

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



DCA21FA174

SEARCH AND RECOVERY

Group Chair's Factual Report

May 19, 2022

A. ACCIDENT

Location: Honolulu, HI
Date: July 2, 2021
Time: 0145 Hawaii standard time (HST)
1145 coordinated universal time (UTC)
Airplane: Boeing 737-275C, Rhoades Aviation, Inc., dba TransAir Flight 810

B. SEARCH AND RECOVERY GROUP

Group Chair	Clinton R. Crookshanks National Transportation Safety Board Denver, Colorado
Group Member	Van McKenny National Transportation Safety Board Los Angeles, California
Group Member	Malak Yunus The Boeing Company Seal Beach, California
Group Member	John F. McLean The Boeing Company Seattle, Washington
Group Member	Jacob Medlang The Boeing Company Seattle, Washington

C. DETAILS OF THE INVESTIGATION

The group met with the first responders from the US Coast Guard, examined the recovered floating debris, and performed an underwater search for the airplane wreckage July 2-11, 2021, in Honolulu, HI.

The group returned to Honolulu October 8 through November 5, 2021, to oversee and assist with the recovery of the airplane wreckage from the sea floor. Following the recovery, the wreckage was examined.

The group chair returned to Honolulu December 6-11, 2021, to retrieve the cockpit crew seats, remove the cargo from the aft fuselage, and dismantle the airplane for disposal. The airplane wreckage was released to the insurance company on December 10, 2021, with the exception of the flight recorders, enhanced ground

proximity warning system (EGPWS) computer, the crew seats, and both engines and related equipment.

D. FACTUAL INFORMATION

1.0 Initial Response

The United States Coast Guard (USCG) joint rescue coordination center was first notified of an aircraft in distress about 0144 Hawaii standard time (HST) on July 2, 2021. Shortly after, the airplane accident was reported to the USCG, and they initiated the launch of a MH-65 helicopter and a C-130 airplane from USCG air station Barbers Point about 0150 HST to the last known position of the airplane. At the same time, the USCG launched a small boat from Base Honolulu and diverted the USCG Cutter Joseph Gerczak to the site. The MH-65 took off about 0215 HST and flew to the last known position of the aircraft after verifying the location with air traffic control. They arrived at the accident site about 0230 HST, identified by a fuel slick and debris on the water, and began searching for survivors. They reported contact with two survivors, one hanging on to a section of the tail and the other on a pile of floating cargo. The first responders from the USCG reported that the aft section of the airplane was floating when they arrived and included the horizontal stabilizers and a portion of the fuselage forward of the tail about 10-20 feet long. There was a fuel slick on the water along with many items of floating debris. The USCG Cutter began retrieving items of floating debris the afternoon of July 2.

2.0 Wreckage Search

The NTSB group members arrived in Honolulu the afternoon of July 2 and met with the USCG at Base Honolulu to be updated on the initial response and search status. The operator's insurance company, AIG Aerospace, sent a representative to Honolulu, and AIG contracted with Lone Star Retrieval (LSR), Red Oak, TX, for recovery of the airplane, who also sent a representative. AIG and LSR were instrumental in providing direction and the funding necessary to complete the search and recovery of the airplane. The group worked closely with these entities throughout the operation.

The group identified a local company, Sea Engineering, Inc. (SEI), that had side scan sonar and Remote Operated Vehicle (ROV) capabilities to perform an underwater search for the wreckage. The group met with SEI to discuss the search operation and assess their capabilities on July 3. SEI provided a quote for the search services the same day which was forwarded to AIG. The insurance company contracted SEI on July 4 to perform search work under the direction of the NTSB beginning on July 6. SEI outfitted their 43-ft workboat Huki Pono (Figure 1) with a CMAX CM2 side scan sonar (Figure 2) and a tethered Seamor Chinook inspection class ROV (Figure 3) for the search. The vessel utilized a Trimble SPS 461 differential GPS for navigation and positioning. Xylem's Hypack/Hysweep 2021 navigation and data collection software was used for collection of

the sonar data and for marking points of interest. The ROV position was tracked with an Applied Acoustics EasyTrack USBL. See Attachment 1 for the SEI report supplied at the conclusion of the search.



Figure 1. Huki Pono workboat



Figure 2. CMAX CM2 side scan sonar



Figure 3. Seamoor Chinook ROV

The search for the accident airplane began on July 6 with SEI personnel, members of the group, and a representative from LSR on board the Huki Pono. The weather conditions were not ideal on day 1 with winds 15-20 mph gusting to 25 mph and seas 5-6 ft. The team decided to initiate the search at the location where the MH-65 found the tail of the airplane and one survivor, 21°16'38.52" N, 158°1'44.16" W (green triangle in Figure 4) that was located west of the last ADS-B position (airplane icon in Figure 4). The side scan sonar, set to 200 m resolution, was deployed in the water, and towed in a grid pattern that covered an area about 2600 ft by 5700 ft first aligned with the sea bottom contours running from northeast to southwest and then perpendicular to the sea bottom contours from northwest to southeast (red lines in Figure 4). The depth of the area was about 150 ft on a shelf that extended out from the shore of Oahu. Several anomalous targets were identified during the search (black triangles). The sonar was recovered and redeployed twice during the day after it flipped upside down during the 180° turn at the end of a scan. Toward the end of the day the group identified a target with an angled shape different from the other targets identified (orange cross). The side scan sonar was recovered and the ROV was deployed to the location of the target. A large, angled rock was identified on the seafloor at the target location. An additional target was examined with the ROV that also was a rocky area of the seafloor. A review of the sonar information at the end of the day showed a large line of targets that matched the bottom contour and that

were consistent with an undersea ledge and some concentrated areas of targets consistent with rock outcroppings.

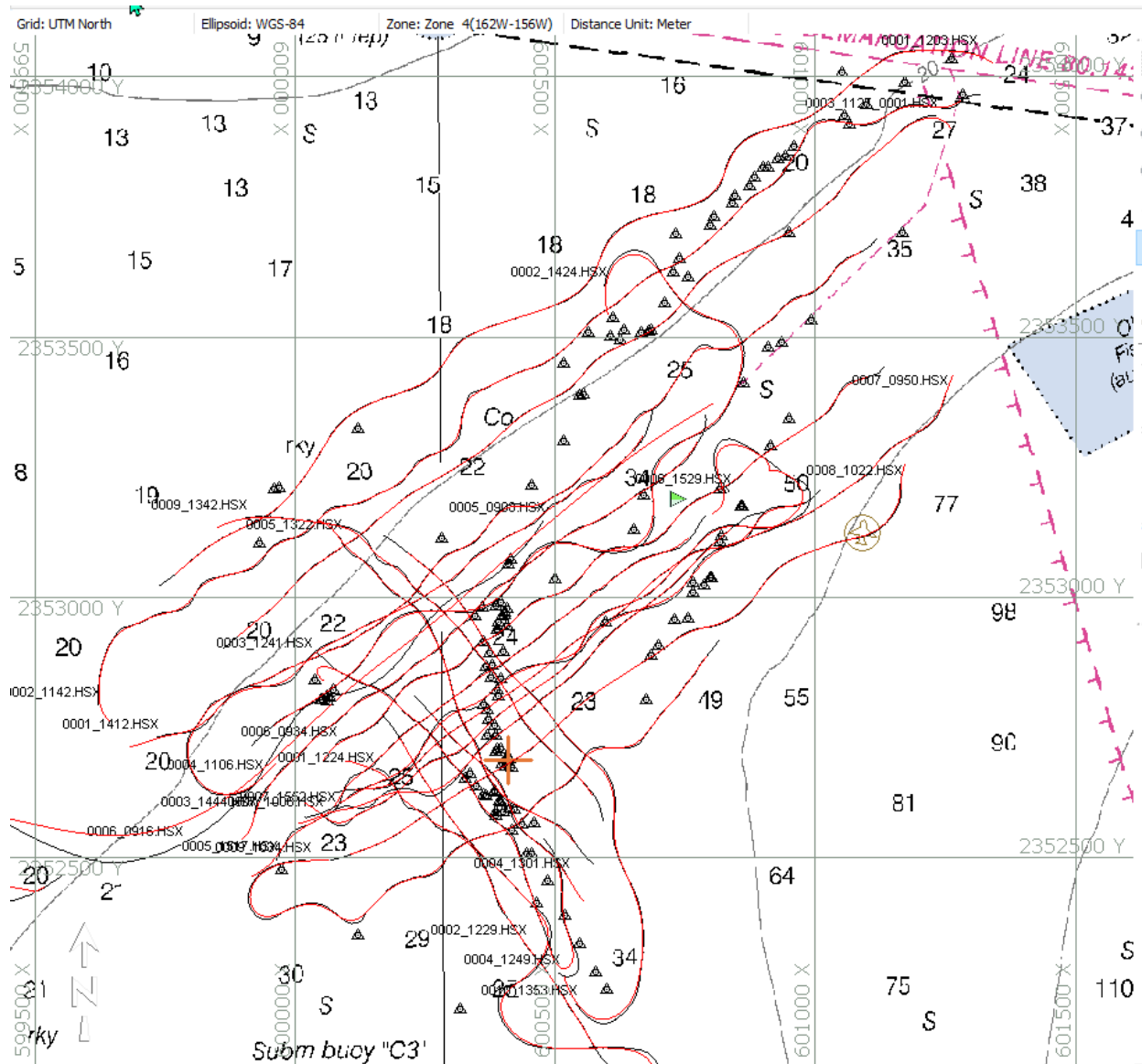


Figure 4. Side scan sonar survey lines and identified targets from day 1

On July 7, the team boarded the Huki Pono with the Boeing provided RJE PRS-275 handheld pinger receiver to search for the underwater locator beacons (ULB) on the flight recorders. The weather conditions were similar to day 1 with the same winds and sea state. The receiver was set to 37.5 kHz and deployed in the water near the location where the USCG identified the tail. Immediately, pinging was detected with two distinct pings indicating both ULBs were active. The team covered the area and obtained 9 distinct points with bearings towards the detected pings (Figure 5). There was no obvious coalescence of the bearings to indicate a precise location of the ULBs but an area in the middle was decided to be the most probable location. The water depth in this area was 300-500 ft. The side scan sonar was deployed and

towed in a grid pattern around the most probable location. There was difficulty getting the towed sonar deep enough to provide adequate coverage at 200 m resolution. A 12-foot long chain was added to the ROV tether line in an attempt to increase the sonar depth (Figure 6). No obvious targets were identified with the side scan sonar.



Figure 5. Pinger survey 1, July 7 morning

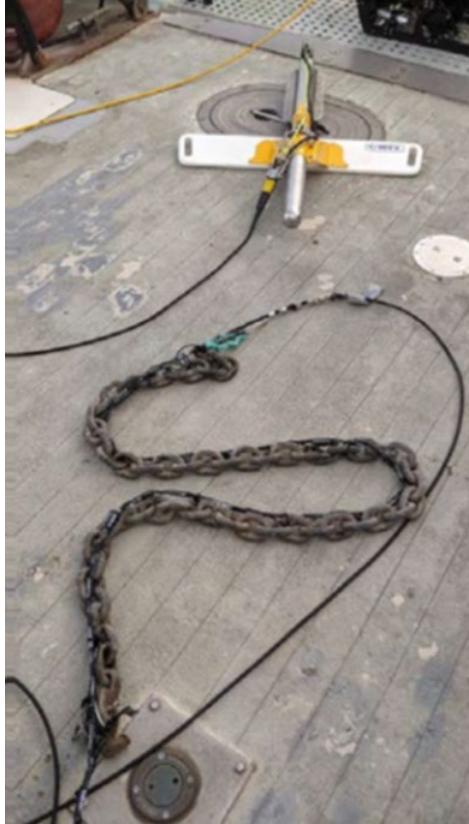


Figure 6. Side scan sonar with tether chain

The team elected to do additional pinger locating work around the area of interest in the afternoon. Six additional locations were surveyed and the bearing to the ping location was obtained (Figure 7). A definite coalescence of the bearings was evident when the data was plotted and was located about $\frac{1}{4}$ mile east-northeast of the USCG tail location. The charted water depth in this area was in excess of 300 feet with a steep drop to deeper water to the south and east. The location was about 0.1 mile north of the last ADS-B point recorded at $21^{\circ}16'37.43''$ N, $158^{\circ}1'31.87''$ W.

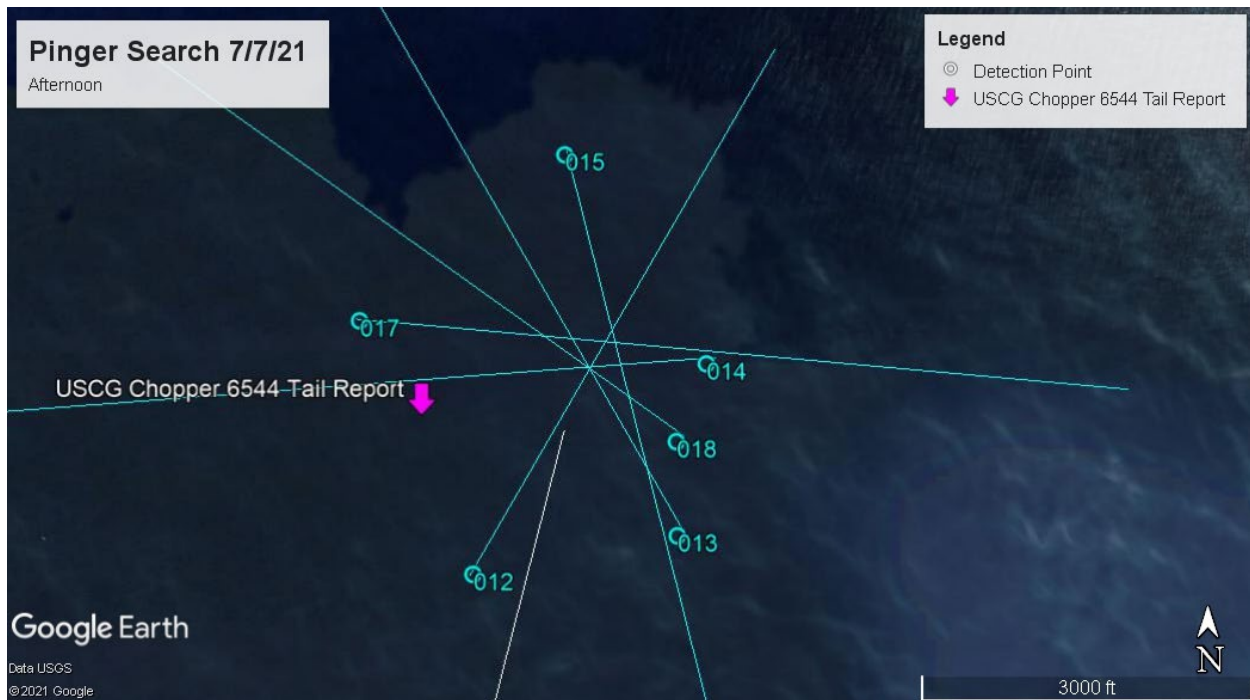


Figure 7. Pinger survey 2, July 7 afternoon

The side scan sonar was redeployed at 200 m resolution with additional weight added to the tow line to increase its depth. A small grid search around the probable location was performed and the group identified two distinct targets with sonar (Figure 8). The larger target had the distinct angular shape of an airplane wings and tail. Additional smaller targets were identified on sonar around the larger items.

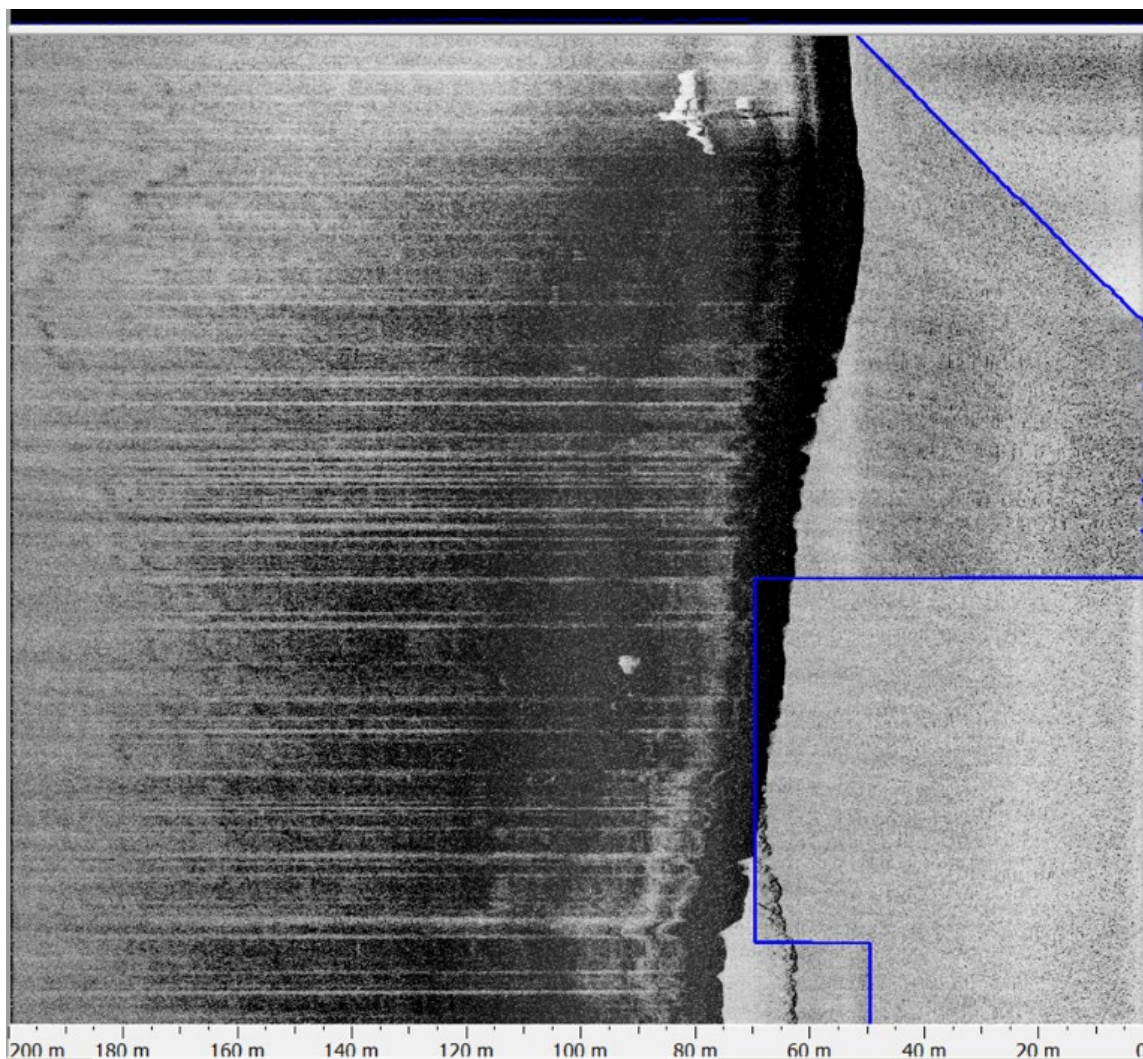


Figure 8. Side scan sonar targets

The side scan sonar was recovered and the ROV was deployed to the area of the airplane shaped target. During the descent, about 100 feet above the seafloor, the aft portion of the airplane appeared on the monitor (Figure 9). The wreckage was located on a sloped area of the seafloor with the forward end of the aft fuselage at a depth about 340 ft and the tail at a depth about 363 ft. A full video survey of the aft fuselage section was performed with the ROV. The fuselage was fractured near body station (BS) 540, the location of the forward spar, and was mostly intact to the tail at BS 1217. There was some damage evident to the lower portion of the fuselage, but the extent could not be determined. Both wings remained attached to the fuselage and both engines were separated from the wings. The flaps and ailerons remained attached to the wings. The left wing leading edge was separated from the wing root to the engine location and all the left wing slats were separated except a small portion at the outboard end. The right wing inboard slat was separated, and the remaining slats were attached. The horizontal stabilizer, elevators, vertical stabilizer, and rudder remained intact and attached. The Auxiliary Power Unit (APU) doors

appeared to be separated. The cargo containers were evident in the forward end of the aft fuselage. The aft fuselage section was located about 0.31 miles east-northeast of the USCG tail location, 210 feet northeast of the identified pinger location, and about 0.14 miles north-northeast of the last ADS-B point.



Figure 9. Aft fuselage wreckage on sea floor

On July 8, the team returned to the site and deployed the ROV to the second smaller target south of the aft fuselage. Upon reaching the seafloor, aircraft debris was identified. A full ROV survey was performed of the surrounding area and the forward fuselage, both engine cores, both thrust reversers, both inlet cowls, the nose landing gear, a section of keel beam, 2 cargo containers, and various items of cargo were located along with many other small pieces of wreckage and avionics boxes. The following locations were obtained for the major items.

Table 1. Major wreckage locations

Item	North Latitude	West Longitude	Depth (feet)
Aft Fuselage (Fwd)	21° 16' 43.71"	158° 01' 27.98"	340
Aft Fuselage (Aft)	21° 16' 42.90"	158° 01' 26.81"	363
Forward Fuselage (Fwd)	21° 16' 39.40"	158° 01' 30.79"	363
Forward Fuselage (Aft)	21° 16' 39.87"	158° 01' 30.35"	364
Nose Landing Gear	21° 16' 39.19"	158° 01' 31.03"	354
Engine #1	21° 16' 38.88"	158° 01' 31.20"	366
Engine #2	21° 16' 39.03"	158° 01' 31.18"	366
Thrust Reverser	21° 16' 37.83"	158° 01' 29.72"	437
Inlet Case #2	21° 16' 37.41"	158° 01' 29.50"	440
Keel Beam	21° 16' 40.00"	158° 01' 32.02"	350
Cargo Can 1 (FedEx)	21° 16' 41.73"	158° 01' 29.52"	341
Cargo Can 2 (TransAir)	21° 16' 41.37"	158° 01' 29.67"	345
Tires	21° 16' 39.97"	158° 01' 28.03"	432

Initially it was thought that only one engine had been located so about a half a day was spent surveying the wreckage looking for the second engine. The Powerplants group examined the ROV video survey at the completion of the day's operation and concluded that both engine cores were located within about 3 feet of each other on the seafloor and adjacent to one thrust reverser.

The forward fuselage was partially intact from the forward pressure bulkhead to about BS 540. There was significant damage to the lower portion evident, but the extent could not be determined. The radome was separated. The main deck cargo door was closed, the cockpit emergency windows were open, and the left entry door was ajar with the handle in the stowed position. There was no cargo present in the forward fuselage. The NLG remained attached to the wheel well structure and was in the up and locked position but the whole assembly was separated from the forward fuselage. The #2 engine inlet case was also located in the debris field separated from the engine.

The debris field was about 0.12 miles long north-south and about 0.10 miles wide east-west (Figure 5). All major portions of the airplane were identified in the debris field.



Figure 10. DCA21FA174 wreckage diagram

The following Figures 11 through 16 are snapshots from the ROV video survey of major identified items of wreckage.



Figure 11. Aft fuselage, wings, and tail



Figure 12. Engine cores and one thrust reverser



Figure 13. Forward fuselage



Figure 14. Engine #2 inlet case



Figure 15. Nose landing gear



Figure 16. Thrust reverser

3.0 Wreckage Recovery Planning

The recovery of the wreckage was a multi-faceted operation that required the use of several different companies and consultation with the USCG, the State of Hawaii, and federal authorities. The group worked extensively with AIG Insurance and Lone Star Retrieval throughout the process.

3.1 Request for Quote

The group developed a Request for Quote (RFQ) outlining the things needed for wreckage recovery. It was sent to companies that specialize in underwater salvage on July 9, 2021.

The RFQ (see Attachment 2) stipulated that any quote should cover the recovery of the major airplane wreckage from the sea floor and transportation to Kalealoa Barbers Point Harbor in Kapolei, HI. The offloading of the wreckage and storage were to be the responsibility of LSR already under contract to AIG. The major items of interest to the investigation were the forward fuselage, aft fuselage (containing the flight recorders), and the engines. The enhanced ground proximity warning system (EGPWS) computer was also of interest if located. The recovery would have to be coordinated with the State of Hawaii and federal authorities for possible impacts to endangered monk seals and sea turtles that could require recovery of the smaller wreckage items so any quote should cover those items. The timing of the

quoted recovery was to include the necessary time to ready equipment and the effects of weather. The ROV survey videos were supplied to the companies that were interested in submitting a quote. Updates to the RFQ were supplied to the companies on July 10, July 15, and July 22 that set the due date for July 23, supplied the GPS coordinates of the major items, supplied the airplane load manifest and fueling information, supplied the Boeing 737 Aircraft Recovery document, and extended the deadline for submissions to July 26.

The group received 4 recovery proposals with some of the companies partnering together and all involving subcontractors with quoted prices ranging from \$2.1 million to \$9.6 million.

3.2 Contract Award

Feedback was provided to AIG on the received quotes based on experience in recovering aircraft, the recovery of all items including smaller debris, the endangered species monitoring, and the cost. AIG selected and informed Eclipse Group, Inc. (EGI) of their successful bid on August 5, 2021, after consultation with the co-insurers. AIG and LSR also selected Pacific Environmental Corporation (PENCO) to provide all spill response operations and American Marine Corporation (AMC) for the offload and storage of the airplane at Kaleloa Harbor. The EGI recovery proposal was shared with the State of Hawaii, Hazard Evaluation and Emergency Response Office, PENCO, and AMC. After the contract was awarded, the NTSB provided EGI with preliminary weight estimates for the larger items provided by Boeing and the cargo manifest. AIG and EGI executed the contract on September 16, 2021, after working out several discrepancies with specific clauses.

3.3 Recovery Plan

EGI began converting the proposal to a draft recovery plan and provided an initial draft of the recovery plan to the NTSB on August 20, 2021, with a projected start date of September 22, 2021. The draft plan had large sections missing at this point and both the NTSB and EGI understood that this initial incomplete draft of the recovery plan would be continuously edited over the course of the planning process. The relevant stakeholders involved with the recovery were made aware of the planning process and paragraphs and sections were continuously exchanged. More complete updates to the recovery plan were provided on August 31, September 1, September 14, and September 17. Throughout the planning process numerous meetings were held to flush out the details of the plan between EGI, LSR, NTSB, Boeing, Curtin Maritime, AMC, and PENCO. EGI finalized the recovery plan on September 22, 2021, with a project start date of October 8 (Attachment 3).

3.4 Federal and State Consultations

After the accident, as the search efforts were going on, the NTSB was advised by SEI and the USCG to contact several federal and state agencies regarding the wreckage recovery efforts.

3.4.1 FAA Consultation

The FAA office of accident investigation supported the initial response and recovery of the airplane. The FAA issued a Notice to Airmen establishing a Temporary Flight Restriction closing the airspace above the wreckage in a 2-mile diameter circle centered on the aft fuselage location from October 11-26, 2021.

3.4.2 USCG Consultation

The NTSB was in contact with USCG Sector Honolulu immediately after the accident and throughout the planning, search, and recovery. The USCG was instrumental in the success of the operation. Initially, the USCG established a 3-mile Safety Zone around the area of impact that was in place throughout the search operations.

Once the wreckage was located and recovery discussions began, the USCG recommended contacting the National Oceanic and Atmospheric Administration (NOAA) regarding compliance with Endangered Species Act (ESA) Section 7 consultation requirements and Essential Fish Habitat (EFH) consultation requirements for the recovery of the airplane wreckage.

The USCG was provided with each draft of the recovery plan during the planning phase. Throughout, they committed to establishing a Safety Zone around the recovery area when operations started including a published Broadcast to Mariners. The safety zone was established from October 9 through November 6 to support the wreckage recovery. In preparation, the USCG requested an environmental statement on September 20 for the recovery to comply with their requirement for environmental considerations review for the Safety Zone. The USCG Environmental Statement (Attachment 4) from EGI was provided to the USCG on September 24.

The finalized recovery plan was shared with USCG Sector Honolulu and USCG Marine Safety Center Salvage Engineering Response Team (SERT) on October 1, for final review, comment, and approval. The SERT provided the following comments to Sector Honolulu and the NTSB on October 4 by email.

- A means to keep the straps in the desired location on the fuselage during the single point lift of each section should be utilized.

Common methods to prevent slipping of the straps are spreader bars or the installation of hold backs.

- Care should be taken to remove sharp edges or abrasive material in way of lifting points to prevent damage to the braided slings.
- Each section should be drained of entrained water as much as possible prior to lifting each section on to the barge to reduce water weight.
- A means to monitor the weight of each lift should be utilized to ensure the crane is operating within its defined capabilities.
- The approved crane boom capacities chart in the ABS issued stability letter differs from the capacity chart in appendix VI. The stability letter's capacity chart has a lower rated capacity and should be the values used when determining the max operation radius of the crane for a lift.
- We have attached the stability letter for DB SALTA VERDE. Lifting operations must comply with these restrictions to include ballasting of the barge, crane boom length, and barge cargo load and center of gravity (note that the weight of the crane, lifting winch, and lifting loads must all be considered as cargo weight).
- In steps 4 and 5 of the aft section lift, the max boom radius must not exceed 45 feet to lift the anticipated 86,000 lbs per the crane boom capacity chart attached to the ABS issued stability letter for DB SALTA VERDE

The stability letter supplied by SERT for the DB SALTA VERDE is included as Attachment 5. The NTSB verified with SERT that the comments provided were advisory in nature and there was no response required as long as all parties were comfortable with the plan and its execution. The NTSB and EGI met with USCG Sector Honolulu staff on October 8 to verify all plans were in place and answer questions. The USCG was copied on all EGI SITREPs during the recovery operation.

3.4.3 NOAA National Marine Fisheries Service (NMFS) Consultation

The NTSB made initial contact with NMFS on July 13 for both ESA and EFH consultation and provided them with the location of the wreckage, ROV survey videos, and the general plan for wreckage recovery. Under the ESA, as soon as practicable after the emergency is under control, the action agency (NTSB) initiates formal consultation with the NMFS if listed species or critical habitat have been adversely affected. The ESA species expected to occur in the wreckage area were the North Pacific sea turtle, hawksbill sea turtle, Hawaiian monk seal, oceanic whitetip shark, giant manta ray, and Main Hawaiian Island insular false killer whale. They

suggested also contacting the US Fish and Wildlife Service (USFWS) regarding ESA consultation. NMFS provided interim suggested best management practices (BMPs) listed below by email to reduce any potential impacts on marine species for the wreckage recovery.

1. Constant vigilance shall be kept for the presence of ESA-listed marine species during all aspects of the proposed action, particularly in-water activities.
2. All work shall be postponed or halted when motile ESA-listed marine species are within 50 meters of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area.
3. When piloting vessels, vessel operators shall alter course to remain at least 50 meters from marine mammals and sea turtles.
4. Reduce vessel speed to 10 knots or less when piloting vessels at or within the ranges described above from marine mammals and sea turtles. Operators shall be particularly vigilant to watch for turtles at or near the surface, and if practicable, reduce vessel speed to 5 knots or less.
5. Marine mammals, sea turtles and other ESA-listed motile species shall not be encircled or trapped between multiple vessels or between vessels and the shore.
6. Do not attempt to intentionally interact with any ESA-listed marine species.

They did not provide specific BMPs for ROV operations but recommended keeping any lines taut to reduce chances of an animal getting entangled. Their basic guidance was to do what we needed to do and monitor for ESA-listed species. After the recovery was completed, they would perform the ESA consultation.

NMFS also provided information on the EFH consultation. EFH in the main Hawaiian Islands has been designated in the marine water column from the surface to a depth of 1,000 meters (m), from the shoreline to the outer boundary of the Exclusive Economic Zone (200 nautical miles), and the seafloor from the shoreline out to a depth of 700 m. Similar to the ESA, as soon as practicable after the emergency is under control, the action agency (NTSB) should initiate formal EFH consultation for any actions that may have an adverse effect to the water column and bottom substrate that occur during the operation. The NMFS provided the below conservation recommendations by email for physical impacts to EFH.

1. Equipment, anchors, structures, or fill shall not be deployed in areas containing live corals, sea grass beds, or visible benthic organisms. Perform pre-deployment reconnaissance (e.g., divers, drop cameras) to ensure these resources are avoided.

2. Minimize physical contact by divers and construction related tools, equipment, and materials with benthic organisms, regardless of size, especially corals and seagrass.
3. Prevent trash and debris from entering the marine environment during the project.
4. Maintain all structures, gear, instrumentation, mooring lines, and equipment to prevent failures.
5. All objects lowered to the bottom shall be lowered in a controlled manner. Note: This can be achieved by the use of buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.
6. In order to minimize malfunction, prior to operations employing submersibles, a pre-deployment test of all operating systems should be run to ensure that equipment is operating correctly, there are no visually apparent physical defects, and conditions are conducive to operations.
7. All submersible missions should have a plan that details the mission, geographic locations, and deployment and retrieval plans to minimize the potential for collisions and groundings and ensure proper retrieval.

They recommended providing an EFH assessment after the recovery operation containing a description of the action, a determination as to how the action will affect EFH, an assessment of the adverse effect, and proposed ways to mitigate for the adverse effects. An adverse effect to EFH is anything that reduces the quantity or quality of EFH. This assessment could be combined with the ESA consultation.

The NMFS was provided information during the planning process including the finalized recovery plan on October 1 and attended the kickoff meeting on October 8. All monitoring and reporting requirements during the recovery were assigned to the environmental consultant, Darla White, MSc., MGIS, working for EGI. NMFS was copied on all EGI environmental SITREPs during the recovery operations. At the conclusion of the operation, the EGI environmental consultant submitted an ESA Environmental Statement (Attachment 6) on November 24 and a separate EFH Environmental Statement (Attachment 7) on November 30 to NMFS on behalf of the NTSB. The ESA report concluded there were no adverse effects to ESA-listed species and was accepted by NMFS on November 29 requiring no further action. The EFH report concluded there were likely adverse effects to EFH and was accepted by NMFS on December 3.

3.4.4 USFWS Consultation

The group made initial contact with USFWS on July 13 for ESA consultation and provided them with the location of the wreckage, ROV survey videos, and the general plan for wreckage recovery. In addition to ESA compliance, they also stated that the recovery operation would need to comply with the provisions of the Fish and Wildlife Coordination Act. Utilizing the ROV survey videos, they evaluated if any trust resources, such as deep-water corals, were present. Their analysis was that the area consisted mostly of a sandy bottom with some hard bottom presence. The hard bottom appeared to be low relief basalt with little observable benthic community. They did not notice any corals within the wreckage area. They recommended that, in the course of the recovery operation, we should take note of high relief areas and avoid them to the extent that is practical. They stated that the recovery operation may have minimal natural resource impacts.

The USFWS was provided information during the planning process including the finalized recovery plan on October 1 and were copied on all EGI environmental SITREPs during the recovery operations. At the conclusion of the operation, they were satisfied with the reporting that was done and required no additional actions.

3.4.5 State of Hawaii Consultation

Initial telephone contact with the State of Hawaii, Department of Health, Hazard Evaluation and Emergency Response Office (HEER) was made on July 3, 2021, to discuss their concerns with respect to the airplane wreckage in the water. A follow up meeting with HEER occurred on July 9 once the wreckage had been located and included a representative from the State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources (DAR). The HEER and DAR representatives were mainly concerned with the cargo onboard, the hazardous materials on the airplane, and the possible impact to any seafloor organisms such as coral. The load manifest and ROV survey videos were supplied for review. On July 12 HEER provided the following concerns by email to be addressed in the recovery planning and execution.

1. Coral concerns - all live rock and coral are protected under law against damage and disturbance;
 - a. It appears that there are not a lot of coral concerns at this time.
2. Poses a risk to human and natural resources not knowing what cargo remains that may leach over time;
 - a. We are very interested in getting more details with respect to the cargo. We know that the cargo has mostly pharmaceuticals - we need to get a better idea of what the 2459 pounds of pharmaceuticals and other 12168 pounds general freight of cargo are. We are concerned that there are

- two "Pharmaceutical Haz" – does this mean hazardous waste, hazmat, or hazardous? How are the pharmaceuticals packaged – cardboard that can easily get wet or waterproof packaging?
- b. Hoping that the sender and/or the receiver of the cargo will be able to provide the info.
3. Poses a risk to divers that may attempt to explore;
 - a. At that depth, recreational divers may not attempt it but commercial divers may. Leaving the plane there poses a liability to the State.
 4. May pose a navigational hazard;
 - a. Based on the depth, this does not pose a navigational hazard
 5. Pollutant or contaminant with Clean Water Act;
 - a. Leaving the plane along with its contents is considered a violation of the Clean Water Act.
 6. Not a disposal site – EPA issues under Clean Water Act.
 - a. State has jurisdiction within the three mile zone; EPA issues disposal sites in consultation with the State.
 7. It would be good to get the SDS of the fire bottles likely still remaining. The fire suppressant (Halon) that most likely is gone may have contained PFAS, per- and polyfluoroalkyl substances; studies and evidence indicate that exposure to PFAS can lead to adverse health outcomes.
 8. With the wings of the plane still intact, the likelihood that most of the fuel is still in the plane is great.

State's position: we would like to be involved with you all with respect to the Salvage plan with the recovery of the wreckage.

The various drafts of the recovery plan were shared with HEER and DAR throughout the planning process including the finalized recovery plan on October 1. EGI and the NTSB met with the State of Hawaii by teleconference on September 7 and in person on October 8 before beginning the recovery operation.

4.0 Wreckage Recovery Operations

EGI utilized the R/V Bold Horizon (BH) as the main vessel for most work. The BH was outfitted with the GP-50 work class ROV deployed off the stern using an A-frame crane. A J-frame crane on the starboard side was used for transporting the wreckage storage baskets from the ship to the sea floor and a telescoping deck crane was used to lift wreckage from the surface to the deck. EGI subcontracted to Curtin Maritime for the DB Salta Verde (DBSV) barge with a Manitowac 4600 crawler crane to lift and transport the large items of wreckage and the barge assist tug Shirley C. The BH,

DBSV, and Shirley C were based in southern California and had to transit the ocean prior to the operation.

The decision was made to staff the recovery vessel with two NTSB investigators, two Boeing engineers, and one representative from LSR for the duration of the operation. An additional NTSB investigator and a Boeing investigator would remain on shore to support the needs of the investigation. The NTSB investigators remained for the duration, one Boeing engineer departed on October 17, and the second Boeing engineer departed October 22. The LSR representative departed on October 22. NTSB and Boeing shore support remained through October 25.

The NTSB arrived in Honolulu on October 7 to begin the operation. Pre-operation meetings between the NTSB and EGI and all the interested state and federal agencies were held on October 8. The NTSB held a press conference to announce the beginning of recovery operations at the airport fire station on October 9. Pre-operation tasks included finding suitable ice chests for the transport of the flight recorders and sourcing distilled water to store the recorders in. The NTSB arranged for the entire recovery team to visit the TransAir facility and examine a sister airplane to take measurements prior to the recovery.

4.1 Safety Gear

Recovery operations on board the BH could present some unique dangers to personnel working on the deck. EGI held ultimate authority for the safety of personnel on board the BH and limited the personnel allowed on the lower working deck during recovery operations. The NTSB investigators were allowed on the main working deck during recovery operations with the required safety equipment outlined below. The list of safety equipment was developed with NTSB management and OMS and some exceeded EGI required equipment.

- Personal Flotation Device (PFD) - USCG Type III PFD required when on deck. NTSB provided inflatable PFDSs for the investigators.
- Personal Locator Beacon (PLB) - NTSB investigators attached company provided PLBs to PFDs.
- Hard Toe Boots - Required when on deck. Closed toe shoes were required in interior spaces of BH.
- Hard Hat - Required on work deck.
- Long Pants - NTSB requirement for working around airplane wreckage.
- Gloves - Leather or cut resistant gloves required for handling of wreckage. Latex gloves underneath for handling cargo or hydraulic fluid contaminated wreckage.

- Chem Lights – Required for night work on deck. Investigators had them attached to PFDs.
- Eye Protection – Required when working around wreckage.

4.2 Weather

Available information indicated that the optimum time weather wise for the recovery of the airplane was late summer and early fall when the winds and sea state would be most favorable. EGI contracted with DTN to provide WeatherOps ongoing weather reporting and forecasting for the duration of the recovery. EGI had established color coded (green, yellow, red) limits for wind and waves that were incorporated into their subscription weather surface. The group received two weather reports per day at 0600 and 1800 local time that included an ongoing 7-day forecast. The EGI wind limits were green below 25 kts, yellow 25-40 kts and red above 40 kts. The wave height limits were green below 8 feet, yellow 8-19 feet and red above 19 feet.

The winds for the duration of the operation were predominantly from the northeast or east-northeast. The first two weeks of the operation saw the strongest winds with winds in the 10-15 kt range and gusts in the 20-25 kt range. On several days, the gusts exceeded 25 kt going into the yellow range. The last week of the operation saw a decrease in the winds with several days where the winds and gusts were less than 10 kt.

The sea swell was predominantly from the southeast or south-southeast for the first two weeks of the operation with a significant wave height of 3-5 feet and a maximum wave height mostly in the 6-7 feet range. There were some days during this time when the maximum wave height was 8 feet or greater in the yellow range. The third week of the operations saw the sea swell predominantly from the south with a significant wave height of 2-3 feet and a maximum wave height of 4-6 feet.

4.3 COVID Protocols

The entire operation occurred during the COVID-19 pandemic requiring specific policies to ensure the safety of personnel. The State of Hawaii required all travelers to the state to either have proof of vaccination or a negative test less than 72-hours prior to arrival. The federal government already had a vaccination mandate for NTSB personnel. EGI and NTSB agreed on protocols for all personnel that would be present for the operation since a positive infection on the ship could bring the operation to a halt. We elected to minimize the transfer of personnel from shore to ship by requiring all personnel to board the ship at the beginning of the operation and remain for the duration or until they departed. EGI policies already required all personnel on the BH to be vaccinated and the group required all personnel not arriving on the BH from California to have a negative COVID test after arriving in

Hawaii but prior to boarding the BH. The DBSV personnel were either vaccinated or had a negative test prior to leaving California for the twelve-day transit to Hawaii. There were no infections or exposures reported during the operation.

4.4 Wreckage Recovery

The team boarded the BH at the port of Honolulu on October 12, 2021, to begin the recovery operations. EGI and NTSB agreed that all wreckage inventory would be performed by the NTSB and Boeing personnel. After transiting to the site, several pre-dive checks of the ROV were accomplished. The wind and sea state prevented deploying the ROV and the BH proceeded further offshore for the night. The ROV went into the water the morning of October 13 for its first test dive that revealed there was insufficient ballast weight for the conditions. The ROV was recovered to the deck and 50 lb of ballast was added. Minutes after redeploying the ROV to perform a pre-operation inspection of the barge anchor sites, the ROV developed a hydraulic leak from one of the manipulator arms. The ROV was recovered, and the leak was fixed but not before the sea state became too rough for operations. A decision was made to adjust the operation times to line up better with calmer seas based on the experience from the first two days and the weather forecast. Operations would begin at 0400 and run until the seas became too rough for safe operations, usually in the mid to late afternoon.

On October 14, several ROV dives were accomplished to examine the 4 barge anchor sites and the sewage outfall located nearby. A 25 m circle around each proposed anchor site was surveyed. The anchor sites all consisted of either sandy or rocky bottom with minimal sea life and no evidence of corral or endangered species. There was no sensitive habitat identified by the environmental consultant. The sewage outfall was observed to have several leaks and some concrete blocks and pipes and automobile tires were observed on the seabed nearby. The first debris basket was deployed to the sea floor near the forward fuselage section. The ROV rigged the nose landing gear (NLG) with a nylon strap around the axle with the opposite end connected to the lifting eye on the ROV. The ROV was then recovered to the surface and the strap was transferred to the BH crane for recovery to the deck. This method would be used for all the larger wreckage items that wouldn't fit in the debris baskets. The NLG, the first item of wreckage recovered, was recovered to the BH deck about 1500 on October 14 (Figure 17).



Figure 17. Recovered nose landing gear

The ROV was deployed on the proposed location for the tug anchor site the morning of October 15. Shortly after beginning the survey, the ROV lost power and had to be recovered. Repair of the electrical anomalies took the remainder of the day, and no further dives were conducted. The ROV was deployed on the location of the engines about 0400 on October 16. The #2 engine was initially rigged with a nylon strap around the forward end of the main shaft. Almost immediately after lifting it off the bottom the strap was cut by the blade remnants and the engine fell back to the sea floor. The #2 engine was re-rigged with a wire rope in a choke configuration around the main shaft and recovered to the surface (Figure 18) about 1330. The #1 engine was then rigged with a wire rope in a choke configuration around the middle part of the case and lifted to the surface. The #1 engine was dropped during the transfer from the ROV to the crane and was relocated and re-rigged. The #1 engine was recovered to the surface (Figure 19) about 1730.

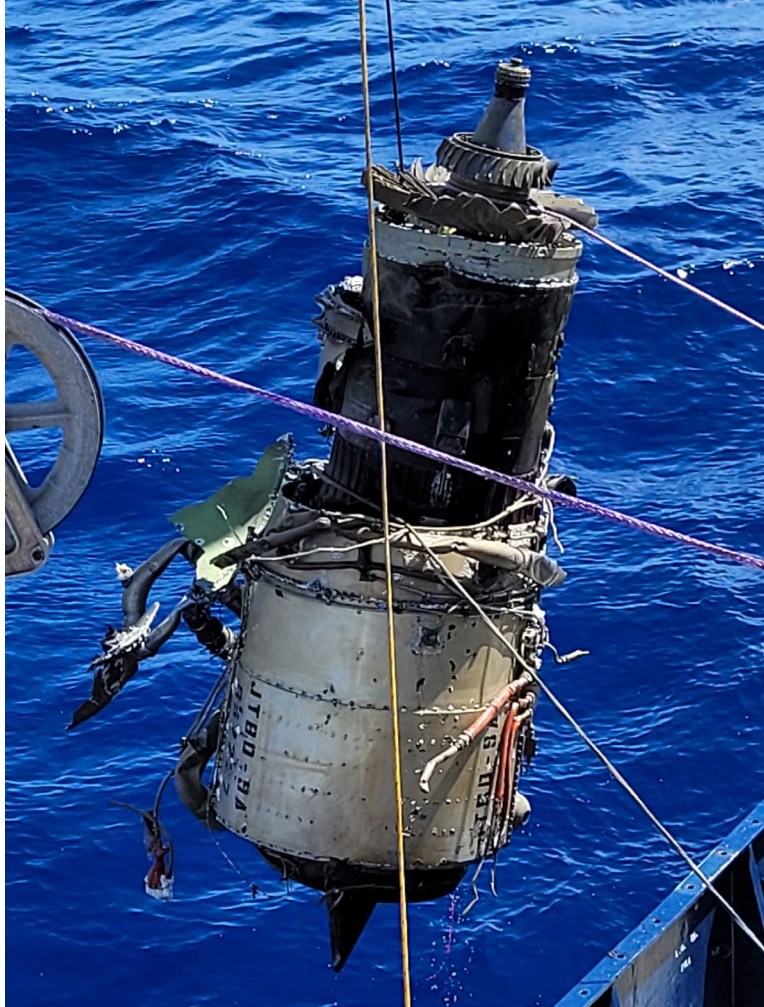


Figure 18. Recovered #2 Engine



Figure 19. Recovered #1 Engine

The ROV was deployed about 0300 on October 17 for targeted recovery of additional engine items. The #2 engine inlet case and both inlet cowls were recovered to the deck of the BH by about 0900 (Figure 20). The decision was made to transfer the engine wreckage to shore to free up deck space on the BH and to give the shore side powerplants investigators wreckage to examine. Much preplanning and logistics were required by both the NTSB IIC and EGI to secure space at the AMC/PENCO facility on pier 14, a docking permit for the BH to arrive, stevedores¹ to oversee the unloading, and a berth for the BH to spend the night at the port of Honolulu. The BH arrived at pier 14 about 1030 and offloaded the engine wreckage at the AMC/PENCO facility.

¹ Trade union personnel responsible for loading and unloading ships at a port.



Figure 20. Recovered engine nose cowls

The Curtin tug Shirley C and DBSV arrived in Hawaiian waters at Kalealoa Harbor on October 14 and began transitioning from transit to recovery operations. EGI and NTSB personnel met with Curtin personnel the afternoon of October 17 to discuss the recovery plan, provide the anchor locations, and examine the barge equipment. EGI had been discussing alternate lifting plans for the large aft fuselage section and indicated to the NTSB that they were considering a vertical lift of this section. NTSB and Boeing engineers met the evening of October 17 to examine the feasibility and provide recommendations. The NTSB IIC and investigators and Boeing party coordinator and engineers met with EGI the morning of October 18 onboard the BH. The investigative team suggested a vertical lift of the aft fuselage would likely result in structural failure and recommended the planned horizontal lift plan be used. Two NTSB investigators, one Boeing engineer and one representative from LSR reboarded the BH that departed for the site about 1200. A NTSB media representative also boarded the BH to document the recovery of the larger items. The Shirley C and DBSV transited to the site the morning of October 18 to set anchors. The weather and sea state forecasts were favorable for recovery of the forward fuselage in the following few days.

The BH arrived on station at the site about 1300 on October 18 and deployed the ROV to the forward fuselage section to begin rigging. The forward end of the forward fuselage was rigged with a wire rope through the open cockpit side windows accomplished by passing a fiberglass pole with the wire rope attached through the windows. The tool was pre-rigged on board the BH deck and taken down by the ROV. The wire rope loops were laid on the sea floor on the left side of the forward fuselage. The aft end of the forward fuselage was rigged with a wire rope passing underneath the structure utilizing the same tool and method as before on the morning of October 19. The wire rope loops were also laid on the left side of the

fuselage and the location for the barge winch hook was provided to the DBSV. The DBSV relocated on its anchor lines to be over the forward fuselage and dropped the winch hook to the bottom. The ROV attached the wire loops to the winch lifting eye. Originally the forward and aft lines were going to be used in a basket configuration with all the wire loops on the lifting eye. The forward line was changed to a choke configuration with only one loop on the lifting eye to keep the section mostly horizontal for the lift. The lift of the forward fuselage was started and before any appreciable weight could be taken up by the winch a problem with the winch transmission developed. The DBSV crew diagnosed the problem and began repairs. All further work was stopped due to sea state and darkness with plans for a lift at first light the following morning.

The morning of October 20 dawned with calm seas and little wind, even less than forecast. LSR arranged for the PENCO OSRV Century to be on site throughout the lift to deal with any unexpected fuel or hydraulic fluid spills. The ROV was deployed to check the rigging and connection to the barge winch before the lift began at 0730. After verifying the rigging and letting the forward fuselage dangle off the sea floor for a while, the ROV was recovered and the BH moved. NTSB personnel were transferred to the barge for the remainder of the lift. The forward fuselage section was recovered to the DBSV about 1100 (Figure 21) and placed with it laying on its left side. There was no evidence of fuel or hydraulic fluid spills during the lift. The lower fuselage was examined and photographed before the section was rotated upright and lashed to the deck (Figure 22). There was extensive damage to the lower fuselage below the floor, only one avionics box remained, and all the floor beams were fractured. The DBSV crane operator reported that the forward fuselage weighed about 6 kips (kilo-pounds) in the water, a maximum of about 22 kips at the air-water interface, and about 15.5 kips in the air after draining. The decision was made to have the DBSV transit to Kalealoa Harbor and offload the forward fuselage prior to recovery of the aft fuselage due to the limited space available on the DBSV deck. The Shirley C and DBSV departed for Kalealoa to offload the forward fuselage under the direction of the NTSB IIC. The ROV was redeployed to survey the aft fuselage section and set cables on the sea floor for rigging. The second debris basket was placed on the sea floor near the location of the cargo containers.

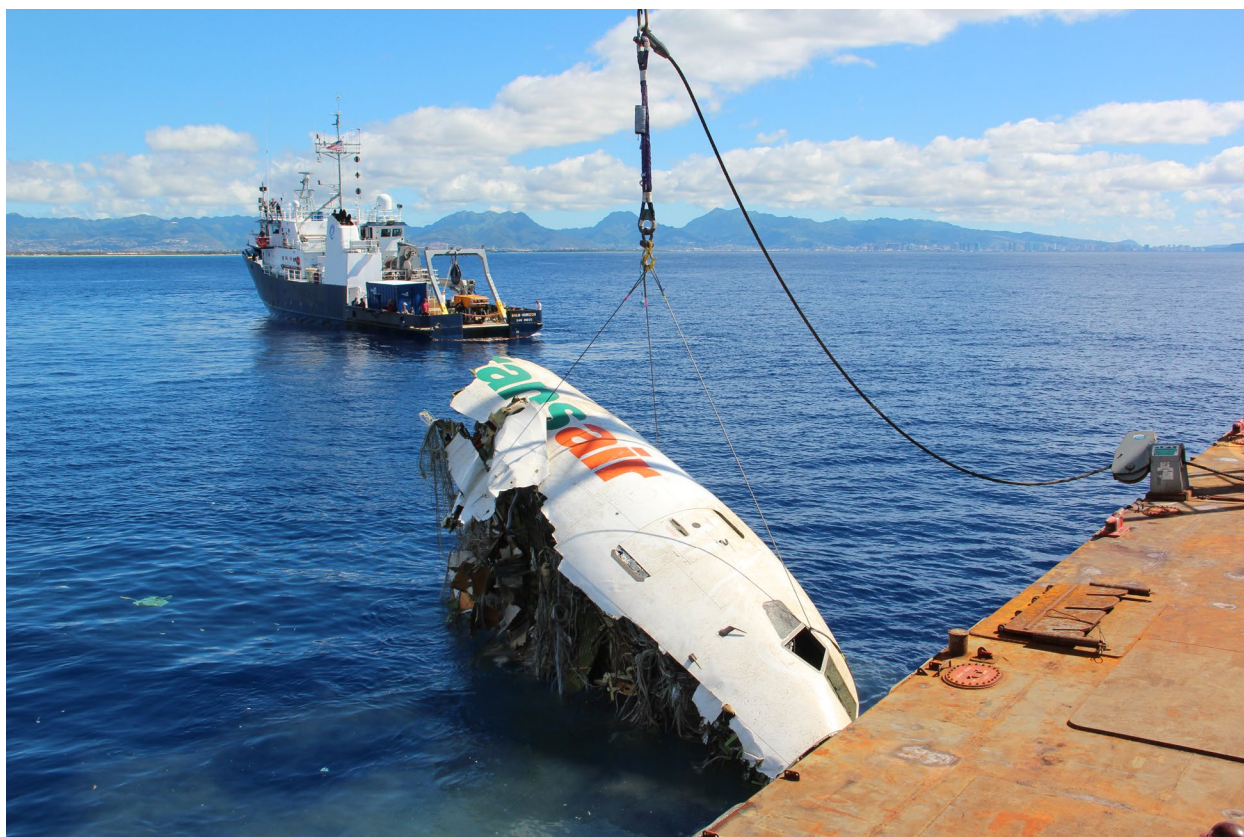


Figure 21. Forward fuselage recovery

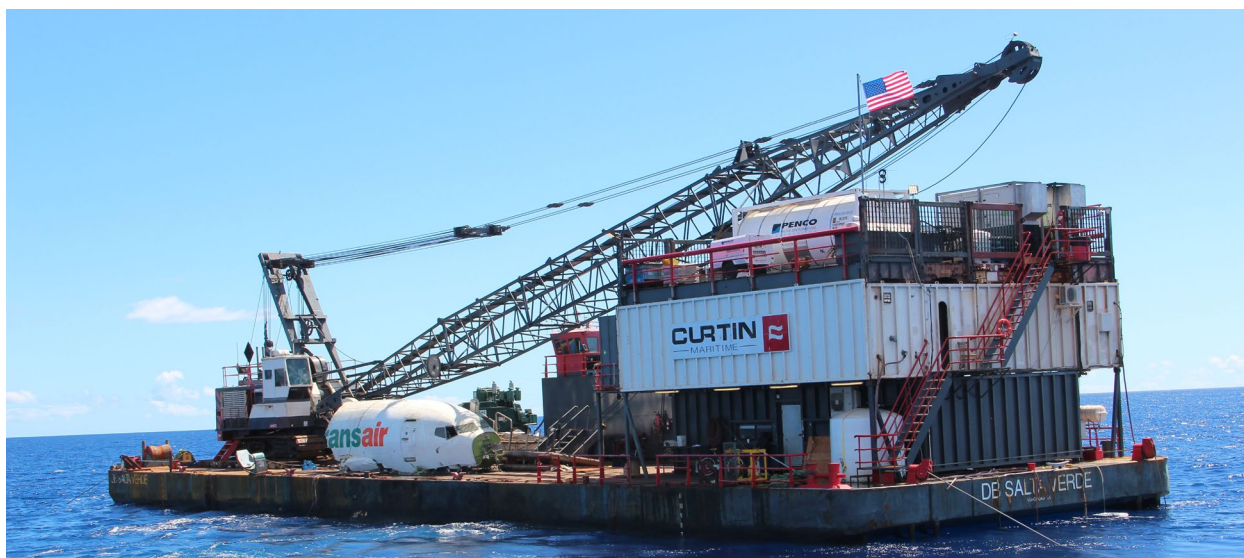


Figure 22. Forward fuselage on barge

The ROV was deployed on the aft fuselage section the morning of October 21 to continue the survey and to rig the tail. Two 12-inch-wide nylon lift straps were slid along the sea floor underneath the tail of the airplane near the area of the aft entry doors and aft pressure bulkhead. The loops were brought to the top of the fuselage for connection in a basket configuration to a third nylon lift strap. The wing root areas

were examined in detail to show that the forward spar on each side of the fuselage was intact. The forward spar was fractured in the wing center tank area but deemed to be intact enough for the lift. Without the DBSV on station to drop the heavy wing lift cables or to lift large items, the choice was made to recover additional smaller items. The thrust reverser assemblies were recovered to the deck of the BH around 1535 and 1830 (Figure 23).



Figure 23. Recovered thrust reversers

The wind and sea state forecast indicated that it would not be favorable for recovering the aft fuselage for a few days, so the decision was made to recover the smaller items of wreckage until there was a window of good weather. The DBSV was instructed to remain in port at Kalealoa until there was a good weather window. The ROV transited the debris field around the location of the forward fuselage and picked up individual items and placed them in the debris basket. The larger items were rigged with straps or cables and recovered to the BH deck. The EGPWS computer was located in the debris field on October 22 (Figure 24) and placed in the basket. A fuel control unit and a fuel pump were also identified and placed in the basket. The APU and keel beam were recovered to the deck of the BH on October 22 (Figure 25 and 26).

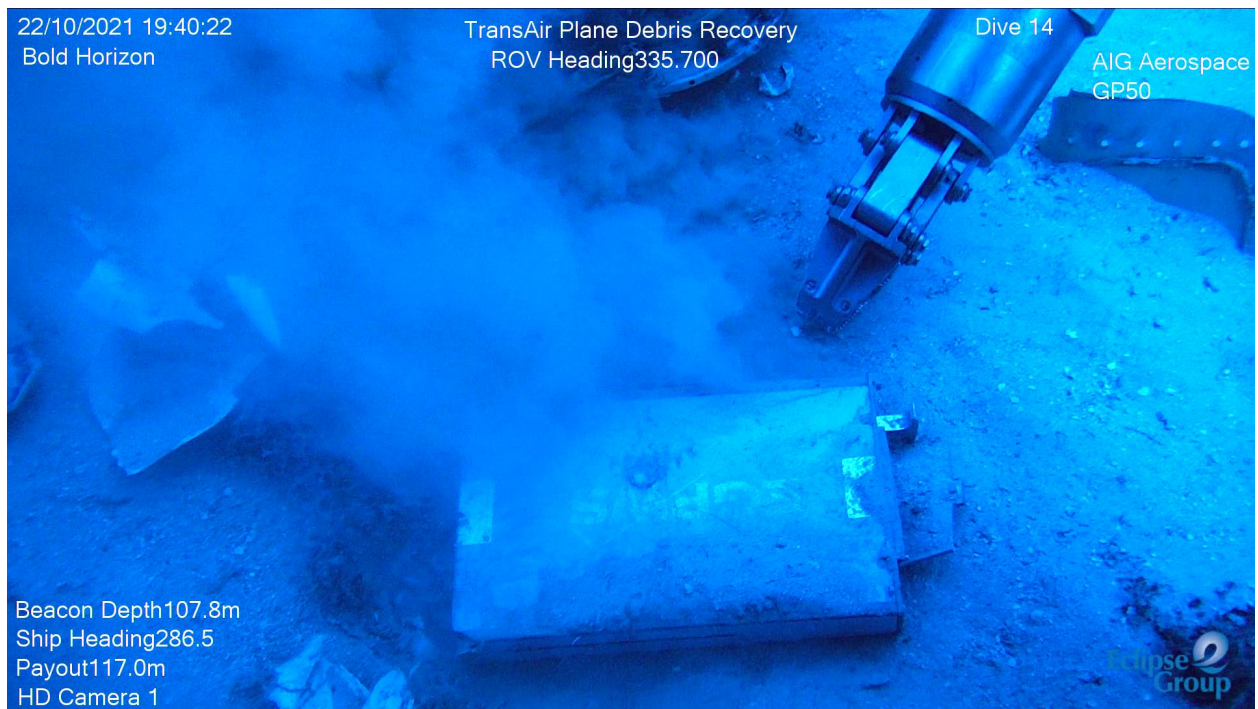


Figure 24. EGPWS computer on sea floor



Figure 25. Recovered APU



Figure 26. Recovered Keel Beam

The recovery of small items continued October 23-25. Additional identified items included engine bleed air lines, several pieces of forward fuselage structure, an engine mount, and an engine bypass duct. The first basket was recovered to the deck of the BH on October 23 (Figure 27), unloaded, and sent back down. The EGPWS computer was rinsed with fresh water and placed in a cooler of distilled water for eventual transport to the NTSB lab. The evening of October 23, the BH had glancing contact with a raised area of sea floor while loitering off Honolulu harbor. Initial inspection revealed no damage or water intrusion into the hull. The evening of October 24 the BH transited to Kalealoa and tied up alongside the DBSV that was still waiting out the weather. The thrust reversers, APU, NLG, baskets, and debris on the BH deck were offloaded onto the barge for transfer to the pier before the BH transited back to the site. The ROV developed an electrical problem with the thrusters while recovering wreckage the morning of October 25. The ROV was recovered, repaired, and redeployed. Another basket of debris was recovered to the deck of the BH that included the Electronic and Equipment (EE) bay door, a segment of the forward lower cargo door, a fuselage skin panel with a static port, and the lower forward access door. The ROV was recovered about 1630 after a hydraulic leak developed on the left manipulator. The BH transited to the port of Honolulu the evening of October 25 where it stayed overnight. On October 26 the compressor was replaced on the deck, garbage was offloaded, and more groceries and water were taken aboard. EGI had a diver inspection of the hull performed that revealed damage to the hull coating layers but no denting or penetration from the bottom contact. The

State of Hawaii was notified of the bottom contact. The sealed EGPWS cooler was transferred to the IIC for transport to Washington, DC.



Figure 27. Debris basket with airplane wreckage

The wind and sea state forecasts were improving and looked to be favorable for recovering the aft fuselage, so the DBSV departed Kalealoa for the site about 0600 on October 27. Anchors were set and the DBSV was on station about 1300 so the BH departed Honolulu for the site. The ROV was deployed and continued picking up small debris and placing it in the baskets after surveying the new barge anchor positions. The crew on the barge and the BH prepared the wire rope wing rigging and established the procedures for the barge to deliver the heavy rigging to the sea floor with the winch. October 28 was spent with the ROV rigging each of the wings. A long wire rope was laid on the sea floor at the wing tip and drug inboard to the wing root area using the winch and ROV. The wing wire rope loops and the tail nylon strap loops were connected to a master link in a basket configuration. The ROV had to be recovered near midday to repair a hydraulic hose that was cut by the wreckage. The aft fuselage rigging was complete by about 1830. The ROV was deployed the morning of October 29 for a final check of all the rigging and the DBSV moved into position over the wreckage. The winch cable was lowered to the sea floor and the master link was attached to the winch cable. Tension on the cable was slowly applied while the ROV watched and recorded video and snap shots. The winch recorded a maximum load of about 63 kips which set the wing cables into the flap structure and

partially lifted the airplane (Figure 28). The aft fuselage was observed rocking on the sea floor while the horizontal stabilizer leading edge was moving up and down through its range of travel. The afternoon sea state was not conducive for a lift, so the tension was taken off the winch cable overnight. The ROV continued picking up smaller parts to include portions of engine cowling, sections of the lower forward fuselage, and numerous other smaller parts. LSR made arrangements for the OSRV Century to be on site the following morning to contain any fuel spills during the aft fuselage lift.



Figure 28. Aft fuselage rigging under tension

October 30 dawned with calm seas and very light winds that were favorable for a lift. The ROV was deployed to install a tag line on the outboard end of the right wing to prevent rotation of the airplane as it was lifted. Tension was applied on the winch line starting about 0830 and the aft fuselage came off the bottom about 5 minutes later with a load of about 80 kips recorded. The airplane attitude as rigged was tail low. The aft fuselage was slowly lifted through the water column until the master link was at the surface. The largest load recorded in the water was about 170 kips during a heave with a steady load of about 70 kips. The ROV observed the lift from the bottom to the surface before being recovered. The barge crane hook was then connected to a short stinger that was previously installed on the master link for the lift out of the water and onto the barge. The winch cable remained attached to the master link during the lift. The aft fuselage broke the surface about 1000 and was slowly lifted through the air-water interface (Figure 29). The crane would lift until the load meter showed about 95 kips before stopping to let water drain to about 75 kips and then repeated. Once the forward end of the section and the wing leading edge

were above the barge height, the section was moved onto the barge for support while water drained. The aft fuselage lift was completed about 1030 (Figure 30). The maximum load recorded on the crane was about 130 kips during a heave while the airplane was still transitioning through the interface. The maximum load recorded when the airplane was fully out of the water was about 110 kips. The OSRV Century was on site during the entire lift and no evidence of a fuel or oil sheen on the water was observed.



Figure 29. Aft fuselage section at water surface



Figure 30. Aft fuselage section on barge

Once the aft fuselage was lashed to the barge, the NTSB investigators were transferred to the tug Shirley C for the transit to Kalealoa Harbor where the wreckage was going to be offloaded and stored. The DBSV and Shirley C tied up alongside pier 7 at Kalealoa Harbor about 1700 on October 30. Once tied up, PENCO personnel boarded the barge to offload any fuel and water remaining in the wing tanks. They reported that the left wing tank was about $\frac{3}{4}$ full of water with no fuel present, the right wing had about 1-2 inches of water at the wing root with no fuel evident, and the center tank had about 6-8 inches of water with about $\frac{1}{2}$ inch of fuel on the surface. All the tanks were sucked dry totaling 1336 gallons. The aft fuselage and all the smaller wreckage were transferred to the pier by the barge crane on October 31 (Figure 31). The rigging was removed from both the forward and aft sections and returned to the DBSV. The two engines and the #2 inlet case were crated after examination by the powerplants group at the AMC facility. The crates were transferred to the DBSV for the return trip to California where the Powerplants group took custody. The BH concluded operations on October 31 after performing a post operation survey of the wreckage area and anchor locations. The BH offloaded the additional wreckage they recovered at AMC on November 1, and it was transferred to Kalealoa.



Figure 31. Aft fuselage transfer to pier

4.5 Flight Recorder Recovery and Shipment

NTSB investigators were able to access the flight recorders once the DBSV was tied up at the harbor. The flight data recorder (FDR) located in the aft galley ceiling was accessed through the right aft entry door. The FDR remained installed in the rack and was undamaged. The cockpit voice recorder (CVR) located in the lower cargo compartment could not be accessed through the aft cargo door due to the fuselage damage. Investigators cut a hole through the right lower fuselage skin to access the CVR. The CVR remained installed in the rack though the rack was partially separated from the fuselage. The CVR was undamaged. The FDR and CVR were placed in a cooler of distilled water for shipment to the NTSB lab in Washington, DC (Figure 32). The cooler with both recorders and water was too heavy for shipment so a second cooler was purchased, and the recorders were separated with each cooler filled with distilled water.

The NTSB Special Operations group coordinated the shipment of the flight recorders with United Airlines Cargo, TSA, and FBI. Since there were no nonstop flights to Washington, DC at the time, a connecting flight was required. The recorders were shipped on United 218 from HNL to ORD on November 2 and connected to United 2677 from ORD to IAD on November 3. The FBI met the inbound airplane at

ORD and transferred the recorders to the outbound flight. The NTSB met the inbound flight at IAD and retrieved the two coolers with the recorders.



Figure 32. Flight recorders from accident airplane

5.0 Wreckage Storage

The arrangements for the offloading and the storage of the wreckage were accomplished by LSR. Available space for storage was located at the port at Kalealoa Harbor. LSR contracted with AMC to provide an unused area about 200 feet by 130 feet at the northeast end of the port terminal. The location was secured in accordance with port security regulations with entry only allowed for port employees holding a Transportation Worker Identification Credential. The State of Hawaii required that plastic sheeting be placed on the ground underneath the wreckage to contain any leaking fuel, oil, or hydraulic fluid. The forward fuselage was offloaded at the port on October 22 by the barge crane to a waiting flatbed. The flatbed was moved to the storage location and the wreckage was lifted to its resting location upright with the nose pointing northeast. The aft fuselage section was offloaded at the port on October 31 using the same method and was placed about 50 feet aft of the forward fuselage oriented in the same direction. The plastic covered area between the fuselage sections and aft of the tail was used to store the other recovered wreckage (Figure 33). The Structures Group examined the wreckage at the storage location as documented in the Structures Group Chair's Factual Report.



Figure 33. Airplane wreckage at storage location

6.0 Wreckage Disposal

The wreckage was released and disposed prior to the completion of the investigation due to the high cost of storage being incurred by AIG. The group chair and LSR returned to Hawaii December 5 to accomplish the disposal. The crew seats were removed, crated, and shipped to the NTSB Materials Lab for further testing prior to disposal. LSR arranged for a dumpster and the equipment required for disposal and contracted with local companies for transport of the wreckage to a scrap facility for destruction. The 4 cargo cans were removed from the aft fuselage and weighed. Cargo can SAA 4052 TXHA weighed 5260 lb with a tare of 478 lb, SAA 3026 TXHA weighed 5300 lb with a tare of 509 lb, SAA 4076 TXHA weighed 4220 lb with a tare of 478 lb, and SAA 3006 TXHA weighed 5630 lb with a tare of 509 lb. Much of the cargo was still waterlogged. The cargo was removed from the cans and put in the dumpster for disposal. The wreckage was dismantled into smaller pieces with an excavator equipped with a hydraulic pincher head. The wings were cut from the fuselage at the wing root (Figure 34). The horizontal stabilizers were cut from the fuselage near their attach points (Figure 35) and the vertical stabilizer was separated in pieces (Figure 36). All the airplane wreckage was destroyed by running it through a shredder. The storage site was then cleaned and returned to AMC and the port as received. The wreckage disposal and cleanup were completed on December 10, 2021.



Figure 34. Right wing being cut from the fuselage



Figure 35. Right horizontal stabilizer being cut from the fuselage



Figure 36. Vertical stabilizer being removed from the fuselage

7.0 Post-Operation Reporting

EGI provided a project final report to the NTSB and AIG Insurance on February 8, 2022. See Attachment 8 for a copy of the report. Additional post operation reports were supplied to NOAA and NMFS as described earlier.

The costs for the search and recovery of the accident airplane were borne by the airline's insurance company AIG Insurance. The NTSB worked extensively with AIG and LSR throughout the process. The total cost was about \$4.5 million with the recovery making up more than half of the total. The other items in descending order were the environmental response by PENCO, storage and shoreside logistics by AMC, project management and disposal by LSR, and the search by SEI.

E. LIST OF ATTACHMENTS

1. Attachment 1 - SEI Search Report
2. Attachment 2 - NTSB Recovery RFQ
3. Attachment 3 - EGI Project Plan
4. Attachment 4 - UCSG Environmental Statement
5. Attachment 5 - DBSV Stability Letter
6. Attachment 6 - ESA Report
7. Attachment 7 - EFH Report
8. Attachment 8 - EGI Final Report

Submitted by:

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