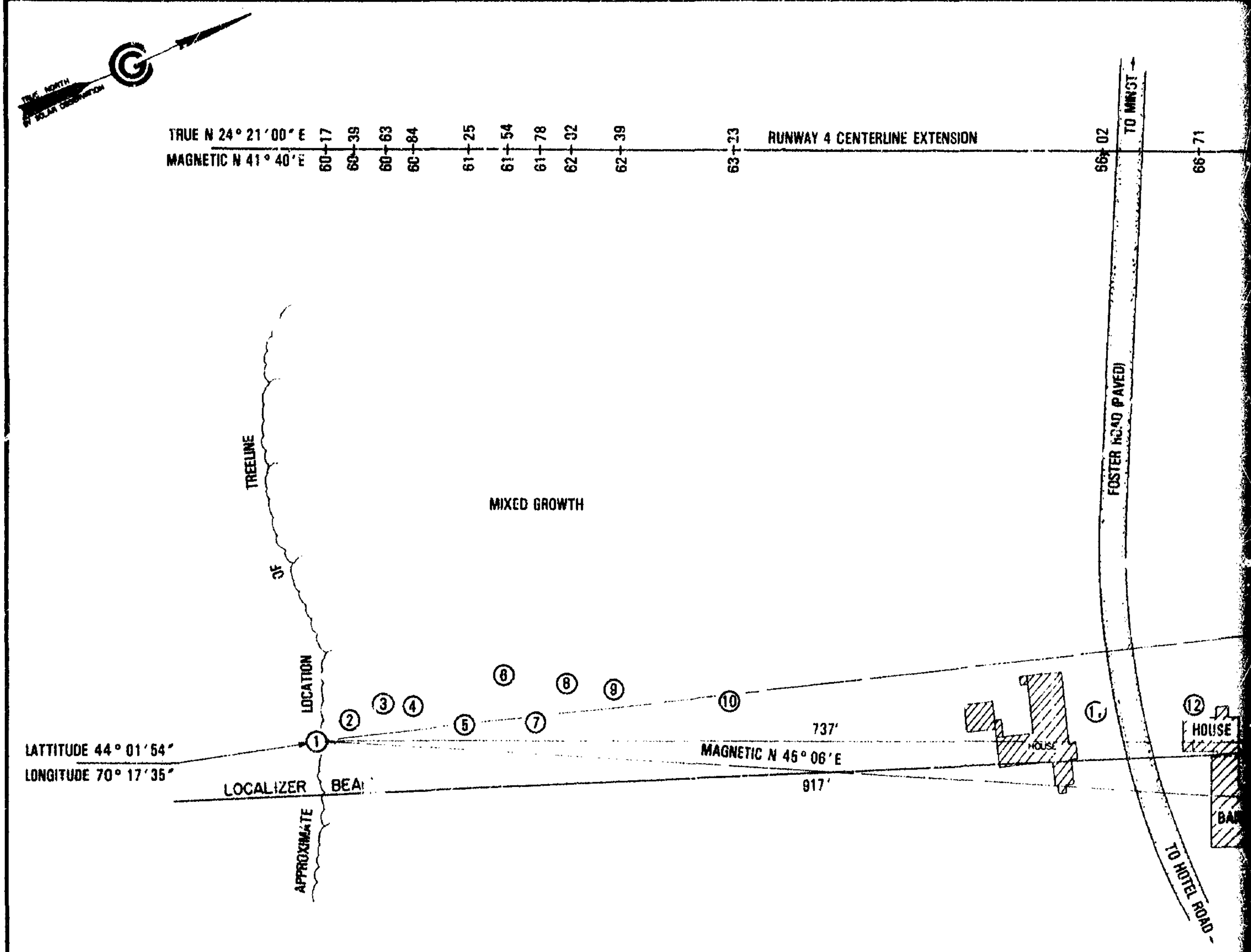
PREPARED FOR
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON D.C.

0 100 200 400 600 800
SCALE 1" = 200'   SEPTEMBER 1985

COURBRON GOTTO ASSOCIATES, INC.

SURVEYING/SOILS CONSULTANTS
249 MAIN STREET
LEWISTON, MAINE
SHEET 1 OF 3

APPENDIX D



POINT DESCRIPTIONS:

POINT DESCRIPTION	STATION	OFFSET	ELEV.	REMARKS
1 INITIAL AIRBORNE COLUSION WITH 8" POPLAR	60+17	440′	313.0 348 370	GRADE POINT TREE WAS SEVERED CANOPY
2 INITIAL AIRBORNE COLUSION WITH 9" OAK	60+39	427′	314.5 342 365	GRADE POINT TREE WAS SEVERED CANOPY
3 RIGHT AILERON	60+63	414′	312.2	GRADE
4 RIGHT OUTBOARD WING PANEL AND TIP	60+84	416′	309.5	GRADE
5 LEFT AILERON OUTBOARD SECTION	61+25	433′	310.1	GRADE
6 LEFT OUTBOARD WING SECTION AND TIP	61+54	394′	311.9	GRADE
7 FUEL CAP	61+78	428′	312.6	GRADE
8 OIL COOLER SCOOP	62+02	398′	318.5 358	GRADE CANOPY
9 LEFT AILERON INBOARD SECTION	62+39	405′	307.9	GRADE
10 RIGHT INBOARD LEADING EDGE	63+23	411′	294.6 335	GRADE CANOPY
11 BROKEN LIMBS IN TOP OF 20" PINE TREE NEXT TO FOSTER ROAD	66+02	419′	269.6 327 338	GRADE APPROXIMATE POINT OF IMPACT CANOPY
12 BROKEN LIMBS IN 14" MAPLE NEXT TO HOUSE	66+71	422′	266.8 297 312	GRADE APPROXIMATE POINT OF IMPACT CANOPY
13 INITIAL GROUND IMPACT	67+54	441′	260.3	GRADE
14 VOR ANTENNA	68+08	471′	257.1	GRADE
15 ENGINE COWL	68+54	473′	255.6	GRADE
16 RADAR ANTENNA	69+00			

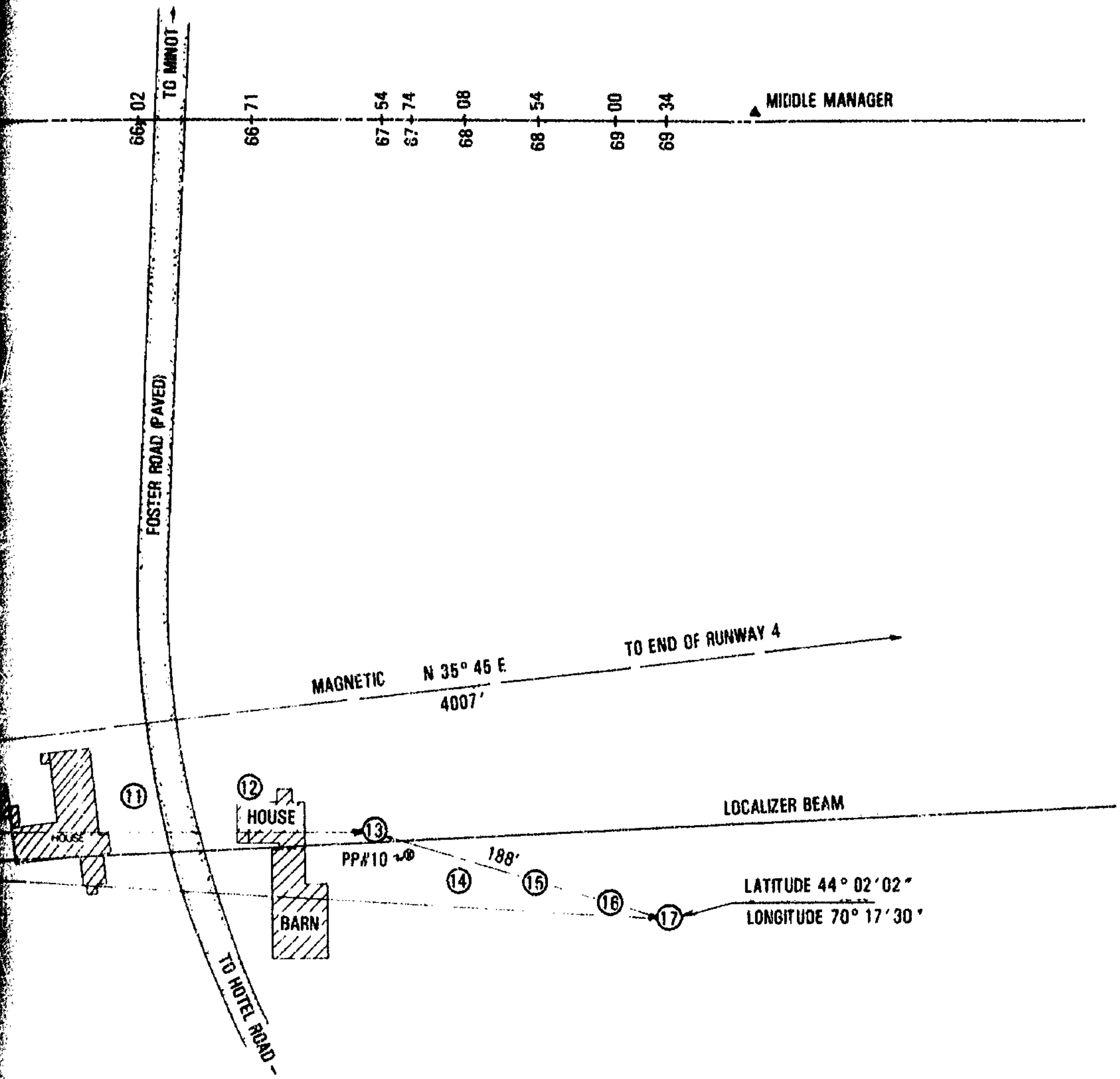
REDUCTION
NOT TO SCALE

NOTES:

1) TRUE BEARINGS BASED ON THE AVERAGE OF SOLAR OBSERVATIONS ALONG THE CENTERLINE OF RUNWAY 4 EXTENSION. MAGNETIC BEARINGS CALCULATED FROM TRUE BEARINGS UTILIZING A WEST DECLINATION OF 17°19′ BASED ON A SURVEY OF RUNWAY 17-36 BY COURBRON GOTTO ASSOCIATES, INC DATED JUNE 1983.

2) BENCH MARK: U.S.C.S. BENCH MARK DISK SET VERTICALLY IN THE NORTHEAST FACE NEAR THE NORTH CORNER OF THE LEWISTON-AUBURN MUNICIPAL AIRPORT BUILDING. ELEVATION=256.36′ (U.S.C.S. DATUM).

3) LATITUDE AND LONGITUDE SHOWN WERE SCALED FROM U.S.G.S. 7.5 MINUTE SERIES MINOT QUADRANGLE.



N
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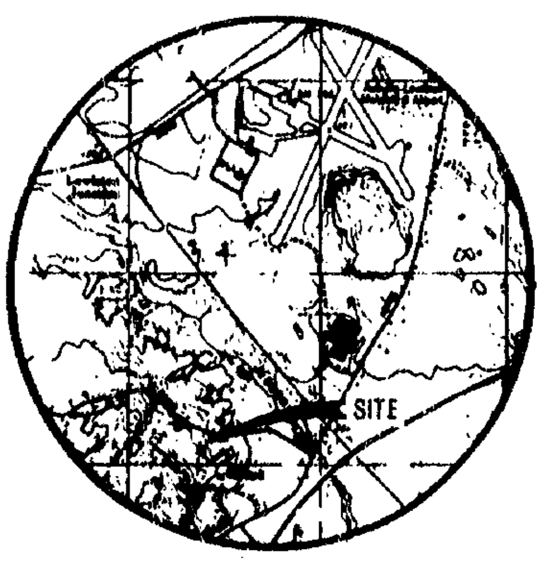
SOLAR OBSERVATIONS ALONG THE
ETIC BEARINGS CALCULATED FROM TRUE
F 17°19' BASED ON A SURVEY OF RUNWAY 17-35
ED JUNE 1983.

T VERTICALLY IN THE NORTHEAST FACE NEAR THE
UNICIPAL AIRPORT BUILDING. ELEVATION = 256.36'

LED FROM U.S.G.S. 7.5 MINUTE SERIES MINOT



LOCATION MAP

WRECKAGE DISTRIBUTION CHART

(DCA-85-A-A035)

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AUBURN-LEWISTON AIRPORT

AUBURN, MAINE
PREPARED FOR
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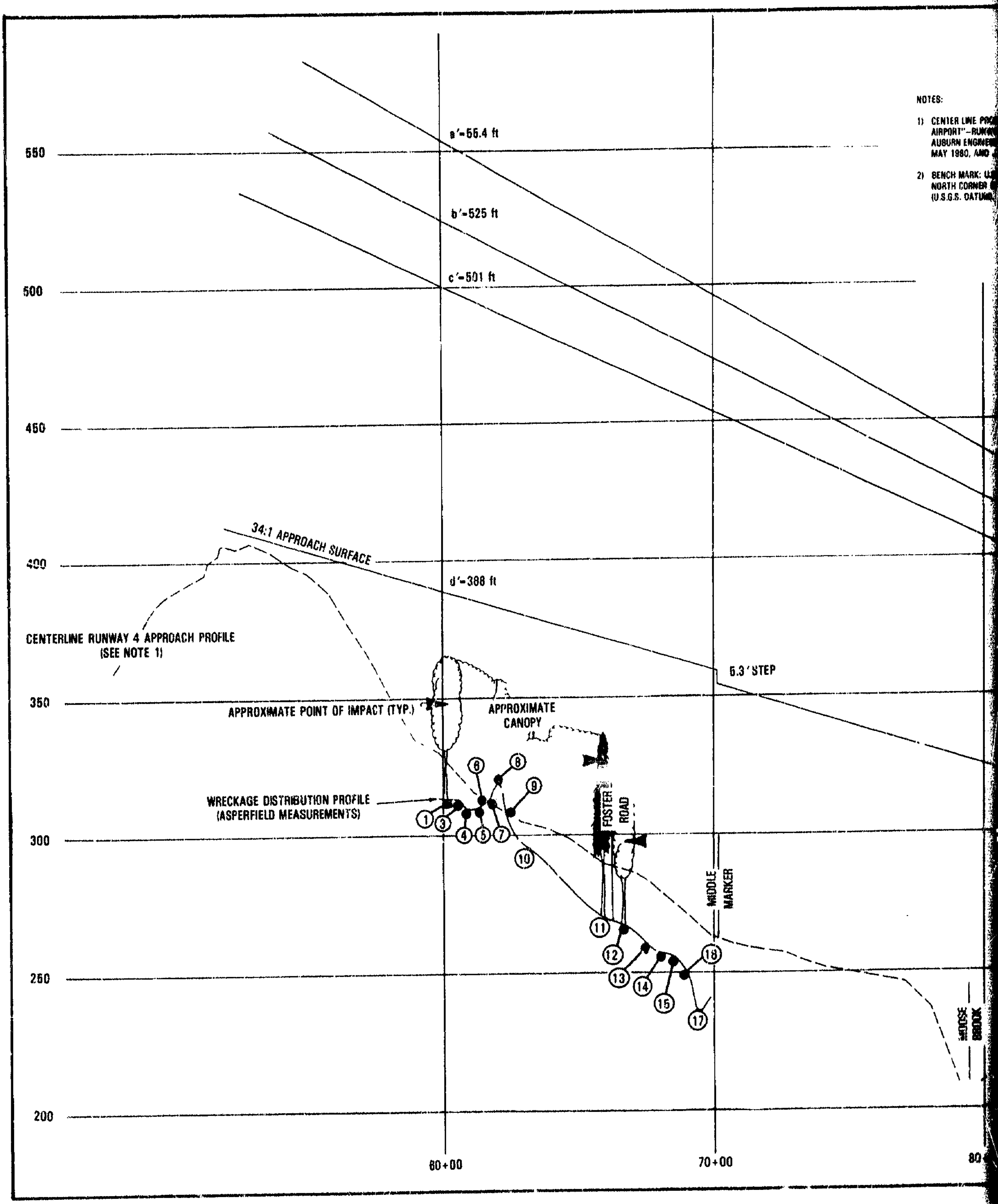
WASHINGTON D.C.

0 25 50 100 150 200
SCALE 1" = 50' SEPTEMBER 1985

COURBRON GOTTO ASSOCIATES, INC.

SURVEYING/SOILS CONSULTANTS
249 MAIN STREET
LEWISTON, MAINE
SHEET 2 OF 3

APPENDIX D



NOTES:
1) CENTER LINE PRO...
AIRPORT"–RUNW...
AUBURN ENGINEE...
MAY 1980, AND ...
2) BENCH MARK: U...
NORTH CORNER ...
(U.S.G.S. DATUM)
550
500
450
400
350
300
250
200
a'=55.4 ft
b'=525 ft
c'=501 ft
d'=388 ft
34:1 APPROACH SURFACE
5.3' STEP
CENTERLINE RUNWAY 4 APPROACH PROFILE
(SEE NOTE 1)
APPROXIMATE POINT OF IMPACT (TYP.)
APPROXIMATE
CANOPY
WRECKAGE DISTRIBUTION PROFILE
(ASPERFIELD MEASUREMENTS)
FOSTER
ROAD
MIDDLE
MARKER
MOOSE
BROOK
60+00
70+00
80+...

WRECKAGE DISTRIBUTION CHART

(DCA-85-A-A035)

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NOTES:

1) CENTER LINE PROFILE SHOWN AS TAKEN FROM PLAN ENTITLED "AUBURN LEWISTON MUNICIPAL AIRPORT"–RUNWAY 4 APPROACH PREPARED BY HOYLE-TANNER & ASSOCIATES BASED ON AUBURN ENGINEERING DEPT. PLAN DATED DECEMBER 14, 1973 AND REVISED MARCH 1980, MAY 1980, AND JUNE 1980 BY HOYLE-TANNER & ASSOCIATES.

2) BENCH MARK: U.S.G.S. BENCH MARK DISK SET VERTICALLY IN THE NORTHEAST FACE NEAR THE NORTH CORNER OF THE LEWISTON-AUBURN MUNICIPAL AIRPORT BUILDING. ELEVATION – 256.36' (U.S.G.S. DATUM).

COURBRON GOTTO ASSOCIATES, INC.

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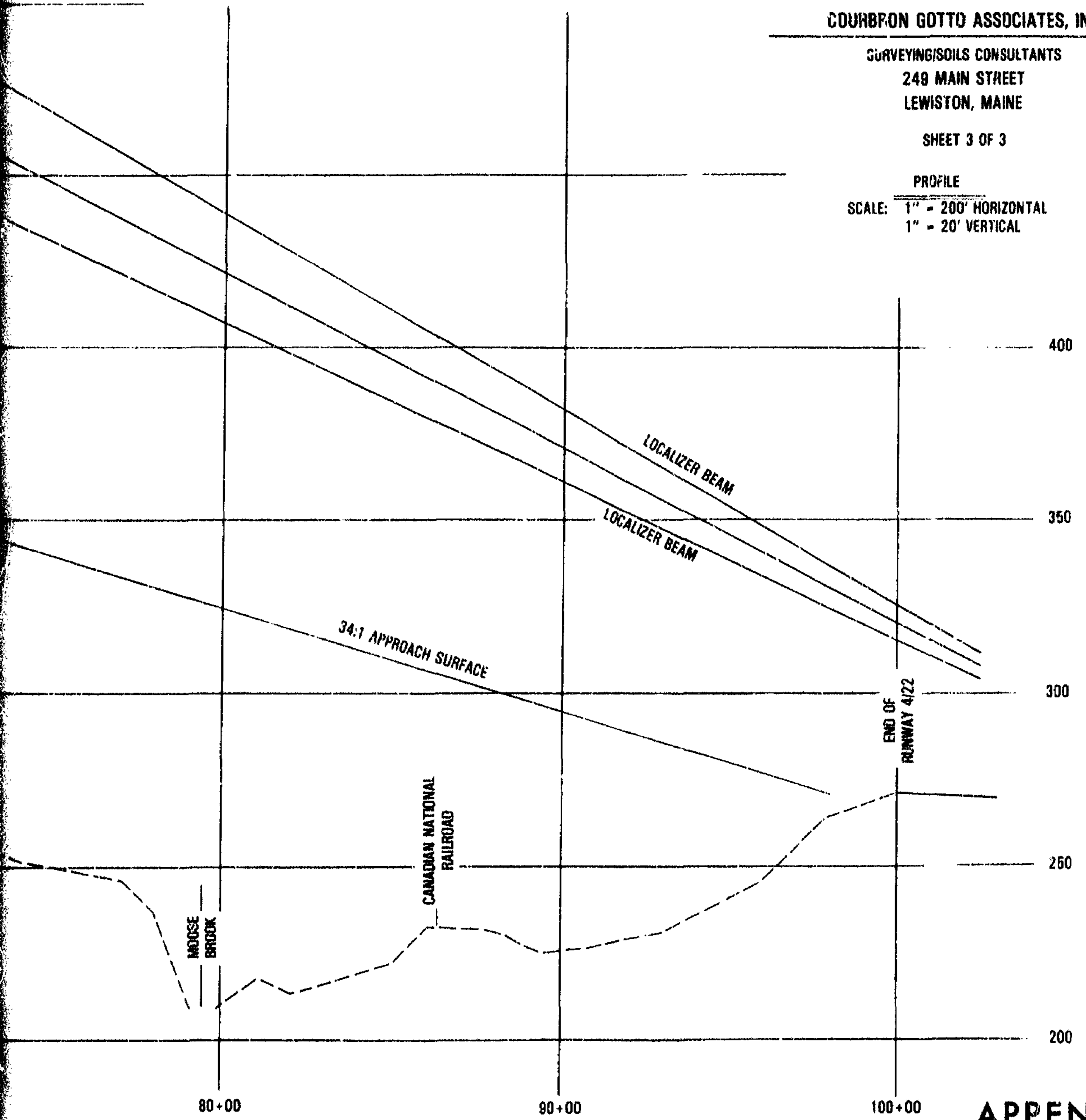
249 MAIN STREET
LEWISTON, MAINE

SHEET 3 OF 3

PROFILE

SCALE: 1" = 200' HORIZONTAL
1" = 20' VERTICAL



APPENDIX D

APPENDIX E

RECONSTRUCTION OF THE FLIGHT EVENTS

Time	Events
2130:10	AJC 808 cleared 16/ for takeoff 4L, turn to 360, proceed direct to Pease when receiving
2132:00	Flight established on a 360 ground track
2134:00 to 2135:00	Turned from 360 ground track and appeared established on the Pease 215 radial for 5 minutes
2139:47	AJC 808 cleared to Augusta via Kennebunk; the flightpath starts a transition from Pease 215 to Pease 222 (a direct line to Kennebunk)
2140:41	AJC 808 cleared to Lewiston via direct Kennebunk
2145:00	Passed slightly to the left of Pease
2145:05 to 2150:00	049 ground track resulting in a maximum 1.5-mile right of course error
2150:00	11 miles south-southeast of Kennebunk, a 33° left turn started to regain the 042 radial
2152:32	Passed slightly to the left of Kennebunk
2152:37	Requested a lower altitude
2153:08	Confirmed that flight was intercepting 036 radial
2153:16 to 2157:30	Started 500 feet per minute descent, 205 KIAS; the flight appeared to be tracking the 038-039 radial but was probably on the off-set 036 radial
2157:30	Rate of descent decreased to about 350 feet per minute
2158:39	Cleared for approach to Lewiston while about 5 miles south of Doley, 4,800 feet altitude, with the rate of descent increasing to about 800 feet per minute, the airspeed increasing 5 knots, and the ground track changing 6° to the right to 044

16/ ATC flight designator.

Time	Events
2159:50	Passed 1.3 miles to the right of Doley, at 4,000 feet, 210 KIAS and the ground track changed 10° left to 034 as the flightpath leveled
2200:00 to 2201:00	Rate of descent decreased to 200 feet per minute for the minute, airspeed dropped from 210 to 190 KIAS over the minute
2200:17	AJC 808 crossed lower boundary of glideslope area into signal area; glideslope needle would have started moving down if ILS tuned in
2200:38	Glideslope needle would be about centered
2200:48	Rate of descent increased to at least 800 feet per minute while the speed was about 190 KIAS
2201:06 to 2201:30	AJC 808 was nearing the upper boundary of the glideslope area; the needle would have been deflected full down or nearly so
2201:26	Right turn to 061 ground track was started, the rate of descent decreases
220:33	ACT asked if AJC was receiving Lewiston localizer, "negative" response
2201:36	Right turn stopped
2201:40	ACT directed a turn to 340°
2201:48	Left turn to 354° started
2202:00	Airspeed about 170 KIAS
2202:10	Left turn stopped at 354° ground track; the airplane leveled off in a shallow descent
2202:22	Passed Lewie (LOM) at 165 KIAS, 2,600 feet, which is about 600 feet too high and 30 knots too fast. The airplane is still above flap and gear speed.
2202:25	Entered right side of localizer still on 354 ground track
2202:27	ATC stated that AJC 808 was over Lewie, and asked if he was receiving it? "Affirmative" response
2202:31 to 2202:40	ATC stated, "Roger ah radar service terminated contact Lewiston Unicom for advisories report missed approach this frequency or on the ground one two four point zero five"

Time	Events
2202:32	Airplane started down
2202:38	Exited left side of localizer, still on 354 ground track
2202:40	Right turn to 049 was started, descent rate increased to about 2,200 feet per minute
2202:53	Descent stopped at 1,900 feet, climb started
2203:00	Right turn stopped, altitude peaked at about 2,300 feet, airspeed about 150 KIAS, momentary 3,000 feet per minute rate of descent started
2203:46	Right turn to 070 started, 1,100 feet altitude
2204:00	Airspeed 130 KIAS
2204:02	650 feet altitude, penetrated the top boundary of glideslope, and at reported ceiling
2204:08 to 2204:10	Exited bottom boundary of glideslope, entered left side of localizer.
2204:16 2204:21	Approximate time of crash, inside right boundary of to localizer and on a 045 ground track.

*U.S. GOVERNMENT PRINTING OFFICE: 1986-181-101:40061