IFA2: The Excavation and Recovery of a MKII Fairey Barracuda from the Solent, Hampshire

Marine archaeological technical report

Ref: 202920.13
January 2020

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Report Information

Document title	IFA2: The Excavation and Recovery of a MKII Fairey Barracuda from the Solent, Hampshire.
Document subtitle	Marine archaeological technical report
Document reference	202920.13
Client name	National Grid IFA 2 Limited
Address	IFA2, Room 39, Fareham Innovation Centre Meteor Way, Fareham, PO13 9FU
Site location	SU 55129 01329
County	Hampshire
National grid reference	SU 55129 01329
Statutory designations	
Planning authority	Marine Management Organisation/Historic England
Planning reference	Marine Licence L/2017/00021/2
Licence under *the Protection of Military Remains* Act 1986	Licence Number 1878
Museum name	Fleet Air Arm Museum
Museum accession code	
WA project name	IFA2 Retained Archaeologist
WA project code(s)	116350, 202920, 202921, 202922
Date(s) of fieldwork	22 May 2019 -- 30 June 2019
Fieldwork directed by	
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Quality Assurance

Version & issue date		Status	Author	Approved by
V1	04.12.2019	Draft	ABB/BS	AEM
V2	19.12.2019	Final	ABB/BS	AEM
V3	30.01.2020	Final inc HE comments	ABB/BS	AEM

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Summary

This document is a report on the archaeological recording and recovery of a Mk. II Fairey Barracuda (6A_pUXO_003), located on the HVAC cable corridor of the IFA2: Interconnexion France-Angleterre cable route. The aircraft crash site was situated directly within the proposed cable corridor for the HVAC route and therefore it constituted a significant constraint for the effective delivery of the IFA2 project. The location was such that there was no possibility to microsite the cables around it, and therefore it had to be removed for the project to continue. A licence was obtained from the MOD under the *Protection of Military Remains Act* 1986, and the methodology was approved by Historic England, with the works being covered by IFA2 existing MMO licences. The work was carried out under the supervision of the Retained Archaeologist, Wessex Archaeology, by James Fisher Marine Services.

The diving operations on the site commenced on 22 May 2019 with mobilisation in Poole and the set up and calibration of the ROV3D camera system prior to the dive vessel and crane barge moving to the Solent and moored overnight on the Isle of Wight.

In total there were 38 days of operations with four weather days. A total of 82 dives occurred, including seven dives for photogrammetry. Of the photogrammetry dives only three were successful due to poor visibility, or the turbidity of the water. The final days diving, completing the post-recovery UXO survey occurred on the 26 June 2019.

Despite adverse visibility, and a significant amount of overburden, the extant remains of the aircraft were successfully recovered and delivered to the Fleet Air Arm Museum for conservation, as part of an ongoing project to rebuild an example of a Fairey Barracuda. Approximately 60% of the aircraft was recovered. Diving operations, including mobilisation, occurred between the 22 May and 26 June 2019 under Marine licence L/2017/00021/2 and licence number 1878, under the *Protection of Military Remains Act,* 1986. Four days were lost to weather.

The project demonstrates the successful embedding of archaeologists into commercial diving teams both as divers, and on the vessel recording finds, advising, and providing input into the recovery operation.

During the recovery stage it was hoped that the preservation of the cockpit would be such that the positions of aircraft controls could be recorded in order to confirm the dry and brief description in the historic record of the events leading to the crash. Unfortunately, the degree of damage and loss of many of these elements prevented this from occurring. However, the position of the landing gear, with one wheel up and the other down, the relatively undamaged state of the airframe, and its proximity to the end of the runway at former RNAS Lee-on-Solent (HMS Daedalus) all confirm that the aircraft was in the process of retracting it undercarriage, a process that put additional demands on the engine, leading to a potential loss of power. This relatively undamaged state, with many components showing no crash damage suggest that the aircraft was therefore travelling at very low speed and had a shallow approach and impact, again implying it only just cleared the end of the runway and beach before impact.

Based on the depth of water and the low speed of the impact it is very likely that the aircraft settled on the seabed laying canted on its port wing and half-raised starboard undercarriage, with its tail above the water. The dynamic nature of the Solent tides and the effects of current and wave action probably broke this off shortly after the crash, though it is also possible that it came away in the crash. Research has shown it was not unusual for a ditched aircraft to break up during the sinking process with the loss of the tail and wings being sometimes noted (Wessex Archaeology, 2008). Fragments of the elevator and the structure of tail were found buried beneath the aircraft,

suggesting that this material was moved by fishing activity from the location where the tailwheel (Plate 27) was recovered. The tailwheel, with its yoke and strut, when located and recovered, was still close to its correct location in the airframe, but completely separated, with no apparent aircraft structure around it.

The starboard wing was found to be separated from the wing stub, and though there is documentary evidence showing that the locking bolts for the folding wing was a potential weak point in the earlier aircraft, the evidence here points to the wing being pulled away by the action of scallop dredging or trawling activity, rather than crash damage. It is not clear whether the orientation of the aircraft as recovered was due to it being moved before it was fully settled into the seabed.

Due to the relatively low weight of aircraft, and the compacted nature of the underlying clay layer in the area, along with its marking as an obstruction on Admiralty charts, it appears that the aircraft was proud of the seabed for much of the time since its loss. It seems unlikely based on the fishing gear and dive weight on the site that it was not known to the local fishing or diving community. The varying size of the different species of marine fouling organisms, including barnacles, oysters, and different worm species, suggest that areas of the aircraft have been covered and uncovered over time, particularly on the starboard side of the aircraft where it was tipped down onto the seabed, and which at the time of recovery covered with up to 500 mm of sediment.

The final identification of the aircraft has not yet been definitively confirmed. Since its recovery there is a strong suggestion that the aircraft is LS473, a Barracuda Mk II coded ‘A’ of 817 Sqn that failed to obtain climbing speed on take-off on 6 January 1944 whilst being flown by Sub Lieutenant (Air) Sandes RNVR (**Plate 69** and **Plate 70**). No other aircrew were present on that flight and there were no casualties. The identification is based on several indicators including the internal primer paint scheme of the aircraft, the torpedo crutch identified, the identity tags and modification plates found on the tube work of the cockpit and engine bearers, the quality control stamps on several parts recovered; and most significantly the engine plate.

In assessing the material recovered the remains of the torpedo crutch (Plate 98) with part of its torpedo retaining cable that were recovered from the site suggest an aircraft that was carrying out operations with a torpedo carried. Comparing the known information of the two candidate aircraft, LS473 is recorded as having been carrying a torpedo at the time of its loss, though none was found. It is presumed it was jettisoned as soon as the pilot realised that the aircraft was not going to reach or maintain a flying speed- ditching on water with a torpedo underneath the aircraft was not advised. It is thought unlikely that the torpedo retaining cable was left on the aircraft if they were not carrying a torpedo, as the cable was only retained by a bungee cord to prevent it damaging the aircraft once the torpedo was dropped, and its flailing about had been shown to cause significant damage to aircraft before the bungee system was implemented.

Different manufactures used different forms of tags and plates to identify the different sub-assemblies of an aircraft, and the plans those sections were built off. Fairey Aviation used a system of brass hook and eye clips or bands on the airframe tubes (Plate 99), whereas Boulton and Paul used a system of a plain metal band with a folded over join, and stamped parts with their manufactures code (Plate 100) as shown on this pipe clip from the Barracuda. The tags so far recovered appear to be of the Fairey pattern, with only a few exceptions. Finally, and though considered to be less conclusive in identifying a manufacturer, as it is presumed that parts in a wartime supply chain could be moved between manufactures, is the Fairey quality control stamped small parts recovered from the aircraft.

Research following the recovery by Wessex Archaeology and the FAAM into the recovered engine plate (Plate 22) received a response from the Rolls Royce Heritage Centre that appears to confirm

the aircraft as LS473. They report that engine 71231 was a Merlin 32 built 8 October 1943 and despatched to Fairey at Stockport on 13 October 1943. It was one of a batch of 280 Merlin 32 built at Derby as part of Air Ministry Order C/ENG/426/C.28(a) and delivered between 11 September 1943 and 17 December 1943. The 281259 number is the Air Ministry identification for the engine. Using this information, and the fact that LS473 came off the production line in November 1943, along with the other pieces of evidence the case becomes stronger for it to be an aircraft manufactured at Fairy, rather than one of the other aircraft manufactures producing the Barracuda. Observations from the team at FAAM during the work on the recovered aircraft have also shown some additional indicators of an aircraft with a short life (Dave Morris, Pers. Comms.). Though both candidate aircraft had short lives the dates for the manufacture of the engine point to the latter aircraft. LS473 was factory released on the 24 November 1943, and lost on the 6 January 1944 (Plate 69), giving the aircraft a life of 42 days. Additionally, amongst the recovered material from the Solent was the aircraft's arrestor hook (Plate 26) showing no signs of wear or use, as might be expected on a newly delivered aircraft that has had limited use. As BV739 was built in July 1943, and lost at the end of September 1943, giving it a life of only 77 days, it is highly unlikely to have been fitted with engine number 71231.

Within the wider area of the crash, three anomalies (6a_pUXO_033, 042 and 056) on the boulder clearance investigations was identified as RATOGs (Rocket Assisted Take Off Gear). These were used on a number of FAA aircraft to give extra power on take-off (Plate 101 and Plate 102) particularly on short aircraft carrier decks when the outgoing aircraft would be heavily laden with fuel and munitions. They ensured that the aircraft would reach take off speed, when prevailing weather conditions were poor or there was a lack of catapult or other accelerator gear available. The label on the TAG cockpit about Assisted Take-off (Plate 63) is referring to this process. They were in use for a short period (1944-1995), as the development of carrier based jet aircraft overcame the issue. Each RATOG was made up of twin 5' rocket motors (based on the standard No.5 Mark I rocket tube with a cordite filling and fired by electrical fuses), each 1.14 m long and 0.14 m in diameter, with a connecting bracket that fitted on to the outer fuselage of the Barracuda just above the trailing edge of the wing (Plate 102) on both sides of the fuselage. These would burn for approximately four seconds and provide a mean thrust of 1,150 lbs. The three recovered all have the layout of fittings suggesting they were used on Fairey models- either the Barracuda or the Firefly. These units would be jettisoned from the aircraft following take off and so the discovery of some close to the end of the runway at RNAS Lee-on-Solent, where aircrew would have been trained to use them, is not unexpected.

One of the three units (6a_pUXO_042) was retained for conservation following certification as free from explosives while the other two were placed within the IFA2 project Archaeological Exclusion Zone.

In its recovery, becoming an object of historical significance, rather than just a crashed aeroplane, the Barracuda's value to the wider community changes from that of a lost military aircraft to that of historic item that can help researchers understand the past, filling in the gaps in our knowledge, linking the documentary record to personal histories of events.

Acknowledgements

This project would not have occurred without the support of a wide range of people and individuals. Special thanks go to Jake Stevens and the team at the National Grid – IFA2 Project. During the diving and recovery operation Keith Forward and the James Fisher Marine Services diving team, and Jenkins Marine and the crews of the *Stour* and *Doreen Dorward* made the archaeological work possible and welcomed our team onboard. Also, thanks are due to 6Alpha, the Queens Harbour Master at Portsmouth, Haslar Marina, EORCA, Cowes Harbour Master, Fairline Yachts of Hythe, Williams Shipping of Southampton, Gosport Boat Yard, and ROV3D for their camera system.

This project also greatly benefited from the advice and guidance of the Curator of the Fleet Air Arm Museum Dave Morris, the museums restoration manager Will Gibbs and volunteer engineer Tony Jupp, all of whom gave their time and advice freely.

The archaeological fieldwork was carried out by Alistair Byford-Bates, Ben Saunders, Graham Scott, and Mike Pacey; with Graham Scott and Mike Pacey carrying out the archaeological diving. Alistair Byford-Bates and Ben Saunders compiled this report, and the illustrations were produced by Will Foster, Ken Lymer and Kitty Foster. Geomatics support was provided by Roberta Marziani, who also completed the photogrammetric modelling of the wreck. The project was managed for Wessex Archaeology by Euan McNeill. Overall quality assurance was provided by Dan Atkinson.

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Marine archaeological technical report

1 INTRODUCTION

1.1 Background

1.1.1 This document is a report on the archaeological recording and recovery of a Mk. II Fairey Barracuda (6A_pUXO_003), located on the HVAC cable corridor of the IFA2: Interconnexion France-Angleterre cable route, constituting six subsea HVAC cables between the landfall at Monks Hill Beach and landfall at Chilling. The aircraft crash site was situated directly within the proposed cable corridor for the HVAC route (**Figure 1**) and therefore it constituted a significant constraint for the effective delivery of the IFA2 project. The location is such that there was no possibility to microsite the cables around it, and therefore it had to be removed for the project to continue.

1.1.2 The work was carried out under the supervision of the Retained Archaeologist, Wessex Archaeology under the conditions set out under Marine Management Organisation (MMO) Marine licence L/2017/00021/2 and licence number 1878, issued by the Ministry of Defence (MOD) under the *Protection of Military Remains Act,* 1986, as laid out in the Written Scheme of Investigation (Wessex Archaeology 2017a) and Method Statement (Wessex Archaeology 2019d). This followed considerable work on the site (as detailed in the following section and the bibliography), including an archaeological pre-disturbance survey.

1.2 Previous work on IFA2

1.2.1 A number of previous heritage method statements have been prepared for this project:

- heritage method statement for HVDC & HVAC Nearshore Survey: UXO Survey, Geotechnical Survey and Protocol for Archaeological Discoveries (the Protocol) (Wessex Archaeology 2017b), which provided details about the incorporation of archaeological assessment into the UXO and geotechnical surveys and outlined the requirements for the Protocol. It was followed by:
    - heritage method statement covering the diving investigation of the HDD TI targets (Wessex Archaeology 2018a);
    - heritage method statement covering the diving investigation of the HVAC targets (Wessex Archaeology 2018b); and
    - heritage method statement covering the recording and recovery of the aircraft (Wessex Archaeology 2019d).
- heritage method statement for Offshore Works (Wessex Archaeology 2017c);

1.2.2 The results of the diving investigation for the HVAC targets provided the basis for the Nearshore Boulder Clearance: HVAC Target Recovery and Investigation heritage method statement (Wessex Archaeology 2018c), which concerned the recovery of timber material,

rocket assisted take-off gear (RATOG), and other material of potential archaeological interest.

1.2.3 The results of the HVAC diving investigation and recovery of targets of archaeological potential were compiled in a report (Wessex Archaeology 2019a) and noted that the aircraft material (6A_pUXO_003) was left *in situ* and that it would be assessed further during a bespoke archaeological survey.

1.3 Previous Work on the Fairey Barracuda Site

1.3.1 During the initial archaeological assessment of geophysical survey data, the site was not identified as an aircraft (Headland Archaeology 2015), however, this is not unusual, as it is difficult to identify aircraft material on the seabed through geophysical survey data alone.

1.3.2 The site was selected as a target for the pre-development UXO survey (**Figure 2**), The first dive on the site during the initial diver survey, undertaken on 19 July 2018 by James Fisher Marine Services, described the site as metal debris covering an area measuring 10 m x 2 m x 1.5 m, with an approximate weight of 15,000 kg. Due to its size and archaeological potential, it was flagged for further investigation.

1.3.3 During a boulder clearance dive carried out by Briggs Marine on 23 September 2018, it was reported that the target appeared to be a previously unknown aircraft wreck and an Archaeological Exclusion Zone (AEZ) was put in place.

1.3.4 A follow up survey by Briggs Marine and the Retained Archaeologist occurred on 17 October 2018. The video data obtained during the initial boulder clearance dive and subsequent diver survey used was to assess character, date and importance, and to facilitate the initial identification to inform the application process for applying for an excavation licence under the *Protection of Military Remains Act* 1986. The site has high archaeological potential. The assessment of the diver video with technical advice from the Fleet Air Arm Museum (FAAM) indicated that the site consisted of the extant remains of a Fairey Barracuda. Operated by the Fleet Air Arm between 1943-55, currently there are no complete examples in existence.

1.3.5 The site has been subject to some disturbance due to its depth and location. The site lies in approximately 8 m of water and 500 m offshore. It is outside the surf zone. However, it appeared to remain substantially intact.

1.3.6 The aircraft was identified as a high-winged single-engine propeller-driven aircraft of aluminium construction. The diver survey recorded the visible length as 9.93 metres, with the tail wheel located approximately 2 m beyond this. The outlines of the visible remains of the wings measured approximately 4 m and 3.2 m. The orientation of the site was west to east, and parallel to the shore. The lack of any visible signs of the forward under carriage and the oil radiator on the engine suggested that the aircraft was laying on its belly.

1.3.7 In discussions with Historic England it was agreed that the preferred option for managing the discovery and it's constraint on the HVAC cable routes was to understand the significance of such a heritage asset. Therefore a method statement was produced that outlined a strategy of evaluation to ensure (where possible) that the horizontal and vertical extent of the area containing archaeological remains would be investigated, and adequate samples taken to characterise the archaeological remains present in sufficient detail, as aligned with Historic England 2016, *Preserving archaeological remains: Decision-taking for sites under development*.

1.3.8 A heritage method statement was produced for an archaeological pre-disturbance survey of the site (Wessex Archaeology 2019b). The aim of the survey was to carry out a Level 2b survey (**Appendix 2**) of the site to obtain data that would assist in identifying the specific aircraft and planning its survey and recovery.

1.3.9 The pre-disturbance diving survey was undertaken from 25 February to 1 March 2019 (Wessex Archaeology 2019c). Material on the seabed included the extant remains of the cockpit, starboard and port wings, and the remains of the propeller, the blades having broken off or been removed. There was no evidence of the tail structure of the aircraft. The survey at this point appeared to confirm, with advice from the FAAM, that the aircraft was a Mk II Fairey Barracuda, number BV739, which was lost 29 September 1943 when it lost power on take-off and ditched with no casualties.

1.4 Basis for Excavation

1.4.1 The basis for this excavation was framed around the need to align with recognised best practice and guidance and delivering UK Government Policy. The work supported Objective 8 of the Government's *South Offshore Marine Plan* (2018): To identify and conserve heritage assets that are significant to the historic environment of the south marine plan areas. This objective sets out that proposals that may harm elements contributing to the significance of heritage assets must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate compromise or harm. As outlined above, it is not possible to avoid or minimise harm to the site, and therefore the heritage method statement set out recommendations for further mitigation through additional assessment and ultimately recovery. This ensured that the development would not have an adverse impact on this asset.

1.4.2 The identification of the aircraft as a Fairey Barracuda and therefore an extinct aircraft type, which is part of an active project by the FAAM to restore an aircraft of this type also contributed to the excavation and recovery outcome. Historic England was not convinced of the initial plan to move and rebury the aircraft with the preferred option being recovery and either recording and disposal, or deposition with a heritage body, who could secure its future in some way. The FAAM was interested in being involved from the start of the project planning and receiving initially specific parts of the recovered aircraft, and then receiving all of the recovered material so helping to mitigate the concerns expressed over the aircraft's future.

1.5 Licences

1.5.1 Work took place under the existing MMO Licence L/2017/00021/2, and the Receiver of Wreck was informed before and after the recovery of finds.

1.5.2 A licence under the *Protection of Military Remains Act* 1986, No: 1878, was granted to Alistair Byford-Bates, Wessex Archaeology, for the excavation and recovery of the aircraft subject to the terms and *caveats* set out in said licence (**Appendix 1**) and the guidance notes *Crashed Military Aircraft of Historic Interest, Licencing of Excavations in the UK. Notes for Guidance of Recovery Groups,* 2011 [Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/28264/POMRACTBOOKLET_Jun11.pdf. Accessed 28.01.2019] (**Appendix 1**).

1.6 Aim and Objectives

1.6.1 The aim was to carry out a Level 4 excavation and removal (as per the description in **Appendix 2**) of the site, to produce a record sufficient to enable analytical reconstruction

and/or reinterpretation of the site, its components and its matrix. The scope was to produce a record of site elements in the course of dismantling and excavation.

1.6.2 The use of specialist archaeological divers, with further advice from FAAM, ensured that the maximum relevant data was obtained. It also ensured that diver observation and interpretation of the remains was as reliable as possible. This was aided by the highly experienced diving team from James Fisher Marine Services.

Excavation and recovery objectives:

- produce a pre- and post-excavation underwater orthographic photogrammetry model of the site;
- recover and record the aircraft material from the site with all retained material to be transferred to the FAAM Yeovilton, part of the National Museum of the Royal Navy (NMRN), to aid their efforts in the reconstruction of a Fairey Barracuda;
- enable detailed recording of aircraft material on-board to enable material to be retained to be identified and separated from items to go into the AEZ; and
- confirm the specific identity of the aircraft if possible.

2 METHODOLOGY

2.1 Introduction

2.1.1 The location of the site is shallow and the previous diver surveys indicated that natural light levels could be good. Underwater visibility was variable, and was subject to wide variations, dependant on prevailing weather conditions and the state of the tide. The current runs sufficiently swiftly that there were occasions were the localised speed of flow stopped diving operations.

2.1.2 The diver surveys confirmed that the aircraft's original lift and strop points had been lost or were no longer sufficient to support lifting. It was also assumed that 76 years of corrosion and other impacts had significantly weakened the remaining structure.

2.1.3 It was viewed as unlikely that it would be possible to recover the aircraft in one piece. Therefore, it was planned that the aircraft would be recovered in sections, preserving the material most relevant to the research objectives of FAAM. The starboard wing was detached at its pivot point, which facilitated its recovery. The engine was separated from the rest of the airframe forward of the firewall, preserving the engine mounting and other features that would assist with answering research questions, or act as replacement or templates for parts that are required as part of the restoration project currently being undertaken by FAAM.

2.1.4 The following methodologies were used subject to minor adaptions based on constraints identified in the field.

2.2 Data Audit

2.2.1 Prior to the mobilisation of the dive team, information on the background, construction and layout of the aircraft was obtained from FAAM, the National Archive, and other print and online sources, to furnish the team with background information, and images, to enable the identification of components and other key parts of the aircraft during the excavation and recovery. A full list of these can be found in the bibliography.

2.2.2 This primary and secondary source data was used to inform the BULSI (Build; Use; Loss; Survival; Investigation) characterisation (**see section 4.3**) and the general interpretation of the site in line with Historic England's guidance for the significance of heritage assets base on the heritage assets archaeological and historic value (Historic England, 2017).

2.3 Geophysical Survey

2.3.1 No additional geophysical survey work was carried out during the diving operations.

2.4 Diver Methodology

2.4.1 The following provides an overview of the diving methodologies:

- A surface supplied dive team operated under the *Diving at Work,* 1997 Inland and Inshore ACOP conducted operations, under the auspices and supervision of the lifting contractor;

- the archaeologist divers operated from a dedicated dive support vessel, integrated into the lifting contractors engineering dive team*;*

- one archaeologist diver and one vessel-based surface support archaeologist was available on each shift;
- prior to the dives, the diver was able to review the results of the previous dives on the site to fully familiarise themselves with the location;
- an observer/advisor from the FAAM was present on site as when available. Their advice on cutting locations, information of locations of possible UXO and in-depth knowledge of the layout and design of the Barracuda was invaluable;
- the diving support/recovery vessel was anchored as close as possible, but not directly over the site. Care was to be taken to ensure that anchors, cable or spud legs did not foul the site;
- a USBL system was used to track the divers, in parallel to hardwire voice communication, and to link recovered finds from the airlift operation to locations on the aircraft and the surrounding area;
- the diver descended to the seabed using a shot and directed to the site by the supervisor,
- diver video was recorded using helmet cameras, and video viewed live by the supervisor and any expert advisors on-board, with the dive supervisor providing instructions to the diver via hard-wired comms. Where possible an additional HD camera was used alongside the helmet mounted camera;
- on the initial dives, the diver visually inspected the site. This was done with the tide running, to preserve the visibility during recording. Photographs and/or video was captured to produce pre- and post-excavation photogrammetry models of the site.
- The initial attempts to record the site using ROV3D stereoscopic camera equipment and software proved to be ineffective due to the combination of adverse subsea conditions (plankton bloom, strong tidal movement and white balance washout from the shallow water) and so the recording methodology switched to standard photogrammetry completed by archaeologist divers or commercial divers under archaeologist instruction. The photogrammetry was completed using GoPro HERO5 or GoPro HERO6 cameras with an INON UFL-G140 SD semi-fisheye lens, giving a maximum angle of view of 140 degrees;
- the depth, and extent of burial, was further defined, along with the structural integrity of the buried material; the sediment within the aircraft airframe was sampled and additional water samples were recovered for testing to better understand the environmental conditions on site;
- the divers under the direction of the diving supervisor carried out hydrainer pump and water jet operations to excavate the overburden from the site, and the interior of the aircraft, the overburden was recovered to surface and passed through a 50 mm grating to recover small items;
- once the sediment around the aircraft was cleared from the site, photographs and/or video was captured to produce, in addition to working photographs, a post-excavation photogrammetry, and orthographic model of the site. These were also used to further inform the lifting methodology;

- small finds were given UIDs and tagged whilst *in situ,* where practical, or on lifting to the surface; and

- all material was wet stored prior to transfer to FAAM.

2.5 Lifting Methodology

2.5.1 The following provides a general overview of the lifting methodology. The heritage method statement was provided to the diving/recovery contractors as part of the tender process. The lifting methodology was modified based on an assessment of the state of the aircraft as it was excavated on the seabed:

- first, the water jet and hydrainer pump removed the over burden and the contents of the airframe, depositing material onto the deck of the support vessel. This was sieved to recover small fragments and any other finds;

- the aircraft was recovered using a barge mounted crane with lifting strops and spreader beams. It was recovered in the sections it had already broken up into, or larger pieces were cut into manageable sections with a reciprocal saw and disc cutter;

- following recovery, a search of the site was carried out to identify any remaining wreck material or artefacts that had become detached during the lifting operation; and

- recovery of material was undertaken with due care and stored in a designated area on-board. The material was kept wet at all times and covered.

2.5.2 The initial lift of the largely intact starboard Youngman flap demonstrated that this method was sufficient for well-preserved structurally stable sections of the plane. Subsequent lifts proved unpredictable with the remainder of the damaged starboard wing fragmenting on lifting, leading to recovery of the section using the lifting basket. The lift of the entire engine block following the cutting of the engine bearers under instruction from FAAM engineers was completed successfully, and similarly the rear section of the fuselage was recovered largely intact, although the loss of the upper skin and frames due to scallop dredging has seriously weakened the structure of this part. Following all of these lifts, diver searches were completed in the excavated area, with loose artefacts being recovered either by lifting basket or recovery line.

2.5.3 Due to time constraints based on the arrival of the cable laying barge, weather delays and the overburden on the site, a modified method using strops rather than the lifting basket was attempted with the central fuselage and port wing by the diving contractor. Unfortunately, this lift was unsuccessful with the section proving structurally weak and fragmenting as it broke surface. The parts of section in question was subsequently lifted using the lifting basket, with the divers recovering additional loose debris to the surface either via the basket or the recovery line.

2.5.4 Concerns over potential consequences of the failure of this lift have subsequently been allayed by the FAAM team while engaged in disassembling and conserving these parts of the aircraft. Despite the loss of full structural intactness of the fuselage and port wing, significant structural tubing sections have been recovered, cleaned and disassembled, and have been found to be fully reusable, with little or no additional intervention.

2.6 On-board Survey and Stabilisation Methodology

2.6.1 The following provides an overview of the work undertaken on-board the vessel, once the material had been recovered.

- recovered material was initially assessed on-board by two suitably qualified and experienced archaeologists with detailed knowledge of the material. Advice on the initial stabilisation of various possible materials likely to be recovered was received by L Wootton (Wessex Archaeology in-house conservator) prior to project mobilisation;
- if material was not labelled on the seabed prior to recovery, it was labelled at this time as well as being hosed down to remove seabed material;
- the archaeologists carried out initial photography using a digital SLR with a minimum image sensor of not less than 10 megapixels, took measurements and described all recovered material to produce the post-recovery record of the finds;
- radiologically contaminated material, namely the cockpit dials and compasses, was wet stored on deck in a sealed container until disposal as FAAM did not wish to hold this material;
- ordnance was dealt with as per IFA2 company policy and following the requirements of the excavation licence, with UXO clearance divers present throughout the operation;
- the small number of organic artefacts recovered were wet stored separately following consultation with L Wootton before transfer to FAAM;
- small artefacts were wet stored in a mixture of deck boxes and adapted Intermediate Bulk Containers (IBCs) which were filled with sea water. The artefact numbers were written on the side of these, while all material identified as containing or potentially containing asbestos was wet stored in an IBC marked as containing asbestos;
- larger fragments of the aircraft (e.g. the engine block) were wrapped in a protective layer of decorators' cloth which was wetted down and then wrapped in plastic to try to retain the moisture. This material was hosed down by the boat crews three times a day to keep it wet before transfer to FAAM;
- all suitable material recovered was transferred to FAAM as soon as possible to be retained until such time that it is deemed to be of no further use archaeologically or in its contribution to the reconstruction of the aircraft they are rebuilding; and
- the material not retained for FAAM (radiologically contaminated material) was returned to the seabed for reburial within the HVAC Deposition site; a rectangular area 81 m x 20 m centred on 622753, 5629978 (WGS84 UTM Zone 30 N).

2.7 Stabilisation, storage and conservation of artefacts at FAAM

2.7.1 The artefacts were transferred to FAAM where they were treated in accordance with the Museum's internal conservation strategy for recovered aircraft remains:

- the sea water was drained from the IBCs and wet storage boxes and replaced with a weak citric acid solution to stabilise and desalinate the material;

- larger artefacts were unwrapped and placed in large storage tanks filled with weak citric acid solution;

- the most at risk and/or fragile artefacts and fragments were selected for deconstruction, cleaning and media blasting alongside *ad hoc* photographic recording;

- volunteers and FAAM conservation engineers continue to work through the remaining artefacts, practising a discard policy that is in line with FAAM procedures; and

- any further recording or data collection will be completed by FAAM staff and volunteers, to form part of the Museum's collection.

2.8 3d Model Reconstruction Methodology (R. Marziani)

2.8.1 The following provides an overview of the process to obtain a 3d model from the photos and the videos recorded:

- to create the model 4 chunks of data were used: the post-excavation shots of the Port-wing shots from 18th of June 2019, the post-excavation shots of the Engine from 29th of May 2019, the Starboard wing shots were captured on 28th of February 2019 and 29th May 2019. A fourth chunk concerning part of the tail was added for completeness, with these shots were taken during the pre-excavation survey on 29th of February 2019;

- all photos were extracted from videos recorded with GoPro Hero5 and 6 (see paragraph 2.4.1) using Lightroom, at this stage some of the shots were slightly corrected and dehazed;

- all 2,994 photos have a resolution 3840x2160 pixels at 240 dpi;

- all photos were edited in Photoshop CS 21.0.2; the photo correction was applied to Tone, Contrast and Colour Balancing. No other filters were applied;

- all photos were processed using Agisoft Metashape 1.5. Alignment was run at medium accuracy and dense cloud in Medium quality with mild filtering. All chunks were scaled using scale bars present on the photos, then all the chunks were aligned using common points. The dense cloud for the Tail or 4th chunk has been processed on High Quality and mild filtering although the model produced has a certain degree of distortion (Fig.5 on Metashape processing report);

- from the merged chunk the complete mesh was produced and then texturized. Metashape colour calibration was also applied during this process. A DEM was also produced from this model;

- the complete model has 3,999,999 faces and it has not been decimated further after processing;

- the full Metashape processing report is included in **Appendix 6**. Total RMSE error is 6.84 cm. Scale bars control error is 0.0067 m;

- the 3d Model was not geo-referenced; and

- the 3d obj was then imported in Rhino version 5 where most of the renders were produced.

3 RESULTS

3.1 Introduction

3.1.1 The archaeological recording and supervision of the recovery of the extant remains of the Barracuda ensured that it was recovered in as timely a method as possible and has furnished much information to correlate the events of its loss. The works have led to the documentation of the pre-excavation condition and layout of the aircraft wreck, documentation of the condition of each section following their targeted excavation and the full recovery of aircraft material from the site, which was subsequently documented before being sent to the FAAM. Work on stabilising and conserving the vast amount of reusable fittings and parts that were recovered is ongoing, and progress can be viewed on the Fairey Barracuda Restoration Facebook page (https://www.facebook.com/FaireyBarracudaRestoration/ Accessed 04/11/2019).

3.1.2 No personal effects, with the exception of some boot fragments, or official books, documents or papers were discovered during the excavation.

3.2 Operational Summary

3.2.1 The diving operations on the site commenced on 22 May 2019 with mobilisation in Poole and the set up and calibration of the ROV3D camera system prior to the dive vessel and crane barge moving to the Solent and moored overnight on the Isle of Wight.

3.2.2 In total there were 38 days of operations with four weather days. A total of 82 dives occurred, including seven dives for photogrammetry. Of the photogrammetry dives only three were successful due to poor visibility, or the turbidity of the water. The final days diving, completing the post-recovery UXO survey occurred on the 26 June 2019.

3.2.3 Demobilisation and final collection and delivery of material occurred on 1-2 July, with the majority of the aircraft delivered to FAAM in three batches on 18, 21 and 28 June. Smaller more fragile finds in need of rapid conservation treatment were taken by FAAM staff on two occasions in the intervening periods.

3.2.4 From the initial survey in February, and the first dives of the operation it was apparent that the starboard wing was probably detached, and that there was a significant amount of overburden on the port wing. It was also clear that the upper parts of the wreck had suffered structural damage from scallop dredging, with the upper surface of the starboard wing, the entire tailplane and the upper part of the cockpit and fuselage above the upper longeron (a horizontal structural member running fore to aft) and the upper parts of the engine cowling all missing or displaced. This damage caused structural weaknesses within the remainder of the wreck as much of the strength of the semi-monocoque construction of the Barracuda comes from having an intact shell. It was also clear that there had been further damage to the starboard wing, with both the front and back spars broken just outboard of the outboard fuel tank. All wing material outboard of this had been removed from the site, probably by scallop dredging.

3.2.5 In contrast to the exposed sections of the aircraft, the buried sections, including the majority of the port wing still had the skin intact although there was damage to the underside and the leading edge, probably from the impact of the plane onto the water. The main cockpit with its cage of struts and spar stubs which formed the structural heart of the aircraft was similarly intact, although recent conservation work on the engine bearers at the FAAM has shown that the lugs on the bearer ends were deformed,

probably as a result of the impact with the water. Despite this, the majority of the heavy structural framing around the cockpit and engine was in good condition.

3.2.6 The final analysis calculated the crash site to be buried in approximately 60 cubic meters of material, with this material mostly being dredged out alongside both sides of the fuselage, as well as on top of and around the port wing.

3.3 Site Description

Description of aircraft wreck pre-excavation

3.3.1 The wreck of the Barracuda was positioned as described in the pre-excavation survey, c. 500 m off the beach close to the end of the runway at the former RNAS Lee-on-Solent. The nose of the aircraft was pointed roughly south-east. The initial pre-excavation diver survey of the site found that the wreck was canted to port, with the port wing buried within the seabed sediments from approximately 1 m outboard of the fuselage. The starboard wing had partially detached from the wing stub to lie flat on the seabed, while the fuselage and engine were also canted to port. The engine block stood proud of the seabed by approximately 0.5 m while the remains of the fuselage became lower aft of the observer's cockpit until it was flush or slightly buried at its furthest extent. The outline of the cockpit aft of the firewall between it and the engine was clear but filled with soft sediment, as were the wing stubs. The tail plane of the aircraft was completely missing. It should therefore be pointed out that while the condition of the buried material was better than expected, the aircraft wreck as a whole was not complete and had suffered damage from marine and human processes, particularly to the areas exposed out of the seabed sediment. These areas had been badly damaged, probably by scallop dredging activity which had ripped off the upper skin of the starboard wing as well as removing much of the upper parts of the cockpits and remaining fuselage, including all of the canopy. It is suspected that this process would also have removed the tail section, possibly as a single piece aft of the join behind the smoke bomb compartment as well as the outer half of the starboard wing, which was missing outboard of the smaller fuel tank. The leading edges of both wings were only found as the rounded frames, with the vast majority of the wing skin around the upper part of the leading edge missing, again suggesting dredge damage. The upper skin of the port wing between the two main spars had survived largely intact, with some original labels in place, as shown in the stitched models of the wreck after excavation, with only some small holes through the skin from the breakdown of the metal. This was also true of much of the remaining fuselage skin below the burial into the seabed sediments, with only small scattered barnacle growth in evidence.

3.3.2 **Figure 3, Figure 4**, **Figure 5** and **Figure 6** show the stitched photogrammetric model of the wreck following excavation of its extents. **Figure 7** shows the aircraft as it would've been before the crash.

Seabed & Ecology

3.3.3 The seabed on the site comprises soft fine silty mud containing shell and shingle overlaying a hard clay deposit. The aircraft wreck was buried within both of these sediments, with the lowest points of the wreck being the underside of the fuselage up to 1.1 m deep within the hard clay. Due to the canted nature of the wreck to port, the port wing was buried in up to 1 m of sediment (including 0.8 m of the hard clay) at the furthest extent from the fuselage, while the starboard wing remains were only buried by the soft upper sediment, with the underside of the wing resting on the hard clay.

3.3.4 It is suspected that the level of soft upper sediment has been variable over the time the aircraft has been underwater, while the harder sediment below may have been fairly stable, while the aircraft slowly sinking into this sediment due to its weight.

3.3.5 A range of marine life and large amounts of free-floating seaweed was observed across the site. The variation in size of limpets and other bivalves on the aircraft structure indicate that the site has covered and uncovered on several occasions since its loss.

Environmental Samples

3.3.6 Environmental samples were taken both on the site and within the aircraft to help inform the conservation process, if required. These were taken by the divers using five litre sealed containers to hold the sample.

3.3.7 The samples are currently being held at Wessex Archaeology's Salisbury offices until such time they are required or are to be disposed of. As yet they have not been requested.

3.4 Archaeological Data

Introduction

3.4.1 The methodology for the recovery of the aircraft was based on the premise that it would need deconstructing to recover it from the seabed. It was therefore decided to start with the detached starboard wing, before removing initially the port wing, the engine, and then the rear part of the fuselage.

3.4.2 The divers identified a total of 193 items, (four prewritten tags were lost during diving operations and the numbers not reused); these include one modern item (a dive weight), and one item, a gauge, that required disposal by redeposition. A total of 284 objects were identified by the archaeologists on the surface, including one modern item, with 11 items redeposited. Items recovered by the divers were individually tagged, whereas smaller unidentified objects comprising aircraft skin and small structural elements recovered from the sieve were bagged together as a single item, according to their location.

3.4.3 Overall, 484 finds numbers were issued, of which four were those lost, and the numbers not reused (5340, 5487, 5488, 5693). Two of the numbers were on modern items (5348, 5784) not associated with the aircraft; and two were issued to the gauges for redeposition (5334, 5785).

3.4.4 Finds varied from individual switches (5408) and labels (5676), through to large sections of fuselage (5661), cockpit and wing stubs (5700), as well as the sections of the cockpit tubing removed for transportation (5698, 5699). Also found were parts of the observer's cockpit, Telegraphist Air Gunner's (TAG's) cockpit and fuselage sections (5442,5443), and the port wing spar (5470-5472). Additional loose and unassociated material, bagged as small fragments and electrical pieces (5439,5580, 5596, 5758) were recovered from the sieve on deck, or during the diver sweeps following the recovery of the separate elements.

3.4.5 More unusual and unexpected elements included surviving fabric from the control surfaces (5713), leather flying boot fragments (5545, 5565, 5768), the screen shield or cover off the radar set (5751), and a fragment of a possible jumper (5505).

3.4.6 Cleaning and conservation works on these artefacts have been ongoing at the FAAM since their recovery and the progress on this alongside further discussion of these artefacts will be expanded in the outline of the different aircraft sections below.

Starboard Wing

3.4.7 The starboard wing was lying flat on the seabed and initial diver investigation confirmed that it had disconnected from the wing stub.

3.4.8 As discussed above, the starboard wing (5504-5540) (**Plate 1-5, Figure 8**) was in a very poor state of preservation with much of its upper surface, leading and trailing edges lost to corrosion and other damage. In addition to this, it was found following excavation around the extant remains that the outboard half of the wing, starting from the outboard fuel tank to the end, was not *in situ*. The pitot tube and mast (5341) (**Plate 6**), which originally hung below the wing, was found upright and roughly in the correct position it should have been in, suggesting that the outboard half of the wing had been in place on the seabed for a period of time after the crash, but had been broken off and moved prior to the recovery operation. It is likely that this was due to scallop dredging, similarly to the damage to the upper surfaces of the remainder of the wing. The extant remains of the wing following excavation were therefore limited to the lower half of the front and rear spars, along with the frames in between and some of the lower wing skin, up to the location of the outboard fuel tank.

3.4.9 The pitot tube (5341) was the primary instrument for measuring the airspeed of the aircraft. To avoid it giving an incorrect reading due to turbulence caused by the aircraft moving through the air, these instruments were usually suspended from the lower surface of a wing on a mast, far enough away from the fuselage to remove much of the turbulence. The mast, made of lightweight laminated cardboard material with stiffener frames inside also held the wiring that powered the 24 volt instrument. The pitot tube itself, made of brass with a small hole in the forward end was probably made by Avimo of Taunton (https://www.gracesguide.co.uk/Avimo Accessed 06/11/2019) who held the patent for a heated element which prevented ice from forming on the tube and blocking airflow. This part was a standard Air Ministry part and was used on many RAF and FAA aircraft.

3.4.10 During the excavation of the internal divisions of the wing, which had been exposed to sediment infilling due to the removal of the upper skin, a number of artefacts relating to the cockpit of the plane were found, including fragments of Perspex from the cockpit canopy and the Boost gauge (5334) (**Plate 7**) from the aircraft's instrument panel. Research suggests this was a Boost Gauge Mk3M, manufactured by Smiths Aircraft Instruments of Cricklewood (https://www.gracesguide.co.uk/Smiths_Aircraft_Instruments Accessed 04/11/2019) and was the type also used in the Mk9 Spitfire and the Mk3 Lancaster (http://www.raf-surplus.co.uk/main-panel-flight-instruments.php Accessed 04/11/2019). The presence of these artefacts within the area of wing is more proof of the damage to the upper exposed parts of the aircraft wreck by dredging in the area.

3.4.11 The large air brake, or Youngman flap (5501) (**Plate 8**) located aft of the trailing edge of the wing, was recovered largely intact and in a good state of preservation, following its separation from the wing by cutting through its hydraulic ram. This air brake was originally held on to the rear underside of the wing by two beams, but the outer one of these had become totally detached, possibly as a result of the impact of the aircraft on the sea. The trailing edge of the air brake had some distortion present with the edge partially deflected upwards, but other than this and a small number of corrosion holes across the skin it was

in a good condition. This is probably due to it having been almost entirely covered in seabed sediments.

3.4.12 Other items recovered from the starboard wing included one of the wing fire extinguishers (5338) (**Plate 9**), the bomb crutches (5509, 5516, 5530 **Figure 9** and **Figure 10**) from under the wing and a number of small Tufnol and Bakelite fittings (pipe clamps in particular) from within the wing structure, some of which are pictured in **Plate 10** and **Plate 11**. Tufnol, a laminated synthetic resin material, was manufactured and supplied to the Air Ministry by Ellison Insultations Ltd of Birmingham (later to become Tufnol Ltd). It was half the weight of aluminium and had a tensile strength of 31-71 tons per square inch (https://www.gracesguide.co.uk/1939_Suppliers_to_the_Aircraft_Industry Accessed 06/11/2019). The Bakelite fittings, including several standard Air Ministry parts (stamped with the Imperial crown and the letters A.M.) were manufactured by Insulators Ltd of Edmonton, London (https://www.gracesguide.co.uk/1939_Suppliers_to_the_Aircraft_Industry Accessed 06/11/2019). These have been cleaned and conserved by the FAAM since their recovery and are shown in **Plate 12**

3.4.13 The wing fire extinguisher (5338) was found in place within the section of the wing close to the join with the main fuselage. Its purpose was to extinguish any fire resulting from the inboard fuel tank being pierced by tracer or cannon rounds. These fire extinguishers (two in each wing and three within the cockpit- **Figure 11**) contained Bromochlorodifluoromethane (BCF) and the starboard wing example appeared to remain full and under pressure.

3.4.14 The inboard fuel tank in the starboard wing was heavily damaged, with the majority of it being reduced to the hard aluminium alloy frames shown in **Plate 1, Plate 2** and **Figure 12**. Some remains of the tank fabric remained along with some of the inlet valve fittings, which can be seen in **Plate 13**.

3.4.15 On recovery to the surface, the fragmentary remains of the wing were unable to support their weight and fell back to the seabed. From there, it was recovered by diver transit into a subsea basket along with other debris in the area. These remains were best preserved around the inboard fuel tank frames, which were made of a thicker more resilient aluminium alloy, although minimal amounts of the rubber/canvas fuel tank skin survived. The fore and aft spar elements (5512, 5521, 5522 and 5523) were recovered but were not complete due to the damage from dredging which had removed much of the upper parts of them. The front spar was cut into three pieces on the advice of the FAAM engineers due to its original length being difficult to store. The FAAM already have a number of complete wing spars from other Barracudas and so the significance of these elements being whole as recovered when they were already damaged and incomplete due to dredging was reduced. This allowed the engineers to see the laminated construction of the spar, made up of nine thin bars of steel riveted together, becoming thinner as it went outboard. The same process was repeated with the starboard wing spars.

Engine

3.4.16 The Roll Royce Merlin 32 engine (5613) (**Plate 14, Plate 15, Plate 16** and **Plate 17**) was lifted on two strops following dredging works around it and cutting works to separate it from the aircraft. These were completed in front of the firewall by cutting through the engine bearers – a total of ten cuts with five bearer tubes to be cut on either side. The rationale behind this, following discussion with the FAAM engineers, was that the need to preserve the mounts and brackets was more important than the tubes. This was carried out with a hydraulic powered reciprocal saw and angle grinder. The two upper bearer

tubes on each side did not prove difficult to cut, with the upper one on the starboard side already having been broken either by impact or by later damage. The lower three tubes proved more complex, particularly on the port side as the plane was canted over, leaving less space for access. This led to an additional cut on one of the tubes but did not cause unacceptable damage to the aircraft remains.

3.4.17 The dredging works around and under the engine found sections of the engine cowling, particularly around the lower nose base of the engine were loose or detached, possibly from the force of the impact of the crash, although a well-made diving concrete weight was found within an area of soft silt low down by the engine. This would suggest that the wreck had been located and visited in the past by divers, and its location close to the anticipated position of the three large engine radiators, which were not found on site, may suggest that it was used for an earlier unauthorised salvage of these and other items.

3.4.18 The radiators should have been located under the front of the engine and were made up of a large circular radiator and two smaller circular radiators below it, all covered by cowling, several pieces of which were found within the area around the engine.

3.4.19 The engine, once recovered to the deck of the crane barge, was hosed off with the barge fire hose to remove the silt and sea creatures that were still within the nooks and crannies of the engine. This allowed the UXO team to identify and remove the Coffman starter block, which contained cordite filled blank cartridges for starting the engine (5619 & 5620) (**Plate 18** and **Plate 19**). Having rendered these safe, the team carefully cut off the remaining engine cowling segments, which contained asbestos tape, and lowered these into water filled tanks to ensure the material remained wet. Loose engine parts were removed and recorded, while the main engine block and propeller hub were extensively photographed. The rocker covers had been lost, either through electrolysis or through earlier salvage but the vast majority of the engine block was complete and in a very high standard of preservation (**Plate 20**). Of particular interest to the FAAM team was the large brass oil header tank just aft of the propeller hub (shaped like a saddle to fit over the propeller shaft- **Plate 21**), which was undamaged unlike previous examples they had acquired. The rocker heads and arms were all in place and only one exhaust had been removed out of the 12 originally present. The lower two propeller blades had also snapped off but had larger stubs than the upper ones (**Plate 21**).

3.4.20 When back at the FAAM, the engine identifier plate was found fixed to the engine by some remaining mud. This identified the engine as a Merlin 32 right hand tractor no. 71231, with a second identifier number of 281259 (**Plate 22**). Additionally, while cleaning up the starboard engine bearer a further manufacturing plate was discovered, stamped with identification number FM117524. The FM prefix to the number demonstrates that the bearer was made by Fairey, rather than by either of the sub-manufacturers Boulton-Paul or Blackburn and gives further weight to the identification of the aircraft as LS473.

3.4.21 The Merlin 32 engine was not the original engine the Barracuda was designed for, The Rolls-Royce air-cooled Boreas, or Exe which was planned to be more powerful and create less drag due to its X layout of cylinders was proposed, however, in mid-1939 Roll-Royce requested that it suspend all work on the Boreas to concentrate on the Merlin, Peregrine and Vulture engines. The loss of the Boreas meant that the power plant for the Barracuda shifted to the Merlin 30, a liquid-cooled engine of supposedly similar power. This was later upgraded to the Merlin 32, which gave a bit more power, however the Barracuda remained underpowered for much of its operational life until the Mark V, which was powered by the Rolls-Royce Griffon (Willis 2016, pp. 10-12; 117).

Rear Fuselage

3.4.22 The rear part of the fuselage (5661) (**Plate 23** and **Plate 24**) was excavated using water jet and hydrainer to clear the sediment from inside the surviving wreckage and outside, working down along the outer sides of the fuselage skin in a trench approximately 0.5 m out from the wreckage. This excavation confirmed that the whole tail plane was missing, with the break coming at the joining frame just in front of the leading edge of the rudder. Following the removal of the sediment, the rear part of the fuselage was separated just aft of the rear catapult bulkhead using a reciprocal saw and angle grinder to cut through the wreckage. The section was detached at this point because the bulkhead was identified as a potential lifting point for the rest of the fuselage, and there were concerns that the rear section would not survive a combined lift, even though it was considered to be of low archaeological potential compared to the cockpit area. The condition of the rear fuselage section was moderate to poor- much of the strength within this section came from the frames/bulkheads at each end which had been removed- the rear one when the tail plane was lost and the front one due to the location of cutting. Without these, the section was only made up of partially intact aluminium skin held together by the two longitudinal longerons and a number of lighter horizontal stiffeners. It was therefore recovered within a lifting basket. Attached to the skin and stiffeners were a number of small metal, Tufnol and Bakelite fixtures and fittings to hold control cables and pipework for the tail plane controls.

3.4.23 Amongst the material recovered with this section were the D/R compass master unit (5659) (**Plate 25**) and the arrestor hook (5660) (**Plate 26**).

3.4.24 The D/R compass was built by the A.T.& E. Strowger Works in Liverpool, who made over 30,000 units during WWII. D/R stands for Distant Reading due to the need for the master unit, which contained both the gyro and magnetic elements of the compass, to be as far away as possible from large ferro-magnetic elements of the aircraft (the engine being the main culprit). Repeater cards for the pilot and navigator were fed the heading information from this unit through an electrical transmission system. The master unit found within the rear fuselage contained the magnetic element, the gyroscope, monitoring and follow-up mechanism along with the repeater transmitter, all suspended in gimbals (https://rochesteravionicarchives.co.uk/collection/navigation-inertial/distant-reading-dr-compass-mk-1 Accessed 05/11/2019). The cover for the unit has “THIS IS A DELICATE INSTRUMENT. HANDLE WITH EXTREME CARE. DO NO DROP OR JAR” stamped on it on several faces.

3.4.25 The arrestor hook was located under the rear fuselage in front of the tail wheel, which had been recovered during the survey dives earlier in the year (**Plate 27**). It was used for carrier based landings- the Barracuda squadrons were predominantly planned to be operated from the *Illustrious* class aircraft carriers and were deployed with the British Pacific Fleet immediately prior to the Japanese surrender. These carriers would have arrestor wires stretched across the flight deck and the arrestor hook would latch on to one of these as the Barracuda landed, bringing the plane to a rapid and bumpy stop- necessary on a crowded deck if your Barracuda was one of the last to land after a sortie.

Port Wing

3.4.26 The port wing (**Figure 8**), excluding the wing stub which was exposed pre-excavation and had lost all its upper skin, was in much more intact condition. Much of the leading-edge had lost its skin and been reduced to only frames and there were some perforations within the upper skin but much of the remaining skin and structure was intact. This included red warning plaques informing ground crew not to open wing spaces before the hydraulic system had been depressurized (**Plate 28**). The spring-loaded pins connecting the wing to

the wing stub were in place as were the hinges and trailing edge of the wing (**Plate 29** and **Figure 13**). The fabric covered wing tip and aileron had not survived.

3.4.27 The Youngman flap air brake was missing, possibly broken off when the plane hit the water, which may suggest that much of the force may have been taken by the port wing or that the flap was partially down when it crashed. Within the wing stub, the accumulators for the hydraulic system were still in place (**Plate 30**) and the port undercarriage, complete with wheel and inner tube were up within the wheel housing (**Plate 31** and **Figure 14**), unlike the starboard landing gear which was only half up (**Plate 32**). This confirmed that the plane had only just taken off and had only managed to fully raise one half of the landing gear before it crashed- with the majority of power required to get the aircraft airborne, the hydraulics system could only manage to raise one half of the under-carriage at a time, with the port side being raised first. This may be the reason why the wreck was tilted to port, with the partially raised starboard undercarriage holding up the starboard side of the plane.

3.4.28 Within the wing itself, the two fuel tanks (5489, 5750) (**Plate 33, Plate 34** and **Figure 12**) had survived intact, although they were filled with sea water. These tanks were constructed of multiple layers of cloth and vulcanised rubber, with a layer of untreated natural rubber in the middle with tough aluminium alloy frames inside (thicker and a different alloy to the rest of the aluminium on the plane, as noted in the starboard wing inboard tank). Self-sealing tanks work because when natural rubber reacts with aviation fuel or petrol it swells, sealing the bullet hole and stopping further leaks. These types of tanks were pioneered by Fireproof Tanks Ltd of Portsmouth who originally manufactured them for the Fairey Battle.

3.4.29 The landing light fitting was also in place on the leading edge, forming the only part of the leading edge that was intact other than frames, although the Perspex cover had smashed as had the lamp (**Plate 35**).

3.4.30 A 1 m long section of the folding trailing edge of the port wing had survived in place closest to the fuselage, which contained one of the hydraulic rams and fittings for the folding part of the wing (**Plate 36** and **Figure 15**). This section has been fully deconstructed by the FAAM engineers and the useable parts including an emergency unlocking handle and the alloy hinge parts which have been fully cleaned and conserved (**Plate 37**). Four of which were present on the aircraft- two in each wing but only one survives from this wreck. This example will be used as a pattern to create the missing three for the restored Barracuda. A second piece of the trailing edge was recovered by subsea basket (**Plate 38**).

3.4.31 Much of the internal fittings, connecting rods, pipework and wiring was still in place (**Plate 39**), along with smaller fittings and the three bomb clutches which were located under the wing (**Plate 40**). While the pipework and wiring are unlikely to be reused by the FAAM restoration, their location and sizes was noted down and the vast number of small alloy, steel, Tufnol and Bakelike fittings will be. Conservation and cleaning has already been completed on some of these (**Plate 12**) and the fact they were found in their correct configuration speeds up their identification and correct placement within the restored Barracuda.

3.4.32 The remains of a flying boot (5545) (**Plate 41, Plate 42** and **Plate 43**) and fragment of possible jumper (5505) (**Plate 44**) were recovered during the excavation of this wing, suggesting that they had been displaced from the cockpit area at some point in the past. The flying boot was a 1943 design known as an escape boot because they were designed

to have the upper cut off should the aircrew land in enemy territory, leaving them with a more civilian style of low ankle boot (https://www.iwm.org.uk/collections/item/object/30015916 Accessed 06/11/2019). Inside the right boot was a small pocket with a knife to allow the pilot to do this.

3.4.33 Though the initial plan was for the port wing to be detached from the fuselage for recovery, on examination this proved not to be possible due to the thickness of the wing at the stub and the necessity to keep individual components complete (specifically the pins which would have been the only sensible place to cut), and with time pressures for recovery mounting, it was decided to lift this wing and the cockpit section of the fuselage as one item. This lift will be discussed in the Main Fuselage section below.

Main Fuselage

3.4.34 The main fuselage for the purposes of this report is classified as the section between the firewall forward to the bulkhead aft of the TAG cockpit. It also includes the wing stubs and the undercarriage torsion boxes. The fuselage layout had the pilot's cockpit in the front, split off from the observer's cockpit behind by a bulkhead. The observer's cockpit communicated with the TAG cockpit at the rear of the section (**Figure 16**). The internal spaces of the fuselage and cockpits were filled with sediment which had preserved the internal fittings very well, as will be discussed below.

3.4.35 The upper Perspex panel canopy (**Figure 17**) of the three cockpits had been removed, probably by scallop dredging activity, as had the twin K-guns (if they had ever been on board, as this was a training flight) at the rear of the TAG cockpit. The magazines from the K-guns were found lying around, and in the wreck, with two found on top of the port wing, two within the sediment next to the fuselage and four within the TAG cockpit itself. These, along with two smoke floats found within the tubes at the rear of the cockpit and one more on the floor of the cockpit were removed by EOD divers and kept submerged in a holding location. Following the end of operations on site, they were removed to a safe location and destroyed.

3.4.36 The Vickers twin K-guns (**Plate 45**), positioned on an arc-track at the aft end of the TAG cockpit, were the Barracuda's only defensive armament. These guns, designed in 1935, were commonly used in single and twin mounts on aircraft and for light anti-aircraft defence- being particularly favoured by the Long Range Desert Group (the precursor of the SAS) mounted on their jeeps and trucks. They fired .303 ammunition from 60 or 100 round top mounted 'pan' magazines, of which the Barracuda usually carried eight or ten.

3.4.37 The smoke bombs were held in resin tubes behind the TAG cockpit (**Plate 46, Plate 47** and **Figure 18**) along with sono-buoys and were deployed by dropping them through the chute on the port side of the cockpit floor. These were sometimes used as markers showing downed aircraft or similar emergency situations but were also used as navigational markers dropped on an outward flight for the Barracudas to use to navigate back to the carrier. They were made up of phosphorus mixed with a colourant and would mark the sea for up to an hour as well as releasing smoke.

3.4.38 Within the TAG cockpit (**Plate 48, Plate 49, Plate 50, Plate 51, Figure 19** and **Figure 20**), many of the fixtures and fittings were still in place, including the large radio set (5437) (**Plate 52** and **Plate 53**), trailing aerial reel (5438) (**Plate 54**), seat back and its cover (5650, 5651) (**Plate 55**) and bucket seat base. The TAG bucket seat (5650) (**Plate 56**) used a similar bucket seat to that of the Supermarine Spitfire, albeit with a shorter and more reinforced back. The bucket seat was to allow the aircrew to sit on their parachutes. This was mounted on a spigot so that the TAG could rotate between radio and gun. Due

to their locations obstructing the EOD diver from completing the UXO search, these were removed and brought to surface individually. The R3078 receiver radio set was held within a frame and included a series of glass valves (5384) (**Plate 57** and **Plate 58**), one of which was recovered fully intact. As the photos illustrate (**Plate 52** and **Plate 53**), much of the radio is complete, including the buttons and tuning knobs and with further cleaning back at the FAAM it is hoped that this artefact can be prepared for display. The trailing aerial reel was also found complete, with the string of lead balls at its trailing end in place (5438) (**Plate 54**). These would have helped it to stream out straight behind the aircraft and be recovered easily. On the floor of the cockpit, a complete Morse key was found (5389) (**Plate 59**). During the recovery of the full fuselage, a further two keys (5460, 5464) similar to this were also found as well as a second design, more like a switch (5463) (**Plate 60**). These were all in near perfect condition, including some of the wiring.

3.4.39 To illuminate the cockpit a series of small light fittings were attached to the frames, several of which were recovered, still with their identification labelling on the wiring (5465) (**Plate 61** and **Plate 62**). A stamped label on the forward-facing rim of the TAG cockpit reminded the TAG that they should be facing aft for assisted take-off (**Plate 63**). “If you can read this, you’re facing the wrong way.”

3.4.40 Forward of the TAG cockpit was the observer’s station (**Plate 64, Plate 65, Figure 21, Figure 22** and **Figure 23**), sat in between the wings with the large bulbous underwing windows to allow for good vision out of the aircraft, and the pilot’s cockpit. These cockpits were covered by the same large domed Perspex canopy which reached back to the lifting hatch of the TAG’s cockpit, which was also missing although fragments of it were found within the silt all around the aircraft. A sliding section above the pilot’s head provided access to the forward cockpit while midway along a second sliding hatch gave access to the observer’s cockpit, as there was no route through between the two.

3.4.41 The observer’s sliding canopy (5579) (**Plate 66** and **Plate 67**) was found fully detached and discarded to one side of the fuselage, suggesting that someone had removed it at some point, possibly to escape from the plane after the crash. This conflicts with the crash reports of both BV739 and LS473 stating that only the pilot was onboard. However, during the excavation of the cockpits a second sole of a right escape boot (5768) (**Plate 68**). This along with the earlier escape boot fragments found close to the port wing and the jumper fragments may be evidence that there was more than one person onboard, and having ditched the plane, they kicked off their escape boots, took off their heavy woollen jumpers and swam the short distance to the shore, rather than waiting from more conventional rescue. The possibility being that the pilot was taking up a new crew member for a familiarisation flight? In the logbook for Flt Lt Sandes, the pilot of LS473, it notes that “he swam 2 miles to shore” which would fit with this evidence (**Plate 69** and **Plate 70**).

3.4.42 The observer’s cockpit, with its large domed side windows, one of which was recovered almost undamaged (5345) (**Plate 71**) allowed them to complete navigation as well as keeping a look out for other aircraft or targets to attack. The radar screen, with its rubber hood or cover (5751) (**Plate 72**), was located on the front bulkhead of this cockpit, which also contained a repeater compass from the gyrocompass towards the tail. The sides and floor of the observer’s cockpit (5700) were filled with the large batteries and distribution boxes that provided the aircraft with 24-volt lights and power. A large quantity of these were found, including several intact batteries (5733) (**Plate 73**) and the main distribution box (**Plate 74**). Further quantities of labelled wiring were also present, generally still attached to the frames and longerons within the cockpits. Also recovered in this area was the pilot’s comfort bag and its holder (5441) (**Plate 75**) and a number of the cockpit lights. The batteries were tested for charge during conservation at the FAAM and were found to

retain 0.7V of charge (**Plate 76**). These batteries were probably manufactured by Nife Batteries of Redditch, who specialised in batteries for aircraft 24V systems (https://www.gracesguide.co.uk/Nife_Batteries Accessed 06/11/2019)

3.4.43 Moving forward to the pilot's cockpit (**Plate 77, Plate 78** and **Plate 79**), while at least some of the upper parts of it had been damaged by the shellfish dredging, leading to the loss of some of the dials, the blind flying panel (5770) (**Plate 80** and **Plate 81**) was recovered, including several *in situ* gauges including the airspeed gauge and artificial horizon, and from within the cockpit itself came the control column (missing the top) (5414) (**Plate 82**), the base of the pilot's seat (5430) (**Plate 83**), and a rubber oxygen mask (5416) (**Plate 84**) which probably belonged to the pilot. The same pattern of oxygen mask can be seen in the photo of Flt Lt Sandes (**Plate 70**). Interestingly the observer's seat was not recovered, suggesting that it had been removed at some point previously. The dials were removed from the blind flying panel, which has undergone conservation at the FAAM (**Plate 85**).

3.4.44 The lift was planned to bring the main fuselage section up along with the remainder of the port wing. To complete this three sets of strops were attached to the remainder of the wreck: one underneath the forward part of the pilot's cockpit, the second underneath the after end of the TAG cockpit and the third halfway out under the port wing. These were attached to spreader bars on the lifting chains to ensure that the weight of the load wouldn't force the chains together. It was decided not to lift directly on the cockpit tubing as these needed to be recovered undamaged and there was concern that using them as lift points would cause distortion or breakage. A series of test lifts were completed to break the suction of the remaining sediment around the wreck and then in the final test lift the wreck was moved 15 m to the northwest, remaining underwater for this. A final check was completed on the lifting points by a diver and then final lift began.

3.4.45 As the wreck clearly the water the weight of the water within the fuel tanks in the wing caused the wreck to rotate so that the wing was pointing directly down into the water (**Plate 86**). The lift unfortunately failed due to the forward strop behind the firewall failing leading to weight being transferred to the after strop and wing strop, which became overloaded and then also failed under the additional stress (**Plate 87**).

3.4.46 The main fuselage (5700) with wing stubs and undercarriage (5455, 5473) was recovered using a subsea basket following the failure of the initial lift (**Plate 88**). The divers followed this up by carrying out search and recovery sweeps after the main part was recovered. These sweeps recovered further heavy material that had been left in position following the lift such as the batteries and other electrical system items which had fallen through the floor of the aircraft. It is clear that the structural integrity of the wreck was not as good as it appeared, with particularly some of the aluminium skin and frames acting as anodes for the iron and steel onboard, making them considerably weaker than on first appearance.

3.4.47 Following their recovery to deck in the subsea basket, the large pieces of the port wing and main fuselage were assessed, and decisions made on where to cut, as they were too large for transport as they were. In consultation with the FAAM engineers it was decided to separate the pilot's cockpit tubing (**Plate 89** and **Plate 90**) from the framing of the observer's cockpit, which would remain attached to the wing stubs which contained important hydraulic and oxygen system parts. It was also decided to cut the pilot's cockpit into separate port and starboard sides to assist with transport and storage. These tubes were left with any fittings that were found on them, including wiring systems, oxygen, fuel and hydraulic hoses and clamps. The port wing was split into the forward and aft main spars, which were cut into three pieces each to reduce their length. Skin panels with their

in-situ stiffeners, fixtures and fittings were clipped off the spars, as was the Perspex landing light and the remaining section of folding trailing edge. A second section of trailing edge was recovered from the seabed later that day.

3.4.48 The cockpit tubing was one of the priorities for the FAAM to conserve due to the complexities of remaking tapering tubes. Following the arrival of the wreck pieces back at the FAAM, the team immediately started separating the tubes and their end fittings (**Plate 91**) and conserving them. **Plate 92, Plate 93, Plate 94** and **Plate 95** show the end results of this work.

3.4.49 Due to the quantity of similar aluminium frame and skin material recovered during this phase, it was decided to place this material along with any fittings still attached to it into large builder's bags for transportation. These were split up according to the section the material was from, but it is anticipated that much of this material will be too corroded and damaged to be of use to the restoration. The fittings and fixtures however are likely to be retained.

Tail Section

3.4.50 The tail section of the plane (**Figure 24**) is thought to have been lost to dredging or other activity in the past. However, a section of elevator torque tube (5706) (**Plate 96**), and rudder ribs (5562) with brass fittings and wooden spacers (**Plate 97**) still in place were recovered during the operation, located along the trailing edge of the port wing.

3.4.51 This suggests that the tail structure was not separated from the rest of the aircraft as a single piece, but that it was broken up over time either due to environmental effects or due to other external forces. Where the majority of it lies is unknown, though it is presumed to have been dragged out of the area by scallop or oyster dredgers. Evidence of this activity was apparent with the remains of coir matting trapped under the starboard wing.

4 DISCUSSION

4.1.1 To understand the value of the site beyond its financial worth, three commonly used techniques for the assessment of wreck sites were used to help understand its heritage value to the wider community.

4.1.2 Though these methods are applied wrecks that are *in situ* the premise of placing a value on a site and the risks it is under are still applicable in this case.

4.1.3 The site and aircraft have therefore been assessed looking at site characterisation, a site risk assessment, and assessing against Historic England's non-statutory site designation criteria and their guidance on conservation principals, significance, and the management of military aircraft crash sites (English Heritage, 2002).

4.1.4 Historic England define the significance of an item as its:

> *'value as a heritage asset to this and future generations because of its heritage interest. That interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting'* (Historic England, 2016).

4.1.5 Historic England's four criteria for selection for a site of importance as outline in their guideline on *Military Aircraft Crash Sites* (Historic England, 2002) requires that three of them are met for a site to be considered of national importance. In the case of the Solent Fairey Barracuda the aircraft achieves three of them to a certain degree as evidenced below. There is currently no evidence for the aircraft achieving the fourth.

4.1.6 Firstly, the aircraft does comprise of significant surviving elements with few or no examples remaining. Though the surviving percentage has not been accurately calculated, it is approximately 60%. This is significantly more than the average 1% for a terrestrial crash site, with 10% survival being considered exceptional (Historic England, 2002).

4.1.7 Secondly, the remains have been shown have a remarkable degree of preservation, with a significant number of parts being stripped down by the FAAM engineers, with original features, pencil marks, and very little corrosion visible on the items. This has led to a reappraisal of the identification of the aircraft (**See 4.2.6**).

4.1.8 Thirdly, based on the known histories of the two potential aircraft (**See Section 4.2.4**) there is no evidence that either was involved in any significant events or raids during their lives although the Barracuda was used in large numbers and notably on raids against the *Tirpitz* in 1944. The candidate aircraft like approximately two thirds of aircraft losses during the war, based on the figures for the Royal Air Force, were lost during non-operational accidents.

4.1.9 Though the decision has been made for the aircraft to contribute to the restoration of another airframe, during the early part of the recovery operation when the degree of completeness and structural integrity of the aircraft was unknown, it was considered as a potential candidate for conservation and display. However, the cost of disassembling and reassembling the remains, along with the potential conservation costs made this an impractical option for its long-term survival.

4.2 Site Description

4.2.1 The location of the aircraft was indicated as a seabed obstruction on Admiralty charts (**Figure 1**). It was only identified as an aircraft from diver observations and video review during boulder clearance operations in 2018 (**See Section 1.3**) following the identification of a seabed anomaly during the interpretation of the geophysical survey for the IFA2 project.

4.3 Aviation Archaeological Potential

4.3.1 The archaeological potential of the aircraft can be viewed in terms of its physical remains and the contribution they can make to the FAAM restoration programme, but also from the personal history of the pilot, who survived the crash, and his recollection and links to the aircraft.

4.3.2 This personal link has generally become more significant in recent years as events pass out of living memory. The journals, logs, photographs, and oral histories of events lose context in isolation and without a sympathetic audience to garner and retain them.

4.3.3 The full value and potential of the recovered finds will not be realised for a number of years, both due to the number recovered but also their conservation and method of reuse by FAAM; either as a replacement part, as a template or patents for a part, or as model for the reconstruction where plans and photographs are not available.

Recorded losses

4.3.4 Two Fairey Barracuda Mk. IIs are recorded as lost near to RNAS Lee-on-Solent (HMS *Daedalus*), in 1943 and 1944, with the additional loss of an Mk. V in 1948 during an emergency landing, and two Mk. IIIs that crashed off Christchurch in Dorset in 1952.

4.3.5 It should be noted that the records for aircraft losses are incomplete due to several factors and therefore additional aircraft may have been lost without being recorded. The Hampshire Historic Environment Record (HER), for example, list only one loss close to the air station.

Potential Candidates

4.3.6 Following discussion and advice from the staff at FAAM the aircraft had been provisionally identified as serial number BV739, a Blackburn built Fairey Barracuda Mk. II. This was delivered to 15 Maintenance Unit (MU) from the manufacturer at Brough on 15 July 1943 and allotted to 822 Squadron based at RNAS Lee-on-Solent (HMS *Daedalus*) that was forming up to be part of the 45th Naval Torpedo Bomber Reconnaissance Wing for service with the Far Eastern Fleet. On 29 September 1943 it lost power on take-off and ditched in shallow water, its pilot Sub Lieutenant DJ Williams survived and served through the remainder of the war.

4.3.7 However, this assessment has changed as the parts of the recovered aircraft have been examined by the museum staff. They now believe that this aircraft is more likely to be Fairey built aircraft, rather than the Blackburn built one initially identified. This would potentially make it Barracuda Mk II LS473 coded ‘A’ of 817 Sqn that failed to obtain climbing speed on take-off on 6 January 1944 whilst being flown by Sub Lieutenant (Air) Sandes RNVR (**Plate 69** and **Plate 70**). It had only been delivered to 15 MU from the manufacturer’s on 24 November 1943. This identification is based on the discovery of components with ‘FM’ (either Fairey Manufacture or Fairey Manchester) stamps on them, on the paint colour of interior surfaces of the airframe (silver for Fairey built aircraft, while Blackburn aircraft were generally a pale grey), and most significantly on the engine plate

(**Plate 22**) recovered from the aircraft's Rolls Royce Merlin engine giving a date of construction for the engine (**see 7.1.12**).

4.4 Site Characterisation

Build

4.4.1 The wreck (6A_pUXO_003) has been conclusively identified as a Mk. II Fairey Barracuda, based on the material recovered.

4.4.2 The origins of the Barracuda's design can be traced back to British Air Ministry Specification S.24/37 in 1937, with the requirement to replace the Fairey Swordfish torpedo bomber reconnaissance (TBR) aircraft under Operational Requirement OR.35. Due to the additional workload that maritime based aircraft were considered to operate under, and like its predecessor, this needed to be a three-seater aircraft with a payload and speed that reflected what was the fast-changing standards in aircraft specifications during this period (Harrison, 2000; Willis, 2016).

4.4.3 Fairey Aviation won the tender with the prototype aircraft first flying in December 1940, and the plane entering operation service in January 1943. The aircraft was a high wing cantilever monoplane with an all metal fuselage, retractable undercarriage, and fixed tailwheel. It had an unusual design of undercarriage to facilitate folding of the wings for storage onboard an aircraft carrier, and an arrestor hook mounted flush in front of the tail wheel. The wings were fitted with Fairey-Youngman flaps, which work as dive brakes, and because of their location also gave the aircraft some of the benefits of a biplane wing construction. Following its initial trials, the tail configuration of the aircraft was altered to a 'T' shaped profile to improve stability. The aircraft was fitted with the Rolls Royce Merlin 30 engine initially, before the Rolls Royce Merlin 32, with a four bladed propeller was selected (Harrison, 2000; Willis, 2016).

4.4.4 The most successful and numerous version of the aircraft was the Mk. II model with 1,693 being built by several manufactures including 675 by Fairey, at their Stockport and Ringway factories, 700 by Blackburn Aircraft, 300 by Boulton and Paul, and 18 at Westland (Harrison, 2000; Willis, 2016). There were five marks in total, though one was never manufactured, and these were produced in varying numbers.

4.4.5 The aircraft was always considered underpowered even with the upgrade to the Rolls Royce Merlin 35. In part this was due to the changes in requirements to the roles the aircraft could carry out, with some being fitted with as many as 14 radio sets for their different operational roles. The Mk. II was also fitted with a metric wavelength Air to Surface Vessel II (ASV) radar, recognisable by the Yagi-Uda antennae visible on the wings.

4.4.6 Barracuda's were armed with twin Vickers K-guns in the TAG's cockpit and a wide range of underslung ordnance from hardpoints on the wings, and a mounting below the fuselage. A forward firing pilot operated gun, and one for the observer were never fitted, or removed early in the aircraft's development. Ordnance loads included a 1,630 lb (750 kg) torpedo, or a 2,000 lb (909 kg) bomb, or six 250 lb (114 kg) bombs under the wings, up to four depth charges dependant on their size, mines, sonobouy dispensers, airborne lifeboats, two Cuda floats (an underwing experimental passenger container), radio station and ordnance delivery pods. The aircraft was also capable of being fitted with rocket assisted take off gear (RATOG), allowing them to operate from the smaller, merchant ship built on, escort carriers employed on convoy protection duties, and the light fleet carriers.

4.4.7 The aircraft as delivered was 12.12 m (39 ft. 9i ns) long, with a wing span of 14.99 m (49 ft. 2 ins) giving a wing area of 37.62 m^2 (405 ft^2), and a height of 4.62 m (15ft. 2 ins). Its empty weight was 4,250 kg (9,350 lb), with a loaded weight of 6,00 kg (13,200 lb), and a maximum take-off weight of 6,409 kg (14,100 lb). The Rolls-Royce Merlin 32 liquid-cooled V12 engine, gave 1,225 kW (1,640 hp) of power, giving the aircraft a maximum speed of 367 km/h (228 mph/198 kts) at 533 m (1,750 ft) and a cruising speed of 314 km/h (195 mph/170 kts). Testing at Boscombe Down in June 1943 demonstrated a maximum range while carrying either a 750kg (1,630 lb) torpedo or a single 909 kg (2,000 lb) bomb of 1,355 km (840 miles) with a practical range of 1,048 km (650 miles). Whilst carrying six 114 kg (250 lb) bombs the maximum range reduced to 1,258 km (780 miles) and the practical range to 1,008 km (625 miles) respectively (Harrison, 2000; Willis, 2016).

Use

4.4.8 As the potential loadouts show (**Section 4.3.6**) the Barracuda was deployed in a wide variety of roles over its service life. Initially developed as a TBR aircraft, its roles expanded to encompass anti-submarine operations, covert operations, and fighter directing and control.

4.4.9 Contrary to many sources the Barracuda did carry out its torpedo strike aircraft role, though this was often in a combination of torpedo and bomb carrying aircraft, with some success during the Norwegian campaign in 1944 prior, and post, the successful first mission to bomb the German Bismarck class battleship *Tirpitz* in April 1944 (Willis, 2016).

4.4.10 The operational life of the Fairey Barracuda is well recorded and the therefore rather than *precis* this extensive history the reader is directed to the bibliography and online sources for the successes and shortcomings of this unusual aircraft.

Loss

4.4.11 Investigation of FAA losses by Wessex Archaeology and FAAM staff suggest two potential candidates for this aircraft. The two aircraft were lost within four months of each other, are the same mark of aircraft, and were both lost due to engine failures on take-off.

4.4.12 One is BV739, a Blackburn built Fairey Barracuda Mk. II. This was delivered to 15 Maintenance Unit (MU) from the manufacturer at Brough on 15 July 1943. On 29 September 1943 it lost power on take-off and ditched in shallow water.

4.4.13 The second is LS473, a Fairey built Mk. II aircraft, that failed to obtain climbing speed on take-off on 6 January 1944 whilst being flown by Sub Lieutenant (Air) Sandes RNVR. It had only been delivered to 15 MU from the manufacturer's on 24 November 1943, possibly as a replacement for BV739.

4.4.14 The identification plates and other maker's marks on the airframe, and its components, are suggestive of an aircraft built by the Fairey Aviation Company's factory at Heaton Chapel, Stockport, formally National Aircraft Factory No. 2, rather than one of the other subcontracted manufacturers of the aircraft.

Survival

4.4.15 Though it is not an exact calculation, approximately 65% of the aircraft was recovered, demonstrating the level of loss that the aircraft had suffered from corrosion and other damage. The majority of this loss could be attributed to damage to the upper parts of the wreck by scallop dredging or similar activities which had removed large parts of the tail, starboard wing and upper parts of the fuselage. The buried portion of the wreck survived

considerably better, although some corrosion damage was clear potentially due to changes in burial depth. The lower parts of the wreck which had been exposed the least from surrounding sediments were the least corroded or colonised by barnacles. Significantly, many of the smaller parts of the aircraft, made from plastics, and other exotic materials, have survived well.

4.4.16 There are no surviving complete examples of the Fairey Barracuda in existence at this time, therefore the remains of this example form an important contribution to the current remains that are known.

4.4.17 FAAM are undertaking a long-term project to restore DP872, a Mk. II aircraft that crashed into Blackhead Moss on the outskirts on Londonderry, Northern Ireland, in August 1944. To this effect they also have the recovered remains of three MKII Barracuda's (LS931, DR306, PM870) and the remains of a Mk. III (MD953), all of which are crash remains from terrestrial sites around the UK. It is the aim of the project to have about 80% original parts in the reconstruction (Willis, 2016).

Investigation

4.4.18 Though there is no documentary evidence for any acts of salvage from the aircraft, either at the time of its loss or subsequently, there is some evidence of activity at the site by divers. This is suggested by the absence of the oil cooling radiators from beneath the front of the engine, some of the cockpit gauges that are missing, and a large shot weight found during dredging. Though oyster and scallop dredging may have removed the significant portion of the upper part of the fuselage, including the canopy and guns, the nature of the damage suggests that items have been recovered by divers in the past. The search of the surrounding area by the James Fisher Marine Services divers, the geophysical survey, and boulder clearance diving, found no evidence of the missing parts, if they had been torn off during the crash.

5 SITE RISK ASSESSMENT

5.1.1 Using the available information, the site was risk assessed using the *EH Risk Management Handbook* (EH 2008). The results are set out in **Appendix 5**. This process was carried out in order to help quantify the value of the site, and the mitigation carried out by its recovery as opposed to its long-term survival in the marine environment. Its use was therefore in order to give an understanding of the aircraft as a historic asset, the future impacts on the site, and how its significance might be maintained through its recovery.

6 ASSESSMENT AGAINST NON-STATUTORY CRITERIA

6.1 Introduction

6.1.1 In order to try to quantify the archaeological and heritage value of the aircraft it has been assessed using the scale presented below against the criteria required for designation under the *Protection of Wrecks Act* 1973 as presented in Historic England's (2012: 9-11) *Ships and Boats: Prehistory to Present*. Though this is designed for ships principally, within the context of being an item of submerged cultural heritage the scale is an appropriate model for assessing the value of the aircraft and the outcomes of its excavation and recovery.

6.2 Assessment Scale

6.2.1 For each criterion, one of the following grades has been selected. This has been done in order to help assess the relative importance of the criteria as they apply to the site. The 'scoring' system is as follows:

- Uncertain – insufficient evidence to comment;
- Variable – the importance of the wreck may change, subject to the context in which it is viewed;
- Not Valuable – this category does not give the asset any special importance;
- Moderately Valuable – this category makes the asset more important than the average wreck site;
- Highly Valuable – this category gives the asset a high degree of importance. A site that is designated is likely to have at least two criteria graded as highly valuable; and
- Extremely Valuable – this category makes the asset exceptionally important. The site could be designated on the grounds of this category alone.

6.3 Non-Statutory Criteria Assessment

Period

6.3.1 **Moderately valuable.** The Fairey Barracuda was the first all metal, monoplane, TBR aircraft adopted by the Fleet Air Arm. It was produced in significant numbers and was one of the longest serving aircraft in FAA history serving between 1943-1955.

Rarity

6.3.2 **Highly valuable.** There are no complete examples of a Fairey Barracuda in existence. Currently the FAAM hold the remains of five, with an additional on-land crashed aircraft known in Norway, and at least two other known, but unlocated marine crash sites. One of these is in the Solent, potentially in the vicinity of this current project.

6.3.3 In addition, there are a number of features that have been observed on the aircraft that have been taken from the earlier model, or not been seen or described in the surviving records, or on the remains of the recovered aircraft. These include the location of some of the engine bay fittings, and the mountings for the pilot's seat.

Documentation

6.3.4 **Highly valuable**. Though there is a wealth of documentary records for the Fairey Barracuda, there are still significant gaps were information has been lost over time. This includes incomplete microfiche records of the aircraft's plans, records at the National Archive, held by the Museum of the Royal Navy at the FAAM, and held by the RAF museum.

6.3.5 The asset is assessed as Highly Valuable as the documentary material available is contextualises and added to by the value of the archaeological evidence and its narrative.

Group Value

6.3.6 **Moderately Valuable.** The aircraft is one of the few known examples of a Fairey Barracuda in existence. Though the identity of the aircraft has not been definitively confirmed, neither of the potential candidates, as far as is known, are linked to any specific military operation, event or individual that would add to its historical interest or value; thereby potentially making it worthy of conservation in its own right.

6.3.7 As with many other crash sites of this period it is an example of the vicissitudes of training and everyday flying operations leading to the loss of an aircraft, and the fortunate escape of the crew.

Survival/Condition

6.3.8 **Highly valuable.** The aircraft has suffered for its 75 years underwater, with significant loss of its outer surfaces, the damage from fishing, possibly illegal salvage, and the effects of being in a shallow dynamic location.

6.3.9 Despite these, there has been good preservation of several significant elements of the aircraft with the engine, a significant proportion of the cockpits, and their contents surviving. As can be seen above there have been a number of items recovered that have not been found before on crash sites, including the Pitot tube and TAG's seat and its fabric.

Potential

6.3.10 **Highly valuable.** With only fragmentary remains of other aircraft in existence, the remains of this aircraft represent a potential link to the personal histories from the second world war, and an opportunity to share that with the wider community at a time when the participants and first-hand memories of that conflict are passing into history.

Frailty/vulnerability

6.3.11 **Highly valuable.** The discovery of a diving shot weigh alongside the aircraft during the excavation, the fishing gear, the damage that the aircraft has suffered, and the dynamic environment that it is in all indicate that the site was vulnerable, and that despite being partially buried in silt, was in long term going to be lost due to these factors.

6.3.12 The location of a number of the finds where they had been displaced indicate that the site would have become a haphazard spread of disassociated material spread over an area dependant on either its redeposition where dragged, or when recovered from fishing gear, its loss through being discarded ashore, or through souvenir hunting.

6.3.13 In general the inability of the project to recover the Barracuda fully intact demonstrates the vulnerability of submerged aircraft remains in general, particularly those in locations with strong tides, currents, changes in sediment levels and heightened human activity. The

variable survival of parts of the wreck shows that if these artefacts remain buried within stable seabed sediments and are not disturbed by human activity on the seabed then they are still in good condition. As noted by Macleod on the aircraft wrecks at Chuuk Lagoon (2016), sheet aluminium does not attract marine growth in the same way that iron and steel do. However, when they are exposed to tidal streams, currents, abrasion through sediment movement and highly destructive seabed activity such as dredging, these wrecks are at high risk and become highly fragile very quickly. It is unlikely that such a wreck would survive a further 70 years.

6.3.14 The recovery of the Barracuda from the Solent has in effect rendered it no longer vulnerable to the conditions and external impacts that it was under in the marine environment. However, the *caveat* to this is that its recovery was part of a process of reuse rather than as a discrete item.

Diversity

6.3.15 **Moderately valuable.** The recovery of several items not considered to be found on this mark of aircraft suggest that it may be either an earlier model with preproduction parts fitted, or more likely, it has been fitted with surplus parts from the previous model. The literature on the development of the Barracuda cites several examples of aircraft being switched from an earlier mark to the next mark in the series during production.

Summary

6.3.16 Overall, the aircraft should be viewed as being **highly valuable** based on the results of this assessment.

7 DISCUSSION

7.1 The loss of the Barracuda

7.1.1 During the recovery stage it was hoped that the preservation of the cockpit would be such that the positions of aircraft controls could be recorded in order to confirm the dry and brief description in the historic record of the events leading to the crash. Unfortunately, the degree of damage and loss of many of these elements prevented this from occurring. However, the position of the landing gear, with one wheel up and the other down, the relatively undamaged state of the airframe, and its proximity to the end of the runway at former RNAS Lee-on-Solent (HMS *Daedalus*) all confirm that the aircraft was in the process of retracting its undercarriage immediately following take-off, a process that put additional demands on the engine, leading to a potential loss of power. The relatively undamaged state of much of the airframe, with many components showing no crash damage suggest that the aircraft was therefore travelling at very low speed and had a shallow approach and impact, again implying it only just cleared the end of the runway and beach before impact.

7.1.2 The orientation of the aircraft with the nose to the south-east may suggest that it had begun to turn in this direction as it hit the surface of the sea, while the presence of 1940s pattern escape boots in and around the wreck suggests that the wreck floated long enough for the aircrew to escape from the cockpits and kick off their heavy boots before swimming to shore.

7.1.3 Based on the depth of water and the low speed of the impact it is very likely that the aircraft settled on the seabed laying canted on its port wing and half-raised starboard undercarriage, with the highest point being the tail to the north-west, which may have been visible above the surface at low tide. The dynamic nature of the Solent tides and the effects of current and wave action may have broken this off shortly after the crash or dredging activity may have removed it later. Research has shown it was not unusual for a ditched aircraft to break up during the sinking process with the loss of the tail and wings being sometimes noted (Wessex Archaeology, 2008), although this is generally in deeper waters where forces have more time to act on structural elements as the aircraft sinks. Fragments of the elevator and the structure of tail were found buried around the trailing edge of the port wing, suggesting that this material was moved by fishing activity from the location where the tailwheel (**Plate 27**) was recovered. The tailwheel, with its yoke and strut, when located and recovered, was still close to its correct location in the airframe, but completely separated, with no apparent aircraft structure around it.

7.1.4 The starboard wing was found to be separated from the wing stub, and though there is documentary evidence showing that the locking bolts for the folding wing was a potential weak point in the earlier aircraft, the evidence here points to the wing being pulled away by the action of dredging or trawling activity, rather than crash damage. It is not clear whether the orientation of the aircraft as recovered was due to it being moved before it was fully settled into the seabed.

7.1.5 Due to the relatively low weight of aircraft, and the compacted nature of the underlying clay layer in the area, along with its marking as an obstruction on Admiralty charts, it appears that parts of the aircraft was proud of the seabed for much of the time since its loss, though this then begs the question why was it not more publicly known as an aircraft crash site. It seems unlikely based on the fishing gear and dive weight on the site that it was not known to the local fishing or diving community. The varying size of the different species of marine fouling organisms, including barnacles, oysters, and different worm species, suggest that the upper areas of the aircraft have been covered and uncovered

over time, particularly on the starboard side of the aircraft where it was tipped up from the seabed, and at the time of recovery covered with up to 500 mm of sediment. The deeper burial of the other wing and the port side of the fuselage surfaces may have allowed for their better survival, although assessing this is uncertain.

7.2 Identification of the airframe

7.2.1 The final identification of the aircraft has not yet been definitively confirmed. Since its recovery there is a strong suggestion that the aircraft is LS473. This is based on several indicators including the internal primer paint scheme of the aircraft, the torpedo crutch identified, the identity tags and modification plates found on the tube work of the cockpit and engine bearers, the quality control stamps on several parts recovered; and most significantly the engine plate.

7.2.2 In assessing the material recovered the remains of the torpedo crutch (**Plate 98**) with part of its torpedo retaining cable that were recovered from the site suggest an aircraft that was carrying out operations with a torpedo carried. Comparing the known information of the two aircraft, LS473 is recorded as having been carrying a torpedo at the time of its loss, though no evidence of this was found. It is presumed it was jettisoned as soon as the pilot realised that the aircraft was not going to reach or maintain a flying speed- ditching on water with a torpedo underneath the aircraft was not advised. It is thought unlikely that the torpedo retaining cable was left on the aircraft if they were not carrying a torpedo, as the cable was only retained by a bungee cord to prevent it damaging the aircraft once the torpedo was dropped, and its flailing about had been shown to cause significant damage to aircraft before the bungee system was implemented.

7.2.3 Different manufactures used different forms of tags and plates to identify the different sub-assemblies of an aircraft, and the plans those sections were built off. Fairey Aviation used a system of brass hook and eye clips or bands on the airframe tubes (**Plate 99**), whereas Boulton and Paul used a system of a plain metal band with a folded over join, and stamped parts with their manufactures code (**Plate 100**) as shown on this pipe clip from the Barracuda. The tags so far recovered appear to be of the Fairey pattern, with only a few exceptions. Finally, and though considered to be less conclusive in identifying a manufacturer, as it is presumed that parts in a wartime supply chain could be moved between manufactures, is the Fairey quality control stamp present on small parts recovered from the aircraft.

7.2.4 Research following the recovery by Wessex Archaeology and the FAAM into the recovered engine plate (**Plate 22**) received a response from the Rolls Royce Heritage Centre that appears to confirm the aircraft as LS473. They report that engine 71231 was a Merlin 32 built 8 October 1943 and despatched to Fairey at Stockport on 13 October 1943. It was one of a batch of 280 Merlin 32 built at Derby as part of Air Ministry Order C/ENG/426/C.28(a) and delivered between 11 September 1943 and 17 December 1943. The 281259 number is the Air Ministry identification for the engine. Using this information, and the fact that LS473 came off the production line in November 1943, along with the other pieces of evidence the case becomes stronger for it to be an aircraft manufactured at Fairy, rather than one of the other aircraft manufactures producing the Barracuda.

7.2.5 Observations from the team at FAAM during the work on the recovered aircraft have also shown some additional indicators of an aircraft with a short life (Dave Morris, Pers. Comms.). Though both aircraft had short lives the dates for the manufacture of the engine point to the latter aircraft. LS473 was factory released on the 24 November 1943, and lost on the 6 January 1944 (**Plate 69**), giving the aircraft a life of 42 days. Additionally, amongst the recovered material from the Solent was the aircraft's arrestor hook (**Plate 26**)

showing no signs of wear or use, as might be expected on a newly delivered aircraft that has had limited use. As BV739 was built in July 1943, and lost at the end of September 1943, giving it a life of only 77 days, it is highly unlikely to have been fitted with engine number 71231.

7.3 Associated finds from the wider context of the crash site

7.3.1 Within the wider area of the crash, three anomalies (6a_pUXO_033, 042 and 056) on the boulder clearance investigations were identified as RATOGs (Rocket Assisted Take Off Gear). These were used on a number of FAA aircraft to give extra power on take-off (**Plate 101** and **Plate 102**) particularly on short aircraft carrier decks when the outgoing aircraft would be heavily laden with fuel and munitions. They ensured that the aircraft would reach take off speed, when prevailing weather conditions were poor or there was a lack of catapult or other accelerator gear available. The label on the TAG cockpit about Assisted Take-off (**Plate 63**) is referring to this process. They were in use for a short period (1944-1995), as the development of carrier based jet aircraft overcame the issue.

7.3.2 Each RATOG was made up of twin 5' rocket motors (based on the standard No.5 Mark I rocket tube with a cordite filling and fired by electrical fuses), each 1.14 m long and 0.14 m in diameter, with a connecting bracket that fitted on to the outer fuselage of the Barracuda just above the trailing edge of the wing (**Plate 102**) on both sides of the fuselage. These would burn for approximately four seconds and provide a mean thrust of 1,150 lbs. The three recovered all have the layout of fittings suggesting they were used on Fairey models- either the Barracuda or the Firefly. These units would be jettisoned from the aircraft following take off and so the discovery of some close to the end of the runway at RNAS Lee-on-Solent, where aircrew would have been trained to use them, is not unexpected.

7.3.3 One of the three units (6a_pUXO_042) was retained for conservation following certification as free from explosives while the other two were placed within the IFA2 project Archaeological Exclusion Zone.

8 CONCLUSIONS

8.1.1 The recovery of the Fairey Barracuda from the Solent as part of the development of the IFA2 interconnector project can be considered a highly successful project in terms of the combining of archaeologists and commercial recovery divers into a single team, achieving a high level of archaeological recording and recovering the aircraft in as quick and timely manner as was possible. The aim of the project as outlined in Section 1.6 were fully met due to the following reasons.

Involvement of FAAM from beginning of project

8.1.2 Prior to its recovery and the full extent of its completeness being known, there was discussion at the FAAM about the possibility of conserving the aircraft material recovered rather than using it in the reconstruction process; the latter being the preferred choice of the Barracuda restoration team. This discussion was solved once it became clear that the condition of the wreck precluded it being lifted whole or in structurally integral segments.

8.1.3 If the FAAM had not offered to take the aircraft in its entirety, the options were redeposition and burial, deposition with another museum, or its disposal following archaeological recording. Historic England was not convinced that redeposition and burial was the best outcome. In addition, no other museum had expressed interest to receive the remains.

8.1.4 The FAAM option follows the concept of 'adaptive reuse' through the deconstruction and reuse of the aircraft parts, also accepting that significant elements were beyond conservation or recovery. 'Adaptive reuse' is most commonly applied to building and landscapes, but its premise of promoting environmental, social, and economic changes, whilst encouraging innovation can all be measured in the outcome of the project and the future reuse of the aircraft.

8.1.5 The ongoing work to select and conserve as much of the original fabric of the wreck as possible is being completed by the Fairey Barracuda Restoration project team at the FAAM, and progress on this can be seen through the project Facebook page (https://www.facebook.com/FaireyBarracudaRestoration/ Accessed 28/01/2020), with regular updates on the material being posted. Their workflow follows a process of desalination within citric acid tubs, followed by deconstruction of identified parts and full cleaning through media blasting of metal components and washing of plastic/Tufnol ones. The effect of this process can be seen in **Plate 37**.

8.1.6 This work is already adding to the understanding of the wartime manufacturing process of aircraft as well as to other research questions the team at FAAM have about FAA aircraft. Further publication of the results of this work will be completed by FAAM.

The use of rapid underwater survey methods

8.1.7 The project aimed to use the ROV3D stereoscopic technology to produce real-time photogrammetric models of the wreck, enabling rapid, accurate surveys of the wreck as it was being excavated. Due to a combination of natural factors (low visibility, plankton blooms, strong tides and bleaching from surface light), this was not successful; however the principles of the technology remain appropriate to underwater surveys in other circumstances.

8.1.8 More generally rapid photogrammetry of submerged archaeological sites through multi-camera arrays, such as those used in the Black Sea MAP work completed recently (Pacheco-Ruiz *et al* 2018), is clearly the best way to quickly and accurately map sites, even in poor visibility. The return to dedicated survey dives at strategic points of the excavation with post-processing of the results by the Wessex geomatics teams later on allowed for a full plan of the site to be created, but not in time for the end of operations. Some survey dives were completed using a two camera set up on a jig with one camera pointed straight down and one at 45 degrees to speed up data collection, similarly to the five camera set up used in the Black Sea MAP project (Pacheco-Ruiz *et al* 2018).

The integration of commercial and archaeological dive teams

8.1.9 The project saw three archaeological divers (one to two present at any one time) integrated within a team of five commercial divers, all of whom were experienced surface supply divers. The experience of the commercial dive time in terms of hours underwater and rapid sediment removal was invaluable to the project progressing as it did, while the presence of archaeological divers with their experience and knowledge of recording processes, aviation archaeology and site formation processes ensured that the archaeological significance of the find was retained while additional information on the crash was recovered.

8.1.10 Without the commercial dive team, the recovery would have been considerably slower, less efficient and more costly to the client. Without the archaeological dive team, there would have been large amounts of archaeological data lost, leading to reduced information on the aircraft and its story, and a reduced significance as an archaeological artefact and dataset.

8.1.11 In its recovery, becoming an object of historical significance, rather than just a crashed aeroplane, the Barracuda's value to the wider community changes from that of a lost military aircraft to that of historic item that can help researchers understand the past, filling in the gaps in our knowledge, linking the documentary record to personal histories of events.

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Wessex Archaeology 2019c, IFA2: Interconnexion France-Angleterre: Pre-disturbance Archaeological Survey of a Fairey Barracuda aircraft crash site (6A_pUXO_003). Internal reference 202920.09.

Wessex Archaeology 2019d, IFA2: Interconnexion France-Angleterre: Method Statement for Recovery of Aircraft Material from a Fairey Barracuda (6A_pUXO_003). Internal reference 202920.10.

Willis, M., 2016. *Orange Series I The Fairey Barracuda*. MMP Books, Poland

APPENDICES

Appendix 1: MOD Covering Letter and Licence

Ministry of Defence

Defence Business Services
Joint Casualty and Compassionate Centre
Imjin Barracks
Gloucester
GL3 1HW

Tel: 01452 712612 Ext 7330 or 6303
Fax: 01452 510813
95471 Ext 7330 or 6303

Mr A Byford-Bates – **by email**
Wessex Archaeology
Portway House
Old Sarum Park
Salisbury
Wiltshire SP4 6EB

Date: 7 March 2019

Dear Mr Byford-Bates

Protection of Military Remains Act 1986

Further to your email of 4 March 2019 advising the recovery under Licence 1874 for Fairey Barracuda RK556 had taken place, however, Fleet Air Arm advised recovered wreckage in fact most probably belonged to Fairey Barracuda BV739.

Therefore, Licence 1874 has now been cancelled and Licence 1878 attached, issued for Fairey Barracuda BV739 retrospectively.

As referred to in our letter of 23 January 2019 sent with the issue of the previous licence:

- please provide the County Archaeologist: David Hopkins, email: David.hopkins@hants.gov.uk, with a copy of your report.
- complete and return the enclosed Report of Items Removed form, with photographs if possible. Please note, a copy of the completed form will be sent to the relevant County Council for their information.
- please note that any items found belong to The Crown until it is agreed by us that they will be transferred to you. Paragraph 19 of the Notes for Guidance refers.

More help or explanation

Please contact us if you have any questions

Yours sincerely

Deborah Morgan

Deborah Morgan (Mrs)
Licensing

Contact us:

Your reference:

Our reference: DBS/14/2/11

Commemorations & Licensing:

Contact Name: Deborah Morgan
Tel: 01452 712612 Ext 7330

email external:
deborah.morgan353@mod.gov.uk

Contact Name: Rosie Barron
Tel: 01452 712612 Ext 6303

This letter has been copied to:
Landowner
County Archaeologist
DIO
EOD

Enclosed:
Licence
Report of Items Removed form

04/14 **JCCC 47**

LICENCE UNDER THE PROTECTION OF MILITARY REMAINS ACT 1986

To: Mr A Byford-Bates

1 The Secretary of State, pursuant to Section 4 of the Protection of Military Remains Act ("the Act"), hereby authorises you and anyone assisting you at your request, to do anything within the area described in the Schedule to this licence ("the Area"), which would otherwise be an offence under Section 2 of the Act.

2 The authority granted by this Licence is subject to the following limitations and conditions.

3 If at any time you, or anyone assisting you, discover human remains or unexploded ordnance within "the Area":

(a) the authority granted by this Licence shall have no further effect, and accordingly all work under this Licence must cease until an officer of the Ministry of Defence tells you that it is operative again.

(b) in the case of human remains:

(i) you must forthwith telephone the Ministry of Defence (01452-712612 6303/7330), or, if you fail to get an answer, you must inform the police as soon as possible thereafter;

(ii) the remains must be treated with due respect at all times.

(iii) the presumed identity of the remains is not to be divulged to anyone, except the Ministry of Defence or the police;

(iv) no steps are to be taken to trace and notify the next of kin;

(c) in the case of unexploded ordnance:

(i) you must forthwith inform the police;

(ii) you must on no account interfere with it.

4 A report of items recovered is to be rendered to the Ministry of Defence upon completion of the recovery operation.

5 **This licence takes effect from 0001 on 07 Mar 2019 and expires at 2359 on 06 Mar 2020 unless revoked.**

Licence No: 1878

Page: 1 of 2

LICENCE UNDER THE PROTECTION OF MILITARY REMAINS ACT 1986

6. This Licence is given solely for the purposes of the Act and does not:

(a) entitle you to enter any land;

(b) affect the rights of any person (including the Crown) as owner of anything found within "the Area", or as owner of the land within "the Area";

(c) entitle you to retain anything found within "the Area";

(d) constitute a licence or consent to do anything for which licence or consent is required under any other enactment.

THE SCHEDULE

An area of land having a radius of 100 metres around OS map reference: SU455101

Issued on behalf of
the Secretary of State
for Defence

Licence No: 1878

Page: 2 of 2

Appendix 2: Recording Levels

Level	Type	Objective	Sub-Level	Character	Scope	Description
1	Assessment	A record sufficient to establish the presence, position and type of the site	1a	Indirect (desk-based)	A basic record based on documentary, cartographic or graphic sources, including photographic (including aerial photographs), geotechnical and geophysical surveys commissioned for purposes other than archaeology.	Documentary assessment/ inventory of a site, compiled at the start of work on a site, and updated as work progresses.
			1b	Direct (field)	A basic record based on field observation, walkover survey, diving inspection, etc., including surveys commissioned specifically for archaeological purposes.	Typically a 1-2 dive visit to the site (to assess a geophysical anomaly, etc.)
2	Evaluation	A record that provides sufficient data to establish the extent, character, date and importance of the site.	2a	Non-intrusive	A limited record based on investigations that might include light cleaning, probing and spot sampling, but without bulk removal of plant growth, soil, debris, etc.	Typically a 2-4 dive visit to assess the site's archaeological potential backed up by a sketch plan of the site with some key measurements included.
			2b	Intrusive	A limited record based on investigations including vigorous cleaning, test pits and/or trenches. May also include recovery (following recording) of elements at immediate risk, or disturbed by investigation	Either an assessment of the buried remains present on a site; the recovery of surface artefacts; or cleaning to inform, for ex ample, a 2a investigation.
3	*In situ*	A record that enables an archaeologist who has not seen the site to	3a	Diagnostic	A detailed record of selected elements of the site	The first stage of a full record of the site. This would include a full measured sketch

		comprehend its components, layout and sequences				of the site and a database (or equivalent) entry for all surface artefacts
			3b	Unexcavated	A detailed record of all elements of the site visible without excavation	Full site plan (ie: planning frame or equivalent accuracy) with individual object drawings, and full photo record (possibly including a mosaic or photogrammetry model)
			3c	Excavated	A detailed record of all elements of the site exposed by open excavation of part or whole of the site.	This may take the form of full or partial excavation of the site
4	Removal	A record sufficient to enable analytical reconstruction and/or reinterpretation of the site, its components and its matrix			A complete record of all elements of the site in the course of dismantling and/or excavation	
5	Intra-site	A record that places the site in the context of its landscape and other comparable sites			A complete record of all elements of the site, combined with selective recording of comparable sites and investigation of the surrounding area.	

Appendix 3: Gazetteer of Finds

Red coloured entries contained hazardous material- generally either asbestos or radium/tritium painted dials. Yellow coloured entries were either lost tags or modern finds.

Ref. no.	Material	Description
5301	Metal	Aircraft tailwheel
5302	Metal	Tailwheel bracket
5303	Metal	Push rod
5304	Brass	Filler cap or similar
5305	Copper?	Pipe- from engine?
5306	Glass	Panel or window fragment?
5307	Wood	Oval with rubber gasket around edge and bronze bolts
5308	Perspex	Curved canopy fragment
5309	Metal	Possible hydraulic cylinder or shock absorber
5310	Perspex and Metal	Canopy fragment
5311	Metal and Plastic	T-section frame with plastic label "A.M." under a crown and "REFILL"
5312	Metal	Frame fragment
5313	Metal	Bolt or spacer
5314	Metal	Long bolt or spacer
5315	Metal	Exhaust manifold
5316	Rubber	seal or belt
5317	Metal	Fragment
5318	Metal	Fragment
5319	Metal	Strut
5320	Metal	Oval panel- possibly camera access hatch
5321	Metal	T section frame fragment
5322	Metal	S/b wing upper skin fragment
5323	Metal	Frame or rib fragment
5324	Metal	Lamp socket with connecting wire
5325	Metal	Angled metal frame fragment
5326	Metal	Fragment sitting on top of s/b wing
5327	Metal	Stringer/ rib fragment
5328	Rubber	Fuel hose segment
5329	Metal	Bracket- top of s/b wing
5330	Metal	Stringer/ rib fragment

Ref. no.	Material	Description
5331	Metal	Pipe/strut section
5332	Metal	Loose skin fragments from s/b wing
5333	Metal	Frame fragment plus two pieces of Perspex sliding panel
5334	Metal	Boost gauge including radium dials
5335	Rubber	Fuel tank rubber/cloth skin from s/b wing tank
5336	Metal	Metal cylinder- left in cockpit as potential UXO
5337	Metal	S/b wing fragments
5338	Metal	S/b wing fire extinguisher
5339	Metal	S/b wing landing gear lo9ck down cradle
5340	n/a	TAG LOST FROM DIVE BOX
5341	Metal	Pitot head and bracket
5342	Metal	Aileron control strut from s/b wing
5343	Metal	Aileron weight and attached skin/frames
5344	Perspex	Perspex fragment from between s/b wing trailing edge and s/b air brake
5345	Perspex	S/b (?) under wing navigators window (complete with aluminium trim)
5346	Perspex	Window/canopy fragment
5347	Metal	S/b wing lower skin panel
5348	Metal	MODERN DIVING WEIGHT
5349	Perspex	Canopy fragment
5350	Metal	Port wing clamp faring
5351	Perspex	Canopy fragment
5352	Perspex	Canopy fragment
5353	Leather	Boot fragment
5354	Metal	Cowling piece *ASBESTOS CONTAINING*
5355	Metal	Inspection plate
5356	Metal	Engine cowling fragment
5357	Metal	Aileron framing
5358	Metal	Wing skin piece
5359	Wood	Object
5360	Metal	Cowling strengtheners
5361	Metal	Wing piece
5362	Metal	Canopy edging pieces

Ref. no.	Material	Description
5363	Metal	Wing skin
5364	Metal	Wing frames
5365	Metal	Aileron frames/skin
5366	Metal	Cable and end piece
5367	Metal	Engine pipe
5368	Metal	Interesting cowling patches
5369	Metal	Bomb crutch
5370	Metal	Bomb crutch
5371	Metal	Unassociated fragments
5372	Perspex	Perspex window fragment
5373	Metal	Hydraulic push ram
5374	Aeroplastic	TAG Seat side
5375	Aeroplastic	TAG Seat side
5376	Aeroplastic	TAG Seat base
5377	Metal	Teleflex unit
5378	Metal	Canopy ram
5379	Aeroplastic?	Economiser oxygen MKII unit cover
5380	Metal	Bomb crutch
5381	Metal	Airframe fragment
5382	Mixed	Voltage regulator unit
5383	Mixed	Radio
5384	Mixed	Valve
5385	Metal	TAG seat frames
5386	Mixed	Battery?
5387	Metal	Radio components.
5388	Mixed	TAG light.
5389	Mixed	TAG Morse key.
5390	Perspex	Canopy fragment
5391	Metal	Canopy frame fragment
5392	Metal	Possible hatch cover with bungee
5393	Metal	Fuselage skin section
5394	Metal	Airframe component
5395	Metal	Airframe component

Ref. no.	Material	Description
5396	Mixed	Radio unit (cable cut by diver)
5397	Metal	Label fragment
5398	Mixed	Foot step
5399	Metal	Filler cap surround
5400	Metal	Metal tubes (seat mount?)
5401	Mixed	Remains of radio unit
5402	Mixed	Ali joining plate with bungee
5403	Mixed	Electrical cabling
5404	Metal	Concretion
5405	Mixed	Radio component/fuse
5406	Metal	Radio cover/hatch
5407	Metal	Tube section
5408	Mixed	Contact switch
5409	Rubber	Rubber mount fragment
5410	Rubber	Rubber strip
5411	Mixed	Instrument gimbal
5412	Mixed	Loose cockpit instrument debris
5413	Mixed	Canopy frame fragment with Perspex attached
5414	mixed	Joystick
5415	Metal	Push rod
5416	Mixed	Oxygen mask
5417	Mixed	Pilots seat and mounting
5418	Metal	Concreated airframe section.
5419	Metal	Control lever base
5420	Mixed	Perspex dial front
5421	Metal	Cockpit fragments
5422	Mixed	Airframe and electrical connectors
5423	Metal	Part of undercarriage
5424	Metal	Elevator trim control wheel
5425	Metal	Fluid level gauge?
5426	Metal	Rudder trim controller wheel
5427	Mixed	Hydraulic pipe and connector
5428	Metal	Canopy frame

Ref. no.	Material	Description
5429	Mixed	Pilot seat parts
5430	Metal	Pilot seat base
5431	Metal	Fuselage/wing fragment
5432	Metal	Small Adjuster clamp
5433	Metal	Engine pipework
5434	Metal	Small section of cowling
5435	Metal	Wing or Fuselage skin & frame section
5436	Rubber	rubber seal strip with rivets
5437	Mixed	TAG radio, cables and cage
5438	Mixed	Aerial reel
5439	Mixed	Scrap bag
5440	Mixed	Smoke flat tube
5441	Mixed	Comfort bag and tube
5442	Mixed	Starboard side rear fuselage
5443	Mixed	Rear fuselage port side
5444	Mixed	Battery pieces
5445	Metal	Control rod
5446	Mixed	Control lines and fragments
5447	Mixed	Electrical items
5448	Metal	port wing spar fragment
5449	Metal	Battery tray
5450	Metal	Hydraulic tubing
5451	Metal	Firewall and electrics on forward bulkhead
5452	Metal	Electrical pieces
5453	Metal	Short section hydraulic pipe and fittings
5454	Mixed	Cable and fitting
5455	Metal	Landing gear
5456	Metal	Control connectors
5457	Metal	Control rod
5458	Plastic	Oxygen economizer box
5459	Metal	Chain and cogs
5460	Plastic	Morse tapper
5461	Metal	Chain linkage

Ref. no.	Material	Description
5462	Metal	Autopilot controls
5463	Plastic	Morse tapper
5464	Plastic	Morse tapper
5465	Plastic	Cell light
5466	Metal	clamp
5467	Metal	Oxygen splitter
5468	Metal	Oil header tank
5469	Metal	Control tube
5470	Metal	Port wing forward spar 1/3
5471	Metal	Port wing forward spar 2/3
5472	Metal	Port wing forward spar 3/3
5473	Metal	Landing gear plus frame (port wing)
5474	Metal and Perspex	port wing landing light
5475	Metal	Port wing tip skin
5476	Metal	Port wing tip skin
5477	Metal	Starboard side engine bearer *CONTAINS ASBESTOS*
5478	Metal	Port wing fragment
5479	Rubber	Hose
5480	Metal	Port wing landing gear cover
5481	Mixed	Navigation light dimmer
5482	Metal	Bomb clutch
5483	Mixed	Bomb clutch pieces
5484	Mixed	Port wing piece
5485	Mixed	Cockpit rim
5486	Metal	Oxygen cylinder
5487		TAG MISSING
5488		TAG MISSING
5489	Mixed	Port inner fuel tank
5490	Metal	Port wing rear spar
5491	Metal	Port wing trailing edge segment
5492	Metal	Rear spar catapult spool
5493	Metal	Hydraulic selector
5494	Metal	Hydraulic hand pump

Ref. no.	Material	Description
5495	Metal	Hydraulic fitting
5496	Metal	Step
5497	Plastic	Cockpit hydraulic accumulator
5498	Metal	Fuel pump
5499	Mixed	Landing gear emergency handle
5500	Metal	Skin and frame fragments from around s/b wing air brake
5501	Metal	S/b wing air brake
5502	Metal	S/b wing air brake control arm (fragment cut off to allow lift)
5503	Metal	Grease nipple
5504	Metal	S/b wing skin and frame fragments
5505	Fabric	Jumper (wool?) fragments
5506	Metal	Rear spar from s/b wing (1 of 2)
5507	Metal	s/b wing fuel tank and underwing skin fragments
5508	Metal	s/b wing lower skin and attachment
5509	Metal	s/b wing bomb clutch
5510	Metal	s/b wing fragment
5511	Metal	s/b wing tubing fragment
5512	Metal	Rear spar from s/b wing (2 of 2)
5513	Metal	S/b wing inboard fuel tank frames
5514	Metal	S/b wing fragment
5515	Metal	S/b wing frames
5516	Metal	S/b wing bomb clutch
5517	Metal	S/b wing skin pieces
5518	Metal	S/b wing stringers
5519	Metal	S/b wing inboard fuel tank part 1/2
5520	Metal	S/b wing inboard fuel tank part 2/2
5521	Metal	S/b wing front spar 1/3
5522	Metal	S/b wing front spar 2/3
5523	Metal	S/b wing front spar 3/3
5524	Metal	S/b wing lower wing skin panel
5525	Metal	Double pipework piece
5526	Metal	Fuel tank panel
5527	Metal	Cross-shaped wing fragment with connector

Ref. no.	Material	Description
5528	Metal	Fuel tank corner/frame
5529	Metal	S/b Youngman's flap cover
5530	Metal	S/b wing bomb clutch
5531	Metal	S/b wing piece
5532	Metal	S/b wing piece
5533	Metal	S/b wing halved cylinder
5534	Wood	Bevelled wood runner + screws
5535	Metal	S/b wing piece
5536	Metal	S/b wing piece
5537	Metal	S/b wing skin fragments
5538	Metal	S/b wing pipe
5539	Metal	S/b wing bomb clamp
5540	Plastic + metal	Electric cable from s/b wing
5541	Metal	Port wing Youngman's flap channel
5542	Perspex	Canopy fragment
5543	Metal	Port wing fragments from sieve
5544	Metal	Wiring and frame fragment
5545	Leather	Boot sole and fragments
5546	Metal	Aileron trailing edge fragments
5547	Leather	Boot mid sole
5548	Plastic	choc bloc piece
5549	Metal	Aileron frames
5550	Metal	Port wing skin and frame pieces
5551	Fabric	Port wing aileron fabric
5552	Metal	Port wing aileron tube piece
5553	Metal	Port wing skin and structural pieces
5554	Metal	Port wing aileron control rods
5555	Metal	Port wing stringer with paint
5556	Metal	Port wing aileron edge rails
5557	Metal	Port wing end frame
5558	Metal	Port wing fuel tank frame fragment
5559	Metal	Port wing fragment
5560	Metal	Port wing aileron torque tube

Ref. no.	Material	Description
5561	Metal	Reduction gearbox (90deg) aileron
5562	Metal	Aileron and trim tab piece
5563	Metal	Port wing inboard fuel tank fire extinguisher
5564	Metal	Port wing sieve scraps of ski
5565	Leather	Boot fragments
5566	Metal	Electrical choc box
5567	Metal	Port wing clamp
5568	Rubber	Port wheel tyre
5569	Rubber	Port wheel inner tube
5570	Metal	Sieve stringer and frame fragments
5571	Plastic	Electrical pieces on plastic board
5572	Metal	S/b engine cowling panel
5573	Metal	S/b engine cowling panel
5574	Metal	Coolant pipe
5575	Metal	Drive shaft piece
5576	Metal	Knuckle joint
5577	Metal	Electric relay box
5578	Metal	Panel and skin pieces (s/b engine)
5579	Perspex	Navigators canopy
5580	Metal	Engine skin scraps
5581	Metal	Engine vent
5582	Plastic	Tuffex mould
5583	Rubber	Tubing
5584	Metal	Knuckle from control rod
5585	Metal	Engine exhaust cowling *ASBESTOS CONTAINING*
5586	Metal	Engine exhaust cowling *ASBESTOS CONTAINING*
5587	Metal	Engine cowling pieces
5588	Metal	Engine piece
5589	Metal	Engine piece
5590	Metal	Engine inspection plate
5591	Metal	Engine exhaust plate *ASBESTOS CONTAINING*
5592	Metal	Engine exhaust cowling *ASBESTOS CONTAINING*
5593	Metal	Radiator chain and cog

Ref. no.	Material	Description
5594	Metal	Engine piece *ASBESTOS CONTAINING*
5595	Rubber	Engine pipe
5596	Metal	Sieve scraps of skin and frame
5597	Metal	Cowling pieces from engine
5598	Metal	Cowling pieces from engine
5599	Rubber	Engine clip
5600	Metal	Engine clip
5601	Metal	Throttle linkage
5602	Metal	Cooling duct
5603	Metal	Engine pipe
5604	Metal	Engine oil pipe
5605	Metal	Water cooling system
5606	Metal	Starboard magneto
5607	Metal	Water pipe from header tank to pump
5608	Metal	Engine pipework
5609	Metal	Engine cowling frame port side *ASBESTOS CONTAINING*
5610	Metal	Part of cooling system
5611	Metal	Engine cowling fragments
5612	Metal	Oil tank/cowling fragments
5613	Metal	Merlin Engine
5614	Metal	Coffman starter block bolts
5615	Metal	Starboard engine bearer
5616	Tufnell	Tufnell pipe block
5617	Metal	Engine solenoid
5618	Metal	Starter breach cocking pulley
5619	Metal	Coffman starter
5620	Metal	Starter cartridges x 3 with firing pin
5621	Metal	Engine copper pipe
5622	Metal	Engine copper pipe
5623	Metal	Engine copper pipe
5624	Metal	Thin engine pipe
5625	Metal	Piece of chain
5626	Metal	Inspection plate ring

Ref. no.	Material	Description
5627	Rubber	Gasket
5628	Metal	Carburettor
5629	Metal	Hydraulic pump
5630	Metal	Engine rod work
5631	Metal	Engine cowling
5632	Metal	Engine piece
5633	Metal	Engine piece
5634	Metal	Metal ring
5635	Metal	Oil pump and hose
5636	Metal	Ribbed pipe
5637	Metal	Cowling pieces
5638	Metal	Cowling pieces
5639	Metal	Engine piece
5640	Metal	Cowling frame strip *ASBESTOS CONTAINING*
5641	Metal	Cowling strips
5642	Metal	Cowling frame strip *ASBESTOS CONTAINING*
5643	Metal	Engine tube
5644	Metal	Engine cowling frame
5645	Metal	Gear wheel
5646	Metal	Bulkhead block
5647	Metal	3/4 brass nipple
5648	Bakelite	Connector cap
5649	Metal	Hydraulic connector
5650	Fibreglass	TAG seat back
5651	Leather	Seat cover
5652	Bakelite	Light fitting
5653	Metal	Frame fragment
5654	Tufnol	Block
5655	Bakelite	Electrical connector
5656	Wood	Two wood fragments
5657	Bakelite	Electrical Connection Box
5658	Mixed	Possible pull handle for canopy.
5659	Mixed	Gyrocompass.

Ref. no.	Material	Description
5660	Metal	Arrestor Hook
5661	Metal	Airframe aft of rear cockpit
5662	Metal	Ram
5663	Metal	Control Rod
5664	Metal	Control Rod
5665	Metal	Tail plane tube
5666	Metal	Angle bracket from airframe
5667	Metal	Tin container
5668	Metal	Longeron section/stringer
5669	Metal	Possible trim tab
5670	Metal	half section of strut
5671	Metal	Bell crank assembly
5672	Metal	Airframe section from rear fuselage
5673	Mixed	Light unit
5674	Metal	Aluminium label
5675	Mixed	Junction box
5676	Metal	Red warning disk
5677	Metal	Pulley block/fairlead
5678	Metal	Electrical contactor (Morse code key?)
5679	Metal	Control rod ball receiver.
5680	Rubber	Rubber seal fragment
5681	Metal	Cable conduit fragment
5682	Metal	Control rod fragment
5683	Metal	Hydraulic 'T' piece
5684	Metal	Hydraulic 'T' piece
5685	Metal	Electrical fitting with text
5686	Metal	Tube section with connector
5687	Perspex	Opening section of navigator’s window
5688	Metal	Hydraulic pipes and connectors
5689	Metal	Circular access panel
5690	Rubber	Rubber window surround
5691	Metal	Circular access panel and surround
5692	Bone	Animal Bone

Ref. no.	Material	Description
5693		TAG MISSING
5694	Metal	Seat harness fastener
5695	Metal	Aircraft fitting/frame end
5696	Metal	Hydraulic piping
5697	Mixed	Electrical plug and cable
5698	Metal	Portside cockpit framing
5699	Metal	Starboard side cockpit framing
5700	Metal	Port and Starboard wing stubs and cockpit centre framing
5701	Metal	Landing gear
5702	Mixed	Fragment
5703	Metal	Wing skin
5704	Metal	Wing skin
5705	Metal	Youngman flap jack
5706	Metal	Aileron torque tube
5707	Metal	Aileron tube
5708	Perspex	Observers side canopy
5709	Metal	Bomb cradle
5710	Metal	Cockpit countershaft
5711	Metal	Observers compass mount
5712	Metal	Bomb cradle
5713	Fabric	Aileron fabric
5714	Metal	Trailing edge
5715	Metal	Main fuselage and port wing SCRAP BAG
5716	Metal	Armament socket
5717	Metal	Electrical fitting
5718	Metal	Fuel sensor off firewall
5719	Metal	Hand held fire extinguisher bracket
5720	Metal	Cockpit control
5721	Metal	Access panel
5722	Metal	Throttle block
5723	Metal	Hydraulic pipe
5724	Mixed	Electrical component and radio
5725	Metal	Hydraulic pipe

Ref. no.	Material	Description
5726	Metal	Stiffening piece
5727	Metal	Verey pistol holster
5728	Metal	De-icer tank
5729	Metal	Seat post
5730	Metal	Aerial
5731	Perspex	Perspex cover panel
5732	Rubber	Strap for rudder pedal
5733	Mixed	Battery parts
5734	Mixed	Radio valves and components
5735	Metal	Bomb clutch
5736	Mixed	Tufnol blocks
5737	Mixed	Lamp holder
5738	Metal	Brass lock
5739	Mixed	Tube with possible light fitting
5740	Mixed	Light fitting
5741	Bakelite	Dimmer switch
5742	Tufnol	Smoke bomb tube
5743	Metal	Rudder pedals
5744	Metal	Wing frames
5745	Metal	Flight control rod
5746	Rubber	Rubber seal fragment
5747	Metal	Wing box section fragment
5748	Metal	Control arm
5749	Mixed	Oxygen economiser box
5750	Mixed	Outboard fuel tank port wing
5751	Rubber	Rubber radar viewing tube
5752	Mixed	Camera film and possible camera leather
5753	Leather	Rudder pedal strap
5754	Mixed	Interesting bits from the sieve during artefact search post-lift
5755	Mixed	Interesting leather/organics from the sieve during artefact search
5756	Metal	Box section
5757	Metal	Air vent
5758	Mixed	Varied electrical pieces

Ref. no.	Material	Description
5759	Mixed	Ram
5760	Rubber and metal	Tube- possibly comfort tube
5761	Metal	Bomb clutch
5762	Mixed	Perspex canopy pieces
5763	Metal	Tubing and rams
5764	Metal	Control arms
5765	Metal	Ram
5766	Mixed	Engine cowling strips *ASBESTOS CONTAINING*
5767	Leather	Leather objects-possibly part of camera casing
5768	Leather	Boot sole and fragments
5769	Glass	Radio valve in case
5770	Metal	Control panel minus gauges
5771	Metal	Canopy rim
5772	Metal	Front spar starboard wing ID plate
5773	Rubber	Edging strip
5774	Metal	Skin and frames
5775	Metal	Bomb clutch
5776	Metal	Fragment
5777	Metal	Triangular frame
5778	Metal	Fragment
5779	Metal	Fuel tank piece
5780	Metal	Fragment
5781	Metal	Box section and bits
5782	Metal	Possible aileron
5783	Metal	Brass cogs and mechanism
5784	Plastic	Barracuda model (fragments)
5785	Mixed	11 x radium dials *DISCARDED*

Appendix 4: Site Risk Assessment

Wreck/Site Name	**Mk. II Fairey Barracuda**		
NRHE / UKHO No.	EH Region	Restricted Area	Principal Land Use
	South East	N/A	Coastland 1 Marine
Latitude (WGS84)			
Longitude (WGS84)			
Class Listing	Period	Status	
Unknown	WWII	C Protection of Military Remains Act 1986	
Licensee		Principal Ownership Category	
None		C MOD/Crown	
Seabed Owner	Navigational Administrative Responsibility		
The Crown Estate	QHM Portsmouth		
Environmental Designations			
NONE			
Seabed Sediment	Energy		
OT	High		
Survival			
Medium (41-60% survival).			
Overall Condition	Condition Trend	Principal Vulnerability	
C Generally satisfactory	B Declining	TRAWL/MECH/DEV	
Amenity Value: Visibility			
A			
Amenity Value: physical accessibility	Amenity Value: intellectual accessibility		
A	C		
Management Action	B, action implemented		
Management Prescription	N, other		
Notes:			
The aircraft was excavated and recovered with guidance from Wessex Archaeology and the Fleet Air Arm Museum			
Risk is assessed as:	**High**		
Data Source	**CON**	**Date & Initials**	**ABB 25.07.19**

Appendix 5: OASIS record form

Project Details:

Project name	IFA2 Retained Archaeologist		
Project code	**202920**		
OASIS ID	**Wessexar1-xxxx**		
Type of project	**Excavation**		
Project description	**Excavation and recovery of a WW2 aircraft from the Solent**		
Project dates	**Start: 22.09.2018**	**End: 31.10.2020**	
Previous work	**Yes**		
Future work	**No**		
Site status	**Protected under the Protection of Military Remains Act 1986**		
Land use	**Marine**		
Monument type	**Aircraft crash site**	**Period**	**Modern**

Project Location:

County	**Hampshire**	**District**	**Maritime**	**Parish**	**maritime**
Site name	**IFA2 Fairey Barracuda excavation and recovery**				
Study area (m²)	**500**				
Site co-ordinates	**Easting 625187.5 Northing 5629866**				

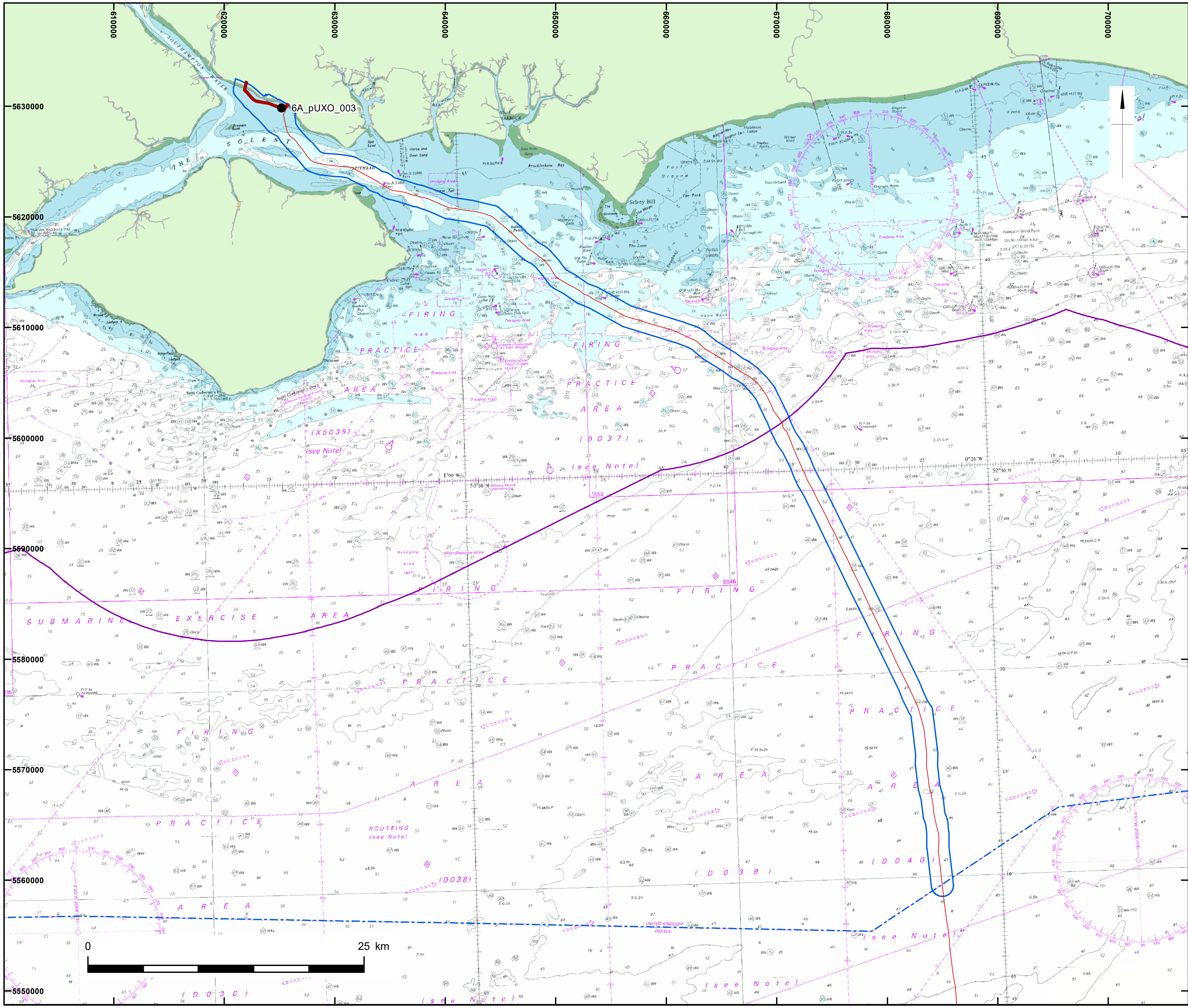
Project Creators:

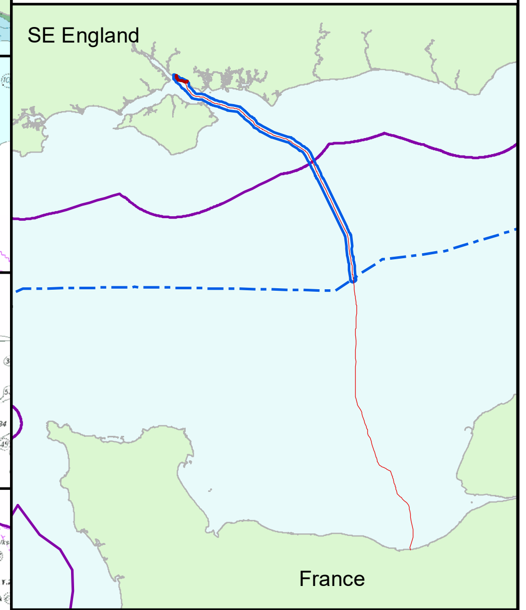
Name of organisation	**Wessex Archaeology**		
Project brief originator	**IFA2**	**Project design originator**	**Wessex Archaeology**
Project manager	**AEM**	**Project supervisor**	**ABB**

Project Archive and Bibliography:

Physical archive	Deposited with FAAM	**Digital archive**	Photos, video, and reports	**Paper archive**	Field records
Report title	IFA2: The Excavation and Recovery of a MKII Fairey Barracuda from the Solent, Hampshire			**Year**	**2019**
Author	Wessex Archaeology	**Place of issue**	**Salisbury**	**Report ref.**	**202920.14**

Appendix 6: Metashape processing report





HVDC route

HVAC corridor

Wider Study Area (WSA) – 1 km buffer

UK-France Median Line

UK Territorial Seas

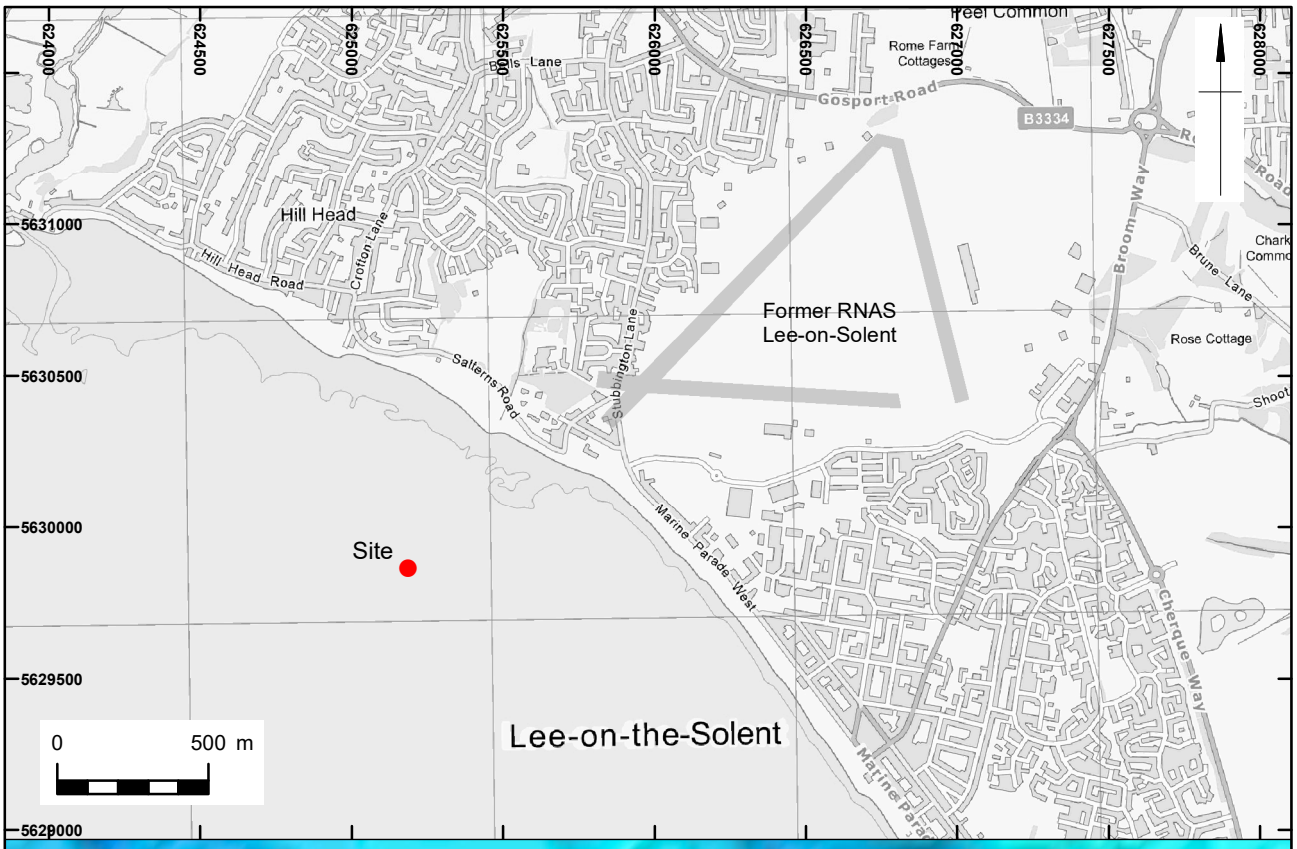
Wreck

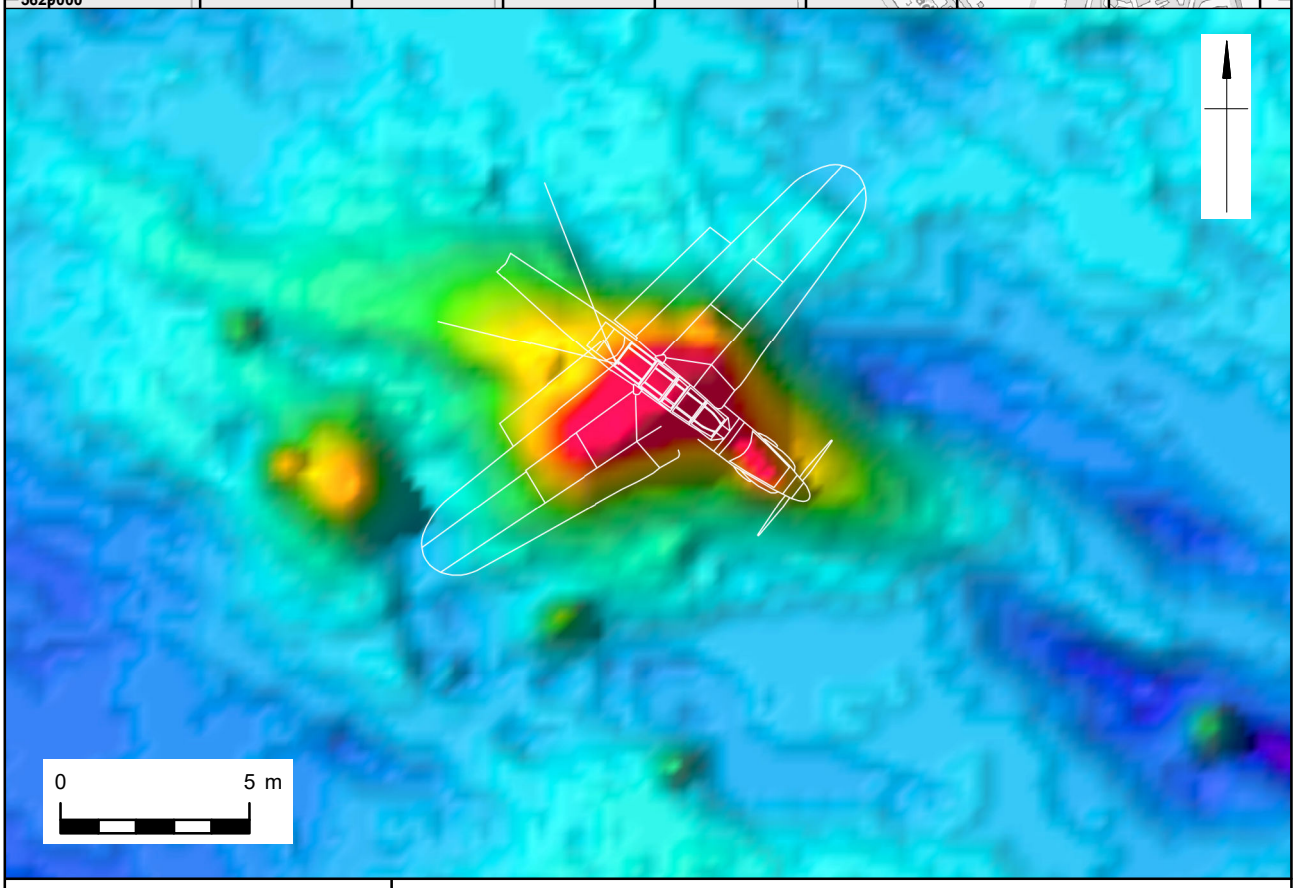
Coordinate system:
wGS84 UTM Zone 30N

Date:	27/03/2019
Revision Number:	0
Scale:	1:350,000 at A3
Illustrator:	KL
Path:	W:\Projects\202920\GIS \FigsMXD\Barracuda\2019_03_27

Cable corridor for the HVAC route showing aircraft site

Figure 1





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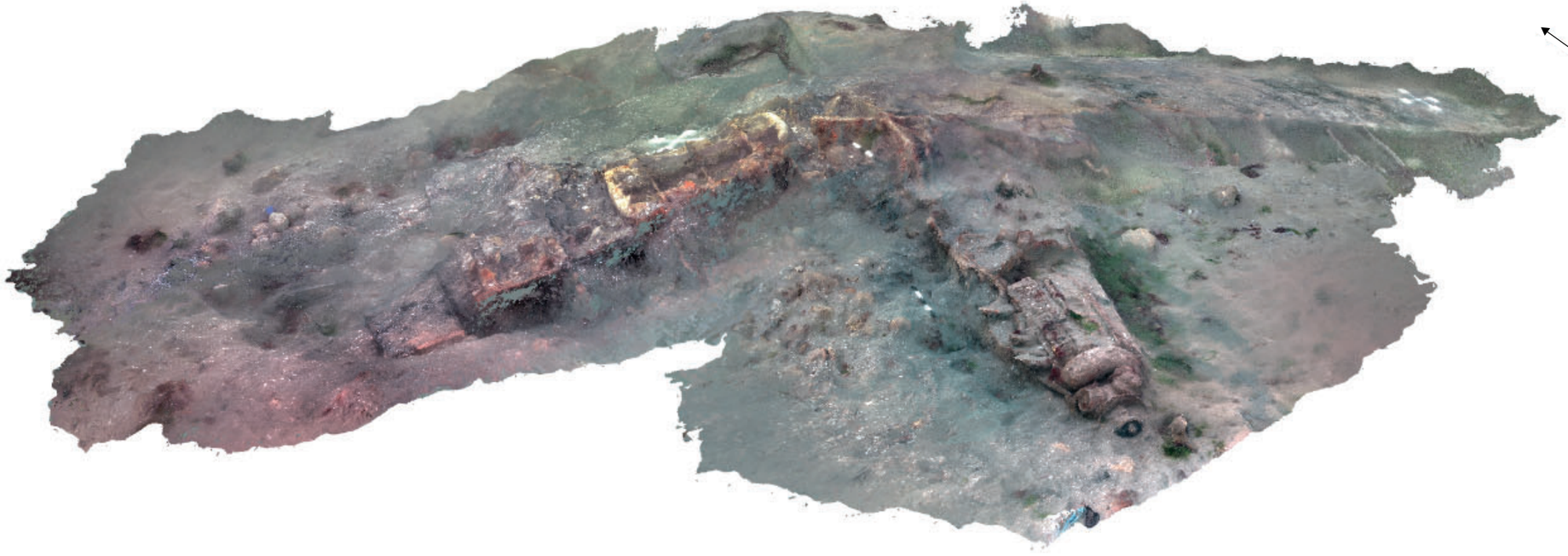
Path:	W:\Projects\202920\GIS\FigsMXD\Barracuda\2020_01_29		

Coordinate system:
wGS84 UTM Zone 30N

Location and orientation of aircraft wreck in relation to former RNAS Lee-on-Solent (with MBES image of site pre-excavation)

Figure 2



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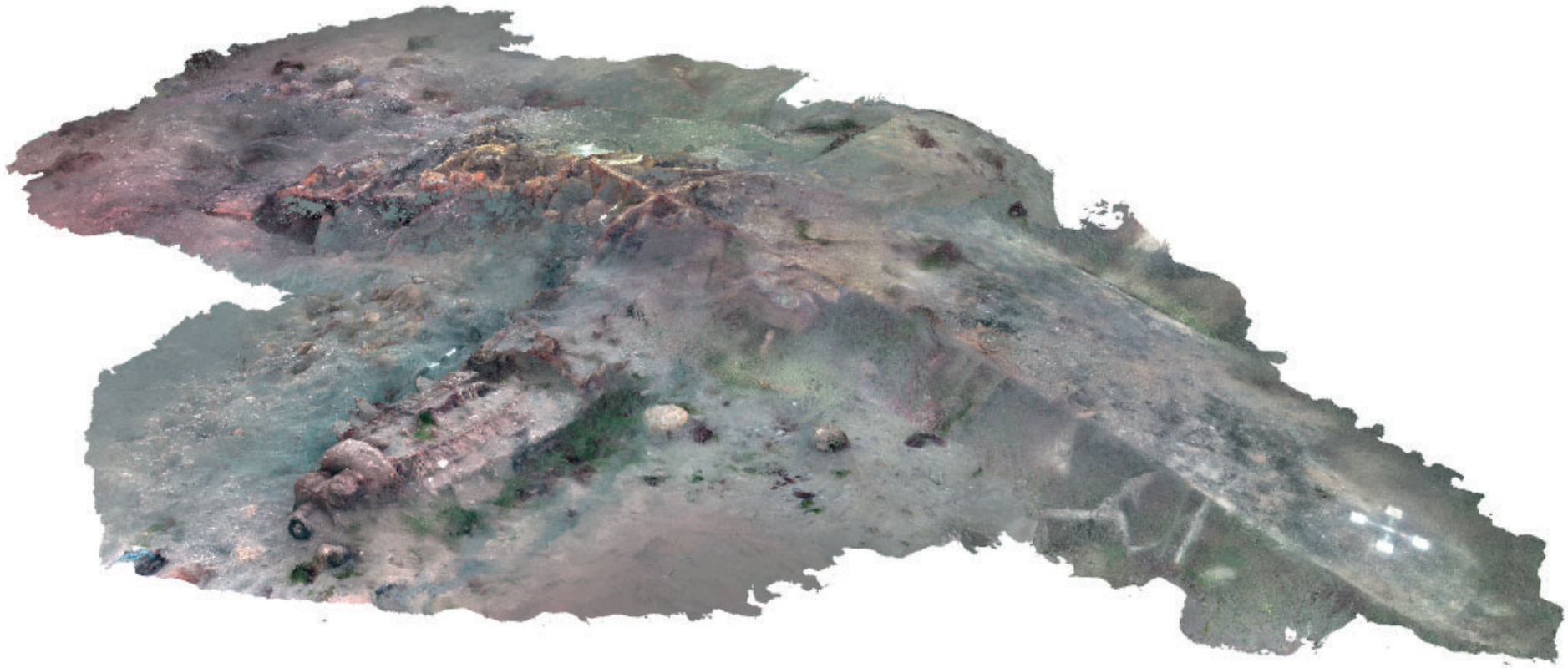
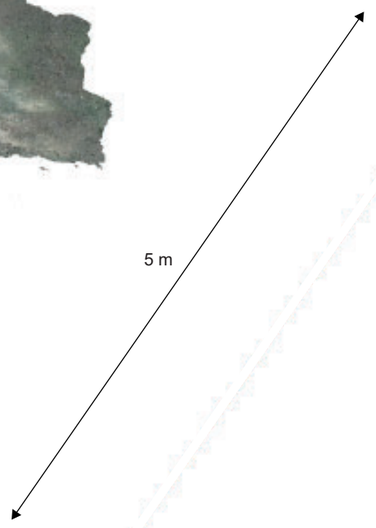
Photogrammetric model of Fairey Barracuda wreck after extents excavation, looking northwest

Figure 3





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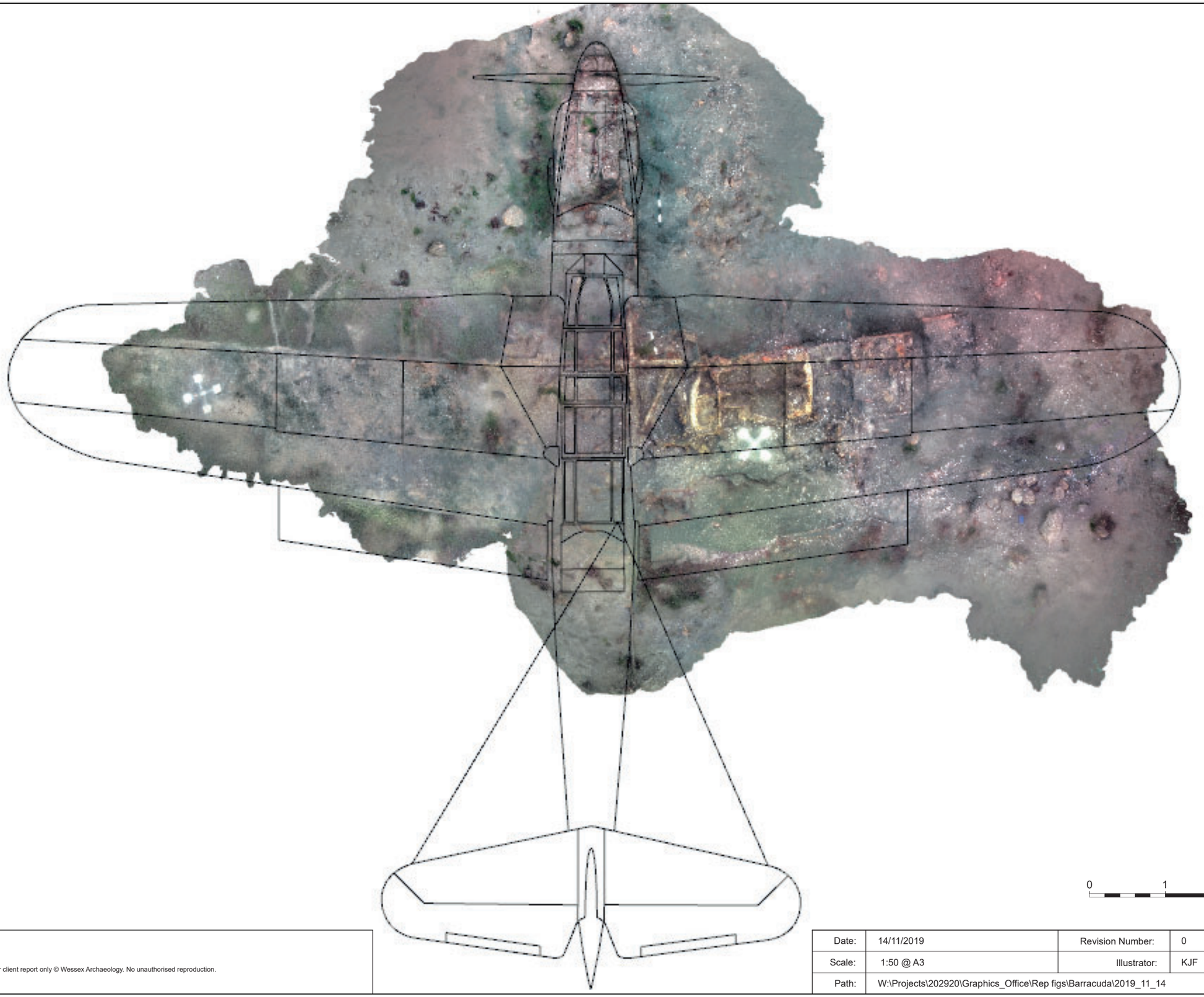
Photogrammetric model of Fairey Barracuda wreck after extents excavation, looking west

Figure 4



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Photogrammetric model of Fairey Barracuda wreck after extents excavation from above with Barracuda outline

Figure 5

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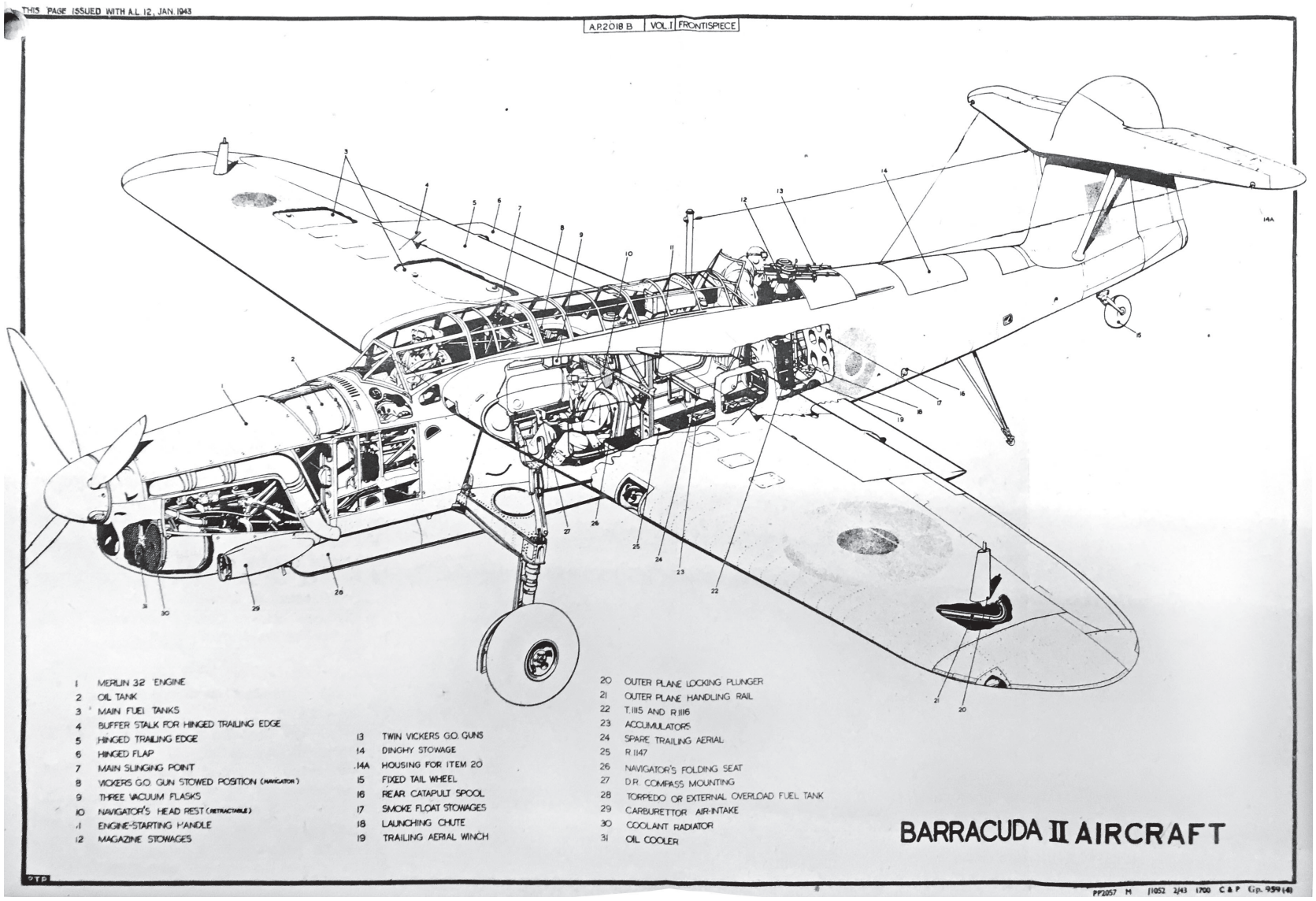
Path:	W:\Projects\202920\Graphics_Office\Rep figs\Barracuda\2019_11_14		

Untextured photogrammetric DEM of Fairey Barracuda wreck after extents excavation from above with Barracuda outline

Figure 6



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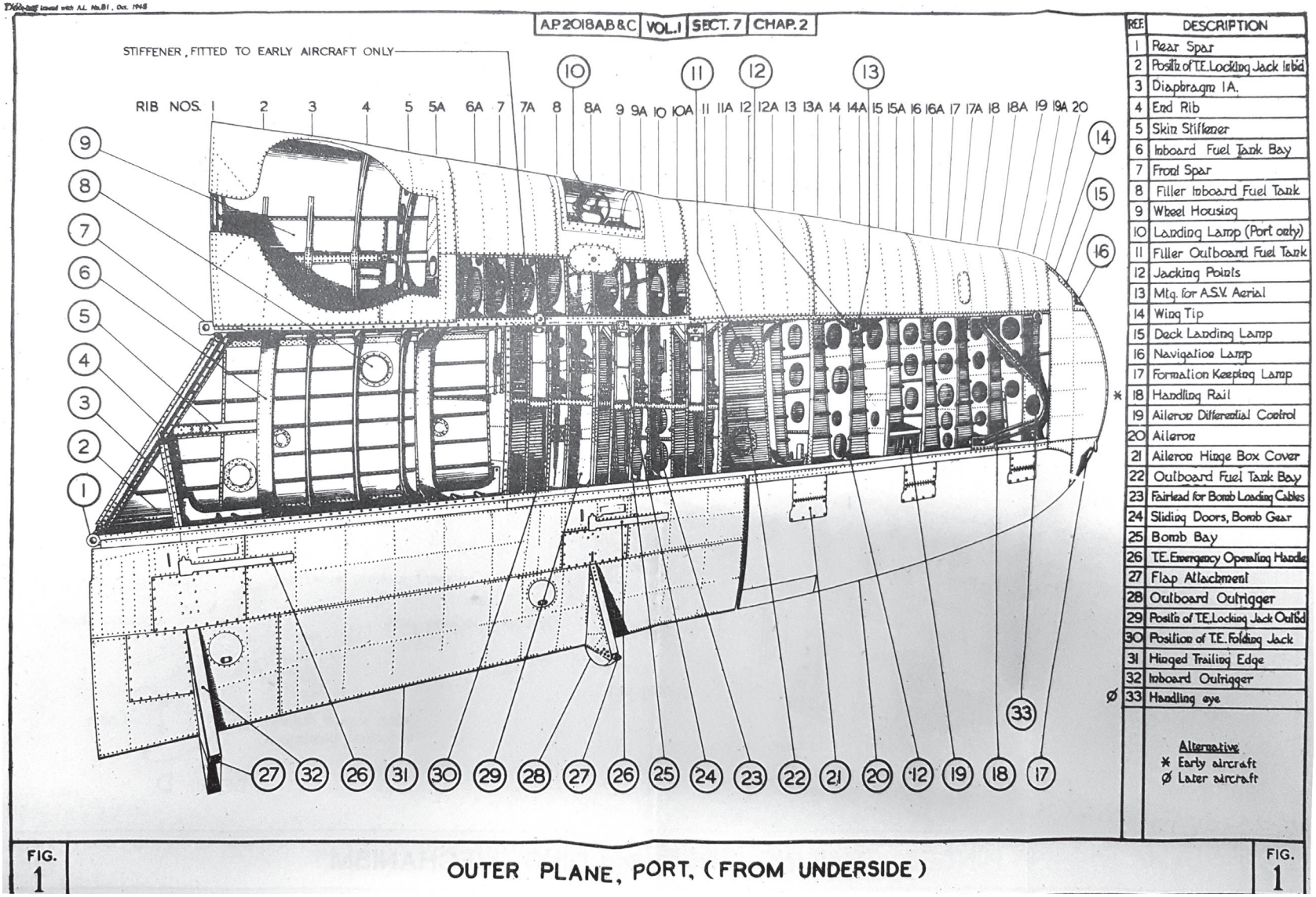
Schematic drawing of Mk II Barracuda (from National Archives AIR10/4448)

Figure 7



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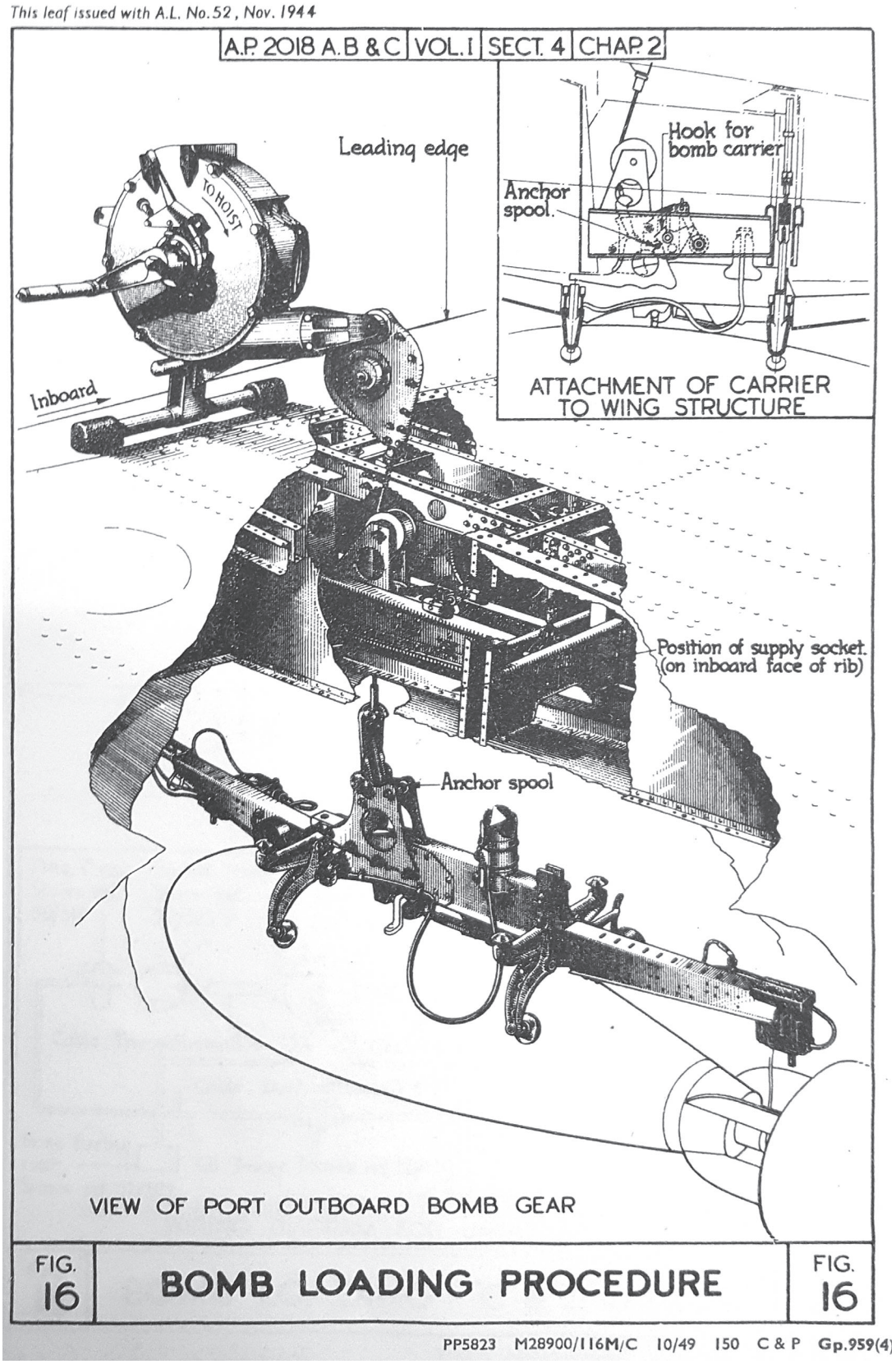
Barracuda wing (Port) with cutout elements (from National Archives AIR10/4448)

Figure 8



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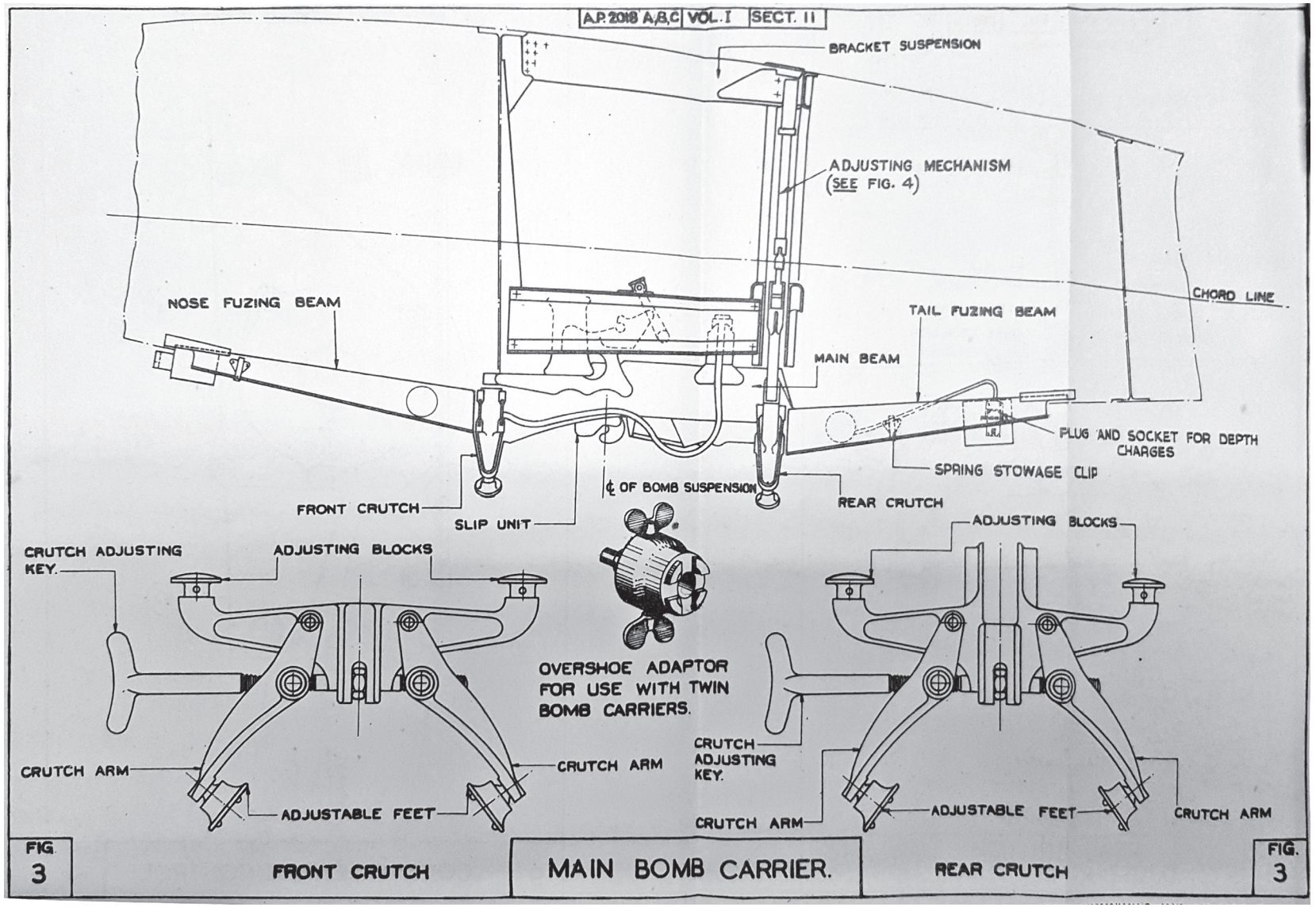
Bomb loading system (from National Archives AIR10/4448) Figure 9



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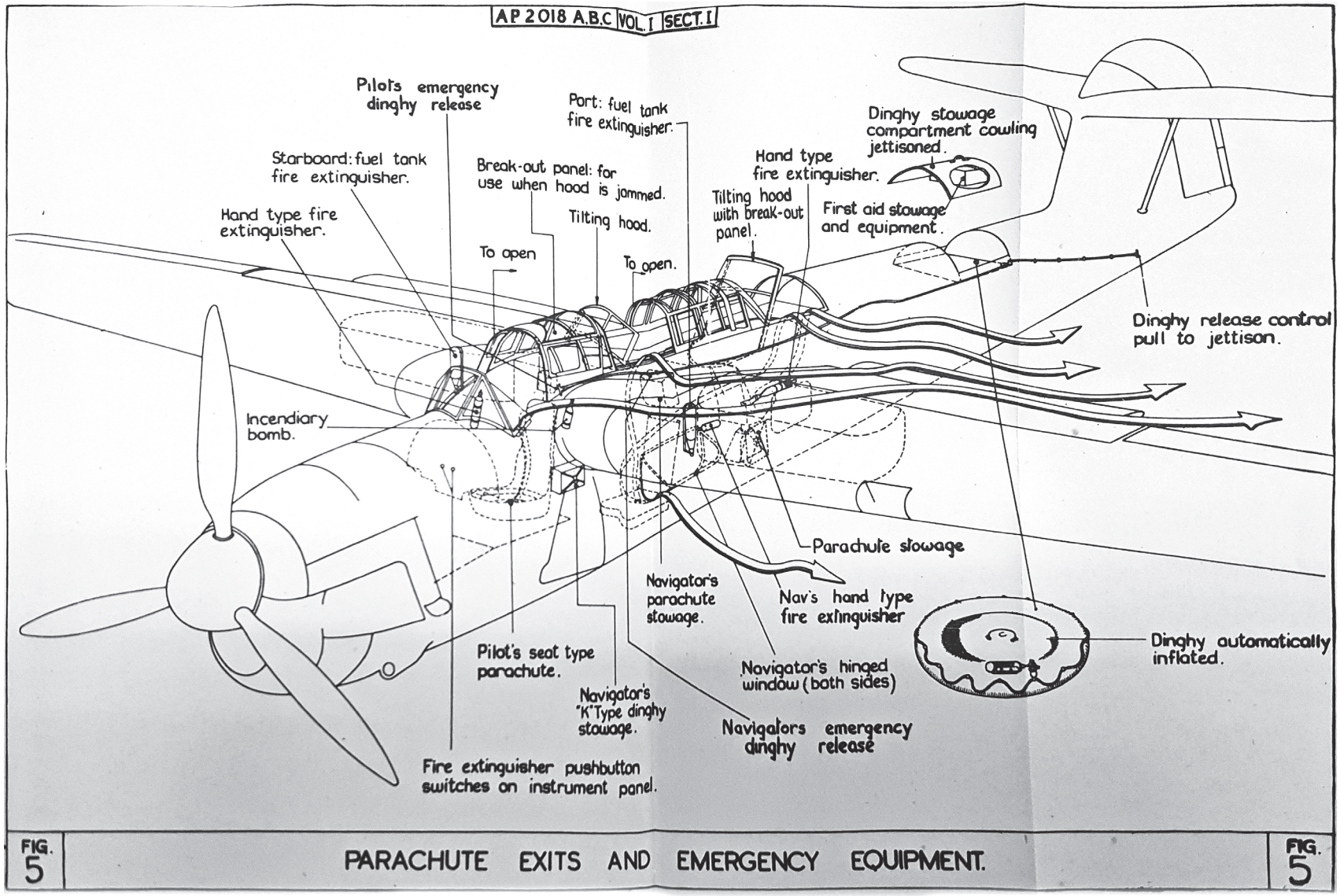
Detail of bomb clutch and bomb release system (from National Archives AIR10/4448)

Figure 10



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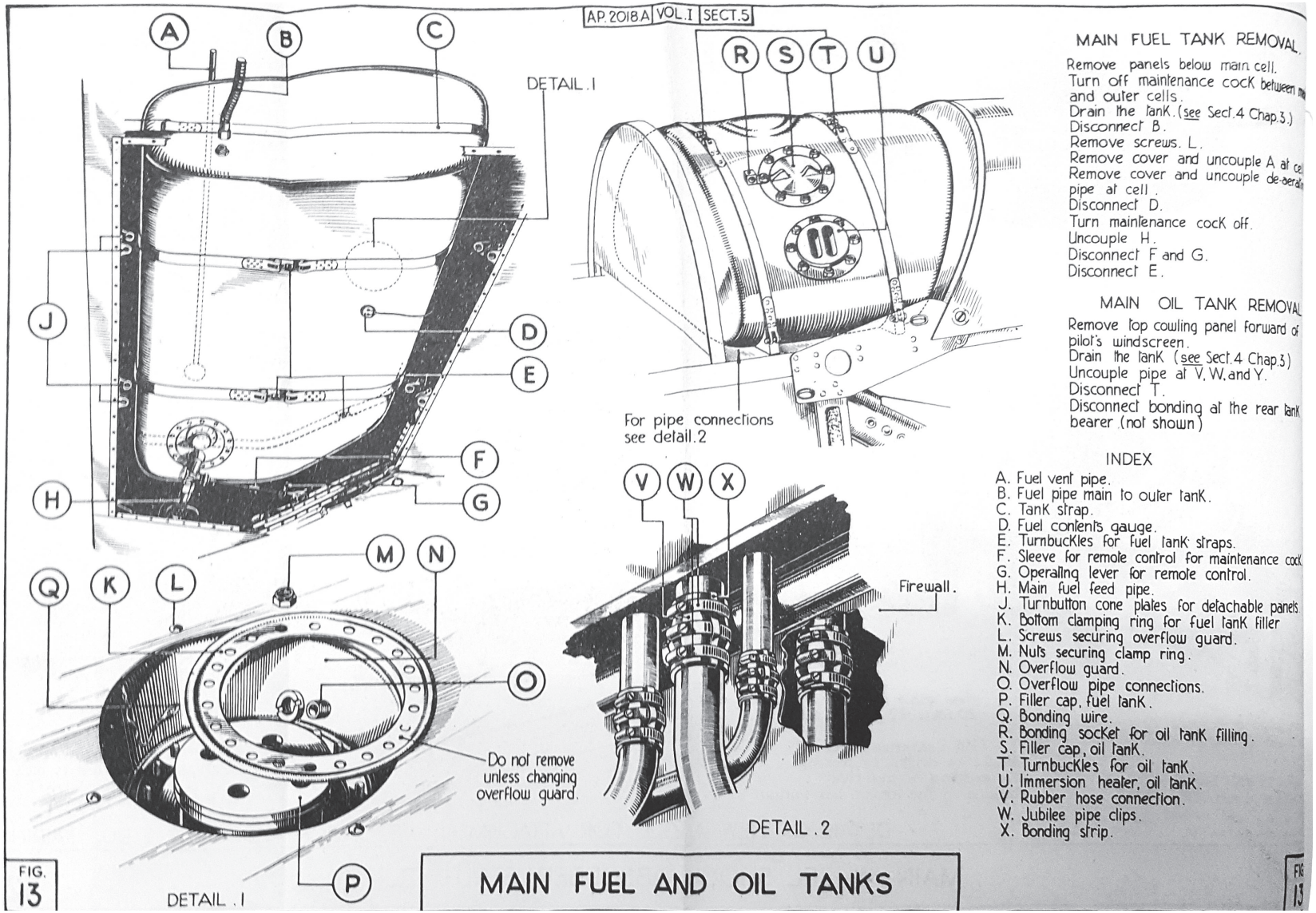
Fairey Barracuda emergency systems (from National Archives AIR10/4448)

Figure 11



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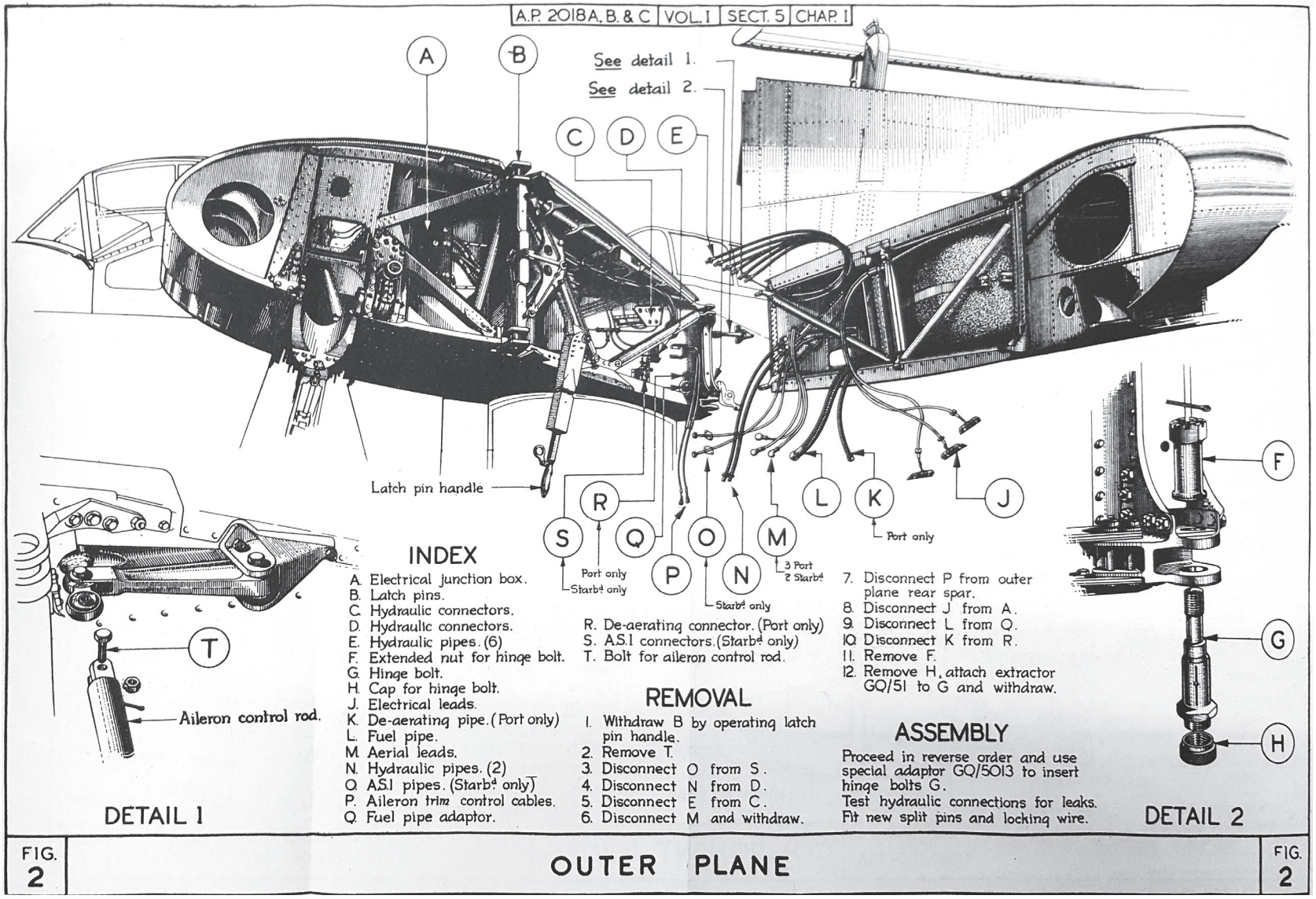
Fuel tank construction and layout (from National Archives AIR10/4448)

Figure 12



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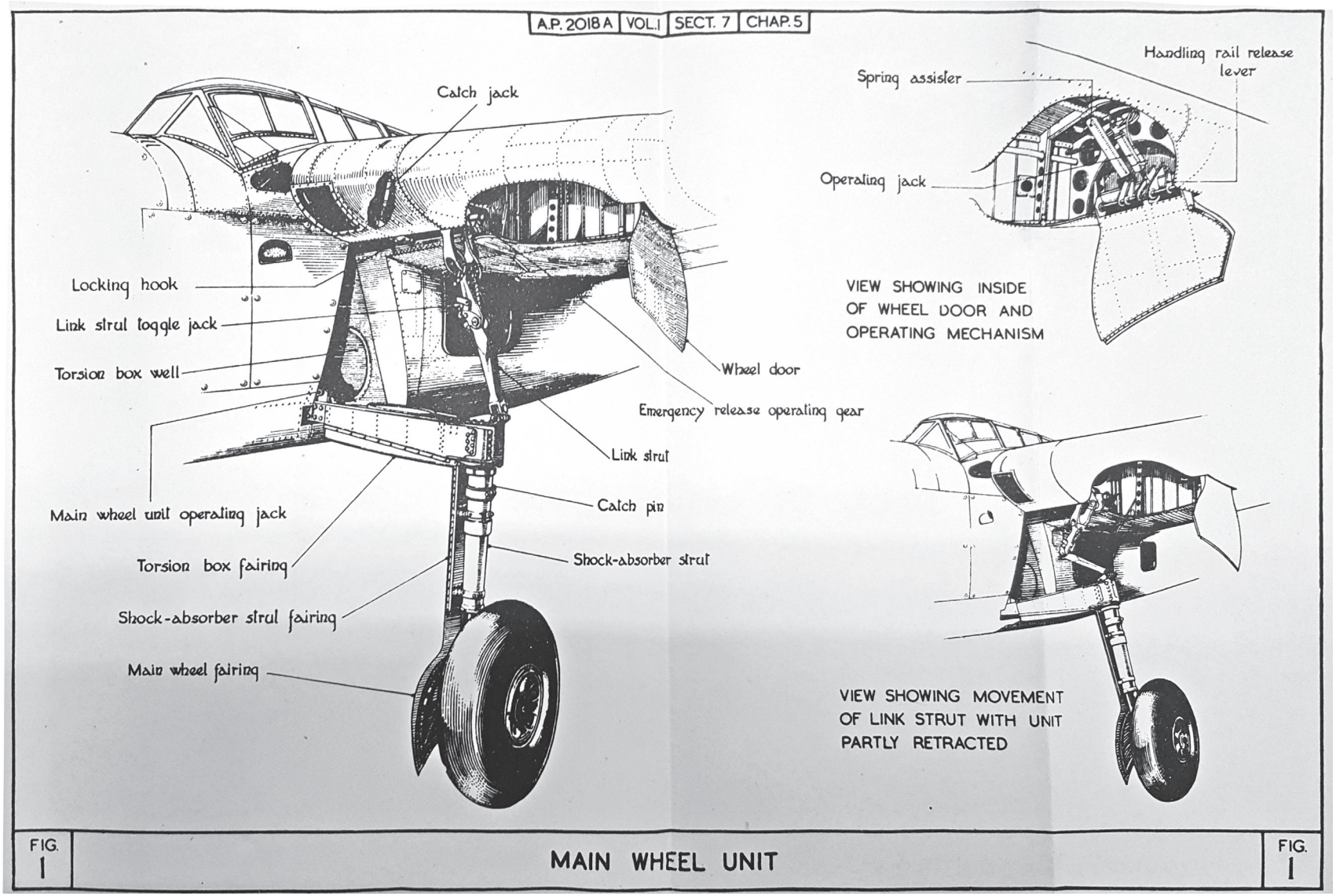
Detail of wing connection to wing stub (from National Archives AIR10/4448)

Figure 13



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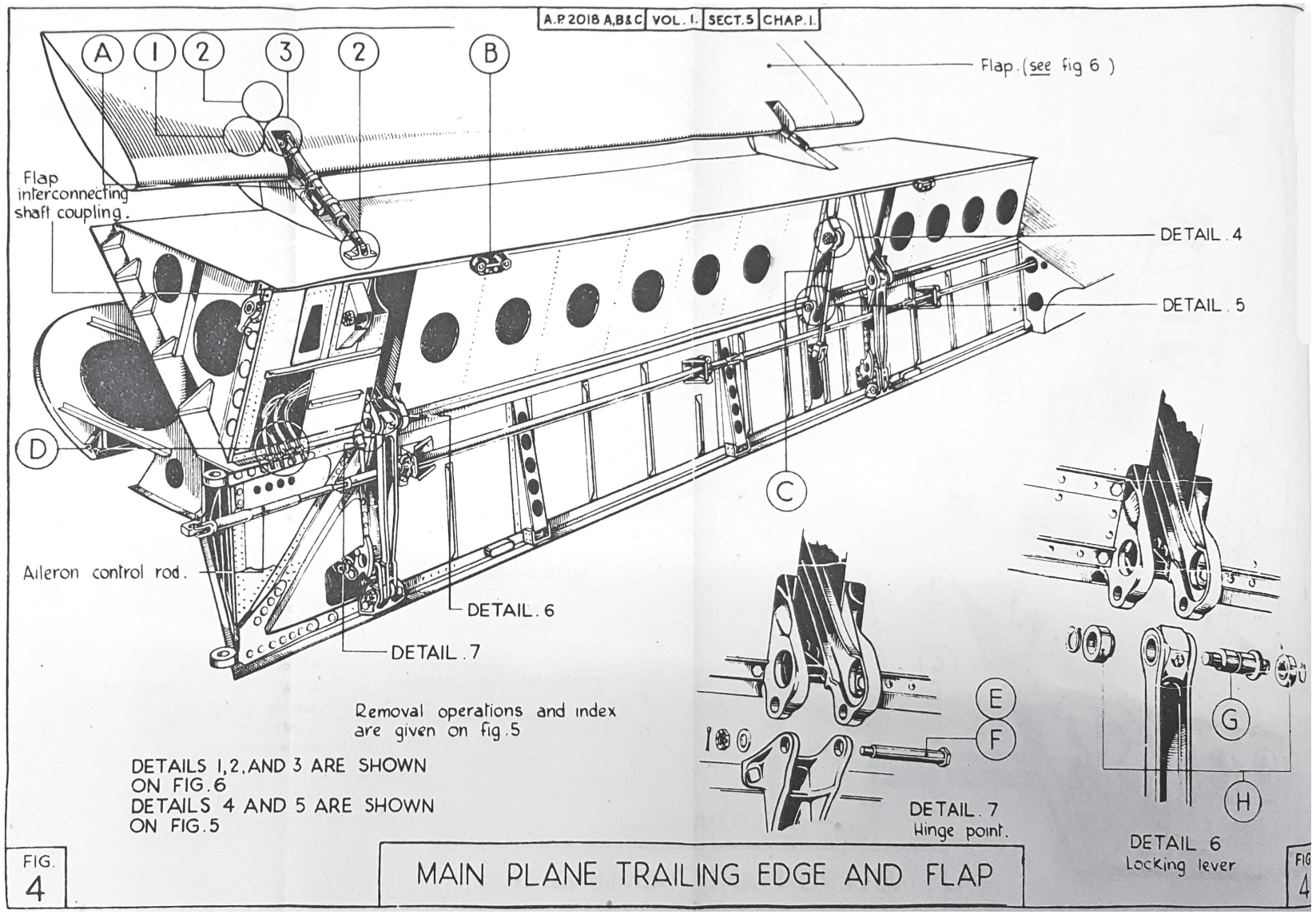
Details of port landing gear (from National Archives AIR10/4448)

Figure 14



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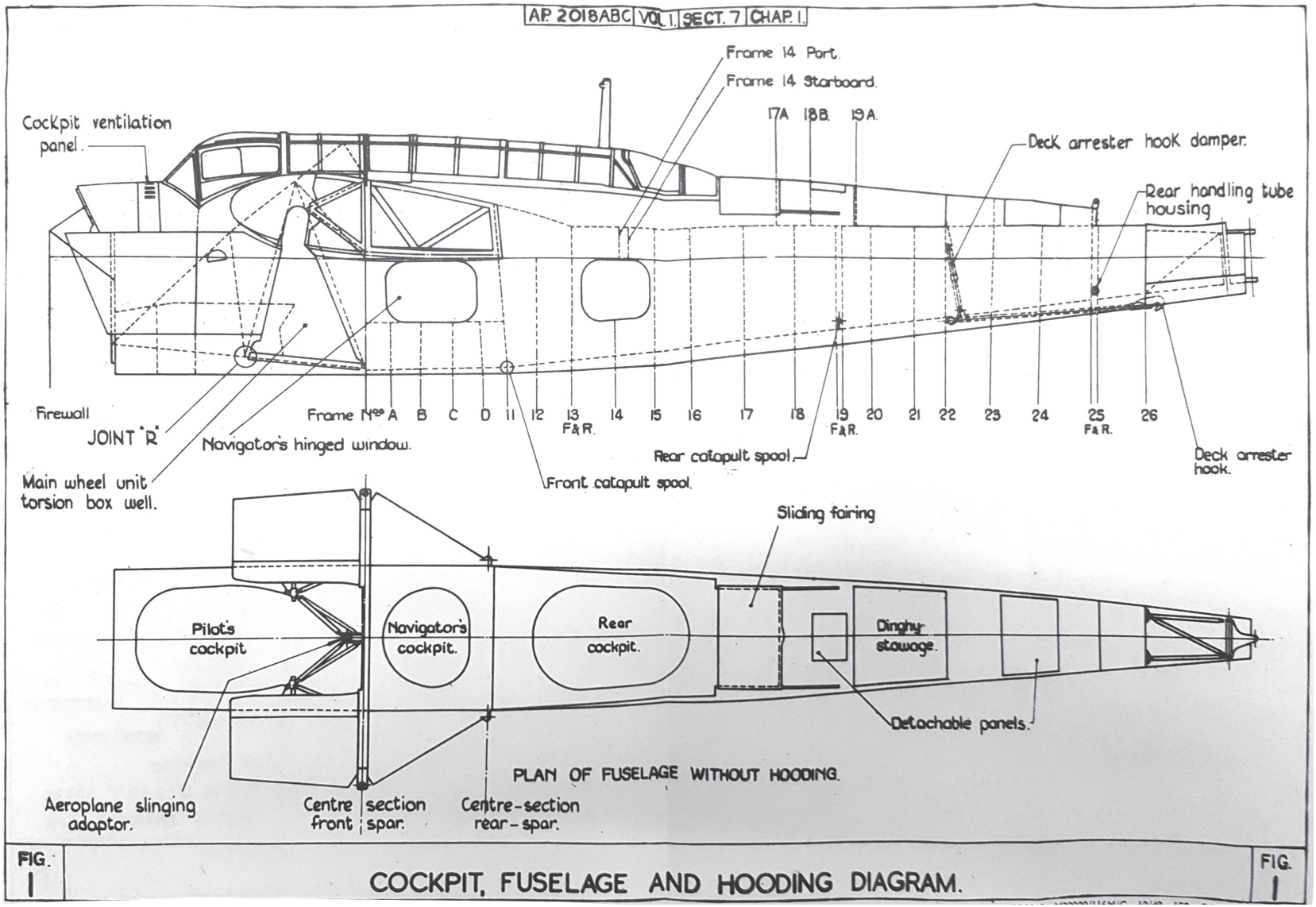
Details of folding trailing edge of wing (from National Archives AIR10/4448)

Figure 15



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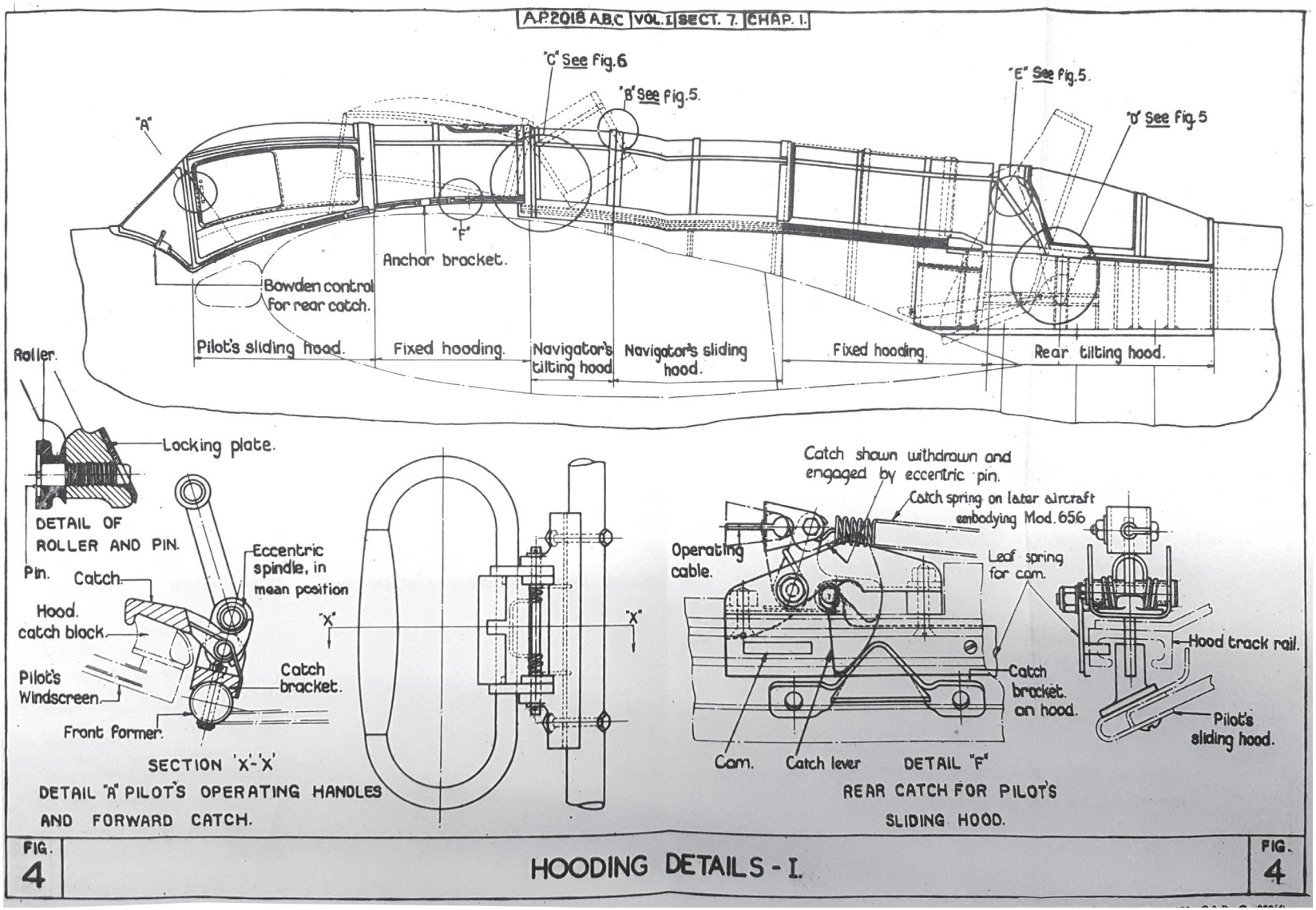
Details of cockpit layout (from National Archives AIR10/4448)

Figure 16



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Details of cockpit canopy (from National Archives AIR10/4448)

Figure 17

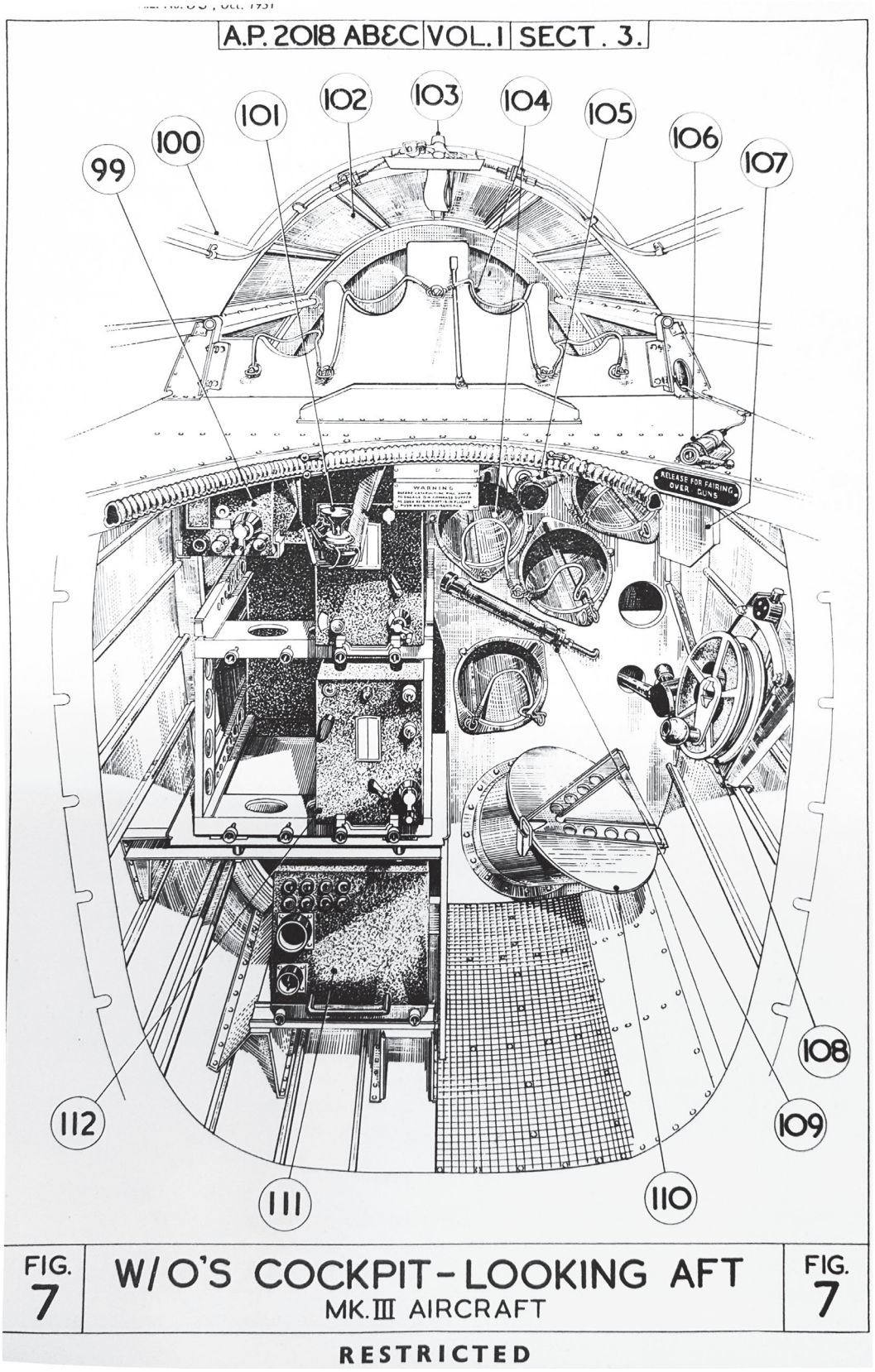

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Diagram of TAG cockpit facing aft showing smoke float holders and chute (from National Archives AIR10/4448) Figure 18

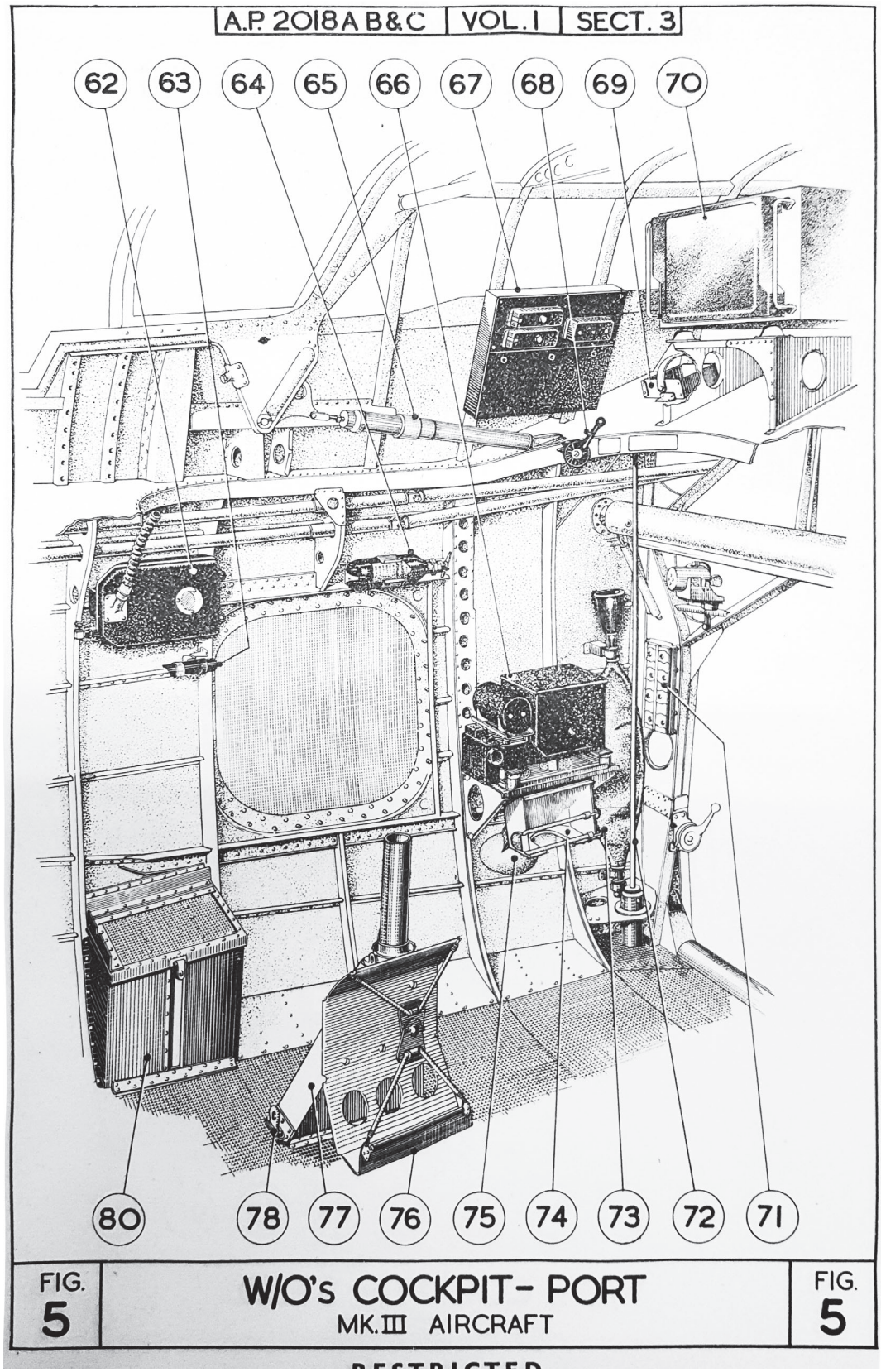

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Diagram of port side of TAG cockpit (from National Archives AIR10/4448) Figure 19

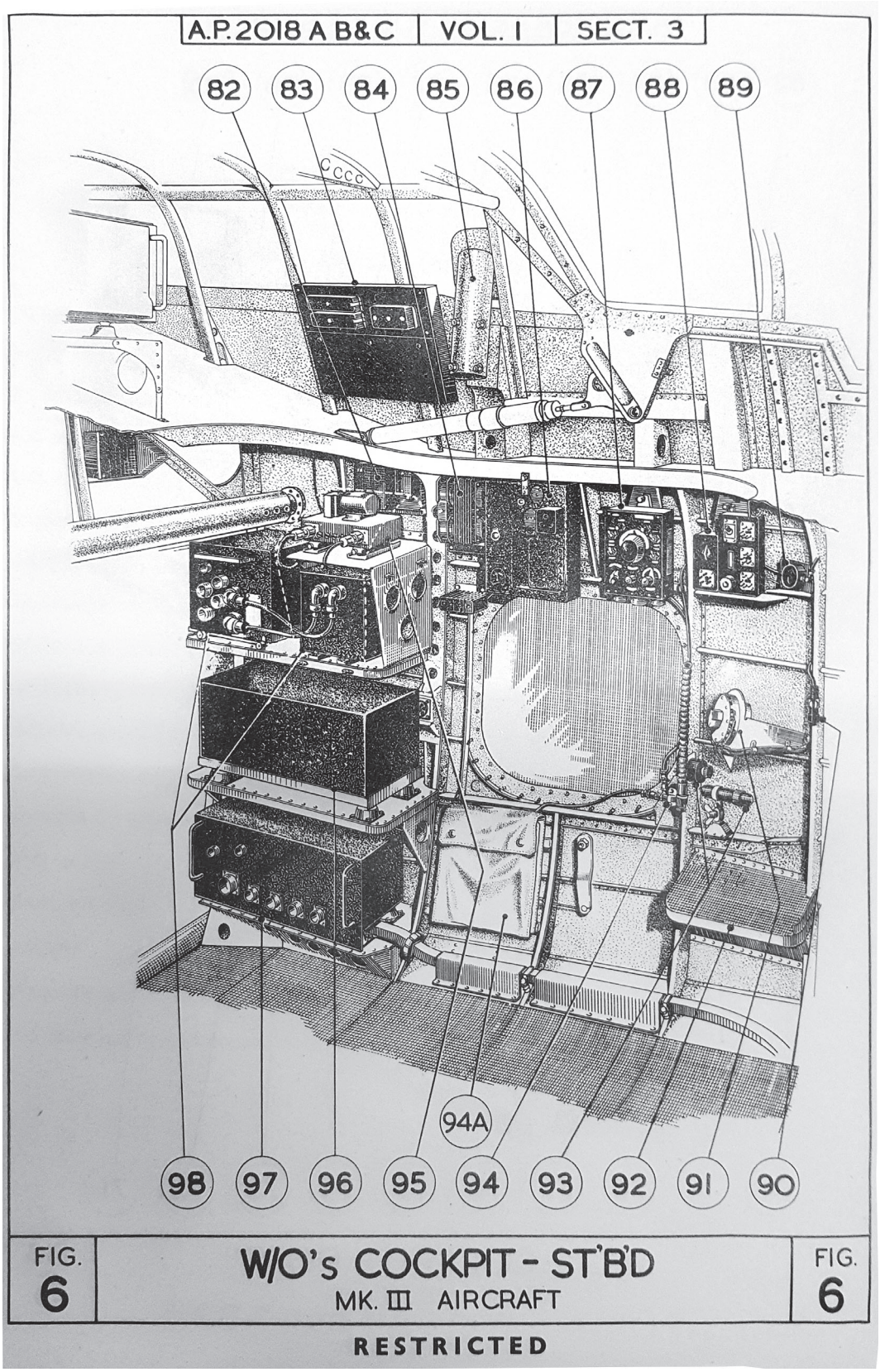

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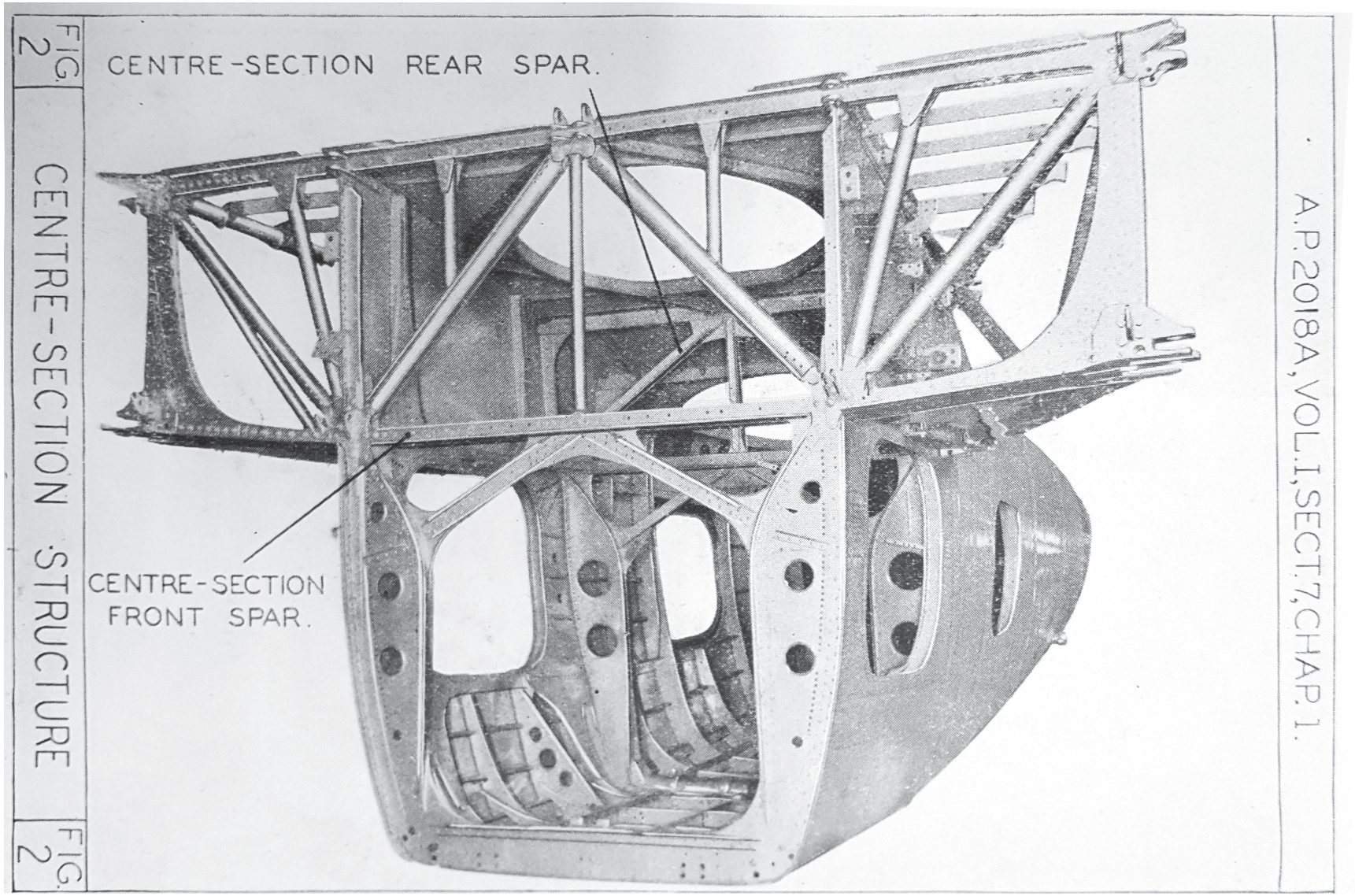
Diagram of starboard side of TAG cockpit (from National Archives AIR10/4448) Figure 20



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Fuselage and wing stubs after manufacture (from National Archives AIR10/4448)

Figure 21

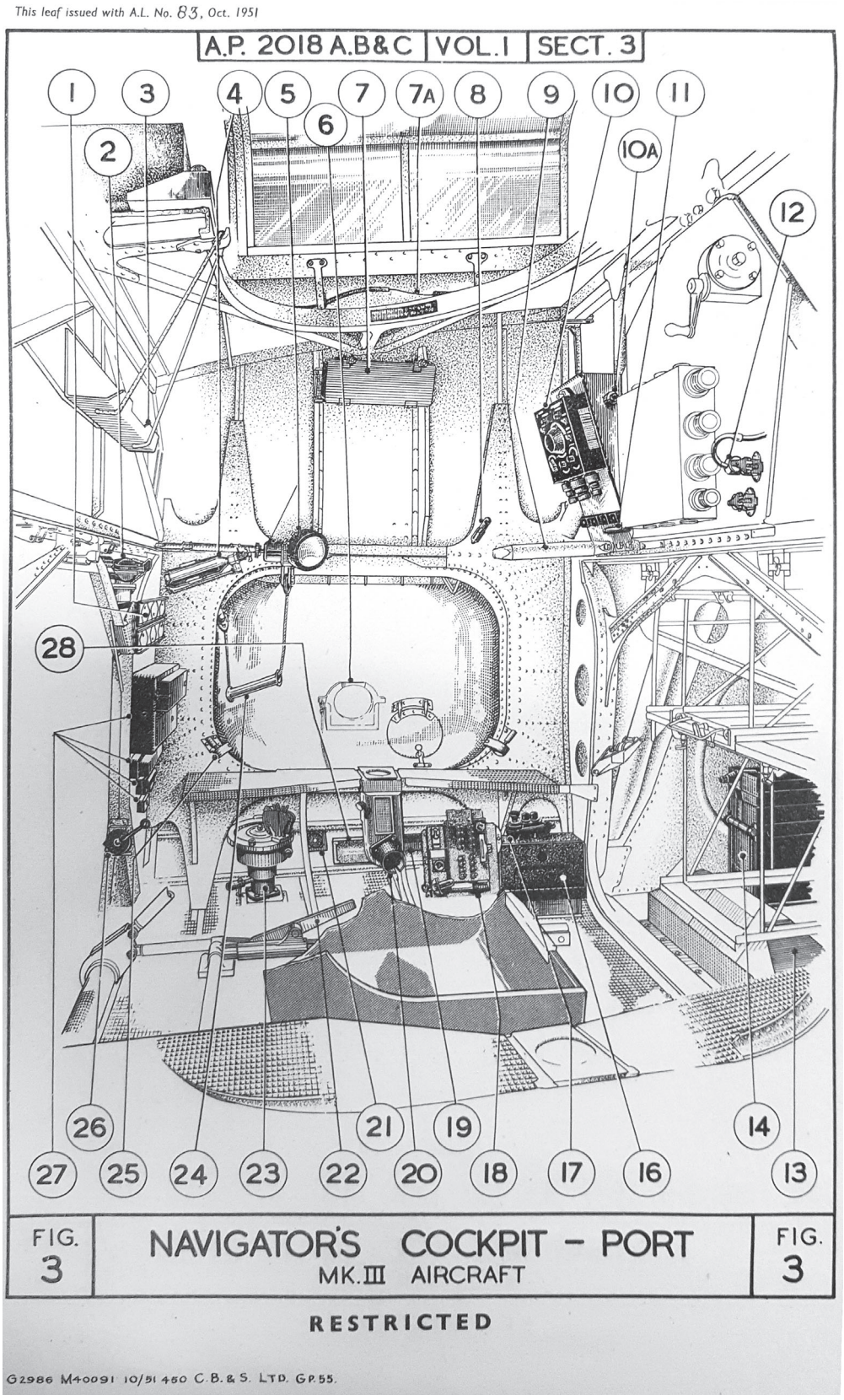

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Diagram of port side of observer's cockpit (from National Archives AIR10/4448) Figure 22

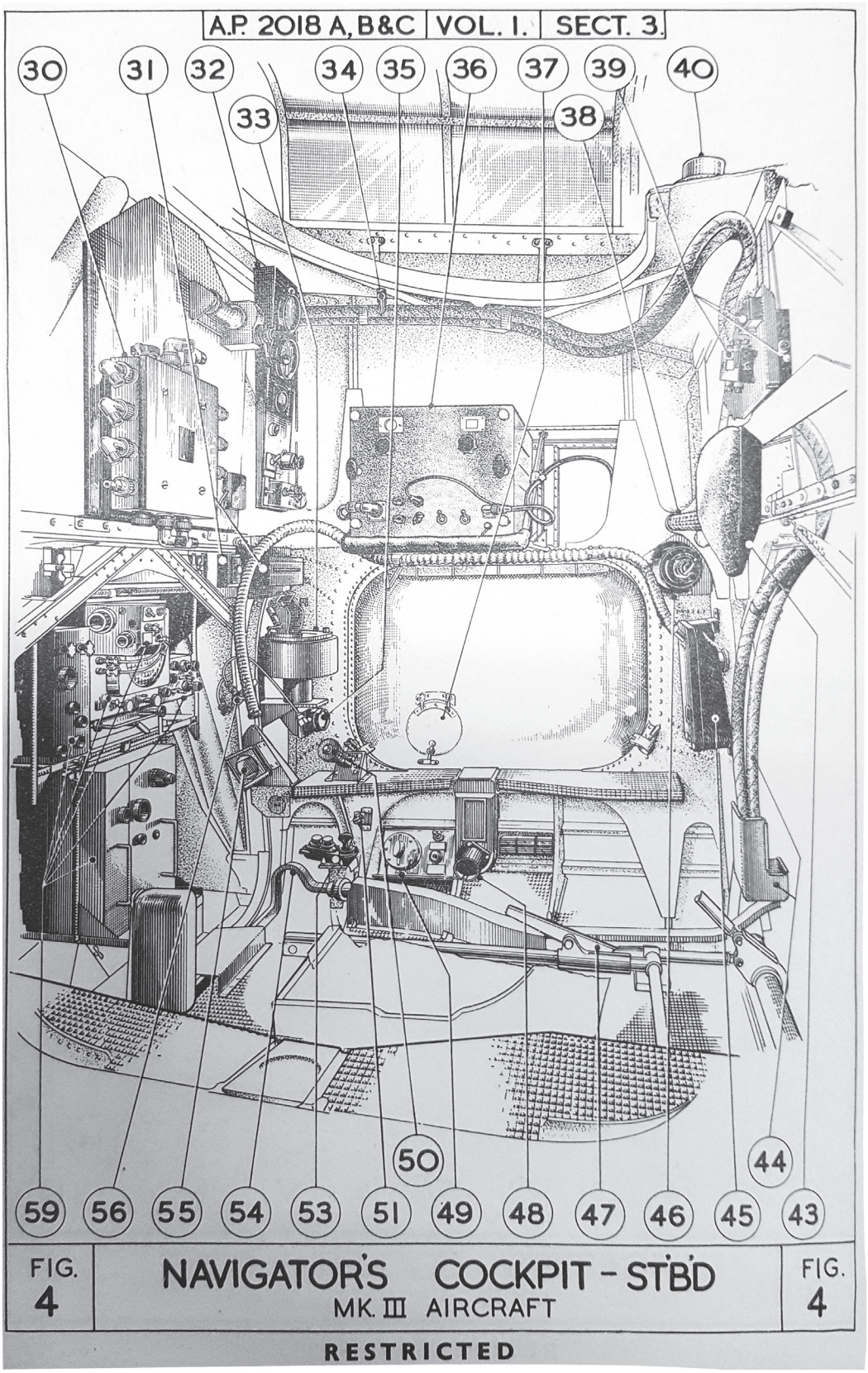

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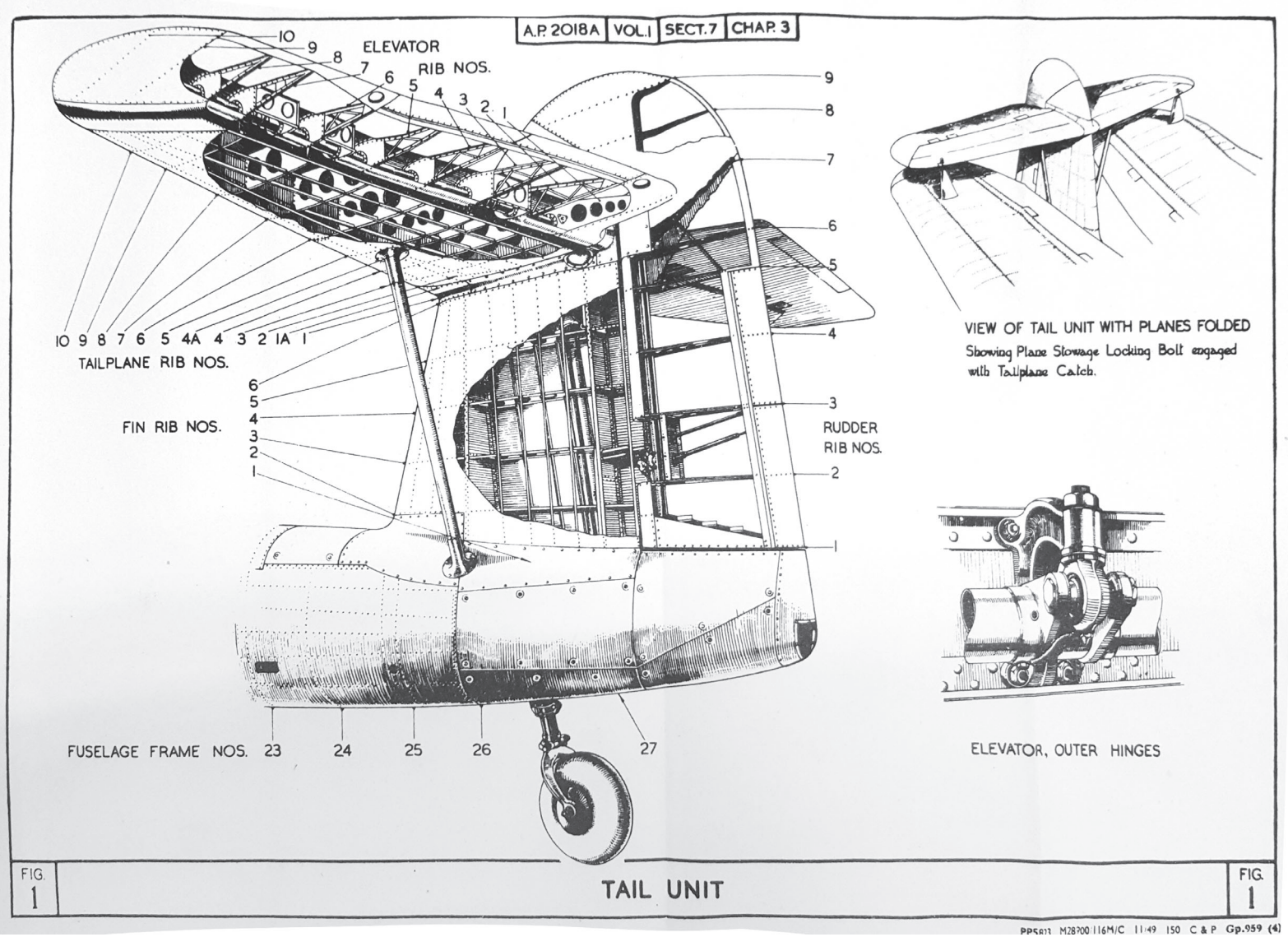
Diagram of starboard side of observer's cockpit (from National Archives AIR10/4448) Figure 23



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Path:	W:\Projects\202920\Graphics_Office\Rep figs\Barracuda\2019_11_14\202920_Fig07-24.ai		

Diagram of the tail plane (from National Archives AIR10/4448)

Figure 24

Plate 1: Starboard wing fragment- inboard fuel tank

Plate 2: Starboard wing fragment- inboard fuel tank

Plate 3: Starboard wing fragment- Rear spar fragment with piston for Youngman flap

Plate 4: Starboard wing fragment- remains of front spar (5521) and support tubing at the inboard end of the wing (5522)

Plate 5: Starboard wing fragment- inner face of lower wing skin with stiffeners

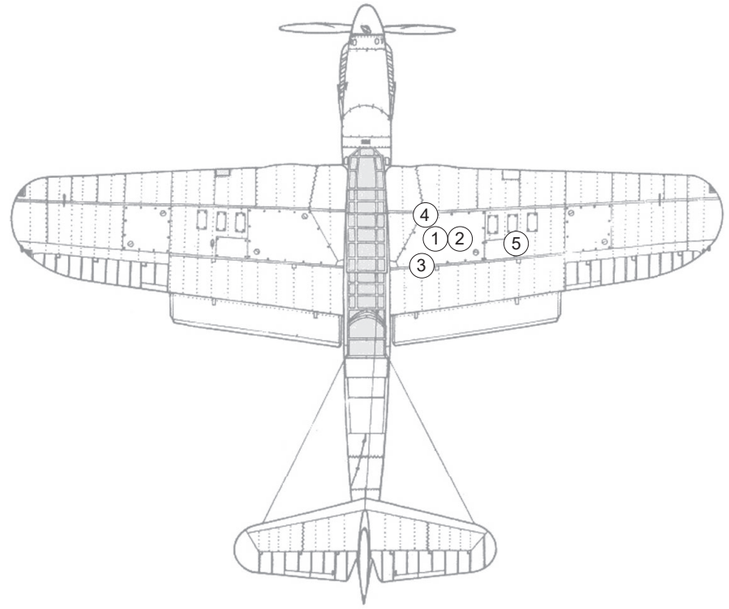

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Plate 6: Pitot tube and mast

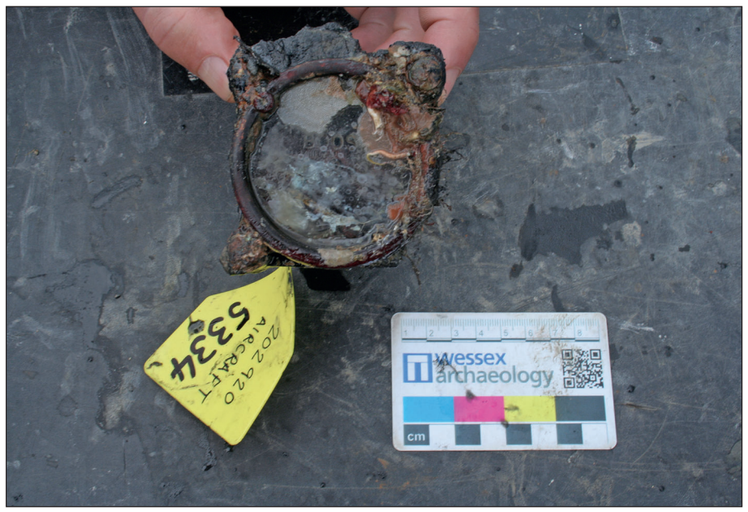


Plate 7: Boost Gauge from pilot's cockpit. Found within starboard wing

Plate 8: Starboard Youngman flap

Plate 9: Starboard wing tank fire extinguisher (5338)

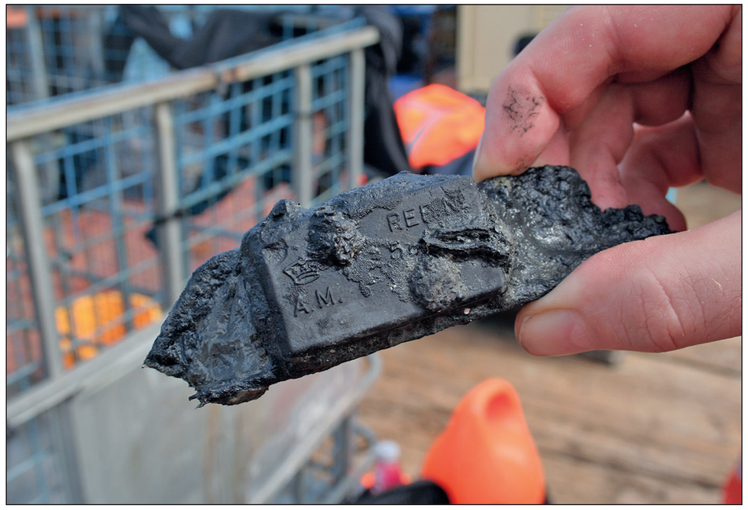
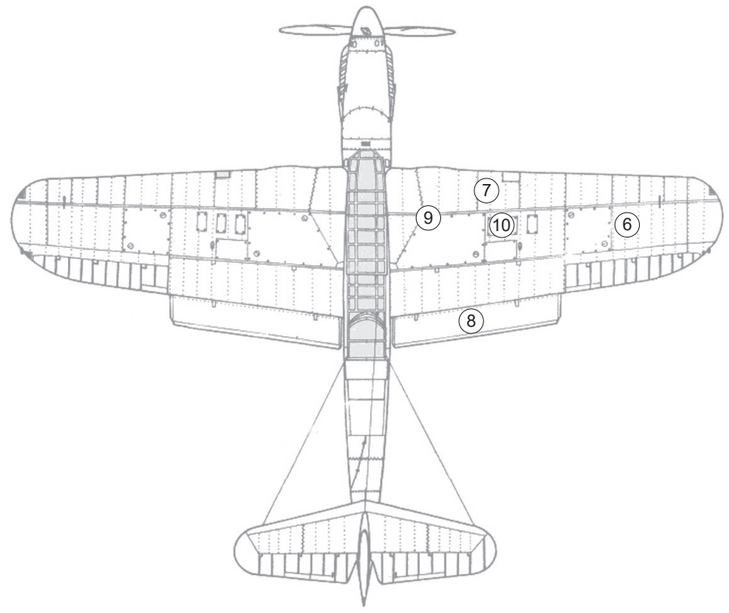


Plate 10: Air Ministry standard Bakelite electrical fitting



Date:	21/08/2019	Revision Number:	0
Scale:	Not to scale	Illustrator:	WAF
Path:	W:\Projects\202920\Graphics_Office\Rep figs\Barracuda\2019_08_21\202920_BarracudaTechRep_Plates.ai		

Plate 11: Air Ministry standard Bakelite electrical fitting

Plate 12: Tufnol and Bakelite blocks, pipe clamps and fittings recovered from the Barracuda and conserved by FAAM © Tony Jupp

Plate 13: Starboard inboard tank fabric and inlet valve

Plate 14: Rolls Royce Merlin 32 engine- port side showing rocker covers and 6 intact exhaust manifolds

Plate 15: Rolls Royce Merlin 32 engine- rear of engine showing supercharger

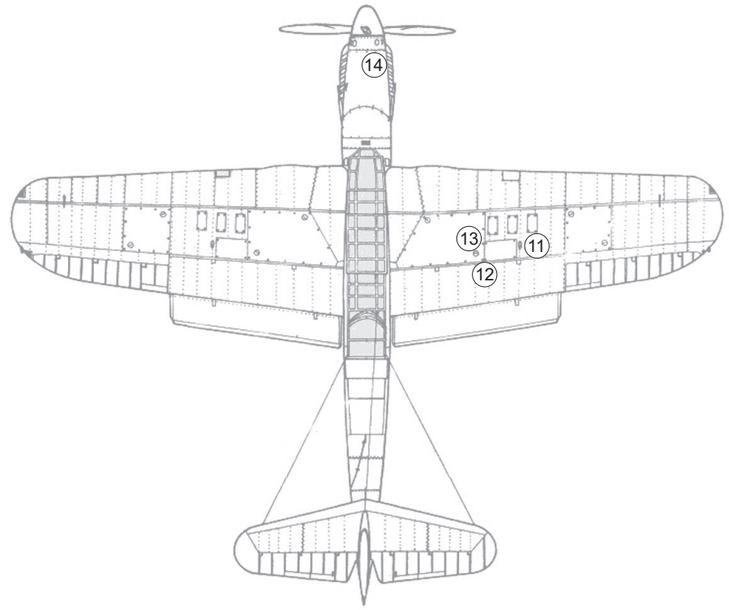


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Plate 16: Rolls Royce Merlin 32 engine- starboard side showing damaged exhaust manifolds

Plate 17: Rolls Royce Merlin 32 engine- front view showing 4 bladed propeller hub without spinner

Plate 18: Coffman starter cartridge holder after cartridges removed for EOD clearance

Plate 19: Coffman starter cartridges after EOD clearance

Plate 20: Starboard side of engine showing high degree of preservation

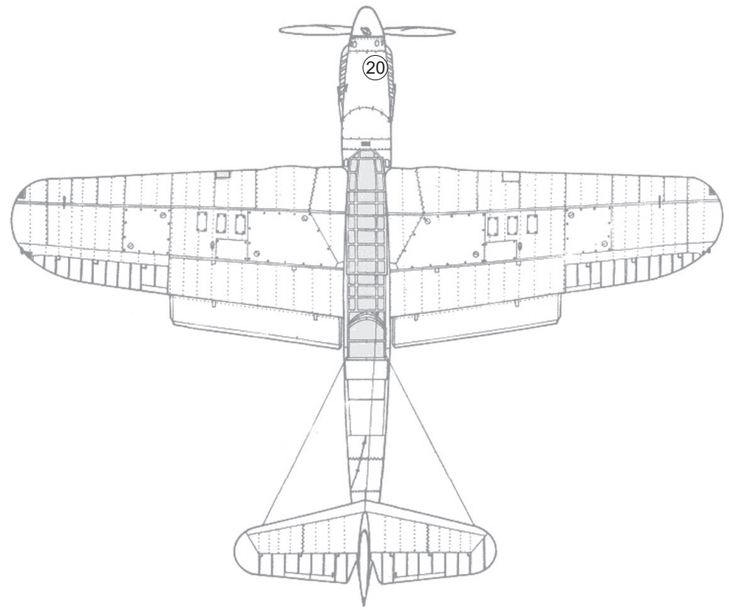

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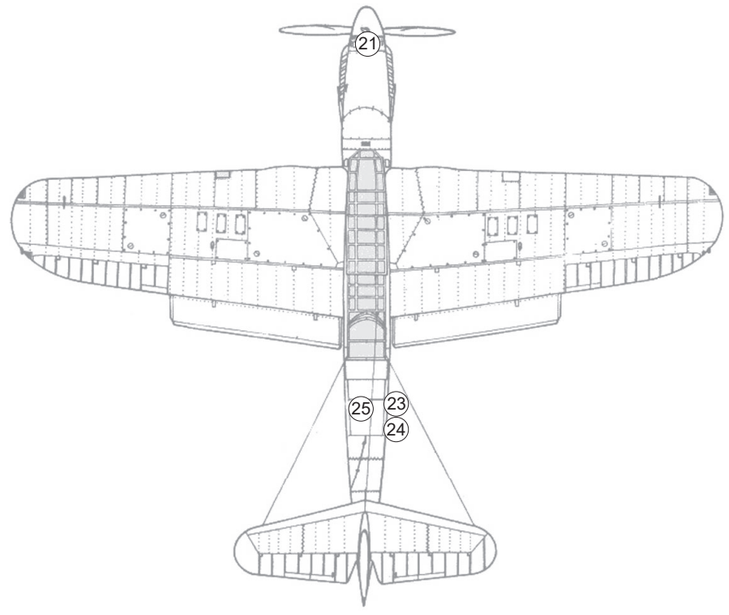
Plate 21: Oil header tank

Plate 22: Identification plate for Merlin 32 engine

Plate 23: Remains of airframe aft of rear cockpit (front of aircraft to left)

Plate 24: Remains of airframe aft of rear cockpit (front of aircraft to left)

Plate 25: Distant Reading (D/R) Compass



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Plates 21–25

Plate 26: Arrestor Hook

Plate 27: Tail wheel and bracket

Plate 28: Warning label from Starboard wing

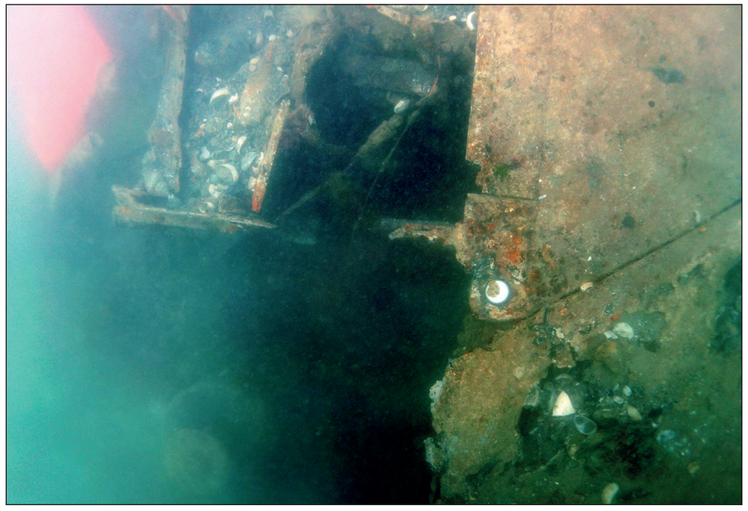

Plate 29: Forward upper wing pin in situ

Plate 30: Hydraulic accumulators in the port wing stub © Tony Jupp

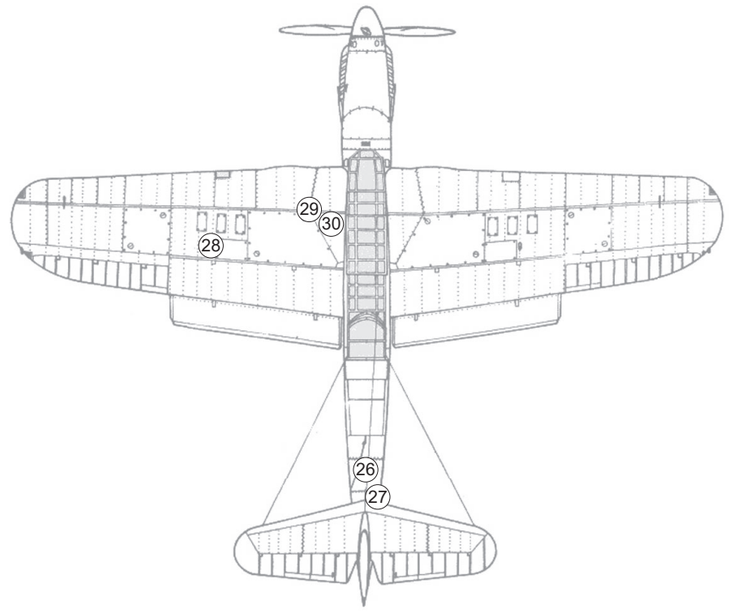

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Plate 31: Port wheel tyre

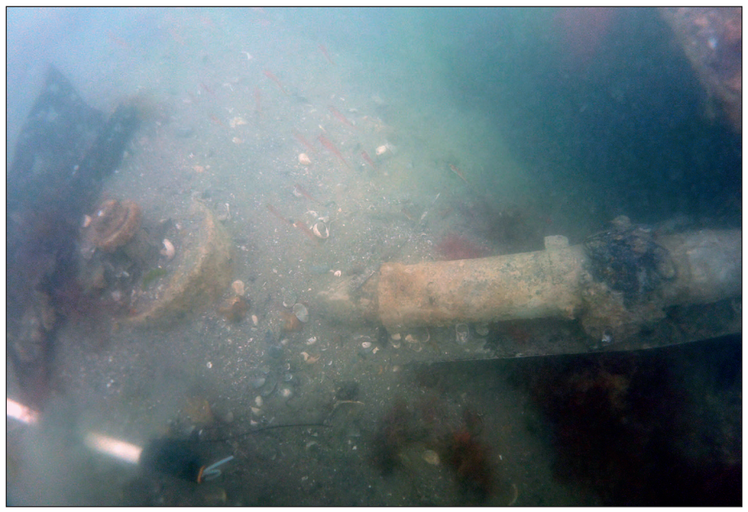

Plate 32: Starboard landing gear in half raised position on seabed

Plate 33: Port inboard fuel tank

Plate 34: Port outboard fuel tank

Plate 35: Landing light and Perspex cover

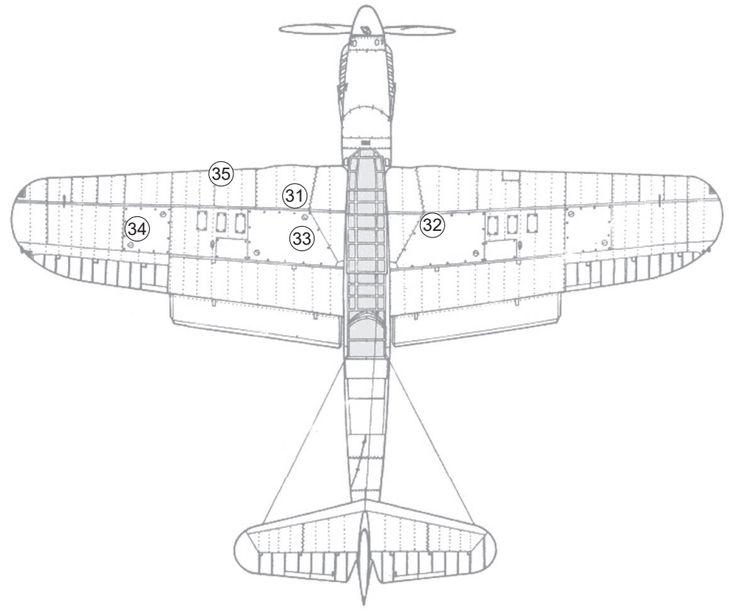

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Plate 36: Inboard section of trailing edge of port wing with hydraulic ram

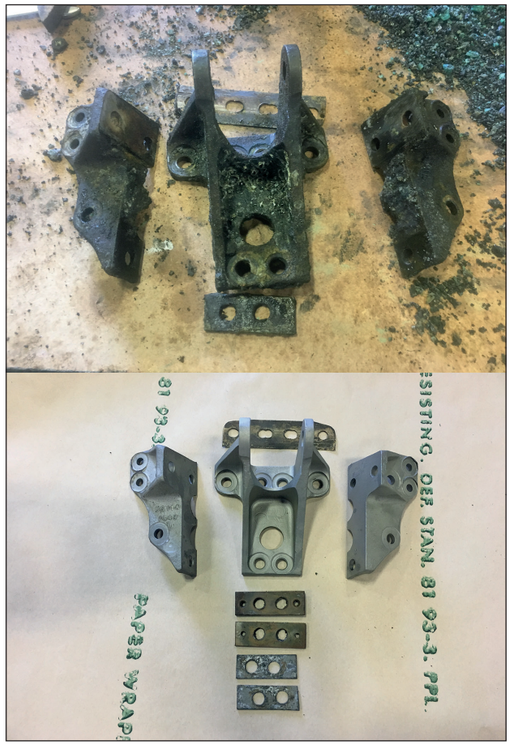

Plate 37: Hinge parts from port wing fold before and after conservation

Plate 38: Outboard section of port wing trailing edge

Plate 39: Section of port wing rear spar with internal fittings and ram for Youngman Flap

Plate 40: Bomb clutch on front spar of port wing

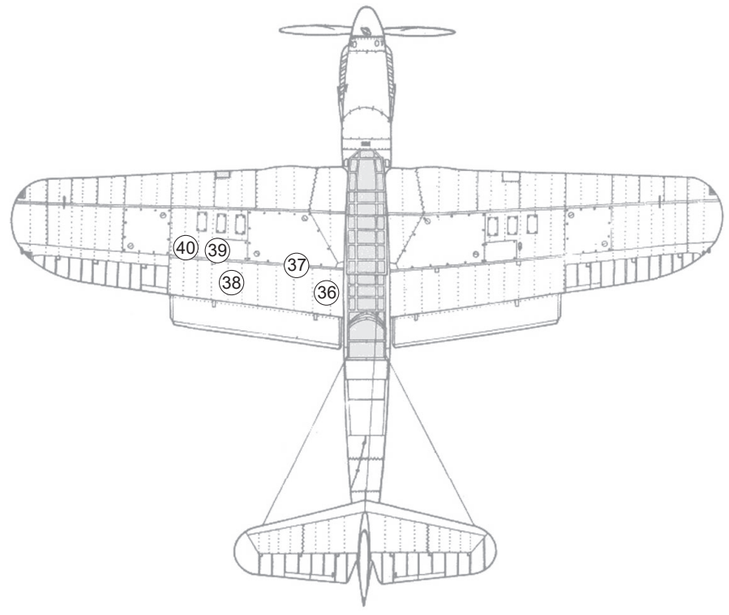

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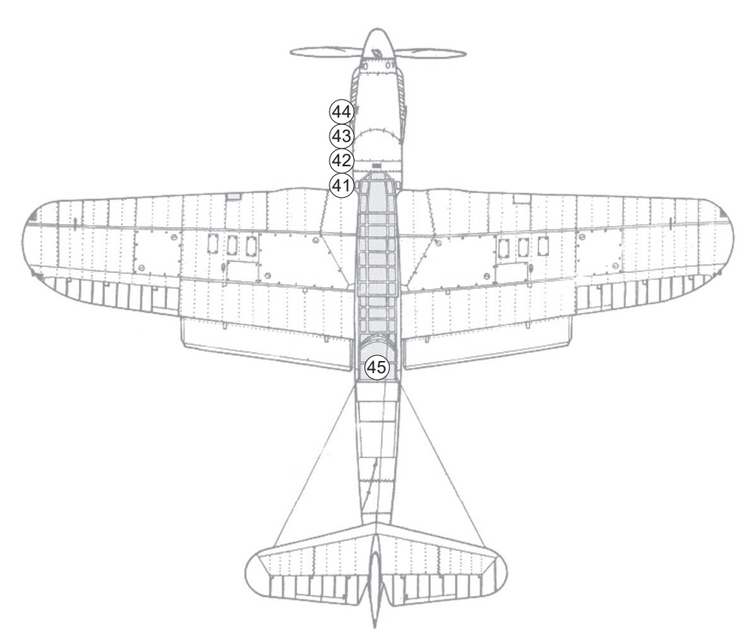
Plate 41: Flying boot fragments

Plate 42: Flying boot fragments

Plate 43: Flying boot fragments

Plate 44: Fragment of a jumper

Plate 45: TAG with Vickers K Gun showing flat pan magazines on top (National Archives, AVIA18/784)



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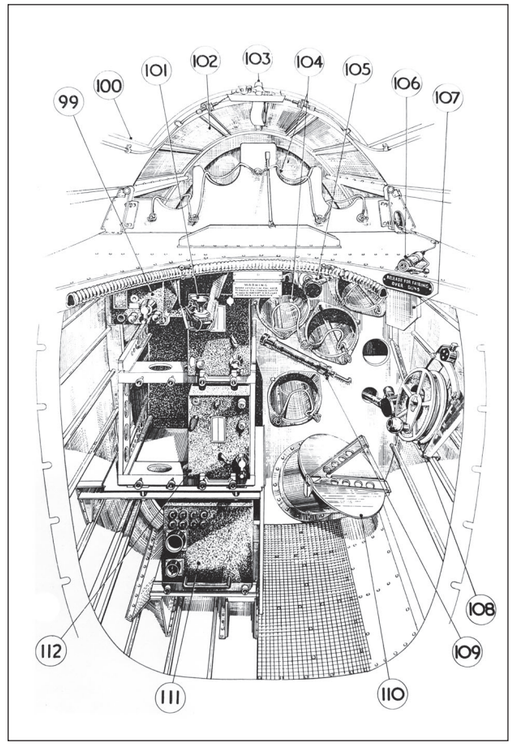

Plate 46: Diagram of TAG cockpit facing aft showing smoke float holders and chute (from National Archives AIR10/4448)

Plate 47: Resin tube for holding smoke floats

Plate 48: Section of TAG cockpit

Plate 49: Section of TAG cockpit

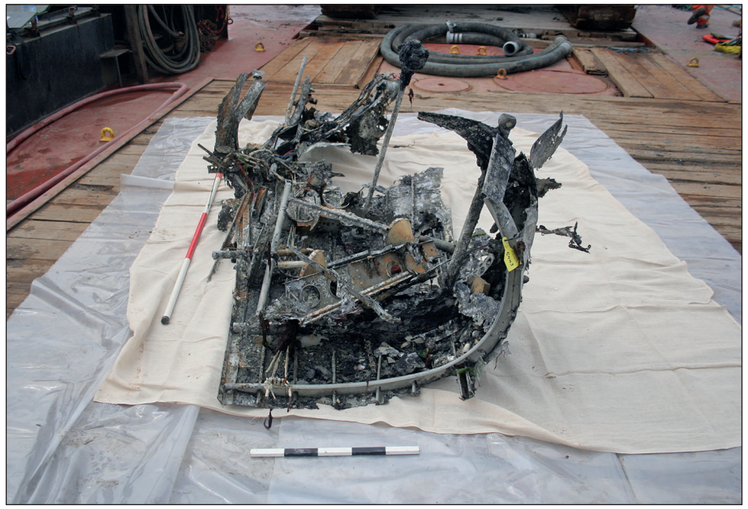

Plate 50: Section of TAG cockpit

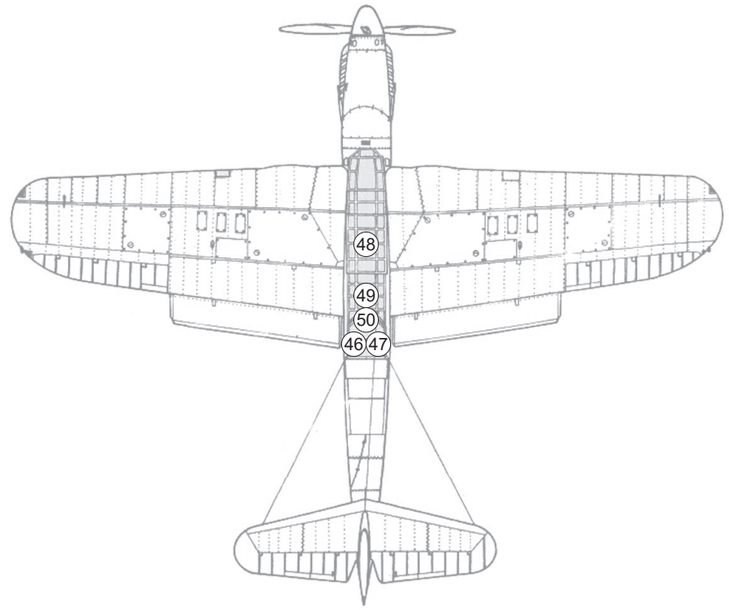

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Plate 51: Section of TAG cockpit

Plate 52: TAG radio, cables and cage

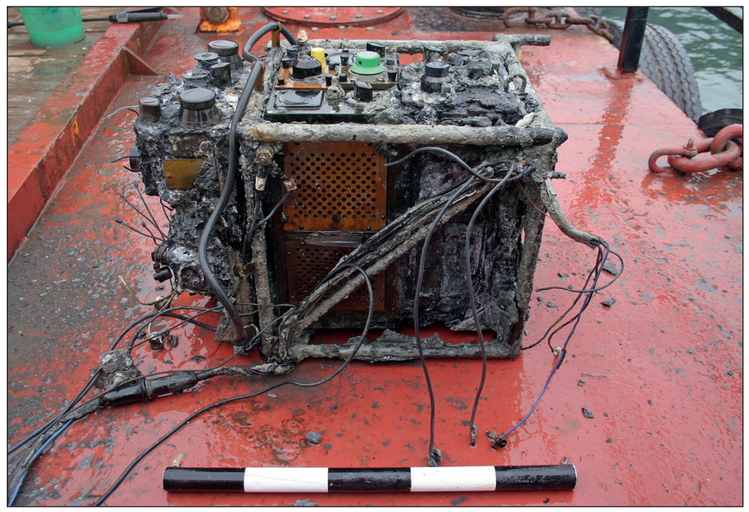

Plate 53: TAG radio, cables and cage

Plate 54: Trailing aerial reel

Plate 55: TAG seat back and cover

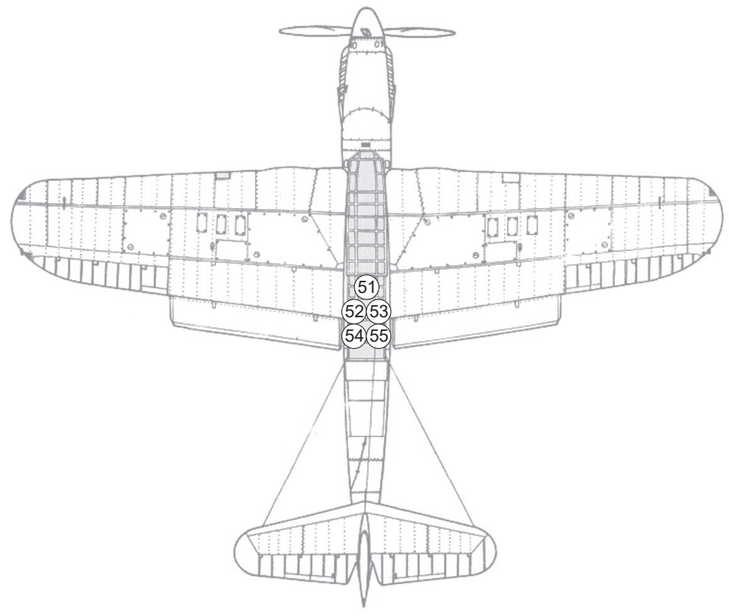

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Plate 56: TAG bucket seat base

Plate 57: Glass radio valve

Plate 58: Glass radio valve

Plate 59: Morse key from TAG cockpit

Plate 60: Switch style Morse key

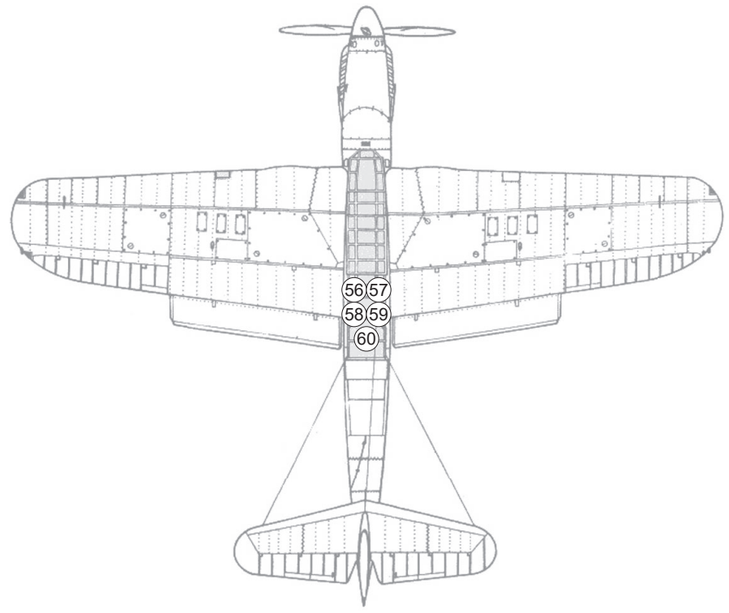

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Plate 61: Cell lamp with cable label

Plate 62: Cockpit light and warning label

Plate 63: TAG Cockpit Rim label

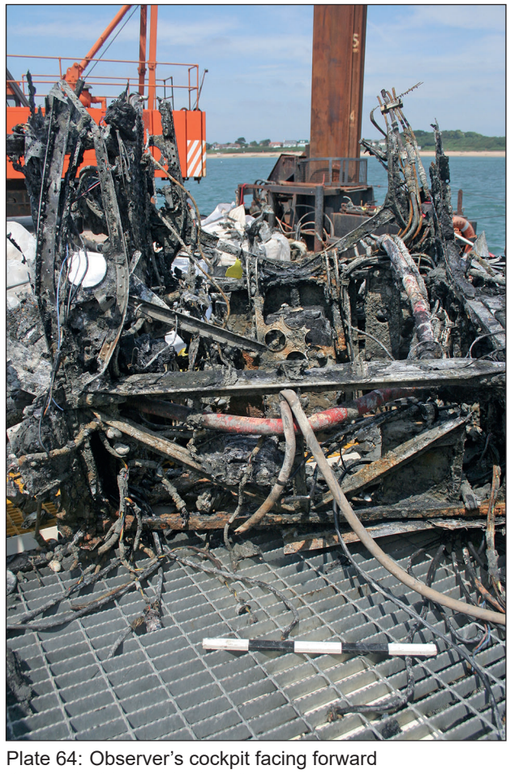

Plate 64: Observer’s cockpit facing forward
(the cockpit is upside down)

Plate 65: Observer's cockpit and wing stubs (upside down)

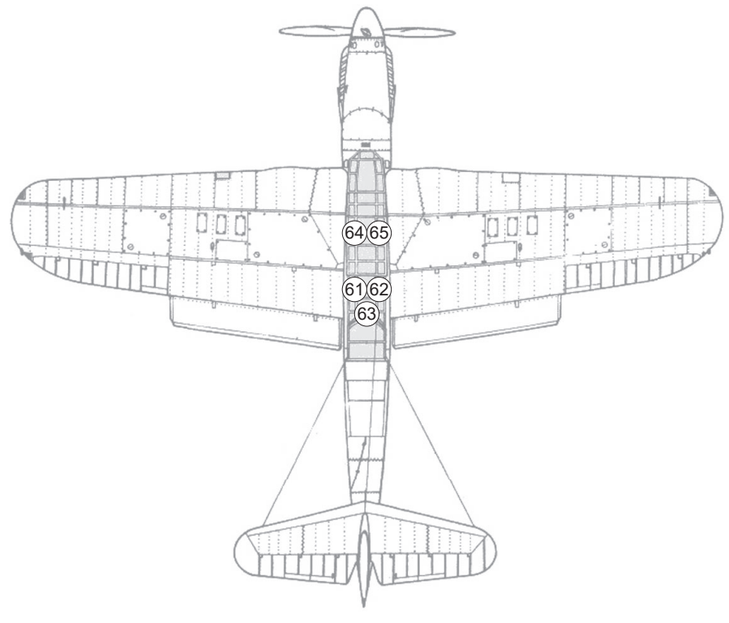

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Plate 66: Observer's sliding canopy

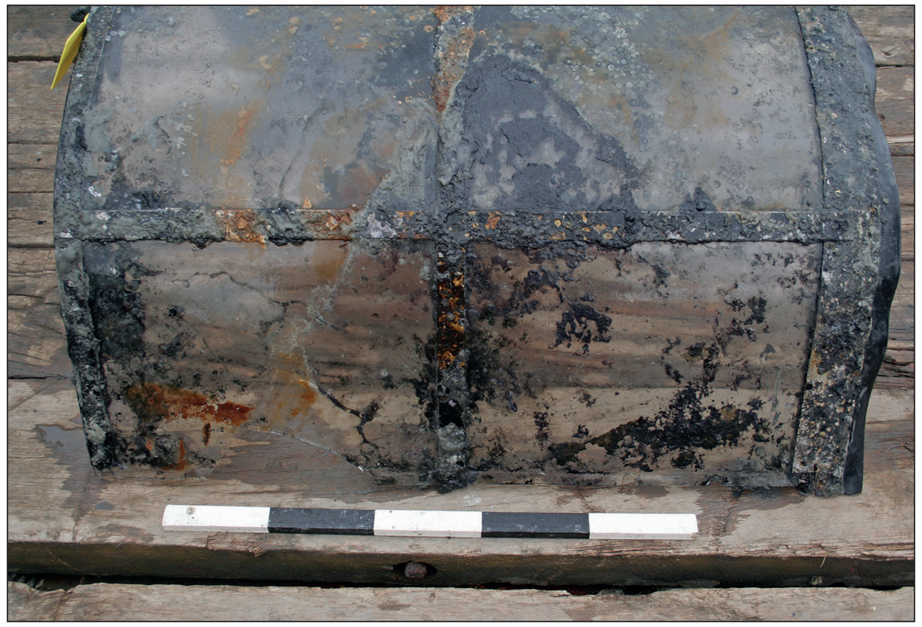

Plate 67: Observer's sliding canopy

Plate 68: Flying boot fragments

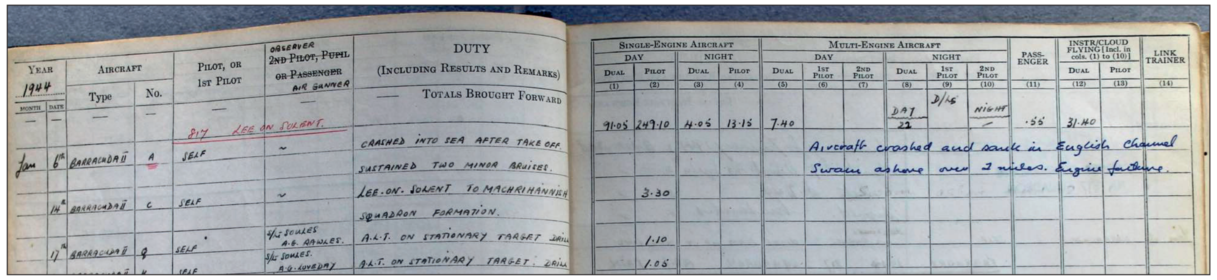

Plate 69: Logbook of Flt Lt Sandes © Tony Jupp

Plate 70: Flt Lt Sandes © Fleet Air Arm Museum

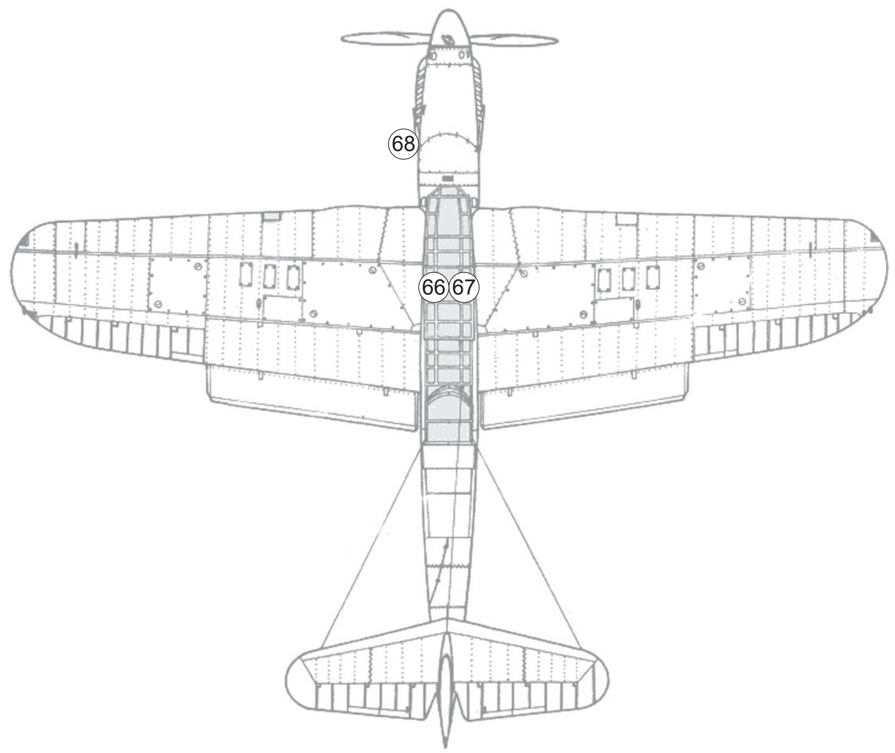

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Plate 71: Starboard observers domed side window

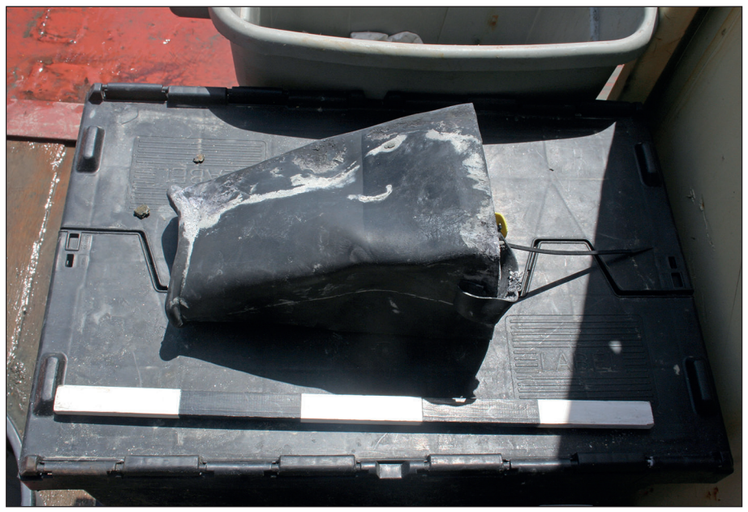

Plate 72: The screen shield or cover off the radar set

Plate 73: Batteries and electrical parts

Plate 74: Batteries and distribution box

Plate 75: Comfort bag and its holder

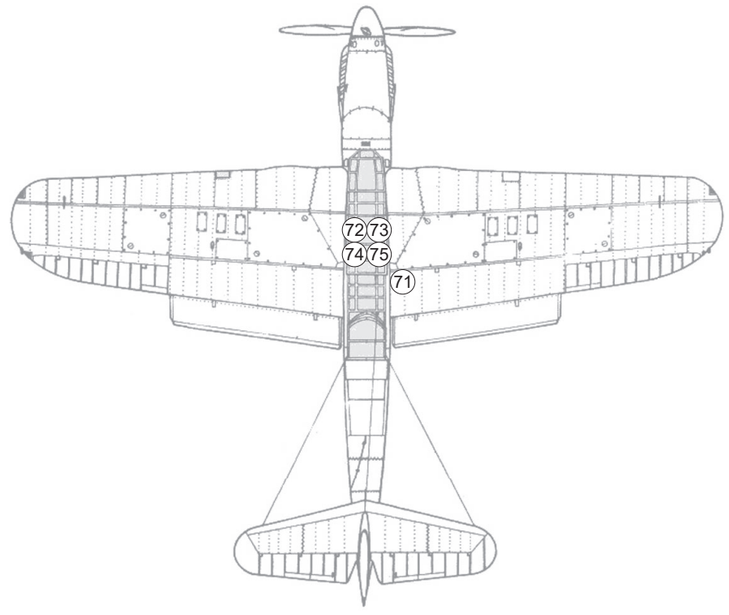

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Plate 76: Batteries after cleaning at FAAM © Tony Jupp

Plate 77: Pilot's cockpit

Plate 78: Pilot's cockpit, Observer's cockpit and wing stubs

Plate 79: Pilot's cockpit, Observer's cockpit and wing stubs

Plate 80: Radium painted dials in the Blind flying panel

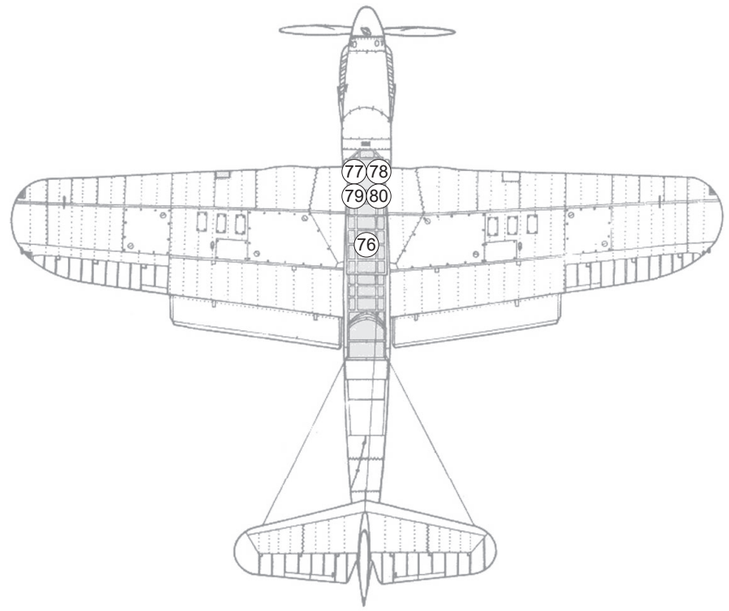

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Plate 81: Blind flying panel

Plate 82: Pilot's control column

Plate 83: Base of pilot's seat with earlier variant mounting

Plate 84: Oxygen mask

Plate 85: Cleaned blind flying panel © Tony Jupp

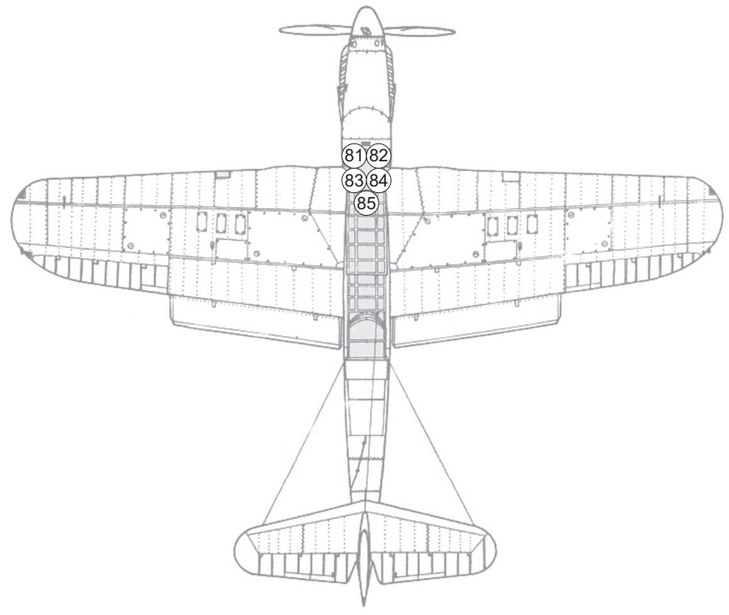

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Plate 86: Initial Lift Prior to structural failure

Plate 87: Material Recovered during lift

Plate 88: Main section following recovery in subsea basket

Plate 89: Pilot's cockpit tubing sections

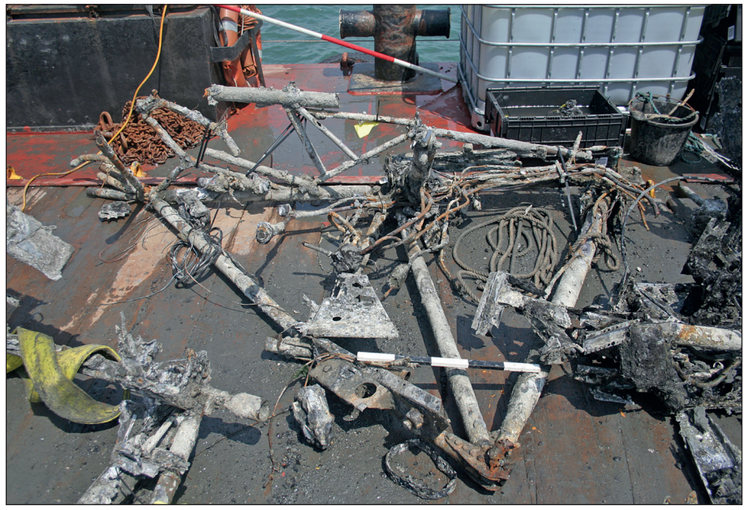

Plate 90: Pilot's cockpit tubing sections

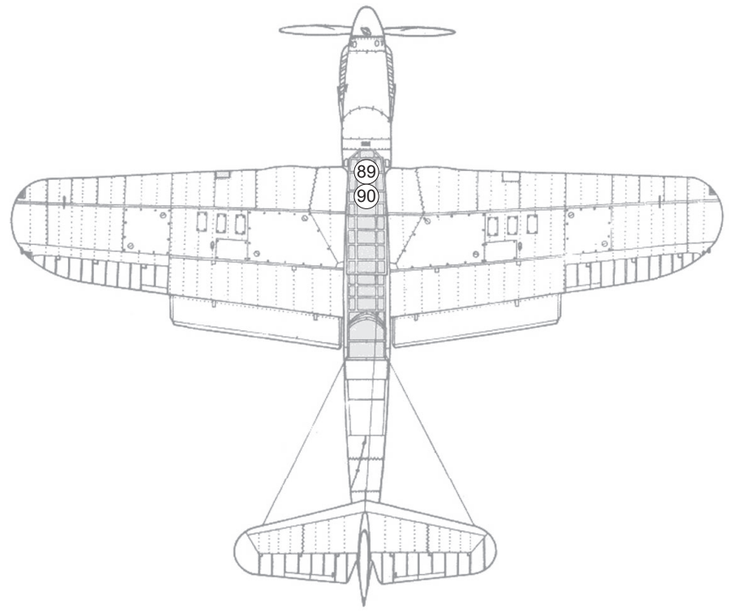

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Plate 91: Cockpit tubes after disassembly © Tony Jupp

Plate 92: Cleaned and conserved tube fittings from Pilot's cockpit © Tony Jupp

Plate 93: Cleaned and conserved tube fittings from Pilot's cockpit © Tony Jupp

Plate 94: Cleaned and conserved tube from Pilot's cockpit © Tony Jupp

Plate 95: Cleaned and conserved tube from Pilot's cockpit (Will Gibbs FAAM engineer for scale) © Tony Jupp

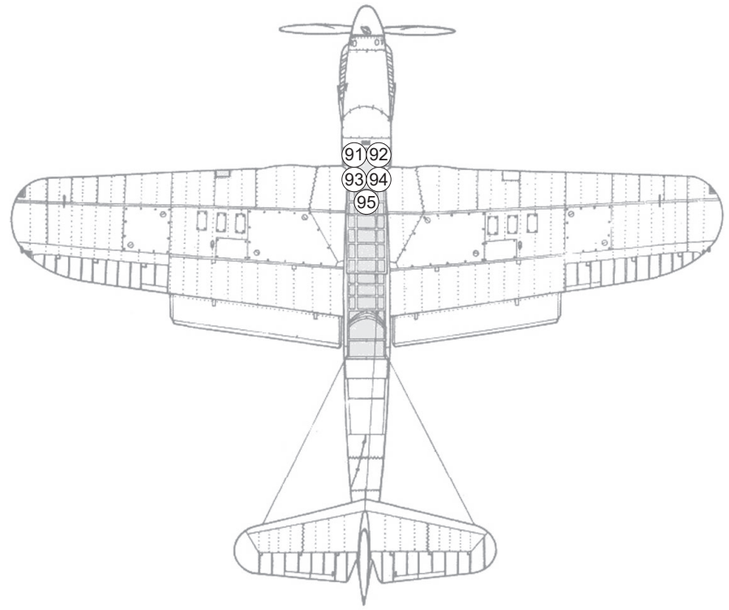

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Plate 96: Elevator torque tube

Plate 97: Rudder ribs with wooden spacers

Plate 98: Torpedo crutch and retaining cable

Plate 99: Fairey Aviation identification band or tag

Plate 100: Boulton and Paul stamped pipe clip

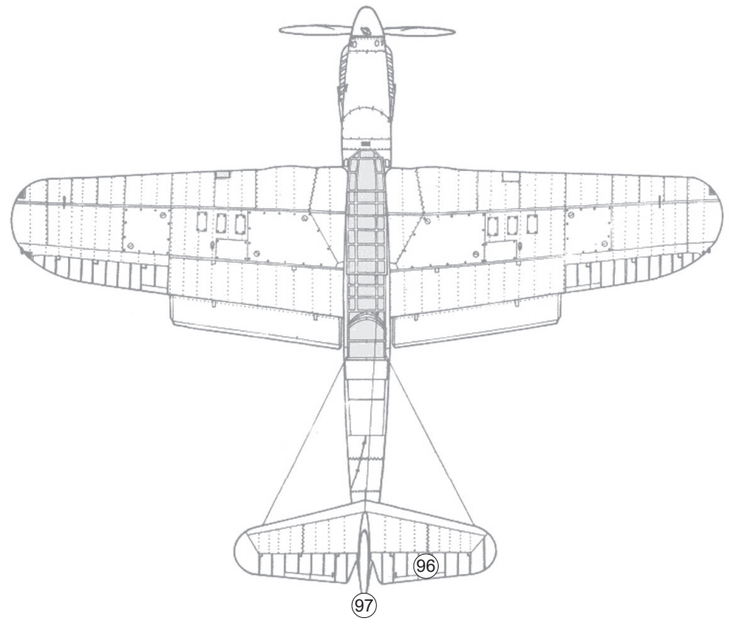

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Plate 101: RATOG found close to wreck (6A/pUXO/015/RATOG)

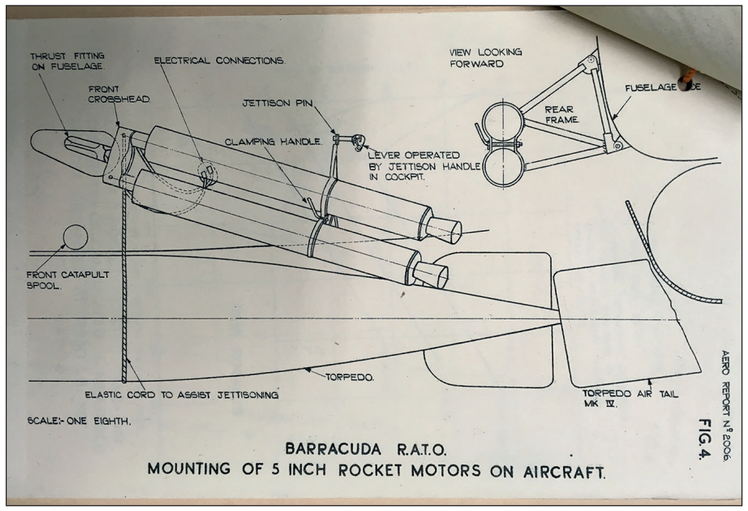
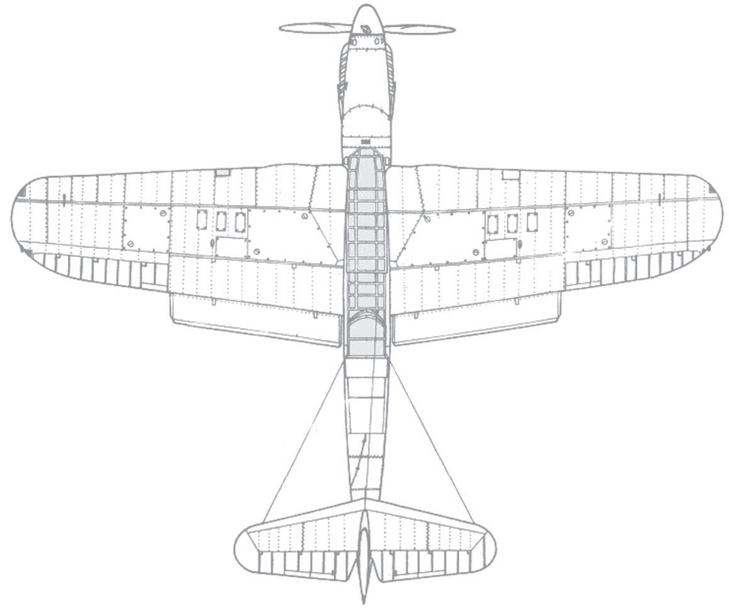


Plate 102: RATOG drawing showing location on Barracuda fuselage
(from National Archives AVIA6/9837)



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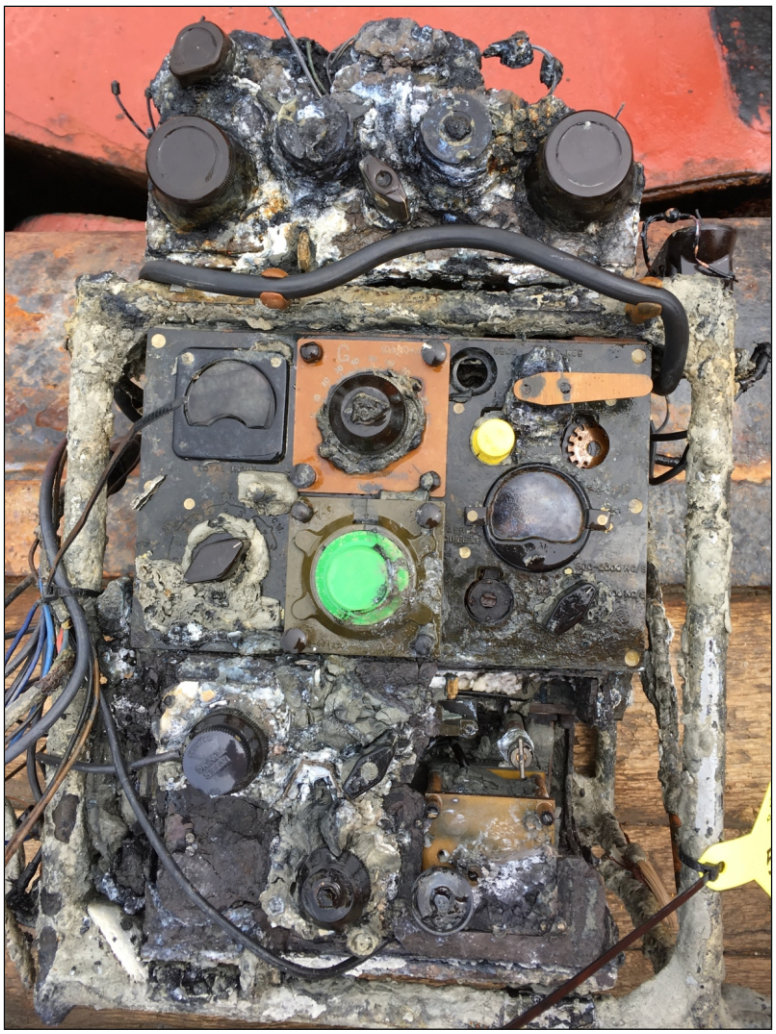

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