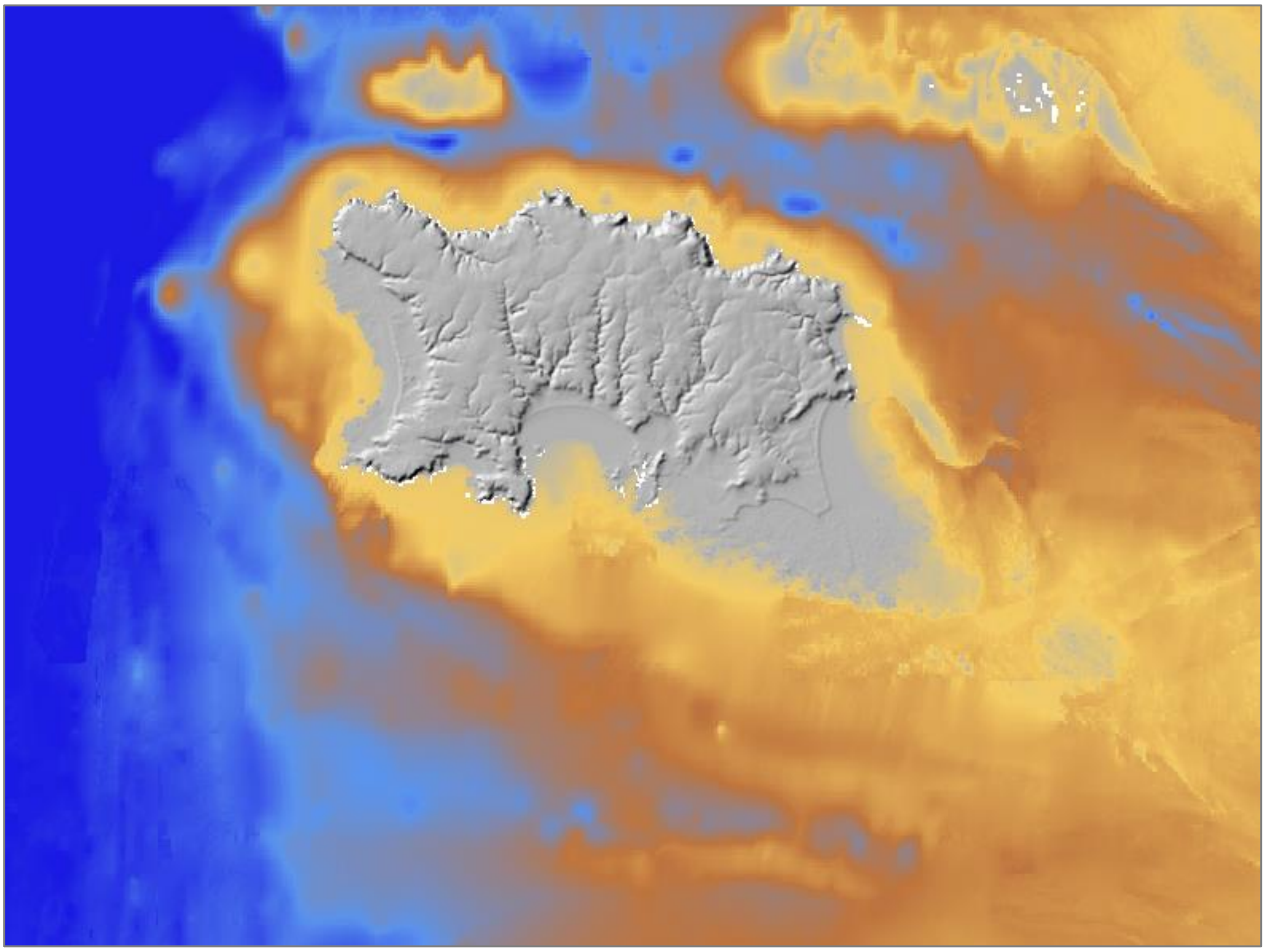
# Archaeological Seabed Mapping Around Jersey

## Desk Appraisal

Antony Firth
June 2022



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*Cover Image: Regional bathymetric data combined with lidar data provided by Jersey Heritage. Uses EMODnet Digital Bathymetry.*

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# Executive Summary


Jersey Heritage is considering a seabed mapping survey to complement a recent lidar survey of the island. Seabed mapping would be intended to provide a baseline dataset that can inform the understanding, appreciation, and management of historic wrecks, submerged prehistoric landscapes and other related coastal and marine heritage assets.

To inform the development of a plan for seabed mapping, Jersey Heritage commissioned Fjordr Ltd. to carry out a preliminary desk-based appraisal to address the folllowing:

- currently available data;
- archaeological context;
- factors contributing to the business case for archaeological seabed mapping;
- next steps.

Preliminary discussion indicated that the best way forward for a regional approach addressing multiple forms of coastal/marine heritage would be through Multi Beam Echo Sounder (MBES) survey. Accordingly, the appraisal of available data, archaeological context and business case takes MBES survey as its premise, rather than considering mapping based on other forms of survey.

There are internationally recognised standards for MBES survey that encompass regional scale survey but also more detailed survey of specific features such as wrecks. In particular, the UK Civil Hydrography Programme operates standard specifications for MBES survey. Data acquired to these specifications is suitable for a wide range of archaeological purposes.

The seabed surveys upon which published charts of Jersey Territorial Waters are based are very dated. The surveys are predominantly over 60 years old with large areas dating to the nineteenth century: much is based on lead line surveys.

The extent of Jersey Territorial Waters is c. 2,335 km$^2$, from high water to the territorial limit. However, much of the intertidal area of Jersey has already been surveyed topographically to a resolution of 0.5m x 0.5m using lidar, so there is little advantage to covering the same area with MBES. The remaining area of Jersey Territorial Waters for which survey by MBES is required is c. 2,300 km$^2$, which includes the intertidal areas of major shoals.

Some areas of Jersey Territorial Waters have been surveyed with MBES but, unfortunately, it has not proved possible to collate existing MBES data during this appraisal.

The appraisal outlines the range and character of archaeological features likely to be visible to MBES survey in the waters around Jersey under four headings: shipwrecks; aircraft wrecks; coastal heritage assets; and prehistoric features, landsurfaces and deposits.

The appraisal concludes with the following five recommendations:

Recommendation 1: Seek access to previous MBES data for Jersey Territorial Waters; review data; develop workflows and methods for MBES data, processing, interpretation, and archiving.

Recommendation 2: Develop overall strategy for MBES survey of Jersey Territorial Waters based on CHP specifications.

Recommendation 3: Consider how archaeological results arising from the interpretation of MBES survey will be incorporated within Jersey HER.

Recommendation 4: Comprehensively collate and review existing archaeological data that has a direct bearing on the presence of archaeological features in areas subject to MBES survey.

Recommendation 5: Continue conversations about multiple benefits of MBES survey in Jersey Territorial Waters with diverse stakeholders.

# Archaeological Seabed Mapping

# Around Jersey

### Desk Appraisal

### Fjordr 16640

## 1. Introduction

Jersey Heritage is considering a seabed mapping survey to complement a recent lidar survey of the island. Seabed mapping would be intended to provide a baseline dataset that can inform the understanding, appreciation, and management of historic wrecks, submerged prehistoric landscapes and other related coastal and marine heritage assets. It is anticipated that seabed mapping will encompass the whole of Jersey Territorial Waters (Figure 1), though this may be achieved in phases.

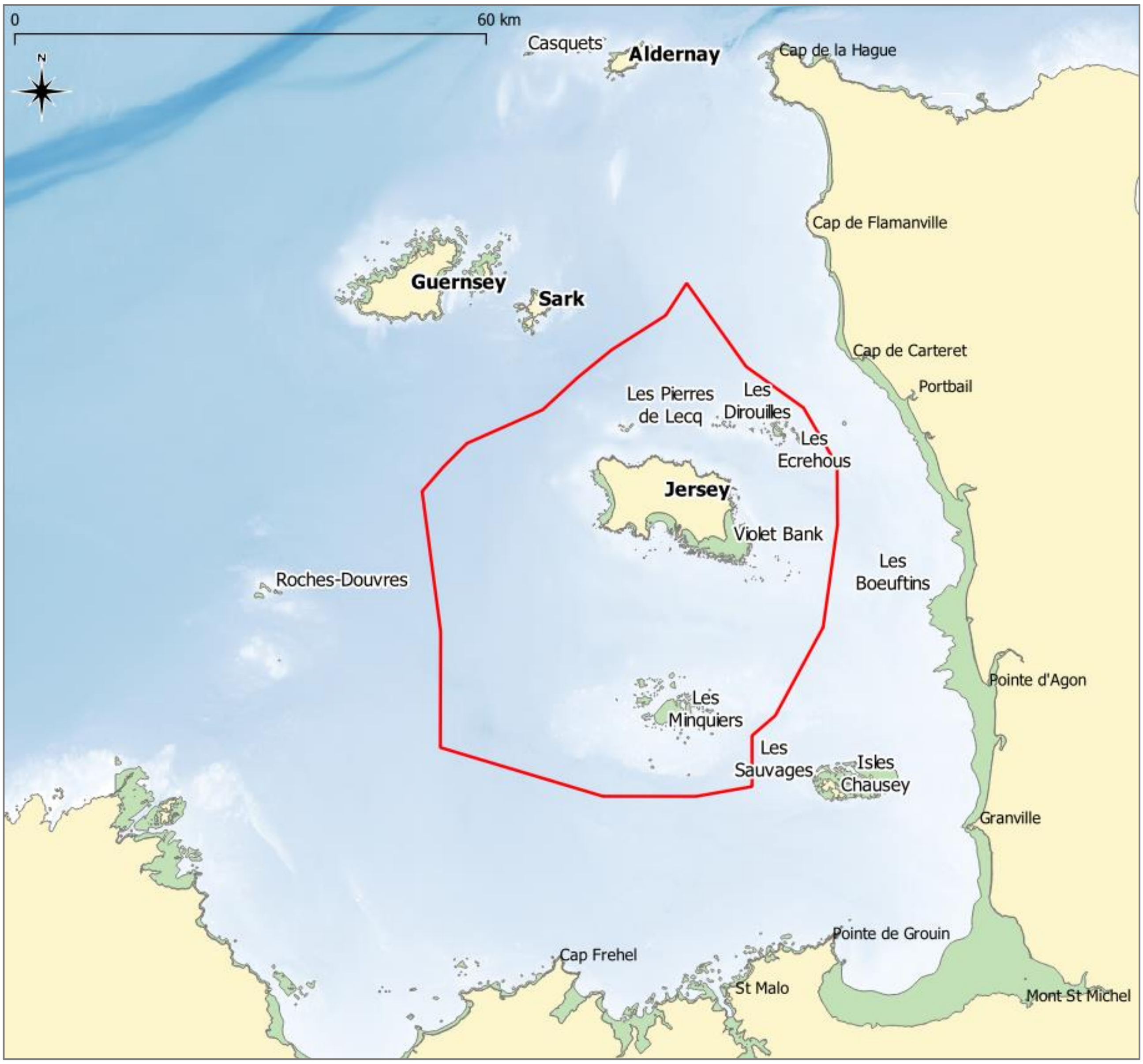


*Figure 1: Jersey and Jersey Territorial Waters (in red). Uses EMODnet Digital Bathymetry.*

To inform the development of a plan for seabed mapping, Jersey Heritage commissioned Fjordr Ltd. to carry out a preliminary desk-based appraisal to address the folllowing:

- currently available data;
- archaeological context;
- factors contributing to the business case for archaeological seabed mapping;
- next steps.

Preliminary discussion indicated that the best way forward for a regional approach addressing multiple forms of coastal/marine heritage would be through Multi Beam Echo Sounder (MBES) survey. During a MBES survey, sound is emitted in a fan of multiple beams that bounce back off the seabed. The distance to the seabed for each beam is calculated from the time it takes the echoes to return. As the survey vessel moves forward, the fan of beams returns height data for a swathe of the seabed. The swathe from each survey line is stitched together to provide complete coverage. The results are in the form of point-cloud (x,y,z) data that can be readily integrated with point-cloud data from the recent lidar survey. MBES data is also compatible with even higher resolution data that can be acquired from photogrammetric methods both above water and below. As with lidar, point-cloud data from MBES surveys can be processed in various ways to create surfaces and other outputs: MBES data is especially suited to 3D digital visualisation methods that can be used in public engagement. Additionally, MBES surveys also typically acquire 'backscatter' data from the returning echoes that can be used to map the hardness and roughness of the seabed. The character of the seabed – such as rock outcrops and different types of sediment – can be interpreted from backscatter; backscatter can also be interpreted for archaeological anomalies. Importantly, a regional MBES dataset offers the greatest potential to 'collect once and use many times' for other marine purposes, potentially enabling cost-sharing during data acquisition and processing.

MBES survey has the further advantage that there are internationally recognised standards for data acquisition and processing that encompass regional scale survey but also more detailed survey of specific features such as wrecks. In particular, the UK Civil Hydrography Programme (CHP)[1] run by the Maritime and Coastguard Agency (MCA) operates standard specifications[2] for MBES survey that maximise the scope for re-use of data. Data acquired to these specifications is suitable for a wide range of archaeological purposes. Although the UK CHP does not encompass Jersey, the model and experience it provides is highly relevant. Moreover, Ports of Jersey Marine Services has in-house capabilities for carrying out MBES survey to a high resolution[3] together with experience of working to CHP specifications.

Accordingly, this appraisal of available data, archaeological context and business case takes MBES survey as its premise, rather than considering mapping based on other forms of survey commonly used in marine archaeology such as sidescan, sub-bottom profiler or magnetometer survey. This appraisal is, therefore, framed in terms of the kinds of results – including the types of archaeological material – likely to be mappable using MBES survey alone. This is not intended to detract from the advantages of these other forms of survey or the importance of the kinds of archaeological material that they are more likely to show: each method has an important place. However, the intensity of data acquisition and interpretation required in applying these other methods means that they are more appropriate to archaeological mapping within more localised, targeted areas than to achieving overall regional coverage as sought by Jersey Heritage. Nonetheless, reference is made to these other forms of survey below where relevant.

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1 https://www.gov.uk/guidance/uk-civil-hydrography-programme-chp

2 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/983560/UK_CHP_Survey_Specification_2020.pdf.

3 https://www.ports.je/jerseyharbours/marineservices/hydrographic-services.

As this appraisal is desk-based it has drawn principally on online sources and material made available via Jersey Heritage and by contacts provided by Jersey Heritage.

## 2. Available data

Various spatial datasets were brought together in the course of the appraisal to help frame the need and scope for a MBES survey for archaeological purposes. Spatial data was collated using a GIS system – QGIS 3.16.6. A project was set up with the Co-ordinate Reference System (CRS) for Jersey: ETRS89 / Jersey Transverse Mercator (EPSG: 3109). Datasets using other CRS are transformed on the fly to match this project CRS.

### 2.1. Background Data

Background datasets provide vital context for understanding the extent and character of possible survey areas, and may also have attributes indicative of historic environment potential through, for example, overall topography and/or seabed sediment characteristics. The following background layers were collated courtesy of the Government of Jersey (GoJ), the Admiralty Marine Data Portal[4], and EMODnet Bathymetry[5]:

| Category | GIS Layer | Source | Use |
|---|---|---|---|
| Coastlines | NBG_Coastal_Final_JTM | GoJ | Shows extent of land above high water, and intertidal areas to low water, covering Jersey and its surrounding islets and reefs. Equivalent extents are also included for the other Channel Islands with their islets etc; and for the local coast of France. |
| Boundaries | Layer 6 Territorial Waters JTM | GoJ | Shows extent of Jersey Territorial Waters; also used to create a 'study area' with an additional buffer of 1 nautical mile (1,852m) for cropping wreck data within or close to Jersey Territorial Waters. |
| | Channel Islands | Admiralty Marine Data Portal | Polylines of maritime boundaries for the Channel Islands. |
| Bathymetry | E4_2020 Bathy | EMODnet | Small scale bathymetric Digital Terrain Model (DTM) with a grid resolution of 1/16 x 1/16 arc minutes, equivalent to a cell size of c. 115m north-south and 76m east-west. Although relatively coarse, it provides a good overview of gross seabed topography, including features that may indicate the potential survival of elements of prehistoric landscapes. |
| | NBG_Bathymetry_50m_JTM_NEW | GoJ | Small scale bathymetric DTM. Although presented using a 50m x 50m cell size, the original data used for this model was generally of lower resolution. The nominally lower resolution EMODnet DTM is probably more useful from an archaeological perspective. |
| Geology | Jersey_Intertidal_Geology_BGS_JTM | GoJ | Geological identification of rocks outcropping in intertidal zone. As this relates to the solid geology of Jersey, it appears to be of limited use from a marine archaeological perspective, though it might provide context to some megalithic sites in the intertidal zone and also for intertidal quarrying. |

4 https://www.admiralty.co.uk/digital-services/data-solutions/admiralty-marine-data-portal.
5 https://www.emodnet-bathymetry.eu/.

| Category | GIS Layer | Source | Use |
|---|---|---|---|
| | Isopachs_N3_Cable_Route_JTM; Isopachs_N1_Cable_Route_JTM | GoJ | This point data indicates the depth/thickness of sediment along corridors to the east of Jersey corresponding to proposals to install an electricity interconnector. Unlike the bathymetric data, the isopachs give a sense of the topography underlying the modern seabed and the vertical extent of sediments within which archaeological material may be found. These cores were subject to geoarchaeological sampling and processing (see below). |
| Habitats | Jersey_Habitat_Map_JTM | GoJ | Habitat map based on 250m cell size categorised by JNCC Marine Habitat Classification for Britain and Ireland[6], and by 'character'. As habitat types are related closely to substrate, they can be used broadly as a proxy for seabed type, which in turn has a bearing on archaeological material in terms of its presence, visibility to survey, and/or condition. |
| Designations | NMGZ Jersey only; | GoJ | The NMGZ layer is a map of No Mobile Gear Zones, which are a form of Marine Protected Area in which fishing using mobile gear – principally trawling and dredging – is prohibited in order to protect key habitats. As these forms of fishing may have impacts on archaeological material, the NMGZs may also offer a degree of incidental heritage protection. Although sometimes damaging, fishing can also be a source of information about archaeological discoveries. |
| | Ramsar_Backup | GoJ | The Ramsar layer maps four Ramsar sites, which are wetlands protected under the Convention on Wetlands of International Importance (the Ramsar Convention) 1971. Ramsar sites are concerned particularly with protecting habitats, including coastal habitats, but attention is directed also at the cultural and social dimension of protected wetlands through the Ramsar Culture Network. |

As well as providing context, the above layers enable basic quantification relevant to the proposed survey: the extent of Jersey Territorial Waters seaward of high water is c. 2,335 km$^2$; the intertidal area around Jersey is c. 38 km2; hence the extent of Jersey Territorial Waters seaward of low water is c. 2,297 km$^2$ (including the intertidal areas and islets of Les Minquiers, Les Pierres de Lecq, Les Dirouilles, Les Écréhous).

## 2.2. Topographic and Satellite Data

The principal dataset added under this heading is the lidar survey carried out on behalf of Jersey Heritage (JH). The detail the lidar provides of known heritage assets and its potential for revealing as-yet unknown assets – and providing wider topographic context – means that the lidar is effectively a direct source of heritage data. The same is true, to a degree, of publicly available satellite imagery, also included here.

[6] https://mhc.jncc.gov.uk/.

| Category | GIS Layer | Source | Use |
|---|---|---|---|
| Topography | DTM_Base_Map-006<br>DTM_Hill_Shade_0_30 | JH | Large scale DTM derived from JH lidar survey with a cell size of 0.5m x 0.5m. It covers a large proportion of the intertidal zone, excepting only some areas exposed only at very low tide. Archaeological features with topographical expression on the coast and in the intertidal can be identified and mapped directly from the DTM, which also provides a topographic context for other archaeological data (e.g. findspots). |
| Satellite | Google (2019) | | Google satellite imagery provides reasonably high-resolution vertical photography covering the coast and much of the intertidal zone. As with the lidar-derived DTM, archaeological features on the coast and in the intertidal zone can be identified and mapped directly. The satellite imagery also provides context for other archaeological data. Comparisons can be made with earlier satellite data using the historic imagery tool of Google Earth Pro. |

## 2.3. Heritage data

Heritage data in two principal forms was collated: data from Jersey's Historic Environment Record (HER), which is a consolidated and curated dataset compiled primarily for historic environment purposes; and wreck data from various sources. Although wrecks are often heritage assets and data about them might be considered to be heritage data intrinsically, in many cases the data has been compiled primarily for other purposes – notably safety of navigation – and this may have a bearing on how it has been recorded. The following heritage datasets were collated:

| Category | GIS Layer | Source | Use |
|---|---|---|---|
| Heritage | HER_all_fields_11-08-21 | JH | Heritage assets relevant to the marine historic environment were first identified from JH's online HER, resulting in a list of 38 Primary Record Numbers that was sent to JH. JH provided the records for these identified assets (and a few additions) in spreadsheet form, which was re-worked slightly for incorporation into the GIS, totalling 44 records (Figure 2; Appendix I). A further field – 'Category' – was added and populated with standard terms to facilitate thematic mapping. |
| Wrecks | Layer 22B Historical Shipwrecks JTM | GoJ | A layer of 76 wrecks within Jersey Territorial Waters including just the name and date of sinking (where known) and a largely incomplete categorisation. GoJ acknowledged that the provenance of this data was not known. |
| | SHOM Epaves Pack | SHOM | A wreck dataset for the whole of French waters downloadable from the Service Hydrographique et Océanographique de la Marine (SHOM). This dataset was clipped to Jersey Territorial Waters, totalling 27 records. |
| | Global Wrecks and Obstructions | UKHO | A wreck dataset downloadable from the UKHO via the Admiralty Marine Data Portal. The December 2021 release is rich and includes details of survey history. This data was clipped to Jersey Territorial Waters with an additional 1 nm buffer to encompass wrecks close to |

| Category | GIS Layer | Source | Use |
|---|---|---|---|
| | | | the boundary, totalling 113 records (Figure 3; Appendix II). Rapid comparison indicates that the UKHO dataset includes all the wrecks included in both GoJ Historical Shipwrecks layer and SHOM Epaves pack. However, the surveying history for each record suggests heavy reliance on non-survey sources – e.g. documentary references, reports of sinkings and observations by divers – rather than survey data. Consequently, the overall reliability of this data may be low. |

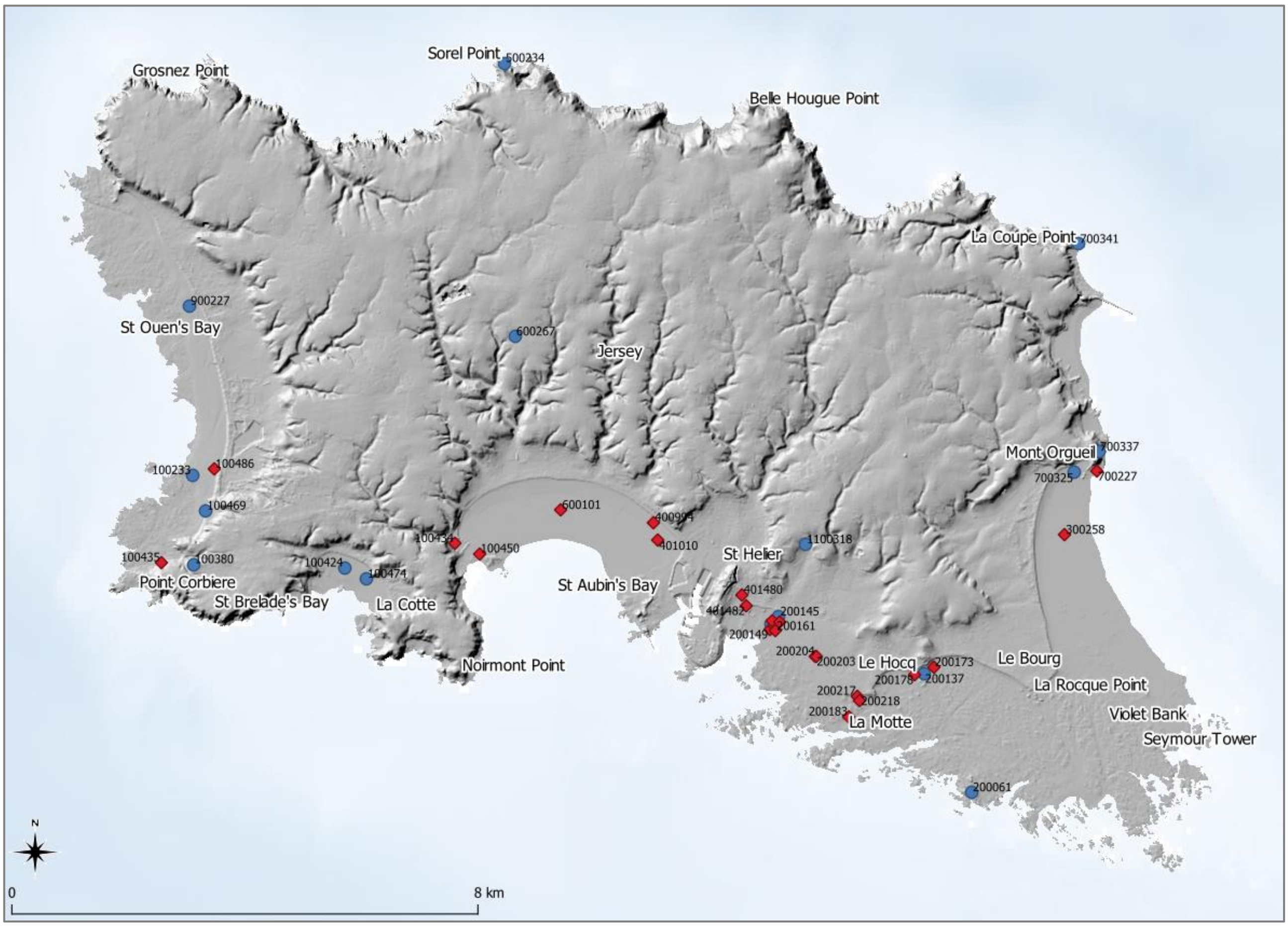



*Figure 2: Selected assets from Jersey HER. See Appendix I: red diamonds = findspots; blue dots = sites.*

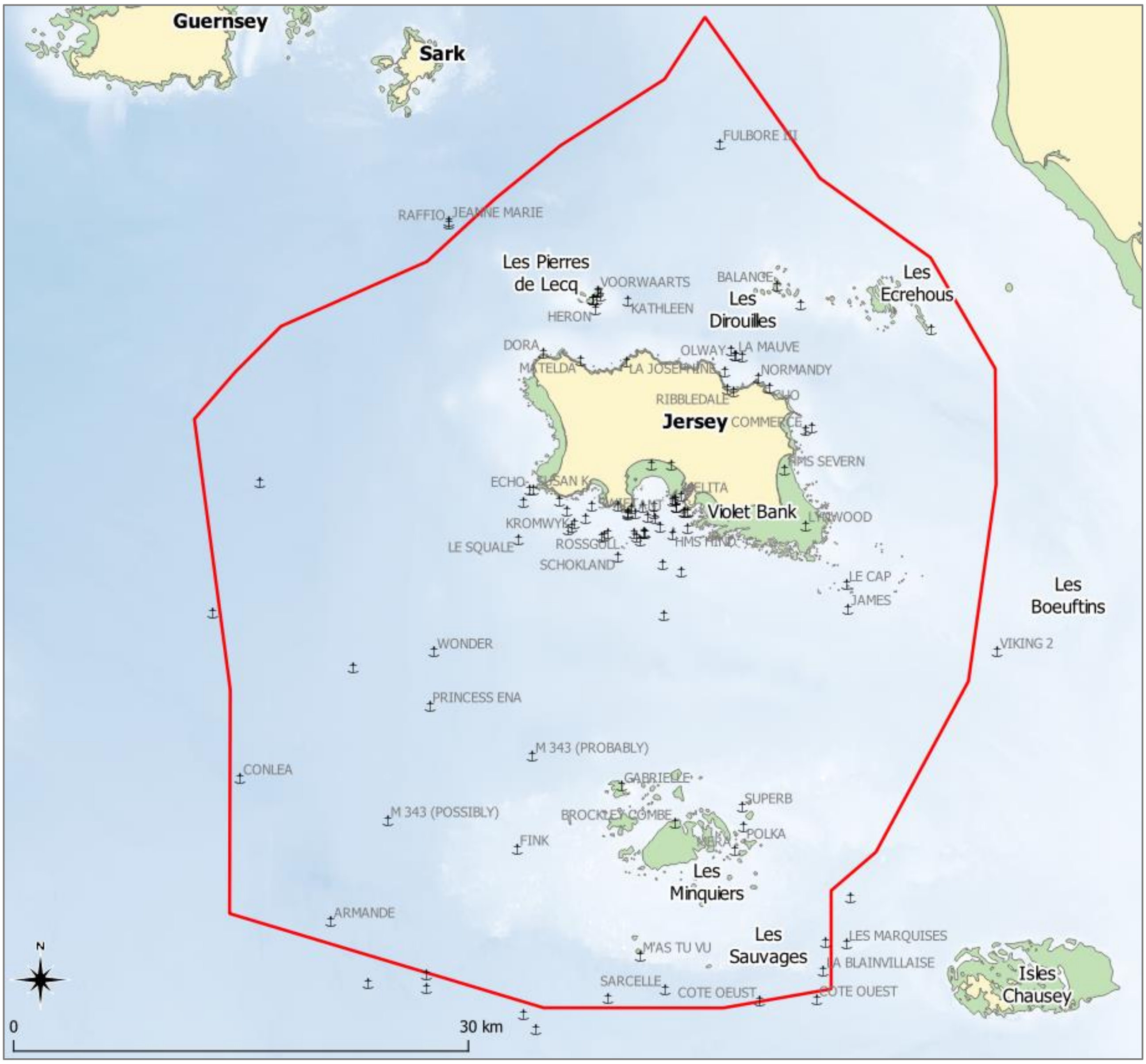



*Figure 3: Wrecks in Jersey Territorial Waters, with vessel name where recorded. See Appendix II. Source: UKHO Global Wrecks and Obstructions dataset available from Admiralty Marine Data Portal under Open Government Licence. Uses EMODnet Digital Bathymetry.*

In addition, 435 records of artefacts catalogued in the Titterington Collection held by Jersey Maritime Museum were made available by Jersey Heritage. The Titterington Collection was donated by Jersey diver Tony Titterington and largely comprises artefacts from wrecks. Whilst this is also heritage data, it relates to material accessioned from heritage assets rather than containing direct details of the heritage assets themselves, such as position information. Without position, this dataset could not be incorporated directly within the GIS. However, the records were categorised according to the wreck or place to which they related, as summarised by count of records in Table 1. Most of the wrecks are included in the UKHO dataset and could be mapped via the UKHO ID included in the table. It should be noted that many of the records categorised as 'no provenance' appear to relate to objects collected on land rather than from wrecks or the seabed.

| Provenance | UKHO ID | Count | Provenance | UKHO ID | Count | Provenance | UKHO ID | Count |
|---|---|---|---|---|---|---|---|---|
| Determinee | 23169 | 204 | St. Brelade | place | 4 | M452 | -- | 1 |
| no provenance | -- | 81 | Metropolis | 23175 | 3 | Minquiers | place | 1 |
| M343 | 23448; 25813 | 30 | St. Aubin's Minesweeper Site | -- | 3 | Noirmont | place | 1 |
| Pygmy | 23167 | 30 | Siett | ?place | 2 | Orphee | 23413 | 1 |
| PT509 | 23429 | 25 | Unidentified wreck | -- | 2 | P38 | -- | 1 |
| Paris | 23173 | 13 | Bellozane | place | 1 | Plemont | place | 1 |
| Schokland | 23160 | 10 | Bristol Channel | -- | 1 | Viper | Alder-ney | 1 |
| German Armed Trawler | -- | 7 | Gabrielle | 23151 | 1 | **Grand Total** | | **435** |
| Jean Marie | 23219 | 4 | Hampden | -- | 1 | | | |
| St. Aubin's Bay | place | 4 | Helman | ?23174 | 1 | | | |

*Table 1: Summary of Titterington Collection, by provenance and count of records*

It should be noted that there are further sources of mappable wreck data, notably the privately operated online database Wrecksite[7]. Downloading data directly from Wrecksite is not permitted, but it is an important resource nonetheless. Further data can be derived from other online sources and publications.

## 2.4. Previous Surveys

Unfortunately, details of the extent of previous bathymetric surveys have remained elusive. Information about the extent of MBES surveys carried out by Port of Jersey have yet to be obtained. It was, however, possible to map two sources indicating previous surveys:

| Category | GIS Layers | Source | Use |
|---|---|---|---|
| Surveys | Bates MBES | Published | MBES survey by Richard Bates, University of St. Andrews, off La Cotte de St. Brelade covering the area between Point Corbiere and Noirmoint Point out to c. 3.8 km seaward. Survey carried out as part of Quaternary Archaeology and Environments of Jersey (QAEJ) project in 2011 and published as part of an article in Antiquity (Scott et al., 2014). Survey noted as having a bin-resolution (i.e. cell size) of 0.5m. Rough extent (c. 23 km$^2$) obtained by georeferencing Fig. 6 from article. Survey data was provided to GoJ (Bates pers. com) but the data has yet to be re-located by this project. In addition to the MBES survey off La Cotte, emails from Richard Bates indicate that they also carried out MBES surveys off St. Helier and Gorey. The extent of these surveys and the location of the data has yet to be confirmed. |
| | Chart Sources | Published | In common with all published Admiralty Charts, charts 3655 and 2669 covering Jersey and the Channel Islands include small scale source diagrams indicating the year in which the latest surveys were carried out for each area of the chart. These source diagrams were georeferenced and digitised to provide an overview of |

[7] https://www.wrecksite.eu/Wrecksite.aspx.

| Category | GIS Layers | Source | Use |
|---|---|---|---|
| | | | the age of surveys on which the current charts are based. |

Mapping the Chart Sources to indicate the age of the surveys on which the current charts are based proved very informative (Figure 4).

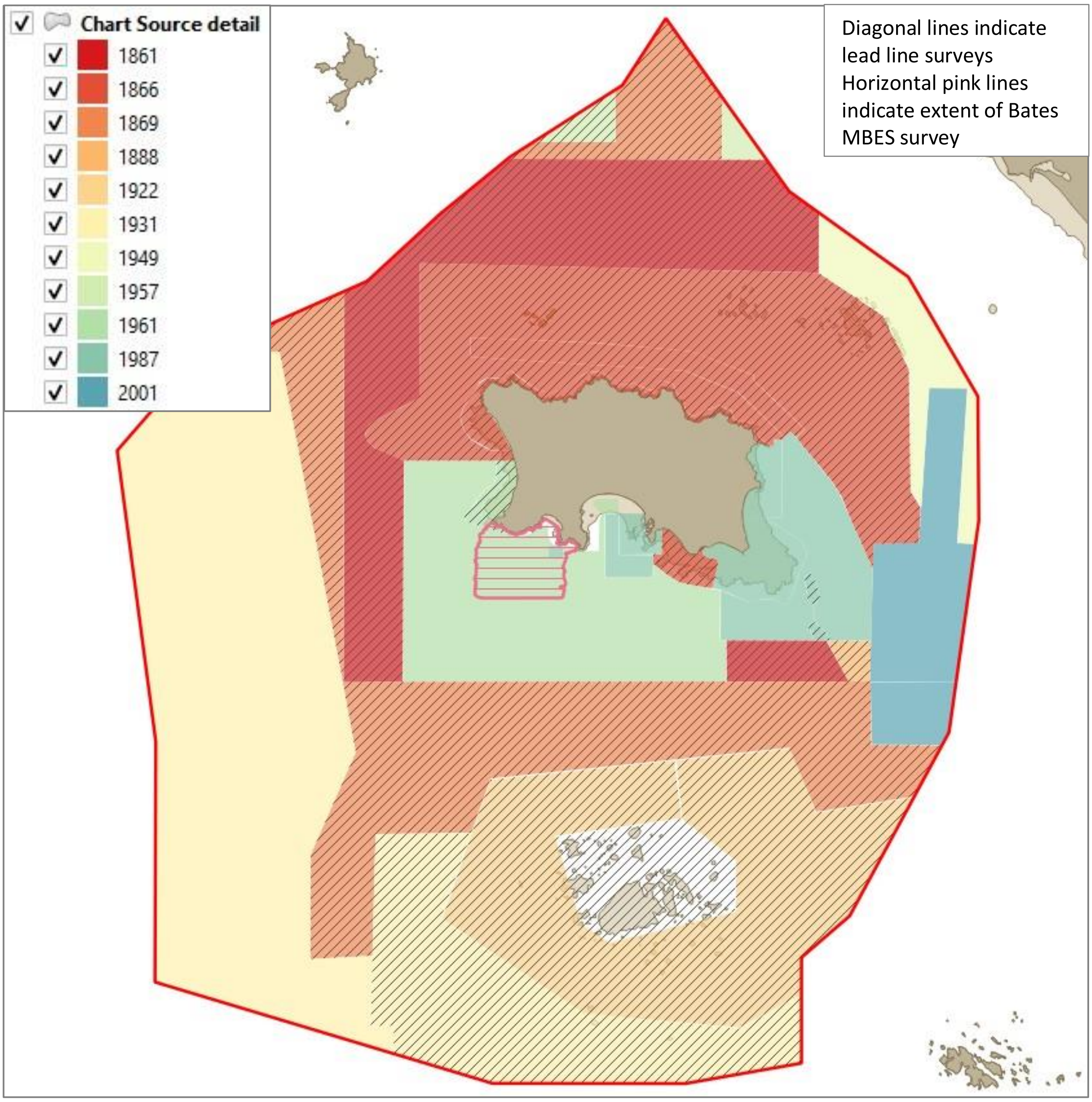



*Figure 4: Year of surveys mapped as chart sources for Admiralty Charts 3655 and 2669.*

The current charts for Jersey Territorial Waters are based largely on surveys over 60 years old, with extensive areas not surveyed since the nineteenth century. Many of the areas surveyed even in the twentieth century are reliant on lead line surveys (manual surveys carried out with a sounding lead). Even the most recent survey used in the charts, from 2001, is likely to have used single beam echo sounder (SBES) – using detailed soundings but on quite widely spaced lines – rather than MBES.

It is perhaps needless to say that the surveys on which the charts are based are of very low-resolution relative to MBES survey. Heritage assets such as wrecks – even prominent ones – are unlikely to be discovered by such surveys unless the survey line of SBES passes, by chance, directly over a prominent wreck. Referring to the UKHO INSPIRE Wrecks Dataset, most wrecks included on the chart appear to have been discovered through means other than seabed survey – such as reports of the original sinking, snagging of fishing gear and discoveries by divers. Earlier hydrographic surveys directed at known wrecks are only likely to have provided basic information using SBES and perhaps wire sweeping[8] to address the key concerns for navigational safety such as position, extent and least depth over a hazard such as a wreck. However, three wrecks in the UKHO dataset (IDs 23178; 87121; 95642) appear to have been subject to MBES survey by the Royal Navy survey launch HMSML Gleaner in September 2016. It is possible that reports of these surveys – in the form of H525 wreck reports – may be available on request from UKHO.

Beyond indicating the gross topography of the seabed, the surveys underpinning current charts for Jersey Territorial Waters are also unlikely to show topographic features indicative of the presence of submerged prehistoric landsurfaces or deposits.

[8] A physical survey method whereby a wire at a known height is swept over a feature to confirm its least depth.

## 3. Archaeological Context

This section considers the range and character of archaeological features likely to be visible to MBES survey in the waters around Jersey, informed by the sources discussed above and secondary sources. Examples and inferences are drawn to illustrate different periods and types of heritage asset. However, this overview is not intended to amount to a comprehensive review of the marine heritage of Jersey: it is not a desk-based assessment and has not considered all the sources that might normally be considered in such an assessment.

As noted in the introduction, this discussion focusses on MBES survey, which records seabed height data (bathymetry) equivalent to the topographic data acquired by lidar survey on land. In general terms, identifying and characterising archaeological features from MBES survey data depends – like lidar – on spotting features whose topography is anomalous compared to the ‘natural’ background, where the source of the anomaly is likely to be of archaeological interest. The background topography also provides context to the anomalous features which can aid their interpretation. In consequence, like lidar, MBES survey is strongly weighted towards the identification of heritage assets that have a topographic expression and are distinct from the background. Heritage assets that are entirely buried or that are indistinguishable from the background topography (e.g. wreckage within an area of outcropping rock) are effectively invisible to MBES. Nonetheless, MBES can be sensitive to very minor height differences and – coupled with an appreciation of the context presented by the background topography – it may be possible to spot assets such as wrecks that are almost entirely buried from the patterning of anomalies, or even from the patterning of bedforms such as sandwaves that are affected by the presence of an archaeological feature on the seabed.

One factor affecting MBES that should be borne in mind is that the survey sensor is mounted near the sea’s surface, typically in the hull of the survey vessel or on a pole. This means that the distance between the sensor and the seabed varies according to water depth – in contrast, for example, to towed sensors such as sidescan sonar that can be deployed at a reasonably constant height above the seabed. In consequence, MBES survey returns a greater density of data – i.e. greater resolution – in shallow water compared to deeper water. MBES systems are typically configured according to the range of water depths in which they are to be deployed. Jersey Territorial Waters are reasonably shallow: they are generally less than 40m, increasing to around 50m only on the western edge of Territorial Waters, and to a maximum of about 57m only at localised points west of Grosnez Point and Les Minquiers. A suitably MBES survey should be capable of achieving reasonable resolution across this range, though the difference in resolution between shallower and deeper areas is still likely to be apparent in the results.

The discussion below focusses on those archaeological features that are likely to be mappable from MBES data, acknowledging that this is not the full range of archaeological material that might be present underwater around Jersey.

The capability of MBES survey for archaeological purposes is dependent on suitable methodologies and expertise being applied when planning the survey, during data acquisition, in subsequent processing, and in interpretation. The identification and characterisation of archaeological features is likely to be more demanding than carrying out MBES survey for other purposes, so it is essential to take advice from suitably experienced archaeological surveyors in respect of each of these stages.

### 3.1. Shipwrecks

Shipwrecks are perhaps the most widely recognised class of marine heritage asset. MBES survey can be very effective in identifying hitherto unknown shipwrecks and also in characterising shipwrecks that are already known. Where the presence of a shipwreck is known but the identity of the vessel is uncertain, MBES survey alone can be sufficient in generating information – such as dimensions and diagnostic features – from which its identification can be secured.

The capabilities of MBES survey with respect to shipwrecks are greatest where the shipwreck is prominent on the seabed. This favours shipwrecks that come to rest on the seabed relatively intact and continue to survive in that form, which in turn favours vessels made of robust materials sunk in reasonably benign conditions. Generally, large wrecks with substantial components – e.g. iron or steel hulls, boilers or engines; large metal items such as cannon and anchors; or large amounts of stone ballast or robust cargo – will be most visible to MBES. This tends to favour wrecks from recent centuries, especially from the mid-nineteenth century onwards.

In Atlantic waters, vessels made wholly or predominantly of wood tend to collapse and degrade to the level of the seabed due to the prevalence of wood boring organisms in the environment. This means that wooden wrecks tend to be less visible to MBES survey, including older vessels but also more recent vernacular craft such as small boats and fishing vessels. Although any surviving wooden hull may not be prominent, metal or stone items that were on the vessel may be evident above bed level. Wooden vessels may also be prominent in MBES survey where they have only survived below seabed level but the level of the seabed has recently fallen, due to the migration of a sandbank, for example. Wooden vessels standing several metres above the seabed have been identified from MBES survey in such circumstances.

Where seabed conditions are not benign, such as reefs, and especially in high energy conditions then even large robust vessels may go completely to pieces. MBES survey will be less capable of distinguishing highly broken up wrecks; and less capable still if the seabed is itself highly irregular with outcrops and gullies. Where a reef is shallow then even the survey itself may be hazardous. Jersey has extensive areas – notably Les Minquiers, the plateaus off Violet Bank, Les Pierres de Lecq, Les Dirouilles, and Les Écréhous – where reefs present higher potential for the presence of historic shipwrecks: best use will need to be made of calm weather and high tides for survey work in these places.

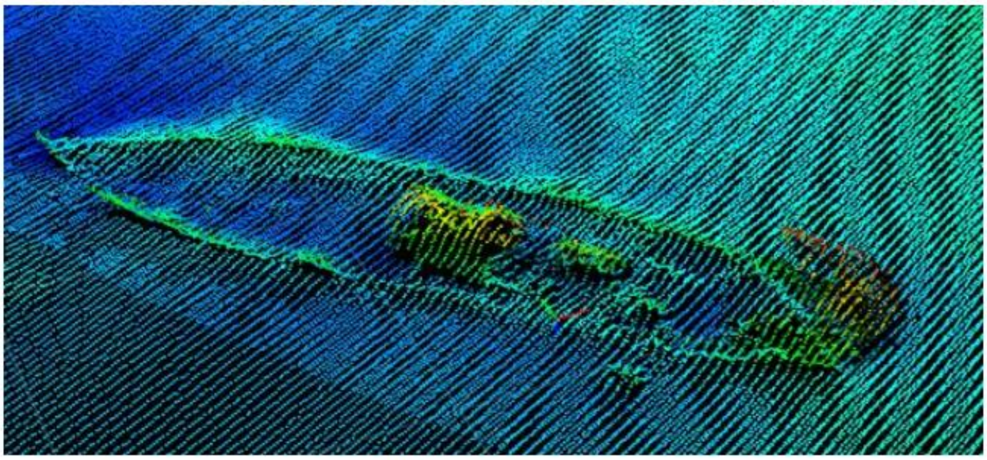
As the Chart Source information showed, the resolution of existing seabed surveys of Jersey Territorial Waters is generally very low: large areas have been surveyed only by lead line or SBES. Consequently, the potential for the discovery of ‘new’ wrecks is quite high. Surveys around the coast of Britain by the Civil Hydrography Programme typically identify several (sometimes many) new wrecks in each survey area.

Acknowledging that wrecks from recent centuries are generally favoured by MBES survey, it is worth underlining that much older wrecks may be revealed by MBES survey from the presence of cargo mounds, for example. Jersey and the Channel Islands have been insular throughout all but the earliest periods of prehistory and, as Jersey’s rich archaeological record demonstrates, it has been inhabited throughout that time. All communication with surrounding areas must have been by sea-going vessel. Even vessels and cargoes dating back to prehistory may be present in Jersey Territorial Waters. Whilst their characteristics are unlikely to favour their discovery by MBES survey, it is not impossible that some could be located.

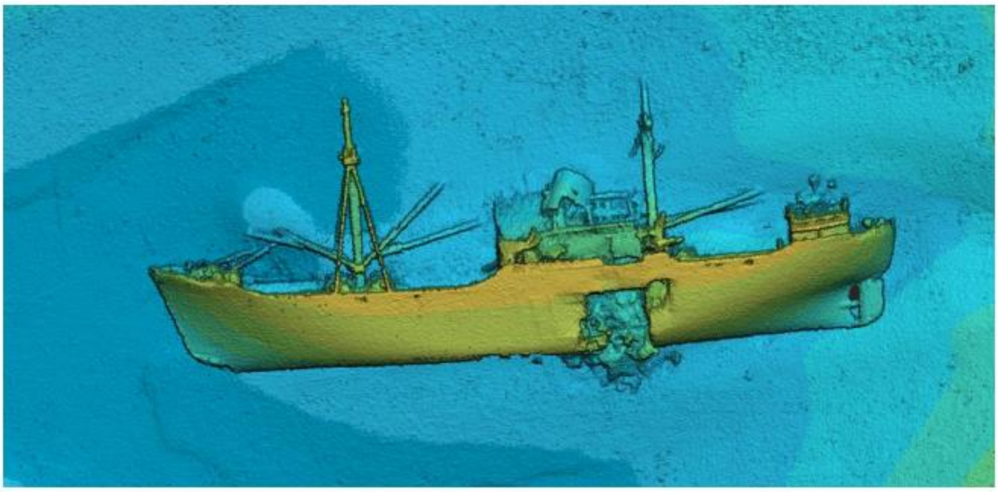
It is worth distinguishing at this stage between two forms of MBES survey: MBES surveys directed towards large areas or regions; and surveys concentrating on specific features such as wrecks (‘wreck investigations’). Regional surveys to the CHP specification will be capable of identifying and broadly characterising both known and previously unknown wrecks, including – with experienced interpretation – wrecks that are relatively small or low lying. However, the same equipment and methods can be optimised to acquire higher resolution over limited area of a wreck and its immediate surroundings[9]. Wreck investigations (Figure 5) can be carried out as part of a

[9] See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/983560/UK_CHP_Survey_Specification_2020.pdf p. 11: ‘4.7 Wreck Investigations’.

regional survey where wrecks have been flagged in advance from previous records, but also ‘on the fly’ if a previously unknown wreck is observed during regional survey itself.



Uncharted wreck from HI 1591 St Abb’s Head to Farne Islands



HI 1589 Eastern Harris. Wreck of the steamship Stassa

*Figure 5: Examples of MBES data from Wreck Investigations, Civil Hydrography Yearbook 2021[10].*

The combination of MBES data from regional surveys and specific wreck investigations conducted as part of those regional surveys is valuable for both new wrecks discovered during the survey but also for those known prior to survey. As already noted, wrecks may be ‘known’ in the sense that the presence of a wreck is confirmed, but its identity is not known either precisely (e.g. as a specific, named vessel) or generally (e.g. by type, period, nationality etc.). MBES survey can often provide data to support the identification of previously known wrecks, or at least to narrow the potential candidates. Even for wrecks that are known and identified, MBES survey can provide vital data on the wreck and its environment relevant to an assessment of its features, overall form, condition, threats, trajectory and so on. MBES survey data is readily ‘readable’ in 2D and 3D formats so it also lends itself to broader interpretation, dissemination and engagement with a range of audiences. Furthermore, MBES survey provides a matchless base dataset for further field investigation and for heritage management of shipwrecks, as discussed below.

10 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/973535/CHAS_2021_Yearbook__002__Tagged.pdf.

## 3.2. Aircraft Wrecks

In terms of MBES survey, aircraft wrecks share characteristics with smaller shipwrecks. The date range of aircraft wrecks is much more tightly constrained, however: the majority of air crash sites date to the Second World War: such as a C-47 Dakota near Belle Hougue Point; and the remains of a Hampden in the Titherington Collection.

The presence of aircraft crash sites pre-dating the Second World War should not be discounted. Military aircraft – including aeroplanes and small airships – were used extensively in marine operations in the First World War, including in patrolling for U-boats from air stations in France. Accidents occurred and could result in aircraft ditching and finding their way to the seabed. Early aircraft were of such light construction that they might be expected to leave little trace after a century on the seabed. However, aircraft engines and machine guns dating to that period have been recovered from the seabed by fishermen in the Humber, for example. Equally, the remains of military and civil aircraft from the interwar period are likely to be slight remains, but their presence cannot be ruled out.

The number of aircraft crashes fell significantly after the Second World War, though losses during post-war military training, for example, continued to occur.

Depending on the circumstances of crashing, aircraft from the Second World War can be readily apparent in MBES data. Sometimes their layout can be sufficiently distinct to identify the aircraft type – or to at least narrow it down – from MBES survey alone. Indeed, a clear image of an aircraft can be misleading as to the conditions of the remains on the seabed, where the aluminium of the wings and fuselage may retain its form but turn out to be highly degraded.

The survival of an aircraft in an identifiable form on the seabed depends on it having been ditched successfully in one piece and then having sunk, come to rest, and remained undisturbed. Many aircraft do not even make this first step: they start to disintegrate in the air (especially if hit by bullets or shells) and they are likely to break apart catastrophically on touching the sea. In such cases, the remains of an aircraft may be fragmentary by the time they reach the seabed. Nonetheless, large fragments and robust components such as engines can have sufficient presence on the seabed to be distinguishable as topographic anomalies in a MBES survey, especially if several anomalies are grouped or have disrupted local bedforms.

Aircraft wrecks are not generally as apparent to MBES survey as prominent shipwrecks, but there is certainly potential for them to be located by MBES survey in Jersey Territorial Waters. The comments above about carrying out more detailed wreck investigation surveys to characterise aircraft wrecks, about the value of MBES data for interpretation and engagement, and as a baseline for further investigations and site management, all apply equally to aircraft wrecks as to shipwrecks.

## 3.3. Coastal Heritage Assets

Coastal heritage assets amenable to MBES survey comprise built structures such as former quays, jetties, piers, fish traps and so on. The presence of such features around Jersey is already attested by lidar data supplemented by satellite imagery available via Google. The fact that such features are already identifiable from available data means that MBES survey is unlikely to be warranted in coastal areas already covered by lidar. MBES for coastal heritage assets can, instead, target areas seaward of intertidal lidar coverage where the water depth at low tide is such that coastal structures might be present due to sea level rise; and areas close to the shore that remain submerged at low tide. These include areas where the seabed falls sharply from rocky coasts, such as small embayments that may have been important landing places or hosted maritime structures. Such environments can be hazardous for survey vessels, contributing to the 'white ribbon' of nearshore areas that are difficult to survey for operational reasons. Identifying coastal heritage assets in these locations might be more readily achieved by other means, including walkover and drone surveys.

Coastal heritage assets related to maritime activity dating from the Post-Medieval and Modern periods – such as port and harbour infrastructure – is likely to be best captured from the existing lidar survey supported by historic maps and documents. Some such assets are already included in the HER, but there may be merit in carrying out a comprehensive review and enhancement exercise to provide consistent mapping of coastal heritage assets and the patterns of maritime activity they imply. Combining lidar and historic maps should help in identifying assets reaching back to the Medieval period. Given the degree to which maritime activity is driven by environmental conditions such as shelter from prevailing wind and waves that persist over many centuries, Medieval coastal activity may point back to the presence of even earlier assets, for which MBES can offer supporting evidence. As noted above, MBES could reveal the presence of earlier structures in areas that are fully submerged (hence not visible to lidar) just beyond low water. These might include, for example, former jetty-type structures constructed of wood that has decayed to near bed level; or stone structures that have been 'robbed out' to low water.

Another consideration is the clearance of rocks from the seabed/foreshore in the approaches to landing places, leaving stretches of sandy foreshore where vessels could take the ground safely. The prominence in lidar data and Google satellite images of long gullies providing access to Le Hocq, Le Bourg and La Rocque, for instance, might indicate the enhancement of natural features by clearance. Clearance evident in MBES in subtidal areas might indicate that the practice dated back to periods when sea level (and hence low water) was lower.

Other coastal structures could have a range of origins. Paul Chambers of the Government of Jersey drew attention to structures in the intertidal area including v-shaped fish traps; networks of cart tracks (*charrières*) used for collecting vraic (seaweed) dating back at least to the sixteenth century; and trot or net stones, which are lines of large stones used for setting nets across gullies – a practice that has continued into recent decades (Chambers pers. comm.). In addition, some large wall-like features have been a focus of attention recently, mostly in the intertidal area of south east Jersey but with examples also from Les Écréhous and Les Minquiers (Tompkins et al., 2019). Although these may be related to cart tracks or be a form of fishtraps, associations with prehistoric material and their location at or even below low water suggest they may date to much earlier periods, when sea level was lower. One suggestion is that they might be a form of shoreline defence against erosion of prehistoric landsurfaces that have since disappeared (cf. Galili et al., 2019). Massive intertidal structures are known in other contexts, such as the clam gardens of the Pacific coast of Canada[11] and fishponds around Hawai'i[12], which might offer parallels. Examples of these coastal structures can be observed in both lidar and satellite imagery and are amenable to mapping from these sources (Figure 6). Given that some of these structures are at the margin of the intertidal area, it is possible that they may also be present in sub tidal areas, hence further examples may be identifiable from MBES data.

[11] https://clamgarden.com/.
[12] https://seagrant.soest.hawaii.edu/the-return-of-kuula/.

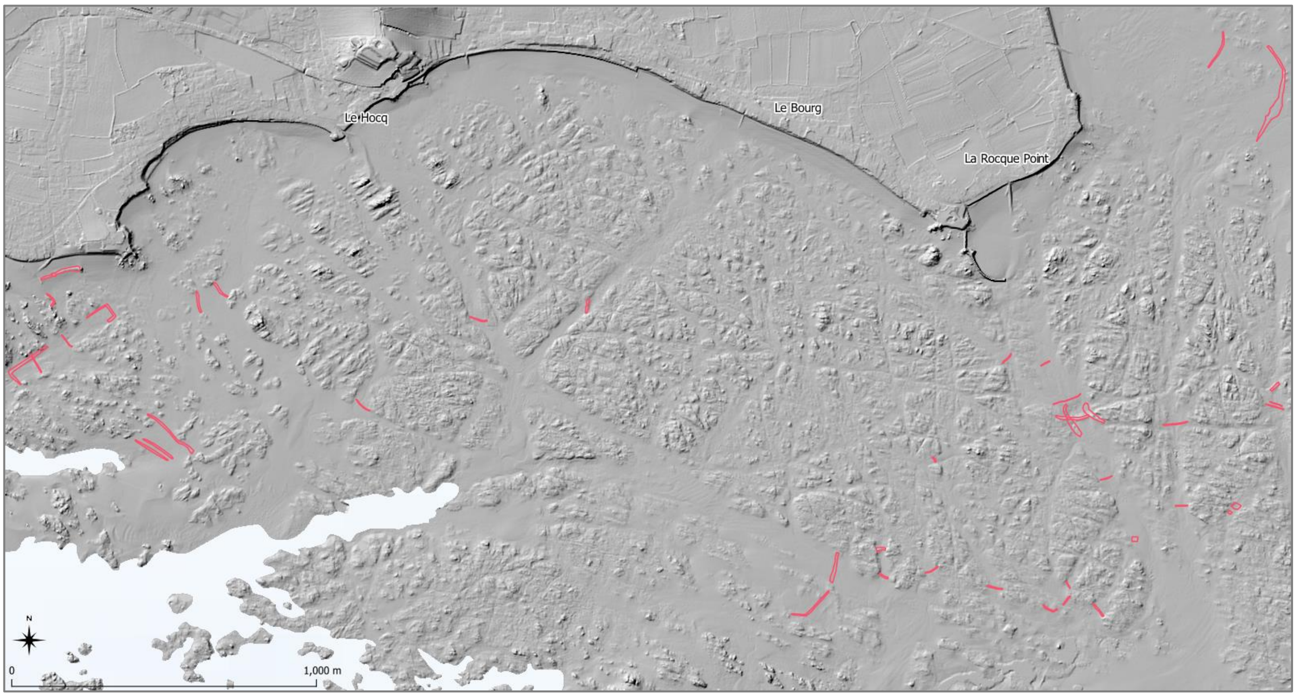



*Figure 6: Intertidal structures visible in lidar and satellite imagery.*

Rectangular structures near La Motte – which currently seem to be demarking or protecting an anchorage for small boats – are former tidal ponds associated with cultivation of oysters in the late nineteenth century[13].

Other intertidal structures dating to the nineteenth century include bathing pools at Havre de Pas (The Lido – opened in 1895) and Victoria Pool (Marine Lake – opened in 1897), which are still in use.

Coastal quarrying likely to date to the eighteenth and nineteenth centuries is very evident on Les Minquiers (Waterhouse et al., 2016, pp. 276–281). Such quarrying was presumably practiced in intertidal areas around Jersey due to both the availability of exposed rock and its proximity to water to enable its transport – especially for building works such as harbours that were also close to the sea. Distinguishing coastal quarrying from natural rock formations based on lidar or MBES data alone may be difficult. However, it is again possible that MBES could complement lidar at the edge of low water, especially if rock has been quarried to form channels that would facilitate boat access.

A further class of feature that might be investigated through MBES survey is anchorages, notably through the presence on the seabed of material that has been lost or deposited. Whilst much of this material is likely to have been items too small to be visible in MBES data, scatters of larger items might be distinguishable as anomalies on an otherwise plain seabed. The individual features of lost anchors are unlikely to be resolved by MBES, but their presence and overall form might lead to their identification as anomalies.

As already noted, coastal heritage assets are present on some of Jersey's shoals and islets such as Écréhous and Les Minquiers, which have not been subject to lidar survey. These areas might be targeted for coastal heritage assets features through MBES survey. The navigational difficulties presented by shoals have already been noted: it may be advisable to conduct lidar and/or drone surveys of the higher parts of the shoals to reduce the exposure of the survey vessel to the hazard they present.

[13] https://www.theislandwiki.org/index.php/Coast:_Green_Island.

### 3.4. Prehistoric Features, Landsurfaces and Deposits

It is helpful to split the potential for submerged prehistoric features into two chronological units, separated by the Last Glacial Maximum (LGM) when glaciation was last at its maximum extent and, correspondingly, sea level was at its lowest.

The LGM occurred about 18,000 years ago when sea level was over 120m lower. Jersey would have been several hundred kilometres from the sea during the LGM and surrounded by land. The landscape is likely to have been a harsh tundra environment, largely dry but with seasonal torrents of glacial meltwater cutting through the Channel from the ice sheets over the Alps, Britain, and Scandinavia. The human population around Jersey at the LGM is likely to have been very sparse or absent.

The post-LGM period encompasses the generally warming climate during which sea level rose and the environment became more temperate. Late Upper Palaeolithic populations – such as those attested by the Magdalenian site at Les Varines – reinhabited the Channel region whilst Jersey Territorial Waters were still exposed as land. Over ensuing millennia, sea level continued to rise, and cultural changes occurred that we associate with the Mesolithic, Neolithic, Bronze Age and Iron Age, by which time sea level would have been relatively close to today's. Having such a large tidal range and extensive intertidal zone – at least in some areas – complicates this overall narrative. The tide rises more in six hours than mean sea level has risen in perhaps 7-8,000 years, so estimating the position of former shorelines must take this large tidal prism into account. Nonetheless, the high-water mark – above which freshwater inputs and sedimentation would have been dominant – rose and progressed landward, diminishing the inhabitable dry land. Rising sea level would have been accompanied by erosion and deposition on the foreshore by marine processes; but in some places, the dynamic balance would have periodically favoured freshwater and land-based processes, causing the growth of freshwater peats on top of recent estuarine or marine deposits, for example. In later periods, human interventions on the coast to protect and reclaim land would have added further complexity. Hence Jersey Territorial Waters host a complex sequence of now-submerged post-LGM prehistoric landscapes.

The pre-LGM period covers a vastly greater chronology than even the post-LGM period, perhaps approaching a million years over which humans are known to have been present in northern Europe. Multiple glacial periods are encompassed by the pre-LGM, during which the climate has varied from very cold to warmer than today. Sea-level has fallen and risen repeatedly to expose and then submerge huge areas of land around Jersey. The flora and fauna have varied; and people have periodically inhabited the region. Clearly, the pre-LGM period has been highly dynamic with all these processes causing the landscape to be repeatedly altered and re-worked: but these dynamics should not detract from an appreciation that repeatedly, over very long periods, Jersey Territorial Waters provided a rich, hospitable environment in which people lived. The pre-LGM period encompasses different human species as well as differences in cultural traits extending across the Lower, Middle, and Early Upper Palaeolithic. The predominant forms of evidence for these people are their stone tools, set within their geological and palaeo-environmental context.

In terms of addressing submerged prehistoric landscapes using MBES, there are commonalities between both pre-LGM and post-LGM periods. Generally, seabed investigation targeting both pre- and post-LGM is focussed on sub-seabed deposits. Typically, investigations focus on sub bottom profiler surveys combined with coring, which can confirm strata and provide seabed samples that can be analysed for geological and palaeo-environmental evidence, accompanied by scientific dating. MBES survey cannot generate such data: it can provide only indirect information of what may be present sub-seabed. Nonetheless, the indirect evidence provided by MBES can be very useful in several ways: it can provide context about the general potential for pre- and post-LGM features and deposits; it can provide specific context to sub bottom and coring data that has already been acquired for other purposes, such as engineering; and it can help identify places where new sub bottom survey and/or coring is likely to produce data relating to prehistory.

Both pre- and post-LGM features can be anticipated within Jersey Territorial Waters. The regional picture is such that the seabed around Jersey would have formed an inhabitable environment in several discrete but prolonged periods when it is known that people were present in equivalent locations in northern Europe.

Intertidal peats at various locations (e.g. St. Ouen’s Bay; St. Brelade’s Bay; Le Tas de Pois, Les Écréhous (Chambers et al., 2019)) are evidence of former inhabitable landsurfaces with which archaeological material is likely to be associated, together with palaeo-environmental and scientific dating evidence. The presence of peat in the current intertidal zone confirms that such fine-grained deposits have survived in a marine environment that is undeniably high-energy: peat in this context suggests that equivalent deposits will have formed and survived in areas that are now fully submerged, either exposed on the seabed or buried by subsequent fluvial or marine processes. Moreover, the presence of archaeological material at the coast and in the intertidal zone dating to periods at which sea level was lower suggests strongly that the now-submerged lands formed part of the inhabitable landscape contemporary with this material. This is true of post-LGM material such as megaliths, copper and flint tools recorded in intertidal areas in Jersey’s HER; and perhaps also the wall-like features mentioned earlier. It is also true of pre-LGM sites such as La Cotte de St. Brelade (Scott et al., 2014) and Mont Orgueil (Waterhouse and Renouf, 2015): material contemporary with these sites could certainly survive in areas that are fully submerged today. Surviving sub-tidal prehistoric landsurfaces are suggested by deposits identified in seabed cores off Grouville Bay, such as peaty clays and a loess deposit (Chambers and Nichols, 2014). More speculatively, sea grass mapped among the habitats around Jersey might also be an indicator of post-LGM landsurfaces: researchers have noted a correlation between seagrass and submerged prehistoric landscapes in Denmark that may be worth investigating off Jersey also (Krause-Jensen et al., 2019).

As recognised at least from the early twentieth century, the gross topography of the seabed around Jersey indicated by charts provides an initial context within which to consider the existing data and indicators of potential outlined above: maps indicating this landscape date back to Joseph Sinel in 1912 (Renouf, 2015, p. 441). The EMODNET bathymetry confirms the overall seabed topography and might provide more detail of the submerged landscape that can be interpreted from it, but MBES survey would increase the resolution very significantly: from c. 115m x 76m to 0.5m x 0.5m. As well as increasing resolution, it should be relatively straightforward to integrate MBES data with the lidar data – also at 0.5m by 0.5m – to present a single surface model upon which different sea-level and landscape scenarios can be mapped, in the manner roughly indicated by Figure 7.

Tying together lidar and MBES data requires attention to the ‘white ribbon’ discussed above, which can be challenging to survey – especially where the seabed falls away quickly, close to rocky hazards. The MBES survey carried out by Bates and colleagues expressly sought to achieve this kind of join-up as a means of understanding the prehistoric landscape irrespective of the current height of sea level, and other archaeological surveys have targeted this zone directly with MBES elsewhere[14]. Surveying the rocky shoals – Les Pierres de Lecq, Les Dirouilles, Les Écréhous, Les Minquiers and so on – will also be challenging, as noted above, but is warranted because these shoals present the higher ground of prehistoric landscapes.

[14] See e.g. https://onlinelibrary.wiley.com/doi/abs/10.1002/jqs.2897.

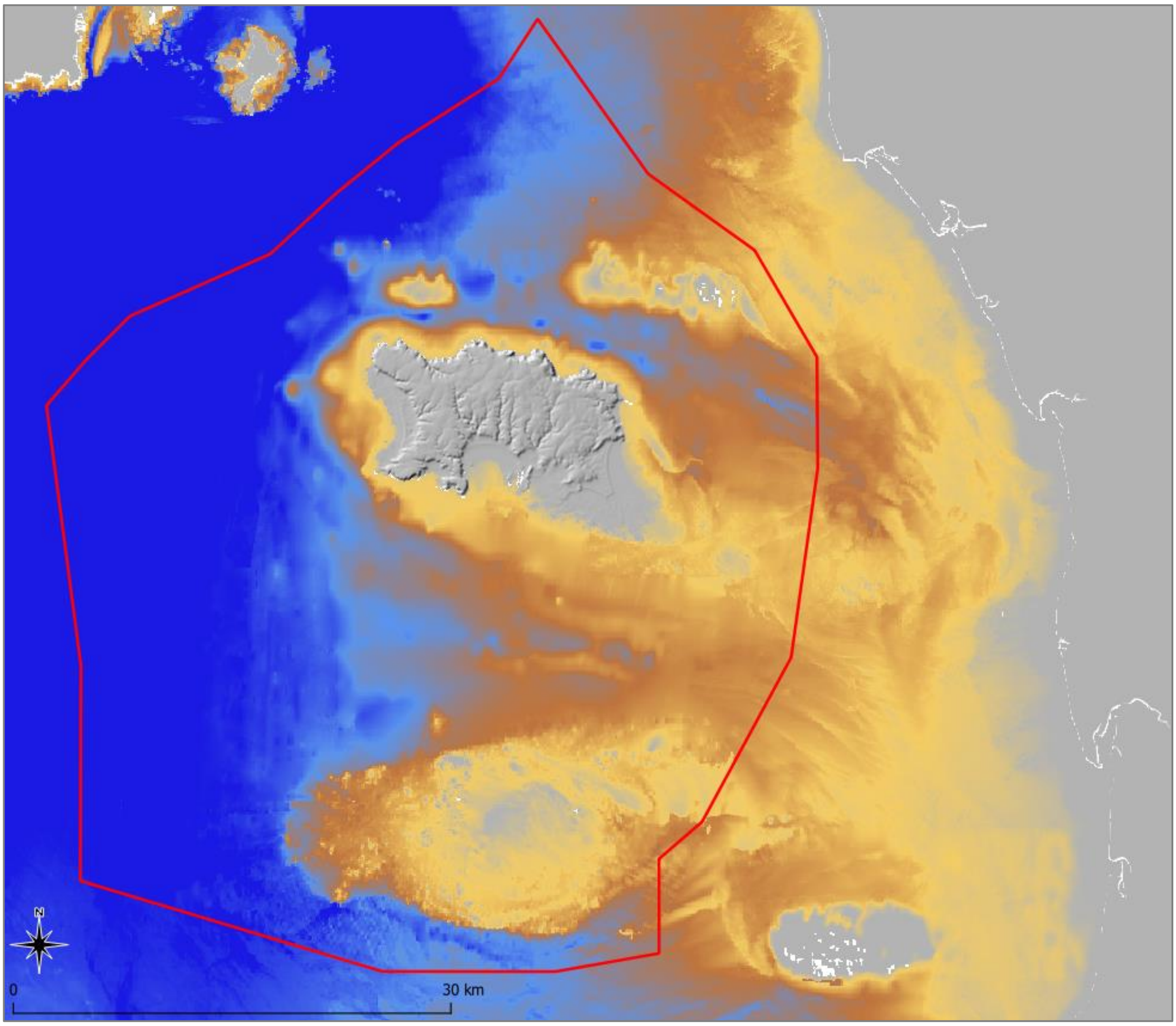



*Figure 7:Quasi-integrated surface model showing lidar and EMODNET bathymetry data with nominally reduced sea-level, for indicative purposes only. Boundary of Jersey Territorial Waters in red. Uses EMODnet Digital Bathymetry.*

The MBES survey by Bates and colleagues sought expressly to achieve a ‘new view’ demonstrated the integration of bathymetric data with information about the topography of the land in a limited area (Scott et al., 2014). Obtaining MBES data across larger areas of Jersey Territorial Waters would significantly improve the interpretative possibilities for both pre- and post-LGM periods, addressing at least some of the problems raised by Conneller (Conneller et al., 2016).

MBES survey is also likely to demonstrate how former landscapes have been altered, removed or buried by marine processes in the course of sea-level rise. Evidence for the alteration of submerged landscapes is important for understanding the influence of post-depositional processes on archaeological potential. Such evidence also warns generally against the seductiveness of too easily equating bathymetry with prehistoric landscapes, which images such as Figure 7 may encourage. The current bathymetry of the seabed around Jersey is partly a product of the erosion and deposition of sediment by marine processes during periods of higher sea-level such as the present. As a result of its tides and its exposure to Atlantic swell and storm waves, Jersey has a high energy environment capable of reshaping the seabed. Moreover, the shallow-water band in which these forces are most intense has repeatedly swept up and down the seabed as sea level has risen and fallen. In view of the repeated application to the seabed of these tremendous forces, it might be feared that no submerged prehistoric features could survive. Yet the presence in Jersey Territorial Waters of fine-grained sediments such as peat and loess already mentioned, and evidence of submerged prehistoric features surviving in other high energy environments globally, demonstrates that some elements of these earlier landscapes have survived. Surface models from MBES survey represent a composite, therefore, of features attributable to former prehistoric landscapes, and features attributable to the effects of marine processes during periods of rising and high sea level.

Landscape features from both pre- and post-LGM periods are likely to be present – perhaps in close association – due to the repeated cycles of exposure and inundation; and some prehistoric landscape features may be buried – including prehistoric surfaces, cut features and deposits that may not be expressed directly in the surface topography captured by MBES survey. It is also likely that former landscape features will be fragmentary and complex, however coherent and appealing the surface model may appear. Identifying prehistoric landscapes from the features of even a high-resolution surface model will require express interpretation – not considered self-evident – especially in understanding the cultural implications for the people who once inhabited them.

With these caveats, MBES survey will nonetheless facilitate regional modelling of possible former landscapes. It will also flag areas where bathymetry is instead likely to represent marine processes, which will be relevant to understanding where landscape features have been eroded, reworked, or buried. Importantly, MBES survey is likely to be of sufficient resolution to locate and map specific palaeo-landscape features that indicate higher potential for the presence and survival of archaeological and palaeo-environmental material from both pre- and post-LGM periods. Examples of such features include:

- Partly or largely unfilled palaeo-channels indicating former watercourses that may have been a focus for human activity. Palaeo-channels may also have higher potential for fine-grained/organic deposits within them and on their margins, which are favourable for preserving artefacts, palaeo-environmental evidence, and material suitable for scientific dating.
- Topographic highs and steep slopes that might have been focal points for prehistoric activity. Locations with good views across the coastal plain seem to have been favoured in the Channel Islands during the Mesolithic at least (Conneller et al., 2016). Steep slopes are important because sea-level rise – twice daily in the case of tides, or over much longer periods in response to climate change – is confined horizontally by the slope, affording a stable location relative to gentle slopes over which rising water moves swiftly[15].
- Hard rock features analogous to features on land where prehistoric material is present, either because it presents features that can be inhabited such as rock shelters; and/or because artefactual and palaeo-environmental material may survive within gullies and other sediment traps.
- Places where topographic highs and/or hard rock are juxtaposed with sedimentary deposits, where the sediment sequence might have a higher potential for archaeological markers and palaeo-environmental material.
- Modern seabed features such as sand waves that may preserve prehistoric landscape features beneath them.
- Areas where current processes are causing the erosion of prehistoric deposits, such that prehistoric deposits are freshly exposed and might be inspected visually by diver or ROV, for example.

[15] Paul Chambers drew particular attention to Les Sauvages, between Les Minquiers and Isles Chausey in the extreme south of Jersey Territorial Waters. Even in the EMODnet bathymetry used in Figure 7, Les Sauvages stands out as a prominent location.

# 4. Business Case

Having set out the principal kinds of archaeological material that MBES survey is likely to illuminate, this section will outline the practical applications of the resulting data. The anticipated use of the data for a range of different needs should contribute positively to the overall case for funding a seabed mapping programme for archaeological purposes.

It is worth underlining that the kind of survey being contemplated would be enormously useful for purposes other than archaeology, notably safety of navigation and marine environmental management. The business case for such uses is not set out here, though coincidences of interest between archaeology and such other uses are flagged.

## 4.1. Heritage management

MBES data will provide core data required for heritage management, notably on the position and extent of heritage assets. Robust data on asset position and extent is central to most mechanisms used in heritage protection, including statutory protection for specific named assets or designated areas around such assets; protection through marine planning/development control; and/or protection using other spatial or zonal approaches (e.g. restrictions on activities or equipment, such as use of fishing gear).

With high resolution data, such as that acquired in wreck investigations, MBES will also form a 'baseline' that might provide evidence that can be used in enforcement. For example, MBES data can provide a 'before' image sufficient to note subsequent damage to an asset or evidence of an impactful activity (such as a trawl scar on the seabed). This baseline can be compared to observations on the seabed by divers, or from repeat MBES survey over time.

As noted above, MBES data will also provide information relating to environmental processes affecting the condition and future trajectory of heritage assets, such as the movement of sand waves, scour and erosion. This information can be used in developing management plans and priorities. As well as providing point-in-time data, MBES can provide a baseline that can be reviewed periodically through repeat surveys to generate 'difference models' showing erosion, deposition, collapse, movement etc.

## 4.2. Public engagement

MBES data is more easily 'readable' by the public than other forms of survey data used for marine archaeology. Moreover, MBES data commonly provides much more extensive coverage than can be obtained from underwater photographs, for example. This means that MBES data is especially valuable for public engagement. MBES is suitable for use in relatively raw forms 'in plan', but it is also readily displayed (still in quite a raw form) in three dimensions, which is additionally engaging. Higher resolution MBES data can show eye-catching detail and can often be juxtaposed with – for example – photographs of the original ship or aircraft type to facilitate public interpretation.

With further processing, MBES data can be developed into all sorts of engaging material, from static images on noticeboards or leaflets, to 3D visualisations, flythroughs and augmented realities with connections to all manner of linked digital resources[16]. Rich interpretative material will often stimulate the public to want to contribute their own information such as photographs and family stories, so MBES data can encourage interaction and user-generated content too (Firth et al., 2019).

MBES data can be used to develop 'virtual dives' that enable members of the public to explore marine heritage sites without getting wet. This can be a powerful way of enabling visitors to

[16] E.g. https://skfb.ly/RICO.

onshore heritage to connect with marine heritage, or to reach out to audiences globally to encourage tourism. Dive tourism can be encouraged by using MBES data to show what is present around Jersey to audiences globally, but also to provide information that divers can use in planning, navigating, and appreciating their visits to assets on the seabed. MBES can also provide a solid baseline for investigation and further onsite recording by volunteer divers, serving as a stimulus for citizen science projects, for example.

The facility with which MBES data enables public engagement encompasses submerged prehistoric archaeology also. The capacity to generate regional models of submerged landscapes and detail of specific palaeo-landscape features has been mentioned above. Again, these relatively raw models can be used as a basis for detailed landscape reconstructions, visualisations, and animations through the addition of information about flora, fauna, and human activity.

The readability and attractiveness of visualisations based on MBES data is especially helpful in reaching audiences through both conventional (newspapers; television) and social media. A remarkable image of heritage that is hitherto unseen because it lies underwater can be a newsworthy story in itself[17].

## 4.3. Archaeological research

Given the current level of survey information about Jersey Territorial Waters, it seems highly likely that MBES survey will result in the identification of as-yet unknown sites and features, potentially in quite large numbers, which will be a tremendous stimulus for archaeological research. Even on wrecks whose identities are known, the additional data likely to be generated by MBES data about their form and character is likely to provide a valuable baseline on which further investigation can build.

As well as research on individual assets, MBES data of sizable areas is likely to encourage multi-asset research to explore regional patterning or other thematic characteristics. In particular, MBES data is likely to encourage research that looks at heritage assets in their marine environmental context, to explore site formation processes, for example. Research around the identification of ephemeral sites – such as automated object recognition or the application of visualisation tools – are also likely to be encouraged by the availability of MBES data.

As noted above, MBES survey would provide essential background and targeting information to support more intensive forms of geophysical and geoarchaeological survey focussing on sub-surface deposits in connection with research into the submerged prehistory of Jersey.

## 4.4. Integrated area-based management

By providing detail of heritage assets in their wider environmental context, MBES data lends itself not only to heritage management but also integrated marine management: especially as MBES data generated by archaeological objectives is likely to be of great utility to other aspects of marine management. Increasing the opportunity to manage heritage assets not only in their own right but within the context of other facets of the marine environment and its use is likely to be beneficial for heritage assets in the longer term. MBES data helps to situate heritage assets as marine features within the overall environment managed, for example, as a Marine Protected Area. Incidental protection can be gained from measures used to manage each facet and mutually beneficial relationships will develop, such as recognising and enhancing the nature conservation value of wreck sites, for example.

[17] e.g. https://inews.co.uk/news/uk/wrecked-first-world-war-british-battle-ship-brought-back-life-digital-technology-18517.

The ‘readability’ of MBES data might lend itself to conceptualising substantial parts of the marine environment as National Marine Parks. Such Parks may not involve any additional regulatory mechanisms, but enhance the effect of existing mechanisms by their greater sense of identity and acknowledgement amongst the public, user groups and stakeholders. Integrating MBES data with lidar data could have an especially valuable role in enabling people onshore to relate to areas offshore as part of a relatable topographic whole.

## 4.5. Development of social and economic benefits

The capacity of MBES data to enable greater public engagement, including among people onshore both locally and around the world, brings with it the opportunity to develop a diverse range of social and economic benefits. The focus MBES data provides for volunteering and citizen science is likely to have positive outcomes for wellbeing, as is increased awareness of marine heritage among people whose enjoyment of the coast and sea can be further augmented. Enhancing heritage tourism and recreation among divers, visitors to coastal sites, and others is likely to have measurable economic as well as social benefits.

Other economic benefits might arise from marine activities that benefit from the ecological characteristics of heritage assets such as shipwrecks. Fish aggregate around shipwrecks for a variety for reasons, making them a target for both sea angling and commercial fishing. MBES data can help demonstrate that economic value is being derived from marine heritage assets. It can also ensure that such value is not being obtained at the expense of heritage: information about the position, extent, orientation, and form of shipwrecks could help both anglers and fishers to reduce potential damage from their activities caused by where and how they deploy their gear. This information could also reduce the risk of losing gear, which represents an economic loss itself and contributes to the environmental cost of ghost fishing.

## 4.6. Placemaking and place branding

Jersey’s cultural heritage is already a major source of character for people who live there and who visit, to which its coast and maritime aspect contributes significantly. The sea which surrounds Jersey is, however, imperfectly known in terms of its heritage – perhaps surprisingly so. Comprehensive MBES survey would change this radically across several different facets of Jersey’s history, adding value to what is already known, but also leading to discoveries of heritage that is currently unknown. Revealing the marine dimension of Jersey’s heritage is likely to be remarkable, especially given the visual character of MBES data, the major themes to which it relates, and the tangible benefits already noted in this section. Aside from the opportunities for engagement already mentioned, the exercise and its results are likely to generate considerable public and media interest both generally and through specific stories. Again, this is likely to be positive for Jersey’s overall sense of place among its population and for Jersey’s brand for people visiting, creating opportunities for specific initiatives at multiple locations around the coast.

## 4.7. Policy context

Interest in the marine environment is relatively high among the public on issues such as threatened species, degradation of habitats, and pollution. However, the crises facing the marine environment and everyone who depends on it are such that even more attention is required, especially in motivating changes in behaviour and greater action, economically and politically. This is evident among marine NGOs in domestic settings but also internationally, prompting the UN General Assembly to prompt the UN Decade of Ocean Science for Sustainable Development 2021-30. The UN Ocean Decade, as it is known, provides valuable context within which to promote MBES survey of Jersey Territorial Waters. Such a survey would be very much in line with the intended outcomes and approach of the UN Ocean Decade, which has drawn fresh attention to the importance of marine cultural heritage. Framing the survey in terms of the UN Ocean Decade is likely to build momentum among stakeholders and potential funding organisations, and generate additional opportunities for public and media interest both in Jersey and further afield.

## 5. Next Steps

This appraisal has brought together existing data relevant to archaeological seabed mapping around Jersey, outlined the principal classes of heritage asset that a MBES survey is suited to mapping, and indicated the wider business case for such a survey.

The seabed surveys upon which published charts of Jersey Territorial Waters are based are very dated. The surveys are predominantly over 60 years old with large areas dating to the nineteenth century: much is based on lead line surveys.

The extent of Jersey Territorial Waters is c. 2,335 km$^2$, from high water to the territorial limit. However, much of the intertidal area of Jersey has already been surveyed topographically to a resolution of 0.5m x 0.5m using lidar, so there is little advantage to covering the same area with MBES. The intertidal of Jersey is c. 38 km$^2$, hence the remaining area of Jersey Territorial Waters for which survey by MBES is required is c. 2,300 km$^2$, which includes the intertidal areas of major shoals such as Les Minquiers, Les Pierres de Lecq, Les Dirouilles and Les Écréhous. This is broadly comparable in size to MBES surveys carried out through the UK Civil Hydrography Programme in recent years around the Isles of Scilly, Anglesey and inshore of Skye.

Unfortunately, it has not proved possible to collate existing MBES data from Jersey Territorial Waters, notably surveys by the Ports of Jersey; and surveys by Richard Bates and colleagues, understood to have been passed on to the Government of Jersey. Richard Bates' survey off St. Brelade's Bay covered about 23 km$^2$; it is understood that surveys were also carried out off St. Helier and Gorey. If the MBES data from these various surveys can be collated, it should reduce the area of new survey. Reviewing the MBES data from these previous surveys should also help in anticipating the results of the new survey – enabling a 'dry run' to test workflows and methods for data management, processing, interpretation, and archiving – which should help in planning for the areas still to be covered.

**Recommendation 1: Seek access to previous MBES data for Jersey Territorial Waters; review data; develop workflows and methods for MBES data, processing, interpretation, and archiving.**

As the area of Jersey Territorial Waters for which new MBES survey is required is sizeable, consideration needs to be given as to the overall survey strategy. This is likely to be driven by funding, which in turn might introduce multiple priorities if co-funding is sought. Availability of survey resources is a further key consideration, potentially requiring a mix of Jersey-based and non-Jersey-based capabilities. Consequently, making recommendations about a strategy for new survey is rather beyond the scope of this appraisal. It is, however, worth underlining points made previously about some of the different environments for which survey data is required. Specific effort will be required to address the 'white ribbon' between existing lidar coverage and new MBES survey, which may be demanding in places where the seabed drops steeply, close to the shore – as on Jersey's north coast. Similarly, the major shoals are important archaeologically because of their heightened potential for shipwrecks, the potential for coastal heritage assets, and because these areas of former high ground are likely to have been favoured in prehistory. However, the major shoals may also be challenging for carrying out MBES survey from conventional vessels, recalling that the shoals do not have the benefit of existing lidar data for their intertidal extents. For both the white ribbon and the major shoals, the overall strategy will need to make best use of suitable tides and weather; and consideration should be given to alternative approaches. The use of drones and photogrammetry on low tides might be worth considering for intertidal areas; autonomous survey vessels (ASVs) could offer advantages where the sea is too shallow or constrained for a conventional survey vessel. The UK Civil Hydrography Programme may be able to share their experience of commissioning MBES survey for similarly challenging areas.

CHP specifications are capable of meeting archaeological requirements for regional mapping and for providing higher resolution data for specific sites (such as 'wreck investigations'). These specifications have the further advantage that they are widely recognised and will generate data that is adequate for other uses, including safety of navigation.

**Recommendation 2: Develop overall strategy for MBES survey of Jersey Territorial Waters based on CHP specifications.**

Looking ahead, the interpretation of MBES data will enable mapping and recording of heritage assets in Jersey's Historic Environment Record. Some attention may be required to the HER to ensure that it can best capture and enable access to the heritage asset data that will be recorded. For coastal heritage assets and prehistoric sites, existing data structures, word lists and recording practices should already be suitable. However, recording ship and aircraft wrecks may require some additional development. Additional development may also be required to record submerged prehistoric landscape features, particularly where these are extensive; and where they indicate potential for archaeological or palaeo-environmental material to be present rather than actual 'sites'. Historic England is actively addressing these issues in its redevelopment of the English National Marine Heritage Record[18] on the Arches platform, which also underpins Jersey HER.

**Recommendation 3: Consider how archaeological results arising from the interpretation of MBES survey will be incorporated within Jersey HER.**

To assist the development of an overall strategy and prepare for the data that will result, it may be helpful to draw together existing information about the archaeology of Jersey Territorial Waters, focusing on material that is known, rather than potential. Whilst this appraisal has outlined key strands, it has not sought to systematically collate site-based data: but such site-based data could help identify priority areas for survey, flag specific sites for 'wreck investigations', and inform development of Jersey HER for marine recording. It could be useful to collate and review the following information, for example:

- Prehistoric evidence from shoreline, intertidal and fully submerged areas, encompassing both archaeological and palaeo-environmental / geoarchaeological evidence.
- Wreck data from sources considered above and others to shortlist confirmed wrecks and places where the presence of wrecks can be confidently suggested. The INSPIRE Wrecks Dataset available from UKHO provides an authoritative starting point, but this appraisal indicates that many references to wrecks in Jersey Territorial Waters are not backed by firm evidence of material on the seabed. Critically reviewing the UKHO data – especially information on survey history – in conjunction with other sources[19] should help to highlight wrecks that can be confidently flagged for higher-resolution wreck investigation during MBES survey. As importantly, critical review could discount many locations where wreck investigations are not merited by current evidence, until regional MBES survey indicates that material is present. Particular attention is likely to be necessary to the position of reported wrecks, prior to committing survey effort.
- There may be value in seeking information from fishermen and sea anglers about 'marks' and gear snags prior to carrying out surveys. Marks are places where fish aggregate, often because there is a feature upstanding from the seabed. Such features may be as-yet unrecorded wrecks or localised rocky areas that may have prehistoric potential[20]. Gear snags or fasteners are places where fishing gear can become caught up, again indicating upstanding features. Information about these places has value to fishermen and sea anglers so they may be reluctant to pass on their positions, but it is a valuable source of information:

[18] https://historicengland.org.uk/research/support-and-collaboration/heritage-information-access-simplified/national-marine-heritage-record/.
[19] Including dive guides and videos, e.g. https://scubadivingjersey.com/wreck-dives; https://youtu.be/Ccz15F44nGA; https://youtu.be/Razx4GEMA8Y; https://youtu.be/ilwrHBcn-aw.
[20] https://historicengland.org.uk/whats-new/research/back-issues/fishing-for-heritage/.

potentially more useful than information about ‘known’ wrecks that is not supported by evidence from the seabed.

- As suggested above, it may be helpful to review evidence for landing places and other maritime sites to ensure that these are comprehensively mapped and recorded. Existing data – namely lidar in conjunction with historic maps and documents – should be sufficient for this. The rationale is not that these places require MBES survey themselves – they are already covered by lidar, on Jersey if not the islets – but that a comprehensive view of maritime activity may help in identifying places with higher potential for archaeological material beyond low water, such as wrecks of smaller/vernacular vessels, anchorage debris, structures relating to marine exploitation etc.

**Recommendation 4: Comprehensively collate and review existing archaeological data that has a direct bearing on the presence of archaeological features in areas subject to MBES survey.**

Conducting MBES survey of Jersey Territorial Waters represents a major investment. To build support – including funding commitments – for this investment, it may be helpful to cast the net wide to bring in interests other than heritage: navigational safety; marine management; nature conservation; the blue economy; blue carbon; and so on. Also, given such investment, it seems sensible to anticipate and enable the fullest possible use of the data that results. Reference has been made above to the ‘collect once, use many times’ principle, which will be facilitated by adopting CHP specifications. The prospect of multiple contributors and multiple users is not just about economics or efficiency, however. The archaeological objectives of MBES survey are to better understand, protect, and engage people in the marine heritage of Jersey. These objectives are likely to be greater if they are rooted in collaboration not only within the heritage sector but beyond. Within the heritage sector, MBES survey could both stimulate and benefit from the process of developing a research framework for Jersey’s marine heritage, encompassing the different strands discussed here. Beyond the heritage sector, MBES survey could help in promoting integrated marine management and the realisation of a wide range of social and economic benefits.

**Recommendation 5: Continue conversations about multiple benefits of MBES survey in Jersey Territorial Waters with diverse stakeholders.**

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## Appendix I: Selected records from Jersey HER

| Primary Reference Number | Site Name | Asset Type/Description |
|---|---|---|
| 0100233 | La Rocco Stones | Stone |
| 0100380 | La Hougue | Mound |
| 0100424 | Lithic Scatter Area | Lithic scatter |
| 0100434 | Artefact Scatter | Artefact scatter |
| 0100435 | | Flint core found near Le Grouet Slip. |
| 0100450 | Scraper | Large worked flint. |
| 0100469 | | Maritime (harbour / slipway) |
| 0100472 | | A flint implement with a grey and white patina of probable Neolithic to Bronze Age period date. |
| 0100474 | Stones | Stone |
| 0200061 | | Military (Martello tower) |
| 0200119 | Greve d'Azette Menhir | Menhir |
| 0200137 | La Pierre aux Crabes | Menhir |
| 0200145 | Seawater Well | Feature |
| 0200149 | | Utilised flint pebble - water worn flint pebble with signs of working. Found 200 yards from high tide level. Illustrated in J. Sinel 'Prehistoric Times & Men of the Channel Islands' Plate II 1914. |
| 0200161 | | Worked Flints |
| 0200162 | | Large broken flint nodule found in boulder clay. |
| 0200163 | | Small orange pottery flask with pointed base and flattened side |
| 0200173 | Site of stone implements | Artefact scatter |
| 0200178 | | Flint nodule - a very large nodule damaged through beach action. |
| 0200183 | | A clay pipe of possible Dutch origin, with the bowl moulded in the style of an acorn and a decorative design of bark and leaves down the stem. Has a small, forward projecting spur under the bowl. In poor condition with surface erosion and barnacles, stem is fractured. |
| 0200191 | | Site of coin finds |
| 0200203 | | A sea worn flint core. Dark grey in colour with white flecks. A large amount of the cortex remains which is grey in places. |
| 0200204 | | An off white coloured flint blade which is sea worn. |
| 0300242 | | Prehistoric occupation site; vernacular buildings; associations with traditional quarrying and fishing |
| 0300258 | | A flint implement which may be a core fragment. The fragment is sea worn and the patina suggests that it is of Palaeolithic date. |
| 0400994 | | A retouched flint flake was found on the beach between St Helier and First Tower. |
| 0401010 | | A double quern was found resting in sand and clay approximately 300 yards from the seawall and approximately 80 yards west of the southwest angle of the Victoria Marine Lake. |
| 0500234 | Le Lavoir des Dames | Jersey folklore site |

| Primary Reference Number | Site Name | Asset Type/Description |
|---|---|---|
| 0600101 | | A fragment of a late Bronze Age socketed axehead, circa 1000 BC - 800 BC. The axehead fragment consists of part of the hollow blade whilst a significant amount of the blade and socket are missing. It has has a brown and green patina with clear areas of damage. The object is heavily sea worn. |
| 0600267 | | Limpet Shell Deposit |
| 0700227 | | A pottery sherd from a vessel which may have been a circular bowl or jug. The manufacture origin is from the Seine Valley area in Picardy, Northern France. This is known as Beauvais and is famous for Medieval stoneware. This type of pottery was imported to Jersey over several centuries and examples of this type have been found at Hamptonne, St Lawrence during archaeological excavations and were dated between circa 1550 and circa 1600. There is little evidence of the sherd being worn by the sea although it would have been in the sea for a long time. It is likely that the sherd was buried for most of the time after its deposition. |
| 0700244 | | Two flint flakes found on the beach. Both are water worn with possible retouching but neither are diagnostically tools. |
| 0700278 | La Maître Île | Religious and funerary (place of worship) |
| 0700325 | Site of paved oyster beds, 1835 | Maritime (miscellaneous) |
| 0700337 | Le Petit Portelet | Settlement |
| 0700341 | La Coupe Megaliths | Megalithic monument |
| 0900227 | St Ouen's Bay Area of Peat Deposits | Peat deposits |
| 1100318 | Les Varines | Settlement |
| 0100486 | Le Braye | A copper alloy axehead of the early to middle Bronze Age, dated approximately the 18-16th century BCE. This is a parallel-sided high-flanged axe (haches à rebord) of a type found in Germany such as the Ilsmoor Hoard, and in The Netherlands, where it is sometimes considered as an import from France. It is related to the Treboul-phase hoards such as at Treboul itself, Vicomte-sur-Rance, France. This example is of Atlantic/Northern French origin. |
| 0200217 | | A complete copper alloy finger ring, of probable post-medieval date. The bezel is square and flat on the reverse. The obverse of the bezel is flat except for 3 convex circular depressions in which gems were set. The bezel is 8mm long and 6mm wide. The central depression still contains a white, polished, spherical gem, probably an opal. |
| 0200218 | Green Island Beach | Copper alloy coin. Milled 12 Deniers of Louis XVI (1774-1792). Minted 1792-1794, very worn. |
| 0300386 | | A complete copper alloy late Bronze Age pegged socketed spearhead with a portion of surviving maple wood shaft with a C14 date of 1207-1004BC (Parisian type Atlantic 2 (1125-1050BC). |
| 0401480 | Havre Des Pas | A number of copper alloy Roman coins found scattered across Havre des Pas beach. |
| 0401482 | Havre Des Pas | An incomplete copper alloy object, probably a scientific instrument or tool from a drawing instrument set or draughtsman's set of Post Medieval to modern date, AD c.1700 - 1900. |

## Appendix II: Wrecks in or near Jersey Territorial Waters from UKHO Global Wrecks and Obstructions dataset

| Wreck_id | Name | Type | Circumstances of Loss |
|---|---|---|---|
| 23151 | GABRIELLE | sailing vessel | WRECKED WHILE ON PASSAGE ST MALO FOR BORDEAUX. |
| 23152 | CONLEA | motor vessel | SANK DURING HEAVY WEATHER, WHEN BUNKER HATCH WAS CARRIED AWAY & ENGINE ROOM FLOODED. (LL). PASSAGE ELING FOR ST MALO. 6 SURVIVORS. |
| 23153 | PRINCESS ENA | steam ship | 3.8.35 CAUGHT FIRE 3.8.35 WHILE ON PASSAGE, WITHOUT PASSENGERS, FROM JERSEY TO ST MALO WHEN 9M OFF LA CORBIERE. WAS ANCHORED BY CREW AND THEN ABANDONED. SHE SANK THE NEXT DAY. (WRECKED ON THE CHANNEL ISLANDS). VESSEL WAS BUILT IN DUNDEE |
| 23154 | | | |
| 23155 | WONDER | sailing vessel | 23.04.1888 SAILING SHIP/CARGO BOAT LOST 7 MILES SSW LA CORBIERE 23.04.1888 WHILST UNDER CAPT PATTEN. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23159 | | minesweeper | |
| 23160 | SCHOKLAND | steam ship | STRUCK A ROCK & SANK. (RAF LAARBRUCH S.A.C.). BUILT 1915 IN ROTTERDAM WITH TRIPLE EXPANSION ENGINE CAPABLE OF 10KNOTS, SCHOONER RIGGED WITH SINGLE TALL FUNNEL. COMMANDEERED BY GERMANS ARMED WITH 2 ANTI-AIRCRAFT GUNS, & USED FOR CARRYIN |
| 23161 | MEGAZAN | lighter | |
| 23162 | SILVONIA | steam ship | BUILT IN 1930 BY R WILLIAMSON & SON. OWNED AT TIME OF LOSS BY NORTHWEST SHIPPING CO. TRIPLE EXPANSION ENGINE OF 136NHP, SINGLE SHAFT. PASSAGE SUNDERLAND FOR ST HELIER. STRUCK A ROCK & SANK IN ST BRELADE BAY. (DODS). |
| 23163 | KILLURIN | | |
| 23164 | ROSSGULL | steam ship | WRECKED AT NOIRMONT POINT, ST HELIER JERSEY. 10 LIVES LOST. OWNED BY ANGLO-FRENCH SS CO. |
| 23165 | HMS HIND | sailing vessel | WRECKED ON HINGUETTE REEF DUE TO PILOTAGE ERROR. CAPTAIN JOHN FUZZER WAS IN COMMAND. MANY OF THE 100 STRONG SHIP'S COMPANY WERE LOST. THE VESSEL'S PILOT WAS SENTENCED TO 3YRS IMPRISONMENT AT SUBSEQUENT COURT MARTIAL. |
| 23166 | ARNOLD MAERSK | steam ship | WRECKED ON GRUNE AUX DARDES, JERSEY. DANISH SHIP UNDER CONTROL OF GERMANS AFTER OCCUPATION OF DENMARK. BUILT IN 1914 BY W GREY & CO. OWNED AT TIME OF LOSS BY A P MOLLER. TRIPLE EXPANSION ENGINES FOR 188 NHP. |
| 23167 | HMS PIGMY | cutter | 2.10.1779 EX HMS MUTINE, FORMERLY FRENCH MUTIN [CAPTURED 2.10.1779]. NAMED 'PIGMY' 20.1.1798. STRANDED 9.8.1805 ON GRUNES AUX DARDES, ST AUBINS BAY, WHILE LEAVING ON FALLING TIDE, DUE TO PILOTS ERROR. BECAME TOTAL LOSS. (T A TITTERINGTON & COLLED |
| 23168 | PRESIDENT POINCARE | tug | |
| 23169 | HMS DETERMINEE (EX LA DETERMINEE) | frigate | VESSEL WAS 6TH RATE OF 24 GUNS. CAPTURED FROM THE FRENCH IN 1799 BY REVOLUTIONNAIRE. (COLLEDGE). WRECKED IN 490916N, 021126W AFTER STRIKING A SUNKEN ROCK OFF NOIRMONT PT. (T A TITTERINGTON). |
| 23170 | | aircraft | 7.12.1942 PROPELLER HAS PROVED TO BE FROM AN RAF WHIRLWIND. THE ONLY WHIRLWINDS LOST IN THIS AREA WERE ON 7.12.1942 DURING ATTACK ON CONVOY OF WHICH 'KROMWYK' WAS PART [SEE 23172]. TWO WERE LOST. THIS PROPELLER BELIEVED TO BE FROM THE AIRCRAFT TH |
| 23171 | LYNWOOD | brigantine | 6.1.77 VESSEL WAS ON VOYAGE HUELVA TO SWANSEA WHEN IT WAS WRECKED ON SEYMOUR TOWER OFF SE JERSEY. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |

| Wreck_id | Name | Type | Circumstances of Loss |
|---|---|---|---|
| 23172 | KROMWYK | barge | 22.2.72 SS 'KROMWYK', AN EX RHINE BARGE CONVERTED AT ROTTERDAM BY GERMANS. SUNK BY RAF WHIRLWINDS. TWO AIRCRAFT LOST IN ACTION. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 22.2.72) NAME GIVEN AS KROWICK. (DIVER MAGAZINE AUG '10) |
| 23173 | PARIS | steam ship | |
| 23174 | HELMA | schooner | 6.1.77 LOSS DUE TO ALLIED AIRCRAFT, WHILST ON VOYAGE JERSEY TO GUERNSEY WITH A CARGO OF POTATOES. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23175 | METROPOLIS | steam ship | |
| 23176 | HARLEQUEEN-K | | 1.12.1883 SANK OFF NOIRMONT POINT AFTER STRIKING VESSEL 'HAPPY RETURNS'. CAPT COLES IN CHARGE AT TIME OF LOSS 1.12.1883. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23177 | JOHN GRAFTON | steam ship | 6.1.77 STRUCK PIGNONET AND SANK. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23178 | ANT | cutter | 15.2.1858 VOYAGE PLYMOUTH TO JERSEY, STRUCK PIGNONET IN ST AUBINS BAY AND SANK. CAPT NORTON IN COMMAND AT TIME OF LOSS, 15.2.1858. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23179 | SWIFT | schooner | 6.1.77 HIT ROCK JUST OFF NOIRMONT POINT AND SANK IMMEDIATELY. CAPT PENNISON IN CHARGE AT TIME OF LOSS. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23180 | | barge | |
| 23181 | | barge | |
| 23182 | DIAMENT | steam ship | STRUCK DOG NEST ROCK AND SANK. AT TIME OF LOSS WAS A WAR PRIZE BEING USED BY THE GERMANS. (LLOYDS). |
| 23183 | FLAMER | schooner | 2.3.1841 TOTAL LOSS ON NOIRMONT POINT ON 2.3.1841. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23185 | VENUS | steam ship | 31.10.1935 LOST ON CRACHEAU JUST NE OF NOIRMONT POINT ON 31.10.1935 UNDER CAPT PITMAN. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23186 | COURIER | | 6.1.77 BECAME A TOTAL LOSS AFTER STRIKING THE GRUNES DU PORT IN ST AUBINS BAY MARCH 1819. CARGO OF COFFEE FROM RIO DE JANEIRO. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23187 | CALEDONIA | steam ship | 6.1.77 STRUCK OYSTER ROCK AND SANK. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23188 | PRINCE OF BOUILLON | | 6.1.77 STRUCK OYSTER ROCK AND SANK. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23189 | CUCKOO | sailing vessel | 6.1.77 STRUCK OYSTER ROCK AND SANK. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23190 | HMS HAVICK | sloop | 17.8.1796 STRANDED WHEN ANCHORS DRAGGED DURING STRONG GALE. VESSEL WAS DUTCH BUILT, HAVING BEEN CAPTURED AT SALDANHA BAY 17.8.1796. |
| 23191 | GULNARE | sailing vessel | 8.9.1836 LOST 8.9.1836 WHILST ON PASSAGE TO GUERNSEY. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23192 | FANNY | cutter | 6.1.77 STRUCK LES BUTTES AND SANK. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23193 | CHARMING BETTY | | 12.3.1759 DROVE ASHORE IN A STORM ON THE SATURDAY PRIOR TO 12.3.1759. (T A TITTERINGTON). |
| 23194 | MARIE ANGER | | REGULAR FRENCH TRADER - STRUCK SW SIDE OF HERMITAGE ROCK AND SANK. (T A TITTERINGTON). |
| 23195 | MELITA | cutter | WAS LOST IN GUERNSEY AND LATER SALVAGED. WHILE BEING TOWED BY TUG 'DON' TO JERSEY, TOW-ROPE PARTED JUST OFF ELIZABETH CASTLE, AND SHE SANK IMMEDIATELY. (T A TITTERINGTON). |

| Wreck_id | Name | Type | Circumstances of Loss |
|---|---|---|---|
| 23196 | ECHO | ketch | 20.12.1884 ON PASSAGE FROM ST MALO TO GUERNSEY WITH XMAS GOODS WHEN SHE HIT JAILERS REEF WEST OF LA CORBIERE ON 20.12.1884 AND KEPT THERE TILL TIDE TURNED BY HIGH WIND. AT SLACK WATER SHE CAME OFF AND SANK. (T A TITTERINGTON, JERSEY MARITIME MUSE |
| 23197 | SUSAN K | | 6.1.77 ON VOYAGE FROM ST MALO TO LONDON WITH ALL SAIL SET WHEN SHE STRUCK JAILERS JUST TO THE WEST OF LA CORBIERE. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23198 | | torpedo boat | |
| 23199 | HMS SEVERN | | 21.12.1804 VESSEL, GROUNDED IN GROUVILLE BAY WHILST BEING TOWED TO GOREY AFTER BEING WASHED ONTO A GRAVEL BANK DURING A STORM & FILLING IN WITH GRAVEL. INITIAL GROUNDING 21.12.1804 & LATER ABANDONED IN APRIL 1805 APPROX. (T A TITTERINGTON, JERSEY |
| 23200 | COMMERCE | | 6.1.77 VESSEL, LOST ON FARA ROCKS. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23201 | | sailing vessel | |
| 23202 | CUO | | 6.1.77 VESSEL, LOST WITH ALL HANDS JUST OUTSIDE ROZEL HARBOUR, NE JERSEY. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23203 | RIBBLEDALE | steam ship | 7.1.66 THE CREW WENT ASHORE ON BOXING DAY, 1926, LEAVING ONE CREWMAN ON BOARD. WHILST THE CREWMAN WAS ASLEEP THE VESSEL DRIFTED ONTO ROCKS ON THE EAST END OF BOULEY BAY AND WHEN THE CREW RETURNED THE VESSEL WAS AGROUND AND SPRINGING PLATES. SHE W |
| 23204 | NORMANDY | | 6.1.77 STRUCK TOUR DE ROZEL AND SANK. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23205 | | | |
| 23207 | LA JOSEPHINE | | 6.1.77 RAN UNDER CLIFFS ALONGSIDE DEVILS HOLE IN THE PARISH OF ST MARY ON THE N COAST OF JERSEY. BROKE UP QUICKLY. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23208 | MATELDA | cutter | 6.1.77 LOST ON ROCKS BETWEEN GREVE DE LECQ AND PLEMONT. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23209 | DORA | | 6.1.77 WAS BEING TOWED FROM GRANVILLE TO GUERNSEY, TO LOAD STONE, WHEN TOW PARTED AND SHE DRIFTED ONTO GROSNEZ POINT, N JERSEY AND SANK. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23211 | | | |
| 23212 | KATHLEEN | fishing vessel | SANK AFTER HITTING SUBMERGED OBJECT 2M OFF N COAST OF JERSEY. (LL). |
| 23213 | LOUISE | cutter | 6.1.77 WRECKED ON PATERNOSTERS REEF, NW JERSEY. IT WAS LATER FOUND THAT SHE WAS FROM VANNES, FRANCE. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23214 | AMIABLE LUCITTE | brigantine | 6.1.77 LOST WITH ALL CREW ON THE PATERNOSTERS REEF. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23215 | PRIMA | brigantine | 6.1.77 LOST ON PATERNOSTERS REEF WHILST ON VOYAGE NEWCASTLE TO JERSEY. OWNED BY G W BISSON. SANK IN 10MINS. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23216 | SCHELDE | motor vessel | |
| 23217 | VOORWAARTS | motor vessel | STRUCK PATERNOSTERS REEF AND STRANDED. |
| 23218 | BALANCE | carrier | |
| 23219 | JEANNE MARIE | steam ship | BUILT IN 1912 BY ATELIERS & CHANTIERS DE FRANCE, DUNKIRK. OWNED AT TIME OF LOSS BY SOC FRANCAISE D'ARMAMENT, MARSEILLE. TRIPLE EXPANSION ENGINE, SINGLE SHAFT. PASSAGE NEW YORK FOR BREST. STRUCK MINE LAID BY UC-47. (LL WW1). |

| Wreck_id | Name | Type | Circumstances of Loss |
|---|---|---|---|
| 23220 | RAFFIO | steam ship | SANK WHEN THE VESSEL TIPPED OVER AND WATER POURED INTO OPEN HOLD, WHILE ENGAGED IN CARGO SALVAGE FROM WK OF 'JEAN MARIE'. ONE LIFE LOST. (STATES SUPERVISOR, GUERNSEY). THOUGHT TO HAVE FOULED A HEAVY SINKER WITH ITS GRAB. (T A TITTERTINGTON). |
| 23396 | | | |
| 23409 | PETITE ANNA | fishing vessel | 20.2.82 REPORTED OVERDUE, LATER WRECKAGE FOUND ON PATERNOSTERS REEF. (LL, 20.2.82). |
| 23413 | ORPHEE | fishing vessel | 20.8.82 STRUCK A ROCK OFF CORBIERE, JERSEY, AND ABANDONED BY CREW. WAS ON PASSAGE GUERNSEY TO JERSEY. VESSEL COULD NOT BE FOUND BY JERSEY LIFEBOAT. (LL, 20.8.82). |
| 23421 | LEASTILIEN | fishing vessel | |
| 23429 | USS PT 509 | patrol boat | RAMMED A GERMAN MINESWEEPER IN THICK FOG. BLEW UP AND SANK. ONLY ONE SURVIVOR. (T A TITTERINGTON). |
| 23448 | M 343 (PROBABLY) | minesweeper | 14.6.44 DAMAGED BY GUNFIRE FROM HMS ASHANTI AND POLISH DESTROYER PIORUN OFF BRITTANY 14.6.44. SCUTTLED OFF ST MALO 6.8.44. (GERMAN SURFACE VESSELS). |
| 23454 | LA MAUVE | barge | SCUTTLED. |
| 23456 | LE SQUALE | Wooden Vessel | 13.1.95 TOOK WATER AND LATER SANK UNDER TOW. TWO CREW RESCUED. (FISHING NEWS, 13.1.95). |
| 23459 | FULBORE III | | TOOK WATER, LOST POWER AND QUICKLY SANK. CREW OF THREE RESCUED BY FV RIPTIDE. |
| 23460 | GE2 | barge | 8.10.97 SCUTTLED. (ASSISTANT HARBOURMASTER, ST HELIER, FAX DTD 8.10.97). |
| 23462 | MARIE GALANTE | fishing vessel | STRUCK LA NORIMONTAISE ROCK, OFF CORBIERE, WHEN RETURNING FROM FISHING. SANK WHILST UNDER TOW BY ANOTHER TRAWLER. |
| 23465 | JAMES | cutter | 6.1.77 HIT LA FROUQUIER AUBERT AND SANK IMMEDIATELY IN APRIL 1826. (T A TITTERINGTON, JERSEY MARITIME MUSEUM, 6.1.77). |
| 23466 | LE CAP | motor vessel | STRUCK SUBMERGED REEF BETWEEN LA GOUBINIERE & LA ROUSSE PLATTE & WAS BADLY HOLED. SANK LATER WHILE UNDER TOW. |
| 23759 | VIKING 2 | fishing vessel | |
| 25796 | FINK | steam ship | SANK DURING A STORM. |
| 25813 | M 343 (POSSIBLY) | minesweeper | 14.6.44 DAMAGED BY GUNFIRE FROM HMS 'ASHANTI' AND 'POLISH PIORUN' OFF BRITTANY ON 14.6.44. SCUTTLED NEAR ST MALO ON 6.8.44. (GERMAN SURFACE VESSELS, VOL 1). |
| 25822 | BROCKLEY COMBE | | |
| 25831 | SARCELLE | fishing vessel | |
| 25833 | M'AS TU VU | fishing vessel | |
| 25837 | | yacht | |
| 25840 | COTE OEUST | fishing vessel | |
| 25861 | LA BLAINVILLAISE | fishing vessel | |
| 25873 | COTE OUEST | fishing vessel | |
| 57598 | OLWAY | barge | SCUTTLED AS A DIVING ATTRACTION. |
| 59613 | SUPERB | steam ship | 6.1.77 STRUCK THE GRUNE DE TURBOT, NEAR MAITRESSE ISLAND, WITH THE LOSS OF 17 LIVES. CAPT PRIAULX, IN CHARGE OF THE VESSEL AT THE TIME OF LOSS, WAS TAKING PASSENGERS TO VIEW THE WK OF THE 'POLKA' [A VESSEL SUNK UNDER THE CHARGE OF CAPT PRIAULX ON |

| Wreck_id | Name | Type | Circumstances of Loss |
|---|---|---|---|
| 59614 | POLKA | steam ship | 6.1.77 STRUCK AN UNKNOWN OBJECT AND SANK ABOUT 0.5M FROM MAITRESSE ISLAND. PASSENGERS AND CREW ALL SAVED. VESSEL WAS UNDER THE CHARGE OF CAPT PRIAULX AT THE TIME OF LOSS. (T TITTERINGTON, JERSEY MARITIME MUSEUM, LTR DTD 6.1.77). |
| 59615 | MERA | | |
| 63091 | | fishing vessel | |
| 64220 | HERON | carrier | BUILT IN NETHERLANDS IN 1956. PASSAGE JERSEY FOR PORTSMOUTH. SANK AFTER STRIKING THE PATERNOSTERS. 3 OF 11 CREW LOST. (DIVER MAGAZINE). |
| 64289 | ARMANDE | fishing vessel | SANK IN FORCE 8 WINDS. GRP HULL. |
| 67674 | | | |
| 67675 | | | |
| 74896 | | ferry | |
| 74900 | PETER PAUL | fishing vessel | BROKE LOOSE FROM MOORINGS DURING NIGHT OF 18-19 MARCH & DRIFTED ONTO ROCKS AT BOULEY BAY, JERSEY. APPEARS TO BE A TOTAL LOSS. (LLOYDS VOL. 219). |
| 74905 | | aircraft | SHOT DOWN BY GERMAN AA BATTERY ON NORTH COAST OF JERSEY. LT ROBERT BLACKLER IN COMMAND, WAS SINGLE SURVIVOR. |
| 77987 | LES MARQUISES | fishing vessel | SANK FOLLOWING COLLISION WITH HIGH SPEED FERRY CONDOR VITESSE (5007 TONS, BUILT 1997) IN FOG. CREW OF 3 RECOVERED, ONE MAN LATER DIED. |
| 78020 | | | |
| 78021 | | | |
| 81551 | | fishing vessel | WAS SWAMPED AND SANK. CREW OF TWO RECOVERED. |
| 84463 | | | |
| 85463 | | | |
| 87121 | | | |
| 87966 | | | |
| 88433 | | | |
| 94846 | | | |
| 94849 | | | |
| 94852 | | | |
| 94853 | | | |
| 95642 | | | |