Aviation Investigation Final Report

Location:	Chester, South Carolina	**Accident Number:**	ERA14FA260
Date & Time:	May 23, 2014, 13:00 Local	**Registration:**	N8890L
Aircraft:	GRUMMAN AMERICAN AVN. CORP. AA1B	**Aircraft Damage:**	Substantial
Defining Event:	Fuel exhaustion	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The airplane departed on a cross-country flight after the pilot purchased 11.92 gallons of fuel. A flight plan found in the wreckage with the accident pilot's name on listed the fuel onboard as 3 hours and 30 minutes and a flight distance of 240 miles. The airplane wreckage was located about 130 miles from the departure airport. Postaccident examination of the propeller indicated that the engine was not producing power at impact.

Examination of the wreckage and surrounding vegetation revealed no evidence of fuel within the fuel tanks and only slight amounts of blight, consistent with fuel spillage, on nearby vegetation at the accident site. Fuel staining was observed on the right wing, and the fuel cap did not have a detent. If the pilot had performed a preflight inspection of the airplane before departure, he would have noticed the fuel staining; thus it likely occurred during the accident flight, although it could not be determined why the pilot did not notice the loose fuel cap. Given the distance flown and cruise speed, the airplane's published fuel consumption indicates that the airplane would have consumed about 11 gallons of fuel in the 90 minutes of flight. Although both fuel tanks likely contained enough fuel for a flight longer than 90 minutes at takeoff, it is likely that any fuel in the right fuel tank was syphoned out during flight due to the loose fuel cap. Even though the estimated fuel consumption calculations showed that the total quantity consumed was less than what was indicated the flight plan, the lack of fuel observed at the accident site and the lack of evidence of any preexisting mechanical anomalies indicate that the total loss of engine power was likely the result of fuel exhaustion. Although the fuel selector valve's Teflon plunger was found fractured, which resulted in the selector valve binding, the fracture was consistent with impact damage.

The airplane was not reported overdue for several days and was located in a wooded area about 3 days after it had departed. The airplane's emergency locator transmitter (ELT) unit had an "ON/OFF/ARM" switch that was found in the "OFF" position. The ELT may have been deactivated by first responders; however, given that there were no reports of ELT signals being detected in the area from the day of the

accident until the airplane was located, the ELT was likely in the "OFF" position before the flight and did not activate due to the switch position, which delayed the search and rescue of the occupants.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's inadequate inflight fuel monitoring, which resulted in fuel exhaustion and the subsequent total loss of engine power. Contributing to the accident was the loose fuel cap, which allowed fuel to syphon out in flight.

Findings

Personnel issues	Fuel planning - Pilot
Personnel issues	Task monitoring/vigilance - Pilot
Personnel issues	Lack of action - Pilot
Aircraft	Fuel - Fluid level
Aircraft	Fuel - Fluid management
Personnel issues	Preflight inspection - Pilot
Aircraft	(general) - Incorrect use/operation
Aircraft	Emergency equipment - Inadequate inspection

Factual Information

History of Flight

Prior to flight	Preflight or dispatch event
Enroute-cruise	Fuel exhaustion (Defining event)
Emergency descent	Off-field or emergency landing
Emergency descent	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On May 23, 2014 about 1300 Eastern Daylight Time, a Grumman American AA1B, N8890L, was substantially damaged when it impacted several trees and terrain near Chester, South Carolina. The airplane had departed from Columbus County Municipal Airport (CPC), Whiteville, North Carolina, about 1130 and had an intended destination of Heaven's Landing (GE99), Clayton, GA. Day visual meteorological conditions prevailed and no flight plan had been filed. The commercial pilot and passenger were fatally injured. The airplane was operated by Warrior to Wings Aero Club and the personal flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91.

Review of Federal Aviation Administration (FAA) radar data revealed that the accident flight was first detected at 1137:49, northwest of CPC, at an altitude of 1,200 feet above mean sea level (msl). The flight flew northwest and then turned towards the west south west. The last radar data near CPC was recorded at 1155:25 at 2,500 feet msl. Radar data obtained from Charlotte Approach Control revealed the accident airplane east of the accident location at 1301:00 at 2,600 feet msl. The last radar data was recorded at 1306:36 at 2,300 feet msl, near the accident location. No further radar data was located.

PERSONNEL INFORMATION

According to FAA and pilot records, the pilot held a commercial pilot certificate with ratings for airplane single-engine land, multiengine land, helicopter and instrument airplane which was issued on October 23, 2013, issued on the basis of his military ratings. He held an FAA third-class medical certificate, issued June 6, 2011, which was issued with no limitations. At the time of the medical examination the pilot reported zero (0) total hours of flight experience and zero (0) hours of flight experience in the 6 months prior to the medical certificate. The pilot's logbook was located within the wreckage. The last recorded entry was dated May 18, 2014 and indicated a pattern work flight at Albert J. Ellis Airport (OAJ), Jacksonville, North Carolina. Including that entry the total recorded flight time was 37.6 flight hours and included 9.5 flight hours in the accident aircraft make and model. According to information provided by the United States Marine Corps (USMC), the pilot had 243.7 total flight hours with the USMC and included 78.1 hours in a single-engine propeller airplane. There were no entries that indicated the pilot had ever flown to GE99.

AIRCRAFT INFORMATION

According to FAA and aircraft maintenance records, the airplane was issued an airworthiness certificate on April 18, 1974, and was registered to Warriors to Wings Aero Club on April 13, 2013, following it purchase on April 12, 2013. It was a two-place, all-metal, low-wing monoplane with fixed-tricycle landing gear. It was powered by a Lycoming O-235-C2C 108-hp engine that had accrued 2,257.6 hours since new, with no entry of an overhaul recorded in any of the logbooks. It was also driven by a McCauley propeller 1A105 SCM 7153. According to the maintenance records, the last recorded tachometer entry was 2,254.4 flight hours, which correlated to the most recent 100-inspection entry for both the airplane and engine. The tachometer was located at the accident scene and indicated 2,257.6 hours.

The airplane's fuel system utilized a tubular main wing spar comprised of a two-cell fuel tank (one cell in each wing). Each fuel cell held 12 gallons of fuel, of which, 11 gallons were considered usable. Fuel quantity was indicated by vertical sight gauges on the left and right cabin walls, each sight gauge corresponded to the respective side fuel cell.

METEOROLOGICAL INFORMATION

The 1255 recorded weather observation at Chester Catwaba Regional Airport (DCM), Chester South Carolina, located 8 miles to the northeast, included wind from 310 degrees at 8 knots, variable between 250 degrees and 350 degrees, visibility 7 miles, clear skies, temperature 32 degrees C, dew point 16 degrees C; barometric altimeter 30.03 inches of mercury.

WRECKAGE AND IMPACT INFORMATION

The airplane was found on May 26, 2014, in a wooded area within a 500-acre private hunting club, located at 34 degrees 40.21 North latitude and 081 degrees 17.01 West longitude, approximately 400 feet prior to a clearing. The clearing was about 500 feet long and 200 feet wide with the longest section oriented in a southwest to northeast direction. The main wreckage was located inverted at an elevation of 484 feet msl. The debris was located within a compact area. The impact line from the first tree strike to the final resting location was about 35 feet in length and on a decent angle of about 38 degrees. The engine remained attached to the airplane with the engine mounts, lines, and cables, and was co-located with the main wreckage. The wreckage debris path was oriented on 273-degree heading from the initial tree strike to the main wreckage.

The area around the accident location was devoid of fuel smell; however, there was little evidence of blight on a few leaves in the surrounding foliage in the immediate vicinity of the impact location. However, the area of blight was not widespread in circumference.

Fuselage

The fuselage assembly, right wing, engine and propeller were located inverted at the base of tree. The left wing was located immediately underneath the wreckage at rest.

The top of the occupant compartment remained intact aft of the windscreen, the windscreen was fractured into multiple pieces. The right side of the airplane was cut by first responders to facilitate recovering of the occupants. The nose gear was impact separated and was located about 15 feet forward of the wreckage, and was one of the furthest pieces from the airplane.

Continuity to all flight control surfaces was confirmed from the T-bar at the base of the pilot control yoke to their associated control surface; except for the left aileron and flap. Both of the left wing flight controls were confirmed from the T-bar to the impact fracture point at the wing root and from that fracture point to the aileron and flap.

The flap indicator and associated flaps were in the up (retracted) position.

The fuel selector indicator was found between the left and right fuel tank detents. The fuel selector valve face plate had a mark on the plate in the same location between the left and right tank detent. The valve was removed from the airframe and the line fittings were removed to examine the position of the orifices. The fuel line that provided fuel to the engine and the fuel line associated with the left fuel tank were both found in the open position. The line associated with the right fuel tank was found in the closed position. Manipulation of the selector valve revealed limited movement within a 30 degree arc and the valve was disassembled. The Teflon plunger was found fractured approximately one-fourth of the way from the bottom of the plunger; the separated piece was found loose in the bottom of the valve body. The damage to the plunger was consistent with impact damage.

The airplane's ignition key was found selected to the "BOTH" position.

Vertical Stabilizer

The empennage assembly remained attached to the fuselage. However, the rudder and elevator were impact-damaged and remained attached to the empennage assembly via the cables. Both the elevator and rudder indicated impact damage and multiple fracture points. The left elevator had impact and scrape marks on the upper side of the surface. The marks were associated with a scrape mark found on the tree that it came to rest against. The tree scrape mark began about 25 feet agl on the tree trunk and ceased about 5 feet agl. The rudder remained attached to the elevator assembly. The rudder and elevator cables were in place, and remained in the pulley groove. The cables remained secured and were continuous to the rudder bar and the T-bar in the cockpit. The rudder stops were in place and secure.

The vertical stabilizer was separated, but remained in the immediate vicinity. The separation was consistent with impact damage.

Left Wing

The left outboard fiberglass wingtip section, was separated and found along the debris path. The fuel cap remained secure and in place and the fuel tank was devoid of fuel. The output from the fuel tank to fuselage was impact separated. The left flap inboard 21 inches was impact separated; however, was in the immediate vicinity of the left wing. The leading edge exhibited crush damage in the aft and slight positive direction. The aileron and flap control tube was fractured at the wingroot due to tensile overload. The left main gear remained attached to its attach point.

Right Wing

The right outboard fiberglass wingtip section, was separated and found along the debris path. The fuel cap remained in place; however, it had been opened by first responders during occupant recovery. The cap was observed loose on the filler neck and exhibited no positive detent at the fuel cap stop and was unable to seal on the filler neck. The fuel tank was devoid of fuel. The wingtip, which was light blue in

color, exhibited staining, similar in color as 100LL fuel. The outboard section of the leading edge exhibited crush damage in the aft and positive direction. The inboard 25 inches, from the wingroot exhibited aft impact damage in the slight positive direction. The right main gear remained attached to its attach point.

Engine

The engine remained attached to the airframe via the mounts, cables and wires. The propeller remained attached to the propeller hub which remained attached to engine. The carburetor remained attached to the engine. Fractures were noted at the attach point for the oil sump as well as radial at the throttle plate shaft. The carburetor was disassembled and trace amounts of a blue fluid observed; however, the carburetor bowl was devoid of fluid. The metal floats remained attached, operated by hand, and exhibited no damage consistent with hydraulic deformation. The fuel inlet screen was removed and was free of debris. The carburetor heat gate operated smoothly with no abnormalities noted. The throttle plate exhibited impact damage but was able to operate. The engine driven diaphragm fuel pump was hand actuated and furnished suction and compression; however, it was devoid of fuel. The spark plugs were removed and appeared gray in color with normal wear and appeared to be recently cleaned. The engine was rotated utilizing a turning tool inserted at the vacuum drive pad and continuity was confirmed through to the propeller flange. Thumb suction and compression was confirmed on all four cylinders. The cylinders were examined utilizing a lighted borescope and all cylinders were normal in wear with no noted defects. The magnetos were removed and when spun utilizing a cordless drill, spark was observed on all 8 leads. The engine driven fuel pump was removed and disassembled the diaphragm was normal and free of debris, no abnormalities were noted. The oil dipstick was absent but oil was present throughout the engine.

The McCauley two bladed propeller, remained attached to propeller hub, and exhibited no S-bending or leading edge damage. However, the propeller flange had aft crushing damage, consistent with impact damage, around the circumference. One propeller blade had an aft bend about 7 1/4 inches from the outside diameter of the hub and chordwise scratches were observed on the backside (as viewed from the pilot seat). The outboard approximate 4 inches of the other propeller blade exhibited a slight bend at of the blade tip but otherwise was unremarkable and indicated no leading edge damage. The propeller signatures were consistent with no rotation at the time of the accident.

ELT

The ELT was co-located with the airplane; however, was impact-separated from the airframe and the antenna; it was located on the ground immediately underneath the tail section. The unit had an "ON/OFF/ARM" switch was found in the "OFF" position. The investigation could not determine if the ELT was deactivated by first responders or was not in the "ARM" or "ON" position at the time of impact. However, there were no reports of ELT signals being detected in the area from the day of the accident until the airplane was located.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed on the pilot on May 27, 2014, by York Pathology Associates, Rock Hill, South Carolina, as authorized by the Chester County Coroner's Office. The cause of death was reported as "blunt force trauma with sudden deceleration injuries."

Forensic toxicology was performed on specimens from the pilot by the FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma. The following were the findings of the toxicological testing:
- Acetone detected in Blood
- 40 (mg/dL, mg/hg) Ethanol detected in Blood
- 24 (mg.dL) Ethanol detected in Urine
- NO ETHANOL detected in Brain
- 8 (mg/dL, mg/hg) Isopropanol detect4ed in Blood
- 12 (mg/dL, mg.hg) N-Propanol detected in Blood
- N-Propanol detected in Urine
- 33.8 (ug/ml, ug/g) Salicylate detected in Urine.

Additionally, putrefaction (which consists of the post-mortem creation of ethanol) was noted as yes.

According to the 2008 edition of Drug Facts and Comparisons, Salicylate is a metabolite of aspirin, an over-the-counter anti-inflammatory medication to treat aches and pains, as an antipyretic to reduce fever. According to the FAA's Aerospace Medical Research database, the therapeutic range of Salicylate 20 -250 ug/ml.

ADDITIONAL INFORMATION

A receipt was located with the pilot's name imprinted and the airplane registration number on it showing 11.92 gallons of 100 LL fuel was purchased at 1121 on the day of the accident at CPC.

Owner's Manual

According to the Gulfstream Aerospace "Owner's Manual," Chapter 5 "Performance" the airplane's engine would consume between 4.5 and 6.5 gallons per hour, at 2,500 feet msl depending on the rpm utilized. The manual further states that, "Actual performance will vary from standard due to variations in atmospheric conditions, engine and propeller condition, mixture leaning technique, and other variables associated with the particular performance item." The performance further provided "notes" when utilizing the performance chart; one of the notes included "Fuel consumption is for level flight with mixture leaned. In the "Performance-Specifications" section, the manual cruise power setting was listed as 75 percent at 3,000 feet.

According to the Lycoming Operator's Manual, the burn rate, depending on percent of power could be as much as 10.7 gallons per hour. However, at 75 percent power, which correlated to 2,350 rpm, the fuel flow would be about 7.3 gallons per hour.

Electronic Data

An Apple iPad was located in the airplane and sent to the NTSB Vehicle Recorder Laboratory. An exterior examination revealed the device had sustained extensive structural damage. The unit was disassembled and the internal board was removed. The internal board was sent to a chip-level recovery service for further recovery. The recovery service stated, "due to the severity and low-level nature of the failure in this case, no data was recoverable."

Flight Plan

An undated flight plan was located in the wreckage the flight plan showed a proposed departure time from Wilmington International Airport (ILM), Wilmington, North Carolina as "1300Z." The flight plan indicated a route of flight as direct to GE99; however, a handwritten note indicated "KHVS refuel top to 20 gal." The flight plan further indicated a true airspeed of 100 knots, a cruising altitude of 6,500 feet msl, an estimated time enroute of 2 hours 45 minutes, and fuel on board as 3 hours and 30 minutes. The flight plan listed the accident pilot as the pilot for the flight.

According to flight planning software, the direct routing from CPC to GE99 was on a 288-degree course and was 238.1 nautical miles. Reviewing that route of flight revealed that the accident location was along the course and was 129.2 nautical miles from the departure airport.

According to a representative of Lockheed Martin Flight Service Station, "no weather briefing or flight plan services were found" for the accident airplane for the days around the departure date.

Flying Club

According to a representative of the flying club that owned the airplane, the club rented the airplane to the members at a "dry rate." They further reported that the pilot member was required to purchase fuel themselves and that the flying club did not provide fuel for the airplane. It was further reported that the plane would have had a minimum of 30 minutes of fuel prior to the flight as that was the regulation required minimum fuel for a visual flight rules flight. They further reported that the accident pilot had planned to depart the home base airport and land at another airport to purchase fuel prior to continuing on to the intended destination.

Pilot Information

Certificate:	Commercial	**Age:**	24
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	June 6, 2011
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 281.2 hours (Total, all aircraft), 9.5 hours (Total, this make and model), 0.8 hours (Last 90 days, all aircraft), 0.8 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	GRUMMAN AMERICAN AVN. CORP.	**Registration:**	N8890L
Model/Series:	AA1B	**Aircraft Category:**	Airplane
Year of Manufacture:	1974	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	AA1B-0390
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	May 23, 2014 100 hour	**Certified Max Gross Wt.:**	1561 lbs
Time Since Last Inspection:	3 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	2258 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	C91 installed, not activated	**Engine Model/Series:**	O-235-C2C
Registered Owner:	WARRIORS TO WINGS AERO CLUB	**Rated Power:**	115 Horsepower
Operator:	WARRIORS TO WINGS AERO CLUB	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	DCM,657 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	12:55 Local	**Direction from Accident Site:**	38°
Lowest Cloud Condition:	Clear	**Visibility**	7 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	310°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.03 inches Hg	**Temperature/Dew Point:**	32°C / 16°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Whiteville, NC (CPC)	**Type of Flight Plan Filed:**	None
Destination:	Clayton, GA (GE99)	**Type of Clearance:**	None
Departure Time:	11:30 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	34.6725,-81.283889

Administrative Information

Investigator In Charge (IIC):	Etcher, Shawn
Additional Participating Persons:	Todd Clamp; FAA/FSDO; Columbia, SC Judson L Rupert; Lycoming Engines; Williamsport, PA
Original Publish Date:	April 27, 2015
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=89273