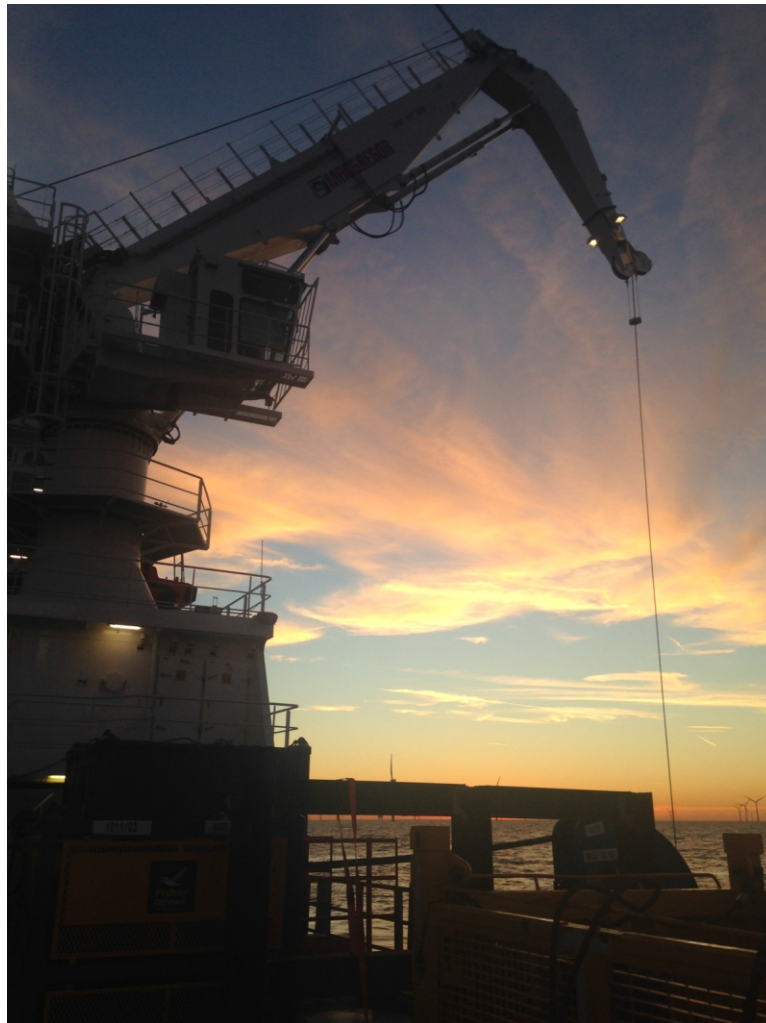




Galloper Offshore Wind Farm

Heritage Method Statement:
Recovery of AB_OSP_Mag_145: Aircraft Material

Post-excavation Assessment report



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June 2019



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Post-excavation Assessment Report

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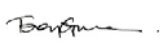
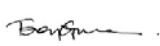

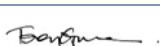
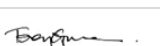
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Galloper Offshore Wind Farm

Heritage Method Statement: Recovery of AB_OSP_Mag_145: Aircraft Material

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Non-technical Summary

Wessex Archaeology was commissioned by Gallopier Wind Farm Limited to undertake the mapping and recovery of aircraft wreckage located approximately 20 m east of the Offshore Substation Platform foundations.

The fieldwork was undertaken using a Work class Remotely Operated Vehicle (WROV) and crane mounted clam shell grab in January 2017 to map the Site and to recover archaeological material considered to be at risk of impact by the development.

Due to poor in-water conditions experienced during the work, mapping of the site was conducted using imaging sonar and close visual inspection of targets, prior to recovery.

A total of 177 finds were recovered and subjected to specialist analysis. These were interpreted as being part of the tail and upper fuselage of a B-17F or G. Given the dating analysis of the recovered finds, the aircraft was probably lost between spring 1943 and summer 1944. The individual aircraft has not been identified, although it is probably associated with the daylight bombing campaign carried out over Occupied Europe by the US Eighth Air Force. A single human remain, a fragment of mandible (jaw bone), was part of the recovered materials. It is from an adult male aged at least 30 years and is very probably one of the aircrew.

Most of the finds recovered were small, fragmentary and in poor condition, and no intact aircraft structure was located. The available evidence suggests that although small fragments may remain buried within the impact area, there is unlikely to be a substantial buried wreckage. The available evidence also suggests that the crash site is likely to be widely dispersed, probably as a result of the aircraft breaking up in the air and/or destructive post-site formation processes.

Based on materials recovered and assessed to date the archaeological potential is assessed as Low-Medium.



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Acknowledgements

This project was commissioned by Galloper Wind Farm Ltd and the assistance of its staff and particularly Offshore Consents Manager Colin McAllister is gratefully acknowledged.

Wessex Archaeology also wish to thank the staff of James Fisher Offshore Limited, Canyon Offshore and the captain and crew of M.V. *Grand Canyon* for their assistance during fieldwork.

The archaeological aspects of the fieldwork were carried out by Graham Scott and Paolo Croce. Post-excavation assessment was carried out by Graham Scott and Paolo Croce, with specialist aviation assistance from Stephen Vizard, Jeff Carless and Julian P. Foynes. This report was compiled by Graham Scott and Toby Gane. Graphics were prepared by Will Foster and Kitty Foster and the project was managed for Wessex Archaeology by Toby Gane, with post-excavation aspects managed by Danielle Wilkinson.



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1 INTRODUCTION AND PROJECT BACKGROUND

- 1.1.1 Wessex Archaeology (WA) was commissioned by Gallopier Wind Farm Limited (GWFL) to undertake a review of archaeological material identified during an Unexploded Ordnance (UXO) Survey undertaken using a Work-class Remotely Operated Vehicle (WROV) as part of the Gallopier Offshore Wind Farm (GWF) project.
- 1.1.2 As part of this review archaeological material was found in the vicinity of the Offshore Substation Platform (OSP) (**Figure 1**). The material, which was found in both surface and shallow-buried contexts, was characterised as debris by the UXO contractor and included aluminium sheets, other aluminium material, wires, metal debris, possible canvas fabric and other lightweight fabric, which were interpreted by WA as possibly indicating the presence of an aircraft wreck (Wessex Archaeology 2016a).
- 1.1.3 The archaeological material was found at four closely spaced UXO target locations referred to collectively as AB_OSP_Mag_0145: aircraft material, located approximately 20 m to the east of the OSP (henceforth 'the Site'; **Figures 1 & 4**) where Array Cables C, D, E, F, G and H join the OSP. The Site had previously been identified by WA as magnetometer contact 70161 (WA 2015). The UXO target locations have the following co-ordinates:

Table 1: Site Co-ordinates (WGS 84, UTM z.31N)

Target	Easting	Northing
AB_OSP_Mag_0145	432692.01	5756145.94
AB_OSP_Mag_0145_A	432697.21	5756145.11
AB_OSP_Mag_0145_B	432693.65	5756154.91
AB_OSP_Mag_0145_C	432697.47	5756143.08

- 1.1.4 An engineering review was undertaken by GWFL to ascertain whether it was possible to reroute the array cables to avoid the Site. The results of the review were that some of the cables could be rerouted to avoid the Site but that full avoidance of the Site was not possible due to its close proximity to the OSP. As the Site was therefore considered to be unavoidably within an area of impact during construction of the OWF, a mitigation methodology that fulfilled Historic England's requirement for mapping and recovery of the aircraft material that would be impacted was agreed by GWFL, the MoD Agency the Joint Casualty and Compassionate Centre (JCCC), Historic England and WA.
- 1.1.5 Mapping and recovery was carried out during fieldwork on the Site in January 2017. This report is a Post-excavation Assessment (PXA) of that work.



2 METHODOLOGY

2.1 Methodology Document

2.1.1 The mapping and recovery process (henceforth 'fieldwork') was subject to a high-level methodology document (henceforth the 'Method Statement'; WA 2017) agreed with Historic England. As anticipated in the agreed Method Statement, the methodology was refined during the fieldwork in accordance with the site conditions encountered. The methodology described in this document is the refined methodology used during the fieldwork.

2.2 Aims and Objectives

2.2.1 The agreed aims of the fieldwork were to make an accurate record of the Site in the condition that it was encountered and to recover sufficient archaeological information to meet the standards outlined by the Chartered Institute for Archaeologists (CIfA) and the Regulator's advisor (WA 2017b: 3).

2.2.2 The objectives were as follows:

- create a sufficiently accurate baseline survey (photographic/ photogrammetric) of the Site;
- evaluate target material for recovery;
- inform recovery method and alternative actions where necessary;
- characterise the survey area and develop conclusions on the extent, state of preservation and the formation process of deposits of archaeological interest, based on the interpretation of both the layout and material recovered from the crash site;
- recover all surface material (where practicable) where construction activities directly impact identified archaeology or items of potential archaeological interest;
- create a suitable field record of the recovery process;
- establish the presence/absence of any human remains, personal effects or specific items recovered from the site that may assist in identifying the aircraft and any possible crew; and
- inform appropriate post-intervention assessment, analysis and publication.

2.2.3 It was agreed that where construction activities would directly impact identified archaeology or items of potential archaeological interest, then these would be recovered where practicable.

2.2.4 Henceforth in this report, archaeological material located on the seabed is referred to as a find/finds.

2.3 Fieldwork Equipment and Staff

2.3.1 Health and safety and operational analysis by GWFL determined that the excavation should be carried out using a remotely operated vehicle (ROV) rather than by divers.

2.3.2 Fieldwork was undertaken on a continuous 24-hour basis from the MV *Grand Canyon*¹, a large, state-of-the-art DP3 offshore construction vessel. The fieldwork was carried out using

¹ http://www.helixesg.com/media/10190/Grand%20Canyon_Final.pdf



one of two embarked Perry Slingsby Triton XLS heavy duty work class remotely operated vehicles (WROVs)². The WROV was piloted by experienced pilot technicians.

- 2.3.3 For mapping, the WROV was equipped with a Kongsberg HiPap acoustic positioning system³ operated in Super Short Base Line mode by specialist surveyors. It was also equipped with colour HD video and stills cameras in addition to its normal colour video and black and white SIT video cameras. For non-visual inspection, the WROV was equipped with a BlueView 2D imaging sonar⁴.
- 2.3.4 For recovery, the WROV was equipped with standard five and seven function Schilling manipulators. Recovered objects were placed in either a steel basket attached to the front of the WROV skid or a small net attached to one of the manipulators, which was used for very small or delicate finds. Oversize finds were placed in a half-height basket, deployed using the vessel's heave compensated 15-ton offshore crane. The basket was positioned on the seabed outside of the known Site limits using the acoustic system.
- 2.3.5 In addition, limited use was made of a 5-ton clam grab to recover finds that could not be recovered using the ROV because they were partly buried. The grab was deployed using the 15-ton crane.
- 2.3.6 The fieldwork was directed on site by two WA marine archaeologists with experience in ROV operations and aircraft crash sites, working in two 12 hour shifts, under the supervision of GWFL client representatives. Daily progress reports were submitted to GWFL by WA, in addition to those prepared by their own representatives.

2.4 Archaeological Recording

- 2.4.1 Mapping and finds recovery was recorded using the WA DIVA system, HD video and still photography. The DIVA system is a WA Access database with a GIS front end that records archaeological finds and other data as 'observation points' linked to a position fix generated by the acoustic system, video time data and still photographs. It has been specifically designed for rapid surveys of submerged archaeological sites of this type and is compliant with MIDAS and other professional standards. Additional hard copy records were kept as appropriate. Contexts and finds were given UIDs.
- 2.4.2 The fieldwork and ongoing PXA have complied with ClfA and other appropriate guidance.

2.5 Mapping

- 2.5.1 In accordance with the Method Statement, fieldwork was undertaken as two separate phases: mapping and recovery.
- 2.5.2 The Method Statement proposed that the Site should first be mapped using photogrammetry or photo-mosaic techniques. However, although attempts were made to map in this way, the very poor visibility encountered throughout the operation (typically 0.5 m or less) caused by the presence of particulate matter in the water column meant that suitable imagery could not be gathered.

² http://www.f-e-t.com/images/uploads/Triton_XLS.pdf

³

<https://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/9DC12B00C48A0B63C1257F0900319BCF?OpenDocument>

⁴ <http://www.blueview.com/videos/2d-imaging-sonar/>



- 2.5.3 As a result, an alternative technique was devised, using the acoustic positioning system of the WROV, the imaging sonar and the colour HD camera. It comprised:
- general inspection of the site area using the imaging sonar;
 - close visual inspection of the seabed using the HD video camera mounted on the lower forward frame of the WROV at an oblique angle and the imaging sonar; and
 - acoustic positioning of any archaeological material located by the sonar and visual inspections.
- 2.5.4 Visual inspection of the Site was achieved by lane-swimming the WROV across the Site, tracking the vehicle with the acoustic system. Lane spacing of 0.5 m was determined by reference to the field of view of the camera, tested against the visibility experienced on the seabed using a scale deployed by manipulator. Full visual coverage of the Site was achieved (**Figure 2**).
- 2.5.5 Each find located was position fixed using the acoustic system (**Figure 3**), photographed and videoed, and recorded as an observation point in the DIVA system.
- 2.5.6 As set out in the Method Statement two geophysical anomalies approximately 15 m south of Site were investigated visually and using the BlueView sonar during the fieldwork. No archaeological material or natural features were observed at these locations and they are not considered further in this report.
- ## 2.6 Recovery
- 2.6.1 Following mapping, an operation to recover all of the finds identified during mapping that were considered by GWFL to be vulnerable to impacts was undertaken (see **Figure 3** for the location of zones of potential impact). Additionally, any finds not seen during mapping but disturbed during recovery were mapped and recovered.
- 2.6.2 Excavation using the WROV manipulators or its low-power dredge was undertaken, to a depth and extent limited to that necessary to recover an individual find. Grabbing was used in a controlled manner for recovery where recovery using the manipulators had been unsuccessful.
- 2.6.3 The WROV was navigated back to each find location using the acoustic system. The location was searched for the find and it and any other additional finds either not seen during mapping or uncovered during the recovery of the original find were recovered. The recovery of each find was recorded as a position fix and as an observation point in the DIVA system.
- 2.6.4 Some difficulty was experienced in relation to relocating archaeological material identified during mapping. This is thought to have been due to the very poor visibility and the normal limitations attendant upon the accuracy of the acoustic system. The thrusters and the contact that inevitably occurred between the WROV skids and the seabed owing to the very low altitude at which the vehicle had to be flown is likely to have caused some redistribution of surface sediment that probably obscured the position of some finds. Due to this uncertainty over identification on Site, all finds located in the very close vicinity of the mapping phase finds positions were given the same number. All finds retained by Wessex Archaeology have been assigned individual UIDs.
- 2.6.5 Accurate positioning of grab recoveries was achieved by means of an acoustic transponder attached to the crane wire above the grab. Depth of penetration is estimated to have been no more than 0.3-0.5 m (although grab locations were subsequently inspected using the



WROV, it did not prove possible to measure actual depth). Grabbed material was recovered to deck for sorting and retrieval of finds by the WA archaeologists, assisted by the riggers.

2.7 Finds handling and recording

2.7.1 Following recovery, most finds and all sensitive finds were stored on-board, submerged wet, in lidded boxes. Some oversize finds were wrapped in plastic to limit drying out. Following demobilisation, the finds were transferred to WA South within three days. They have been recorded and are currently being held in passive storage for possible further analysis. Appropriate reports have been submitted to the relevant coroner and HM Receiver of Wreck.

2.8 Research into aircraft Identification

2.8.1 In the absence of aircraft identification plates or other unique identifying numbers that are traceable to individual airframes, efforts to identify the aircraft have been based upon a comparison of not before and not after manufacturing dates derived from the recovered artefacts with aircraft loss records derived from American Eighth Air Force records and British air/sea rescue records.

2.8.2 Eighth Air Force loss records have been sourced from secondary sources considered reliable by WA, specifically the archive of the American Air Museum in Britain⁵ and the database of The Eighth Air Force Historical Society⁶. Research has been assisted by further information from the air crash site investigator Jeff Carless.

2.8.3 Air/sea rescue aircraft loss records have been sourced from a private archive held by the independent expert Julian Foynes. This extensive secondary source has been derived from original contemporary document series held at The National Archives (TNA) and other archives and from further private research over the course of many years.

2.8.4 Loss positions given in loss and air/sea rescue records are usually rough co-ordinates or approximate distances from locations on the coast. They are rarely precise and are often highly approximate. They are typically based upon long distance visual estimates or direction-finding fixes if no survivors or trace of the aircraft was subsequently found, the position at which accompanying aircraft saw the crash or the position at which air/sea rescue launches or aircraft recovered survivors or observed floating wreckage. All positions given in these records are likely to be approximate to a greater or lesser degree and crash positions based upon visual observations or direction finding may be inaccurate by several miles. As a result, it is difficult to compare loss positions given in these reports with site co-ordinates with a high degree of confidence.

2.9 Post-excavation assessment

2.9.1 In accordance with the Method Statement, the observed penetration of the grab below 20 cm means that the fieldwork has been classified as including excavation.

3 RESULTS

3.1 Description of the Site

3.1.1 The site lies to the west of the Outer Gabbard, at a depth of about 30 m (**Figure 1**). The Site boundary as defined in the Method Statement is the limit of a 2 m radius buffer placed

⁵ <http://www.americanairmuseum.com/archive>

⁶ <http://www.8thafhs.org/new/database.php>

around the four UXO targets identified as containing possible aircraft material (AB_OSP_Mag_0145/AB_OSP_Mag_0145_A/AB_OSP_Mag_0145_B/AB_OSP_Mag_0145_C; **Figure 2**). Total Site area is 87.2 m².

- 3.1.2 The seabed within the Site and in its near vicinity has no significant relief. Observed and excavated sediment consisted of a single context (context number **1000**). This comprises light brown gravelly sand. The gravel is rounded to sub-angular flint up to 100 mm in diameter. Frequent mollusc remains (bivalvia) and a few crustaceans and echinoids are noted. The sediment is interpreted as recent/mobile sediment. There was also some evidence of mid greyish brown clay within the grab samples that could be part of the surface of the underlying London Clay formation.
- 3.1.3 Previous studies have identified that the base of the geological sequence across the Site is the Eocene London Clay Formation, which is considered an immobile geological unit comprising firm to stiff silty clay and clayey and sandy silt with subordinate sand. Although the London Clay is reported to be exposed in places across GWF, in others it is thought to be overlain by a thin veneer of sands and gravels, not exceeding 1 m in depth (WA 2017a: 2). Observations made during UXO investigations and during the fieldwork suggest that this thin veneer extends across the Site and is context **1000**. The presence of clay within the grab samples suggests that **1000** is a thin deposit. However, as no full depth excavation was undertaken, it is not possible to say at exactly what depth the London Clay Formation occurs.

3.2 Recovered Finds

- 3.2.1 A total of 182 finds were recovered from the finds locations shown in **Figure 3**. All the finds recovered were either small fragments or individual items. As a result of this and the fact that many were recovered by clam shell grab, the orientation of only a small proportion was recordable. No coherent aircraft structure or large item such as an engine were either observed or recovered. **Appendix 1** contains a catalogue of the recovered finds.

- 3.2.2 Significant finds with diagnostic potential include the following:

Human skeletal remains (HSR)

- 3.2.3 A small worn adult right and anterior mandible fragment was found in the upcast of Grab 3 (**Figure 3; Plate 1**). It exhibits ante mortem loss of the right P2-M1 teeth, with full resorption of sockets and narrowing of alveolus. Although this level of tooth loss is occasionally seen in young males with poor dental hygiene or diet, and certain dental defects can lead to early tooth loss, it suggests that the deceased is unlikely to have been younger than 30 at the time of death. The squared mental protuberance suggests that the deceased was male.
- 3.2.4 This type of object is difficult to spot against the background seabed sediment present on site (sand and gravel) in poor visibility. Therefore, whilst it was not seen during the mapping phase and is therefore likely to have been buried, it is not possible to state with absolute confidence that it was buried.

Spar

- 3.2.5 A riveted box-section aluminium girder, 2.97 m long, was located in the vicinity of WA0011 (**Figure 3; Plate 2**). This can be identified as a probable vertical spar from the tail of the aircraft. This was the only large piece of wreckage found.



Rudder or tail-plane rib

- 3.2.6 An end-fragment of a small webbed frame was found. This has a longitudinally curved shape and narrows to one end. Its shape and size suggest that if originating from a large aircraft then it is likely to be part of a rudder or tail-plane rib (**Plate 3**).

Web frame

- 3.2.7 A number of small fragments of webbed aluminium frame were found, of a type typically used in aircraft construction (**Plate 4**).

Stringers

- 3.2.8 Several fragments of very lightly built L-shaped aluminium bar, some bulbed and up to 1.7 m long were recovered (**Plate 5**). These have small aircraft-type rivets or rivet holes. Some fragments have traces of rubber gasket on one side. These have a form typical of longitudinal stringers from a monocoque aircraft fuselage. Printed along the length of one of the inner sides of one fragment is '24ST', which is the material type. The modern equivalent is grade 2024 aluminium.

Tail gear retracting assembly

- 3.2.9 A threaded assembly consisting principally of a threaded screw 890 mm long with stop assemblies at each end, gears and axle were found in the upcast of Grab 2 (**Figure 3; Plate 6**). Amongst several markings stamped onto the castings is ASSY-69-1787-13. This identifies it as an American manufactured tail gear retracting screw from a B-17 (USAAF 1942: Figures 110 & 112⁷; USAAF 1943: 92⁸).

De-icer boot fragments

- 3.2.10 Five small fragments of rubber sheet, with black and yellow/green bands and rivet impressions and one with a valve were found (**Plate 7**). These can be identified as fragments of de-icer shoe/s.
- 3.2.11 The rubber is stamped with a trade mark and 'Goodrich'. This stands for B.F. Goodrich and the trade mark is associated with the period including the Second World War. The stamp also includes a model number (2-163) and a part number (2-163-8-1). It also includes a patent number, which is illegible. B.F. Goodrich manufactured a variety of rubber goods during the war, including this type of equipment.

Life raft CO2 cylinder

- 3.2.12 A small, heavily concreted cylinder was found (**Plate 8**). This has a fabric sheath, which is a typical means of securing a cylinder to the side of a life raft and the size of the cylinder is consistent with a small, aircraft-deployed, life raft. Part of the inlet valve survives with traces of rubber fabric around it. The cylinder is very heavily concreted and no cylinder stamps can be seen as a result.

Fuselage/wing skin fragments

- 3.2.13 A large number of fragments of aluminium sheet were found. Typically, these have either rivets typical of aircraft construction or small rivet holes. Paint coat is evident, both olive-type green and very dark, possibly black, although the latter is probably due to a post-deposition chemical reaction. The general condition of these fragments is very poor, with very severe thinning and resulting holes. However, one of these fragments has a curvature

⁷ <https://www.avialogs.com/index.php/en/aircraft/usa/boeing/b-17flyingfortress.html>

⁸ <https://www.avialogs.com/index.php/en/aircraft/usa/boeing/b-17flyingfortress.html>



suggestive of a tail-plane leading edge skin. In addition, fabric cover was found, which is typically associated with rudders and elevators.

Clothing

- 3.2.14 Small fragments of clothing (possibly crew undergarments) and heating pads were found in the upcast of Grab 1 (**Figure 3; Plate 9 & Plate 10**).

Parachute material

- 3.2.15 Fragments of what appear to be parachute shroud were observed (WA0043; **Figure 3**). If it is parachute, it is not known whether this might be for personnel or for equipment deployment. These fragments were not recovered, as they lay outside of the area thought to be subject to impact.

Ammunition

- 3.2.16 A total of five rounds of small arms ammunition with seated bullets were recovered from WA0069 and were retained by the UXO officer, in addition to an empty cartridge casing fragment (**Plate 11**). The complete rounds had a length of approximately 138 mm and a diameter of approximately 20 mm. The rounds were 80-100% covered in marine growth and were generally damaged and/or corroded.
- 3.2.17 The rounds are 0.5-inch calibre. They can be identified on the grounds of shape and approximate dimensions as probably having been manufactured for use in Browning M2 Machine Guns. Identification was confirmed during fieldwork by the EOD specialists.
- 3.2.18 The base of the cartridge cases of those bullets from which the marine growth was cleaned are stamped with the letters 'L' and 'C' and with the number '43'. This means that they were manufactured at the Lake City Army Ammunition Plant in Missouri, USA in 1943 by Remington Arms.

4 DISCUSSION

4.1 Site Character

Type of site

- 4.1.1 Many of the finds can be positively identified as fragments of aircraft structure or equipment. The only plausible explanation for the Site is that it is part of an aircraft crash site. Unless the presence of ammunition is co-incident, which seems highly unlikely, the aircraft must have been armed with machine guns and was therefore a military aircraft. The great majority of aircraft crash sites around the UK coast date from the Second World War

Date of loss

- 4.1.2 The date of manufacture stamps on the small arms ammunition mean that the aircraft must have been lost in 1943 or later. This type of ammunition was expended in huge quantities and issues of supply and demand therefore mean that it is unlikely to have been very old when the loss of the aircraft occurred. Allowing time for the supply process, the aircraft was probably lost in the period spring 1943 to summer 1944.

Place of manufacture

- 4.1.3 The aircraft can be identified as being of American manufacture for the following reasons:
- The presence of 24ST aluminium is typical of aircraft manufactured in the US during the Second World War;



- B.F. Goodrich is known to have supplied rubber technical goods, including de-icing boots and life rafts, to the American armed forces;
- De-icing boots were not used on British or *Luftwaffe* aircraft;
- Browning M2 machine guns were very widely used by the American Army Air Force (the precursor to the modern US Air Force) and the 0.5-inch small arms ammunition production line at Lake City Armoury is known to have been set up to supply the American Army during the Second World War; and
- the Site lies between the wartime bases of the American 8th Air Force and Occupied Europe.

Aircraft type and service nationality

- 4.1.4 The wreckage can be positively identified as coming from a B-17 by the presence of a B-17 retracting screw with B-17 part numbers. Whilst the B-17, a four-engine heavy bomber, saw limited service with the RAF from 1941 onwards, the aircraft was overwhelmingly used by the US Army Air Force (USAAF), the precursor to the US Air Force, and by the Eighth Air Force (8 AF) based in East Anglia and Cambridgeshire. On a balance of probability basis, the aircraft is therefore very likely to have been in American service and operated by the Eighth Air Force.

Make and model

- 4.1.5 B-17 heavy bombers were produced in various models, with models E to G being operated by the Eighth Air Force. No operational loss has been traced for the B-17E within the date range provided by the ammunition. As the Eighth expanded, the B-17E was superseded by the far more numerous B-17F and, from autumn 1943, the even more numerous B-17G. The aircraft is therefore likely to be a B-17F or G.

Identification

- 4.1.6 The artefactual and human remains evidence does not in itself allow the Site to be matched with a known B-17F or G.
- 4.1.7 The Site is approximately 60 km (37 miles) east-north-east of Clacton-on-Sea, 50 km (31 miles) east of Harwich, 46 km (28 miles) east of Felixstowe, 33 km (20 miles) east-south-east of Orfordness and 47 km (29 miles) south-east of Southwold. Although eight B-17 losses that resulted in fatalities have been identified in or potentially in the general area (**Appendix 2; Figure 5**), none of the records consulted contain loss location details that exactly match the position of the Site. Given the approximate nature of the positions derived from contemporary records, it is nevertheless possible that the Site contains one of these losses. However, this cannot be proven on the available evidence.
- 4.1.8 Alternatively, the wreckage recovered may be from an aircraft that was not observed to crash or which did not report itself to be in difficulties and was not therefore located using accurate direction-finding equipment. This might arise if an aircraft damaged over the Continent was unable to send an SOS because its radio had been knocked out and it landed out of sight of other aircraft, rescue launches and shore observers. This is possible, although the Site would have been in visual range of at least three Felixstowe air/sea rescue launch standing patrol positions by 1943⁹ and the aircraft would have been flying in daylight and probably in clear conditions.



4.2 Site formation processes

- 4.2.1 It is believed that the site is made up of a relatively thin layer of superficial/mobile sediment, under which the London Clay bedrock formation lies. This view is supported by the inclusion in the grab samples of London Clay.
- 4.2.2 Only a very small proportion of the aircraft was recovered and none of the large and normally survivable components such as engines and propellers have been found. As well as material from the aft fuselage and tail, material from the upper mid-fuselage has been found, as on B-17F and G models, the life rafts were stowed above the bomb bay, just aft of the top turret (USAAF 1944: 338¹⁰). Due to the poor visibility encountered, only a few objects were able to be roughly orientated by alignment with the WROV compass. The recorded orientations of the finds indicate no obvious pattern and therefore does not appear to add to this interpretation. There are four potential explanations for this lack of wreckage.
- 4.2.3 Firstly, if the aircraft broke up in mid-air as a result of damage, the wreckage may have been widely scattered. Although the fieldwork was tightly confined to the buffered area shown in **Figures 1 & 2**, previous UXO investigations located 0.5-inch calibre small arms ammunition 67 m NNW of the site (AB_OSP_Mag_0153; WA 2017a: 10). As it is unlikely that this is co-incident, this supports the theory of wide scatter during loss.
- 4.2.4 Secondly, it is possible that wreck material may have been dispersed or even largely destroyed by post-site formation processes, particularly late 20th century commercial trawling. This is known to have occurred elsewhere in this region and the theory is supported by the same evidence. No large ferrous anomalies that may indicate more significant aircraft components (e.g. engines) have been detected in the vicinity of the Site from the magnetometer surveys undertaken by GWFL.
- 4.2.5 Thirdly, a significant part of the Site may have buried archaeological remains which were not mapped or recovered. The limited extent and depth of the intrusive investigation carried out during fieldwork means that it is not possible to rule this out and it should be noted that Grab 2 resulted in the recovery of a large number of finds that were not observed during mapping. However, these were almost entirely very small fragments. Furthermore, previous geophysical and UXO investigations of both the Site and the surrounding area suggest that there is little wreckage within the Site and there is likely to be little scope for burial of a substantial amount of wreckage due to limited sedimentary depth above the London Clay (WA 2017a: 2).
- 4.2.6 Fourthly, a combination of the above could have acted to form the site. This would have required part of the aircraft to have either remained intact or to have fallen in a tight cluster. As with the third explanation, this theory is unlikely due to the lack of large or coherent items of wreckage found during grabbing and the limited depth of sediment likely over the London Clay.
- 4.2.7 On balance, the available evidence suggests that the Site is likely to be part of a widely-dispersed crash site, caused either by a damaged aircraft breaking up in the air or by destructive post-deposition formation processes.

4.3 Human Skeletal Remains

- 4.3.1 Whilst it is possible that the human skeletal remain is co-incident with the Site, given its proximity to the aircraft remains it is more likely that it is associated with the aircraft

¹⁰ <https://www.avialogs.com/index.php/en/aircraft/usa/boeing/b-17flyingfortress.html>



wreckage and is therefore aircrew. The interpretation of the wreckage as coming from the tail of the aircraft suggests that the remains could be associated with a waist gunner or, more likely, the tail gunner. As the aircraft has not been identified, the remains cannot be associated with a known individual.

5 STATEMENT OF POTENTIAL

5.1 Archaeological potential

5.1.1 It is unusual but not entirely rare to find aircraft remains in sub-tidal situations in proximity to and within the territorial waters of the United Kingdom, especially off the east, south-east and south coasts of England. The aircraft material discovered at the Site is fragmentary and is in the condition expected of an aircraft that has suffered catastrophic damage, either at the time of loss or subsequently.

5.1.2 No coherent aircraft structure has been found and what has been found is fragmentary and in poor condition. Based on materials recovered and assessed to date the archaeological potential would be assessed as Low/Medium. Nevertheless, the archaeological potential of many of the individual components of the aircraft relate to their rarity rather than condition and further investigation may link the wreckage with a particular aircraft, event or person. The archaeological importance of the Site is therefore currently considered **Uncertain**.

5.2 Historical potential (Campaign)

5.2.1 At present, there is no evidence to substantiate a particular campaign or raid ('a Mission'¹¹). A broad date range of spring 1943 to summer 1944 can be derived from the artefactual evidence and it is therefore highly likely that the aircraft is associated with the American daylight bomber offensive against Occupied Europe carried out by the Eighth Air Force. Recorded aircraft crashes near the site, described above, are for aircraft that crashed during Missions 512, 513 or 359, but there is no certainty that the aircraft material originates from any of these crashes. The likelihood of the loss having occurred other than in the context of a Mission is remote.

5.3 Historical potential (People)

5.3.1 At present, there is no evidence to substantiate a particular link with any historical figures.

5.4 Historical potential (Units)

5.4.1 At present, there is no evidence to substantiate a particular link with a specific unit within the Eighth Air Force. One record of an aircraft crash near the site was for a Fortress of the 710th Bomb Squadron, 447th Bomb Group, but confirmation of this identity has not been established.

5.5 Historical potential (Variant)

5.5.1 At present, all that can be substantiated is that the aircraft was a B-17 "Flying Fortress", very probably a B-17F or G.

5.6 Conclusion

5.6.1 The recovered material is likely to relate to an unidentified late war B-17F or G, one of many based in England during the Eighth Air Force bomber offensive over Occupied Europe. It is assessed as being of Low-Medium archaeological potential. Should a connection eventually

¹¹ Each American bomber sortie was given a unique number and described as a 'Mission'.



be identified with a particular Mission or event, person and/or unit, that may increase the archaeological importance of the material.

6 PROPOSALS FOR ANALYSIS, PUBLICATION AND ARCHIVE

6.1 Introduction

6.1.1 The following publication suggestion will be discussed with the client:

- An academic report in the *Journal of Conflict Archaeology* (subject to acceptance)

6.1.2 The academic report will comprise an integrated interpretation and discussion of the findings commensurate with the significance of the data recovered. This will include a discussion of the wider context of the findings and examination of selected original historic records relating to the known losses included in **Appendix 2**.

6.2 Aims and Objectives

6.2.1 The aims for the analysis and publication phase are as follows:

- To ensure the long-term curation of the data recovered and its dissemination in a form appropriate to its significance and academic value.
- To carry out an agreed programme of post-excavation analysis and reporting following the procedures set out in MoRPHE (English Heritage 2006).
- To produce report text for publication in the format set out above.

6.2.2 The tasks required to complete the academic report are detailed in **Table 2** below.

6.2.3 The academic report will contain a description of the materials and functions of finds represented in the assemblage. Further detailed proposals for each class of material are listed below. The affinities of the assemblage will be discussed, with any implications for the understanding of the Site. A limited discussion of the intra-site distribution will also be included. A small selection of key finds will be illustrated as a representative sample, focusing on the Eighth Air Force.

6.3 Research

6.3.1 Although the available loss location information is not sufficient to justify further detailed research concerning aircraft losses set out in **Appendix 2**, academic publication of the results would benefit from additional narrative and referencing information. Therefore, selected primary records may be obtained during preparation of the academic report to supplement the information obtained from secondary sources.

6.4 Analysis

6.4.1 The material archive has already been assessed by specialists who found that no further analytical studies are possible given the lack of diagnostic material present.

6.5 Publication

6.5.1 The results of analysis and research will be synthesised into a publication programme as agreed with the Client and approved by Historic England.



6.6 Archive

- 6.6.1 The material, digital and paper archive generated will be compiled and prepared in accordance with the appropriate guidance. Endeavours will be made for the archive to be deposited in a suitable repository.
- 6.6.2 A copy of the academic report will be sent to the 2nd Air Division library at <http://www.2ndair.org.uk/index.htm>, and an entry made on the American Air Museum's website at <http://www.americanairmuseum.com/>.

7 PROVISIONAL TASK LIST AND RESOURCES

7.1 Task List and Resources

- 7.1.1 Table 2 below presents the list of tasks and resources required to produce reports for publication in the two formats set out above (not including printing). Proposed personnel and their qualifications are listed at 7.3.1.

Table 2: Task list and resources estimate

Task	Grade*	Days/cost
ANALYSIS TASKS		
Conservation Assessment	Conservation Manager	1
RESEARCH TASKS		
Primary Records	TS/PO	1
Secondary Sources	TS/PO	1
Archival Synthesis	TS/PO	4
PUBLICATION TASKS		
Overview and Summary	TS/PO	1
Introduction and Methods	TS/PO	1
Archaeological background	TS/PO	1
Site descriptions	TS/PO	1
Discussion and synthesis, acknowledgements and bibliography	TS/PO	2
Preparation of publication illustrations	TS/DO	1.5
Editing/reading and amendments	Quality & Publications Manager	1
Other tasks		
Conservation	Conservation Manager	4
Management	Project Manager	4
Archive preparation	SPO ¹²	2
Finalise finds box lists and index	Finds Officer	1

¹² Senior Project Officer with relevant experience.



Carry out & document discard policy	Finds Officer	1
Digitise job sheets & checking	SPO	0.5
Archive deposition	SPO	1
Box storage grant	Archive Manager	TBC

*Ext: External Specialist, Aircraft Finds
TS: Technical Specialist
PO: Project Officer
DO: Drawing Office
SPO: Senior Project Officer

7.1.2 Historic England will be consulted on arrangements for peer review/refereeing of the academic publication.

7.2 Programme

7.2.1 The publication programme will be completed in 2019.

7.3 Personnel

7.3.1 It is currently proposed that the following Wessex Archaeology core staff will be involved in the programme of post-excavation analyses.

Project Manager	Danielle Wilkinson MMA ACIfA
Finds Manager	Lorraine Mepham, BA, MCIfA
Technical Specialist (TS)/Co-author	Graham Scott, BA, ACIfA
Project Officer/Co-author	Robert MacKintosh, LLB(Hons), MSc,
Finds Officer (FO)	Vicki Lambert, BA, ACIfA
Conservation Manager	Lynn Wootton, BSc, ICON
Quality & Publications Manager	Pippa Bradley, FSA, BA, MPhil MCIfA

7.4 Wessex Archaeology Quality Standards

7.4.1 Wessex Archaeology operates an integrated project management system. Projects are assigned to individual Project Managers who monitor their progress and quality and control budgets from inception to completion, in all aspects including Health and Safety. Projects are managed in accordance with English Heritage guidelines outlined in the document MoRPHE Project Manager Guide (English Heritage 2006).

8 STORAGE AND CURATION

8.1 Museum

8.1.1 It is recommended that the project archive resulting from the excavation be deposited with an appropriate Museum Service Store. Deposition of the finds with a Museum will only be carried out with the full agreement of the statutory authority (Essex County Council).

8.2 Preparation of Archive

8.2.1 The complete Site archive, which will include paper records, photographic records, graphics, and artefacts, will be prepared following the guidelines for the deposition of archaeological archives in the Southend Museum Service Store, and in general following nationally recommended guidelines (Walker 1990; SMA 1995; Richards and Robinson 2000; Brown 2007).



8.2.2 All archive elements are marked with the Site code and accession code, and a full index will be prepared. The archive is anticipated to comprise the following:

- 20 cardboard boxes or airtight plastic boxes of artefacts and ecofacts ordered by material type;
- 4 files/document cases of paper records & A3/A4 graphics;
- 5 files photographs;
- 2 A1 graphics.

8.3 Conservation

8.3.1 No immediate conservation requirements were noted in the field. Finds which have been identified as of unstable condition and therefore potentially in need of further conservation treatment comprise the metal objects, particularly un-anodised aluminium which has reacted adversely with the seawater.

8.3.2 Some metal objects may be X-radiographed as part of the assessment phase, as a basic record and also to aid identification. On the basis of the X-rays, the range of objects present and their provenance on the Site, no objects have yet been selected for further conservation treatment. Recommendations are made for the discard of some material types (see below). An assessment of conservation requirements will be undertaken.

8.4 Human Skeletal Remains

8.4.1 Following full recording and analysis, it is anticipated that the human mandible will ultimately be repatriated by the US authorities. Pending repatriation, it will remain in wet storage at WA South in the care of the Conservation Manager. It will gradually be desalinated to reduce the risk of deterioration due to its removal from the marine environment.

8.5 Discard Policy

8.5.1 Wessex Archaeology follows the guidelines set out in *Selection, Retention and Dispersal* (Society of Museum Archaeologists 1993), which allows for the discard of selected artefact and ecofact categories which are not considered to warrant any future analysis. Any further discard is likely to be relatively minimal, but the following categories are proposed for discard:

- Intrusive material: modern, undiagnostic; total discard
- Metalwork: undated objects; undiagnostic, unstable for long-term curation; total discard.

8.5.2 The discard of environmental remains and samples follows the guidelines laid out in Wessex Archaeology's 'Archive and Dispersal Policy for Environmental Remains and Samples'. The archive policy conforms to nationally recommended guidelines (SMA 1993; 1995; English Heritage 2002) and is available upon request.

8.5.3 The discard policy for both finds and environmental material will be fully documented in the project archive.

9 REFERENCES

Brown, D.H., 2007, *Archaeological archives; a guide to best practice in creation, compilation, transfer and curation*, Archaeological Archives Forum



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10 APPENDIX 1 – FINDS REGISTER

UID	Figure 3	Interpretation	No.	Material	Grab	Dive
WA2001	WA0052	stringer - extruded	1	Al		11
WA2002	WA0051	web plate?	1	Al		11
WA2003	WA0077	rib, fragment	1	Al		11
WA2004	WA009	pivot	1	Al		11
WA2005		fragment	1	Al		11
WA2006		plate, fragment	1	Al		11
WA2007		web plate	1	Al		11
WA2008		web plate	1	Al		11
WA2009		Uncertain	1	concretion		11
WA2010		fragment	2	Al		11
WA2011		internal vertical rib	1	Al		11
WA2012		plate, fragment	1	Al		12
WA2013	WA0016	electrical component	1	concretion		12
WA2014	WA0053	stringer - extruded	1	Al		12
WA2015	WA0019	wire	1	Copper		12
WA2016	WA0043	De-icer boot	1	rubber		13
WA2017	WA0056	Mass balance weight / trim tab	1	lead		13
WA2018	WA0014 (part of)	strap, frag	1	Al		13
WA2019		plate and L-bar, fabric gasket	1	Al		14
WA2020		plate, fragment	1	Al		14
WA2021		De-icer boot	1	rubber		14
WA2022		fabric gasket	1	fabric		14
WA2023	WA0059/1	web plate	1	Al		15
WA2024	WA0059/2	concretion	1	concretion		15
WA2025	WA0059/3	end of internal rib	2	Al		15
WA2026	WA0059/4	rib, fragment	1	Al		15
WA2027	WA0043	control surface lining	1	fabric		15
WA2028	WA0043	plate, fragment	1	Al		15
WA2029	WA0007	life raft cylinder	1	Steel? - Rubber		15
WA2030	WA0043	plate, fragment	1	Al		15
WA2031		control surface lining	1	fabric		16/17
WA2032		plate, fragment	1	Al		16/17
WA2033		joint strip	1	Al		16/17
WA2034		fragment	1	Al		16/17
WA2035		plate, fragment	1	Al		16/17
WA2036		plate, fragment	1	Al		16/17
WA2037		plate, fragment	1	Al		16/17



UID	Figure 3	Interpretation	No.	Material	Grab	Dive
WA2038		control surface lining	1	fabric		16/17
WA2039		skin plate	1	Al		18
WA2040		plate, fragment	1	Al		18
WA2041		fragment of parachute shroud line	1	Al, fabric		18
WA2042	WA0050	stringer - extruded	1	Al		11
WA2043		cable pulley	1	Formica	1	19
WA2044		De-icer boot	1	rubber	1	19
WA2045	WA0017	three-way pipe	1	Al		12
WA2046		De-icer boot	1	rubber	1	19
WA2047		heating pad	1	concretion and fabric	1	19
WA2048		concretion	1	concretion	1	19
WA2049		shell case	1	metal alloy	1	19
WA2050		concretion	1	concretion	1	19
WA2051		stringer	1	Al	1	19
WA2052		plate	1	Al	1	19
WA2053		pattern for rib?	1	Al	1	19
WA2054		wire with tag	1	copper	1	19
WA2055		plate, fragment	1	Al	1	19
WA2056		plate, fragment	1	Al	2	19
WA2057		plate, fragment	1	Al	2	19
WA2058		channel bar	1	Al	2	19
WA2059		plate, fragment	1	Al	2	19
WA2060		plate, fragment	1	Al	2	19
WA2061		rubber band/gasket	1	rubber	2	19
WA2062		wire with tag	1	copper	2	19
WA2063		wire	2	copper	2	19
WA2064		insulator	1	ceramic	2	19
WA2065		clips	3	stainless steel	2	19
WA2066		B-17 retracting gear assy	1	composite	2	19
WA2067		Mass balance weight / trim tab	2	Lead	2	19/20
WA2068		stringer	1	Al	2	19/20
WA2069		stringer	1	Al	2	19/20
WA2070		web frame - lightening hole	1	Al	2	19/20
WA2071		plate, fragment	1	Al	2	19/20
WA2072		plate and channel bar, fragments	10	Al	2	19/20
WA2073		electrical component	1	concretion	2	19/20
WA2074	WA0043	base of light bulb	1	various		20
WA2075		tension turnbuckle	1	various	1	19



UID	Figure 3	Interpretation	No.	Material	Grab	Dive
WA2076		heating pad	1	fabric and concretion	1	19
WA2077		wire	4	copper	1	19
WA2078		wire with tag	1	copper	1	19
WA2079		stingers, fragments	15	Al	1	19
WA2080		plate, fragment	22	Al	1	19
WA2081		concretions	9	various	3	19
WA2082	WA0048 / part of	stringer	1	Al		14
WA2083		L-bar	1	Al		18
WA2084		L-bar	1	Al		18
WA2085		ammo rack feeder	1	stainless steel		18
WA2086		wire	1	copper		18
WA2087	WA0045	de-icer boot	1	rubber		18
WA2088		L-bar	1	Al	2	19
WA2089		plate, fragment	1	Al	2	19
WA2090	WA0043	plate, fragment	7	Al		20
WA2091		L-bar	1	Al	1	19
WA2092		plate, fragment	1	Al	1	19
WA2093		plate, part of web frame?	1	Al	1	20
WA2094		undergarment	1	fabric	1	19
WA2095		wire	2	copper	1	19
WA2096		stringer, fragment	1	Al	1	19
WA2097		tension turnbuckle, fragment	1	Al?	1	19
WA2098		plate, fragment	1	Al	1	19
WA2099		plate, fragment	1	Al	1	19
WA2100		solenoid coil	1	plastic?	2	19
WA2101		wire	1	copper	1	19
WA2102		wire	2	copper	1	19
WA2103		undergarment	1	fabric	1	19
WA2104	WA11/12/63	spar	1	Al		16
WA2105	WA0065	stringer - extruded	1	Al		18
WA2106	WA0049	capping	1	Al		18
WA2107		web plate, capping at the top part of rib or frame	1	Al	1	19
WA2108		human remains	1	bone	3	19/20
		shells	5	metal alloy	1	19



11 APPENDIX 2 – B-17 CASUALTIES IN THE GENERAL AREA OF THE SITE

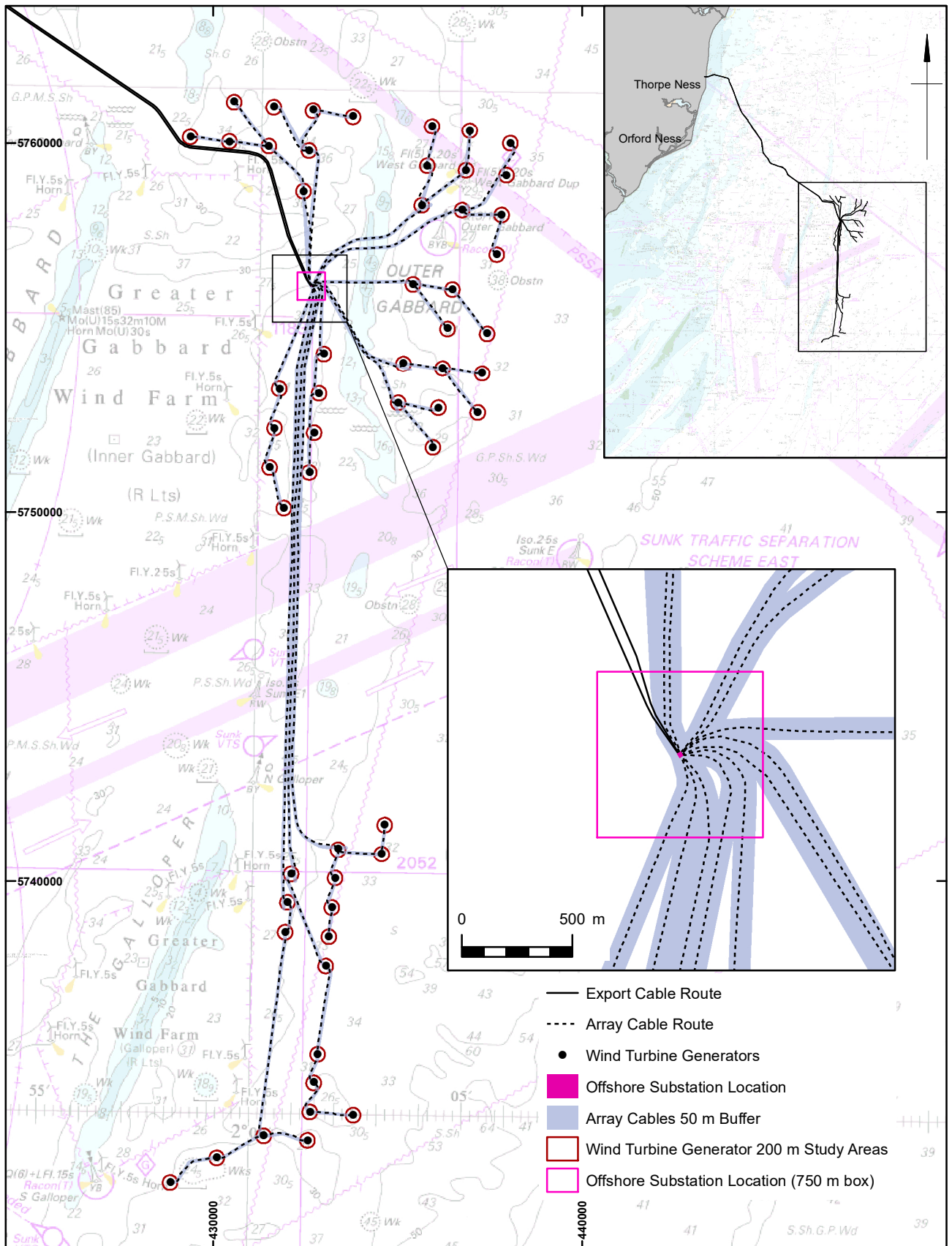
The site is approximately 60 km (37 miles) east-north-east of Clacton-on-Sea, 50 km (31 miles) east of Harwich, 46 km (28 miles) east of Felixstowe, 33 km (20 miles) east-south-east of Orfordness and 47 km (29 miles) south-east of Southwold (**Figure 5**).

Date	Casualty	Notes
22/06/1943	Nine of ten crew from unidentified B-17 saved by air/sea rescue launch HSL 2562 approximately 26 miles south-east of Orfordness	8 th Air Force raids on Huls, Germany and Antwerp, Belgium took place on this date (Mission 65).
26/06/1943	Unidentified B-17 of the 91 st Bomb ¹³ Group seen to ditch approximately 26 miles east of Orfordness by an air/sea rescue launch. Nine of ten crew rescued.	8 th Air Force raids on Villacoublay, Tricqueville and Le Mans, France took place on this date (Mission 68)
23/03/1944	Unidentified B-17 observed to crash 40 miles east of Felixstowe. Piece of yellow canvas attached to wreckage seen. Otherwise plane and crew not found.	8 th Air Force raids on Brunswick, Munster, Osnabruck, Achmer and Handorf, Germany took place on this date (Mission 275).
13/04/1944	Unidentified B-17 observed to crash 18 miles east of Orfordness. Nothing found by air/sea rescue aircraft and vessels.	8 th Air Force raids on various targets in Germany and leaflet drop over the Netherlands on this date.
20/05/1944	Three crewmen from an unidentified B-17 rescued 26-34 miles 88 degrees from Felixstowe.	No mention of a crashed aircraft - not clear whether it crashed or at this location. 8 th Air Force raids on Liege, Orly, Rheims and Villacoublay, France on this date.
21/07/1944	Unidentified B-17 observed to crash approximately 37 miles east of Clacton. One survivor and one body recovered.	B-17G 43-37763 crashed on this date 'off North Foreland' and could be this casualty ¹⁴ .
31/07/1944	Unidentified B-17 of 305 th Bomb Group (possibly 336 th Bomb Squadron) observed to crash approximately 20 miles east of Felixstowe. Nine survivors rescued.	8 th Air Force raid on Munich, Ludwigshafen, Mannheim and airfields in France (Mission 507).
19/09/1944	Unidentified B-17 of 351 st Bomb Group (511 th Bomb Squadron) observed to crash 38 miles east of Clacton, although air/sea rescue reports imply crash site may be 16 miles north of the Galloper buoy. Nine survivors recovered from 35 miles east of Clacton.	8 th Air Force raid on marshalling yards in Germany and targets of opportunity (Mission 642). B-17G 42-38153 'Bedlam Ball' ditched in 'the Channel' on this date and could be this aircraft ¹⁵ .

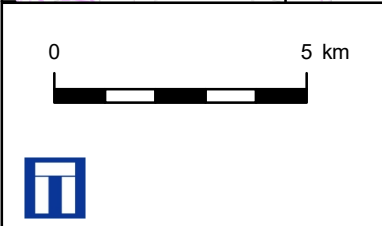
¹³ Widely used shortened form of 'Bombardment Group'

¹⁴ <http://www.americanairmuseum.com/aircraft/11769>

¹⁵ <http://www.8thafhs.org/new/groups.php>



- Export Cable Route
- - - Array Cable Route
- Wind Turbine Generators
- Offshore Substation Location
- Array Cables 50 m Buffer
- Wind Turbine Generator 200 m Study Areas
- Offshore Substation Location (750 m box)

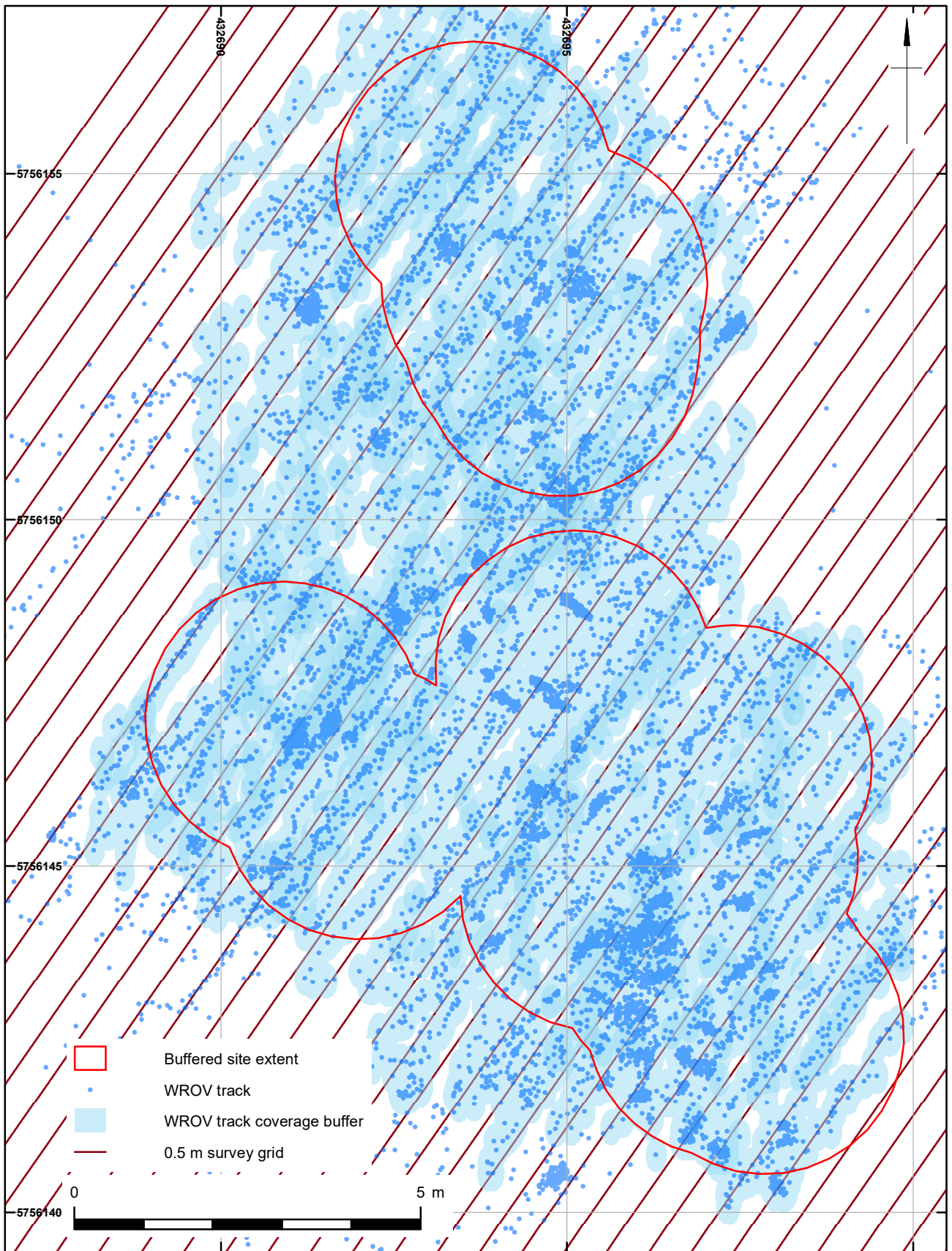



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Date:	19/02/2017	Revision Number:	1
Scale:	1:150,000 & 1:25,000 at A4	Illustrator:	KJF
Path:	W:\Projects\106224\GIS\Figs\MXD\AB_OSP_Mag_145_Aircraft-Recovery\		

AB_OSP_Mag_0145: Aircraft - Site Location: Substation

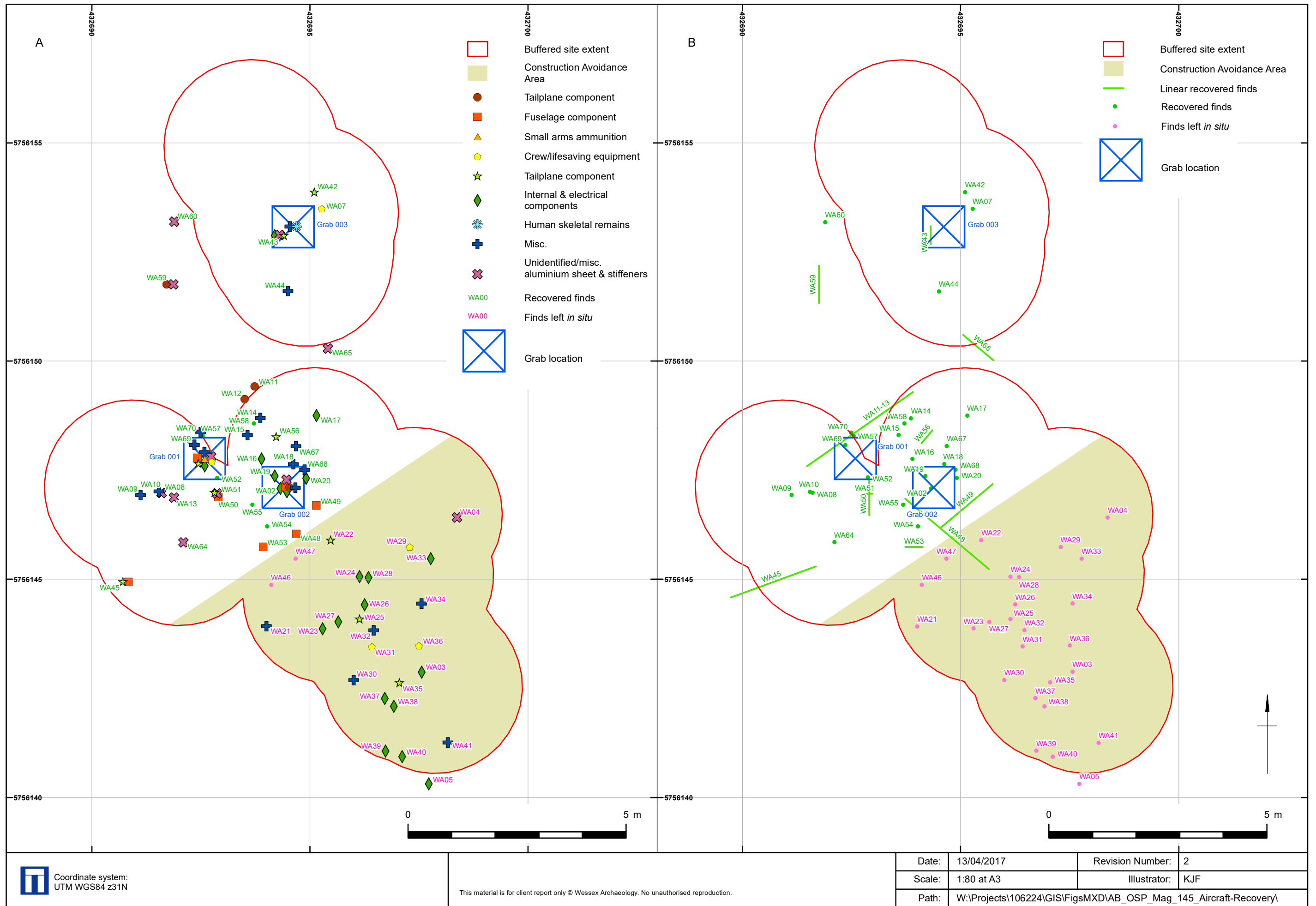
Figure 1



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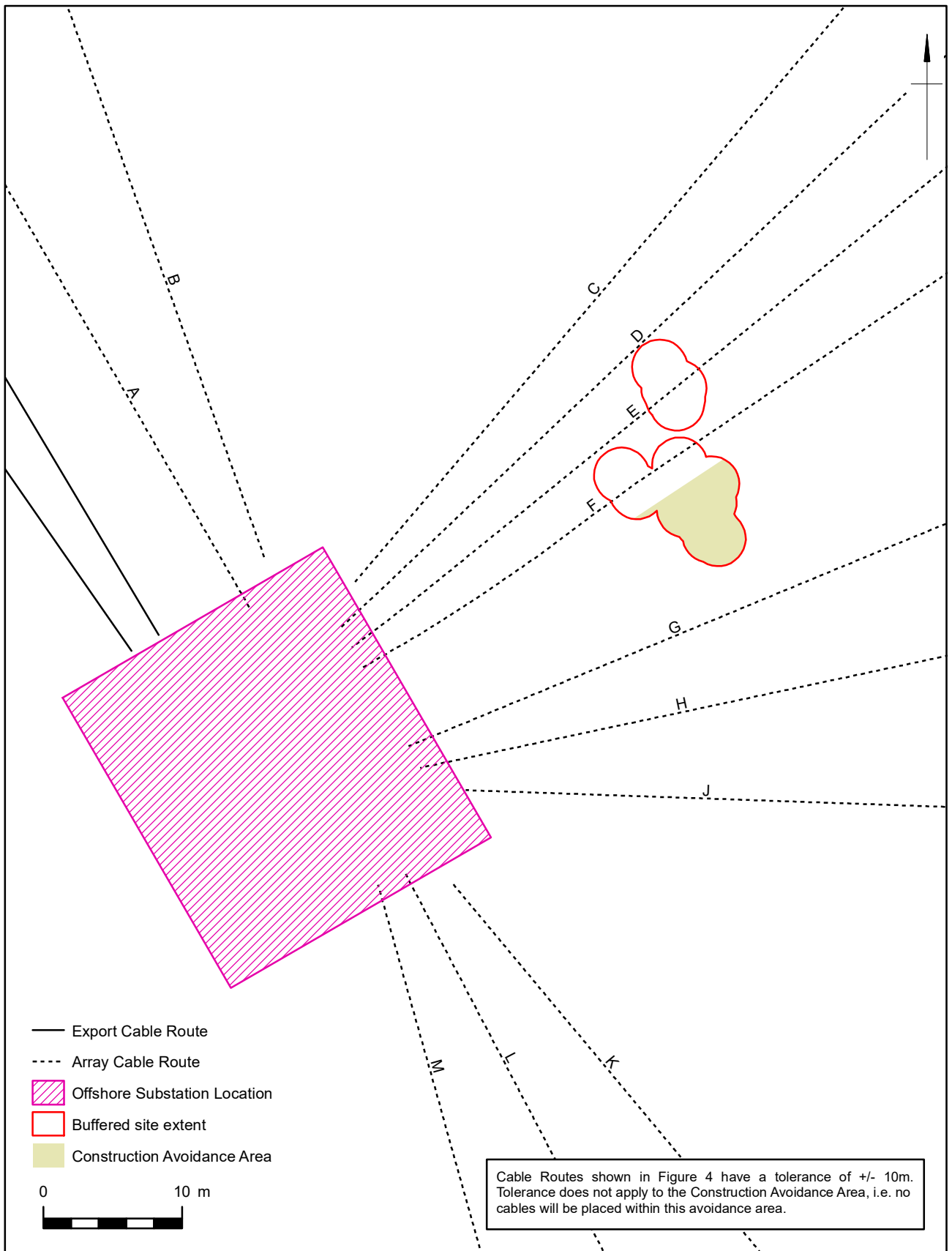
Survey coverage


Figure 2



Plan of archaeological material observed during mapping phase

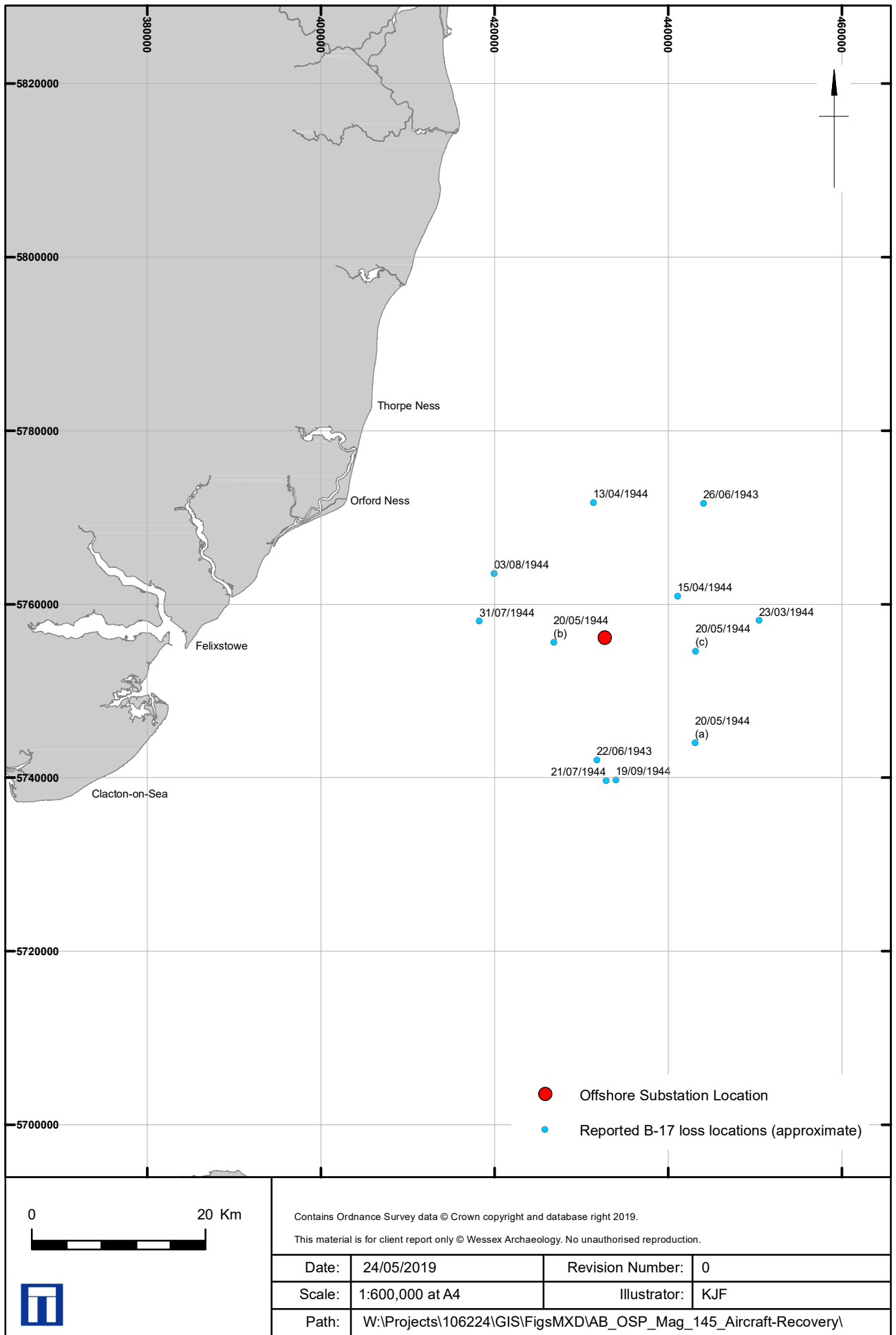
Figure 3



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	Scale:	1:400 at A4	Illustrator: KJF
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OSP, Indicative Cable Array and Construction Avoidance Area locations

Figure 4



Approximate locations of selected known B-17F/G losses

Figure 5



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Plate 1: Mandible fragment

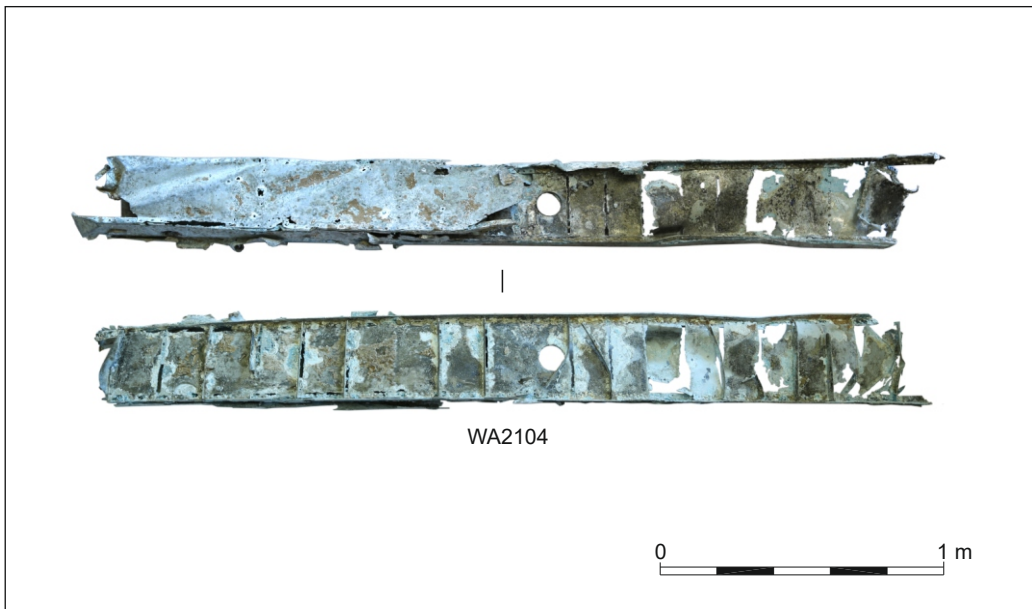


Plate 2: Spar


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Plate 3: Rudder or tail-plane rib

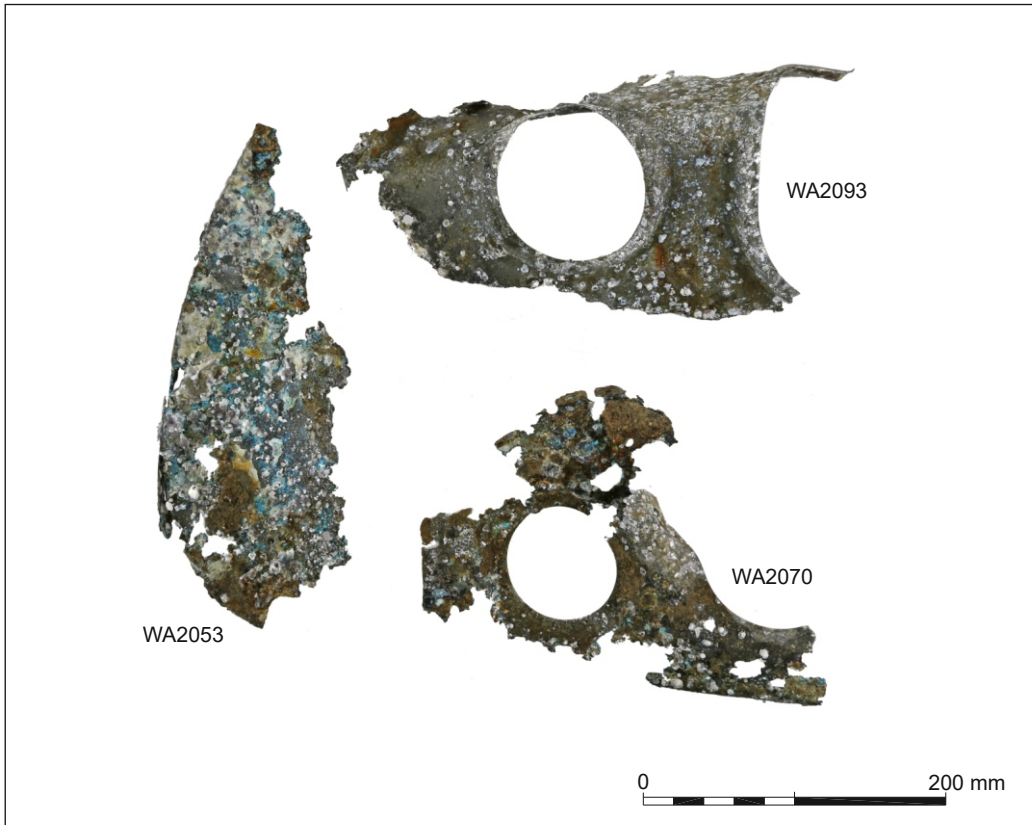



Plate 4: Web frame

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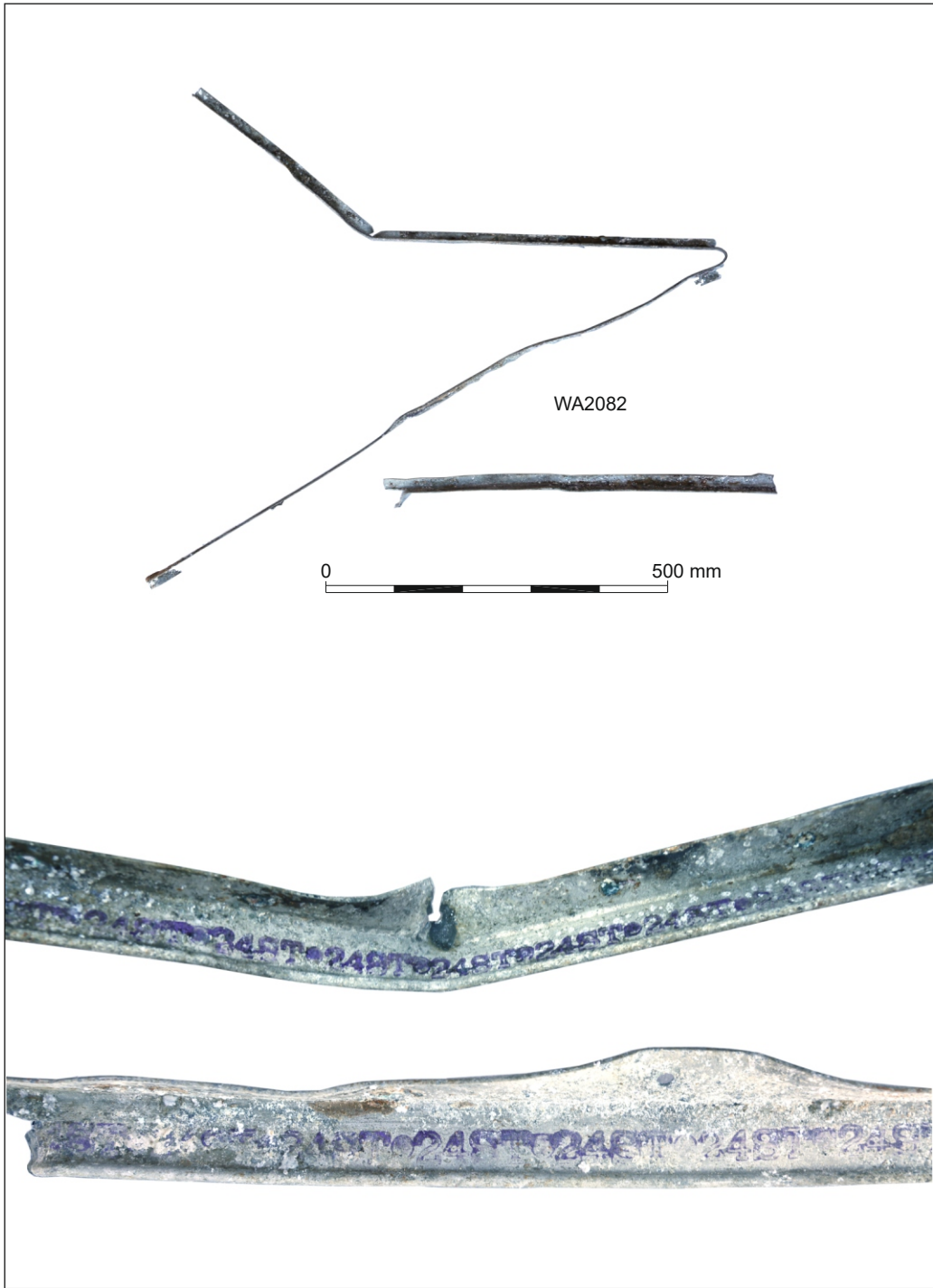



Plate 5: Stringer fragment

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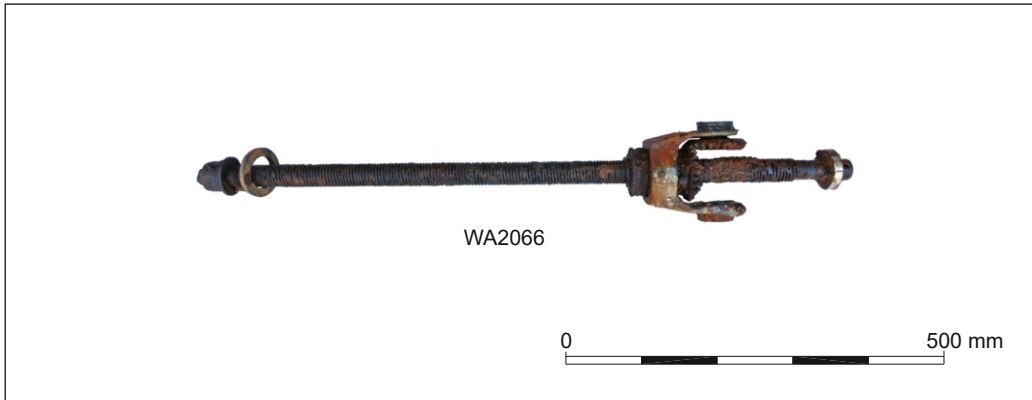


Plate 6: Tail gear retracting assembly

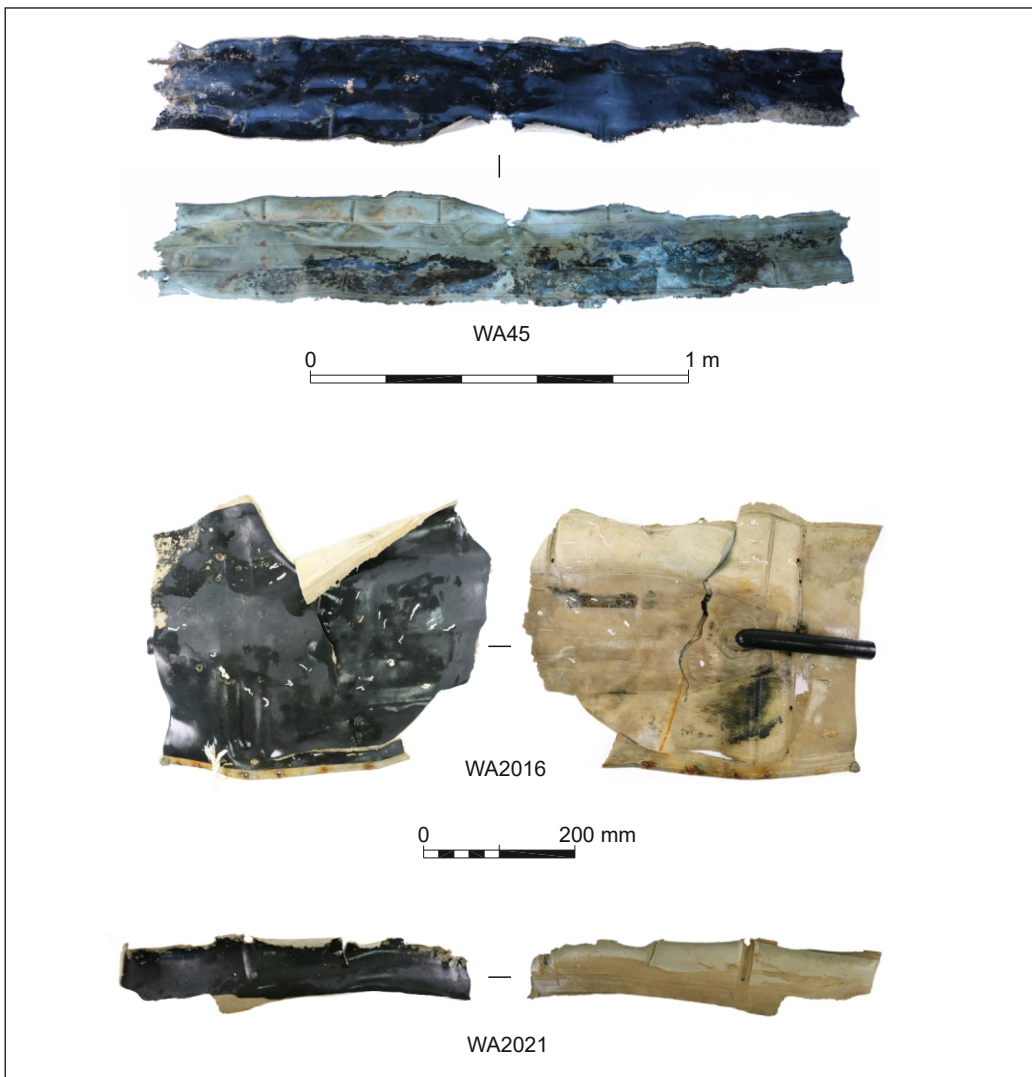



Plate 7: De-icer boot fragments

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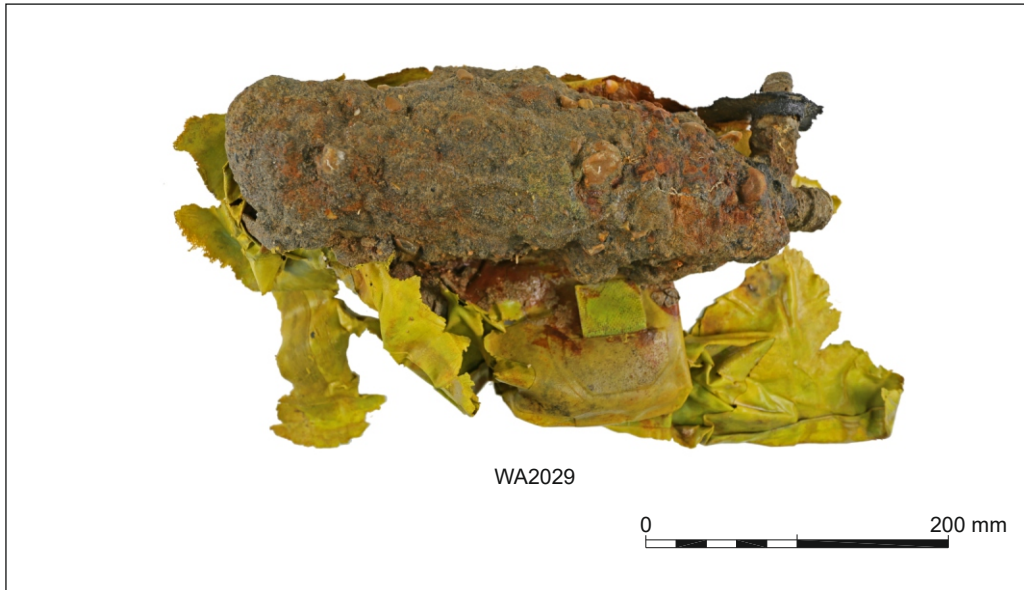


Plate 8: Life raft CO2 cylinder

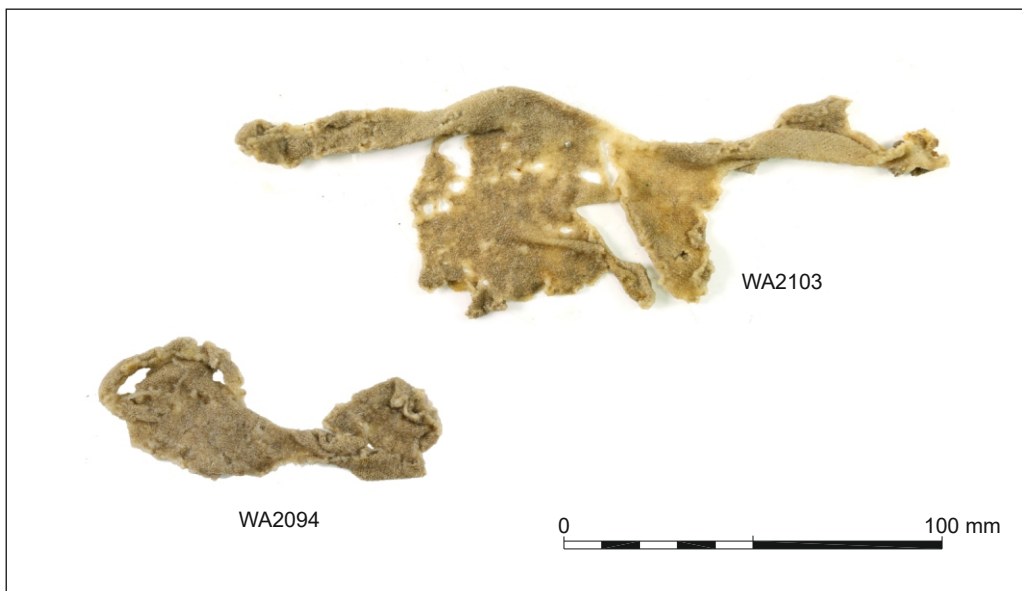


Plate 9: Clothing



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Plate 10: Heating pads



Plate 11: Round

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