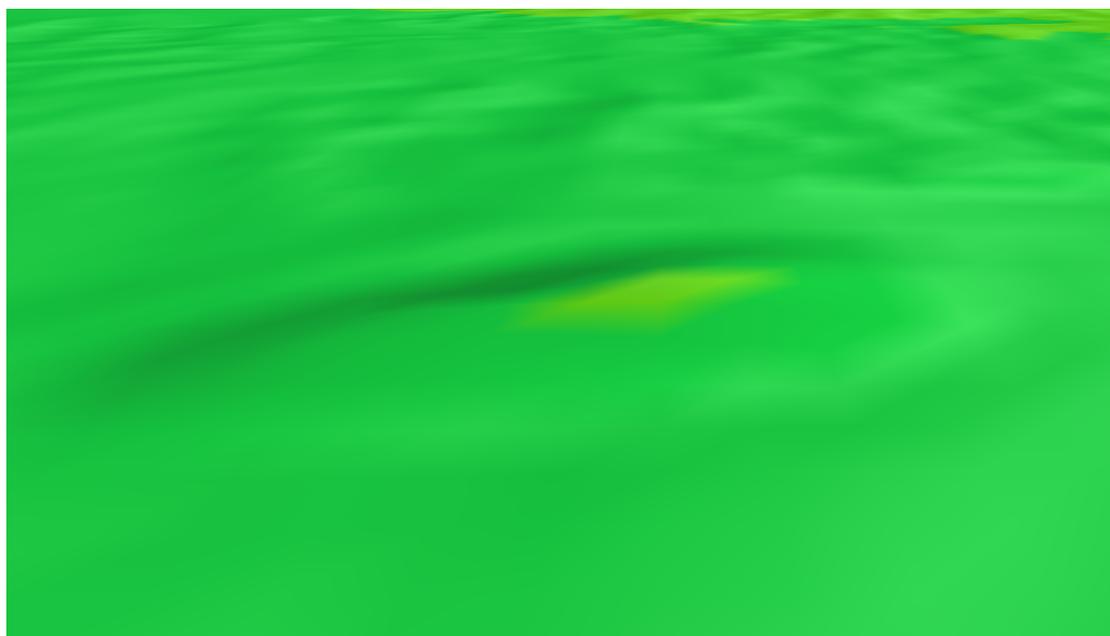


Appendix 16.1

Marine Historic Environment Technical Baseline



Dounreay Trì Offshore Wind Farm Caithness



Marine Historic Environment Technical Baseline Report

October 2015

Title:	647 Dounreay Marine Historic Environment Baseline Assessment
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Executive Summary

ORCA Marine was commissioned by Aquatera Limited to assess the potential marine historic environment impacts of a proposed three turbine offshore windfarm with an installed capacity of between 15 to 30 MW, approximately 9km off the coast of Dounreay by Hexicon AB. This is part of a floating demonstrator project called Dounreay Tri. The technical baseline assessment will identify any marine sites of archaeological or historical significance that might be affected by the proposed development.

11 potential shipwreck sites were recorded by the desk-based assessment that potentially could be within the Hexicon – Dounreay Demonstration Site and Cable Route Search Area. The listed positions of all of the shipwreck sites are tentative, being derived from an unverified location of loss, but they have been included in this report as the descriptions of their loss indicate they could fall within these areas. One shipwreck (HMT *Orsino*) would be considered of **high importance** as it is a war grave (lost during World War I). The others are recorded as being in or close to Sandside Bay and Dounreay, at the south end of the Cable Route Search Area. Eight of these are of **low importance**, and two of **negligible importance**.

Two Multi-Beam EchoSounder (MBES) anomalies were noted during the assessment of the geophysical data collected by Marine Scotland for the Hexicon – Dounreay Demonstration Site and Cable Route Search Area - one probably natural, the other potentially anthropogenic. In addition, two Non-Sub Contacts were located outside the Hexicon – Dounreay Demonstration Site and Cable Route Search Area. The MBES survey did not cover the north-east corner of the Demonstration Site, the east side of the and Cable Route Search Area or the southernmost 2km of the and Cable Route Search Area, including Sandside Bay

While it is possible that evidence of periglacial occupation (in the form of submerged prehistoric artefacts and paleo-landscape remains) survives on the seabed, there is considered **low potential** for preservation of such remains due to the flat, exposed nature of the seabed in the Hexicon – Dounreay Demonstration Site and the northern part of the Cable Route Search Area in waters deeper than 50m. However, in the Cable Corridor Search Area in waters shallower than 50m there is **moderate** potential for preservation of submerged prehistoric artefacts and palaeo-landscape remains. This will be especially true closer to the shore in Sandside Bay. There is a **moderately high probability** that there will be evidence of submerged landscapes,

submerged peat and postglacial tsunami deposits beneath the sands in the bay, the intertidal zone and possibly the dunes. This is all potential evidence of the historic environment and for human activity in the area.

The seabed morphology and tidal regime will also affect the preservation of wrecks and their associated artefacts, thus there is **low potential** for the project to impact on significant unknown, unrecorded wreck remains that may not be visible in the geophysical data.

1.0 Introduction

ORCA Marine was commissioned by Aquatera Limited to assess the potential impacts of a proposed three turbine offshore windfarm with an installed capacity of between 15 to 30 MW, approximately 9km off the coast of Dounreay by Hexicon AB. This is part of a floating demonstrator project called Dounreay Tri (1.01 Schedule I - Hexicon EIA Scoping and ES production SOW.docx.pdf: 2).

This assessment will identify any sites of archaeological or historical importance that might be affected by the proposed development. These documents will be used to inform an Environmental Impact Assessment (EIA) and a chapter in the Environmental Statement (ES).

The **study area** for this report comprises the Hexicon – Dounreay Demonstration Site and Cable Route Search Area. (**Plate 1**) and the marine geophysical survey area where it extends beyond these (**Figure 1**). Data was also captured for the wider general area for wrecks with unverified and unknown locations that had the possibility of lying within the Hexicon – Dounreay Demonstration Site and Cable Route Search Area.

This report incorporates a Desk Based Assessment (DBA) of potential submerged cultural heritage in the study area prepared by Scientific Underwater Logistics and Diving (SULA Diving) on behalf of ORCA Marine. SULA Diving were also commissioned to assist in the evaluation of the Marine Scotland remote sensing survey data (multi-beam echosounder (MBES) (1.01 Schedule I - Hexicon EIA Scoping and ES production SOW.docx.pdf) covering the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area.

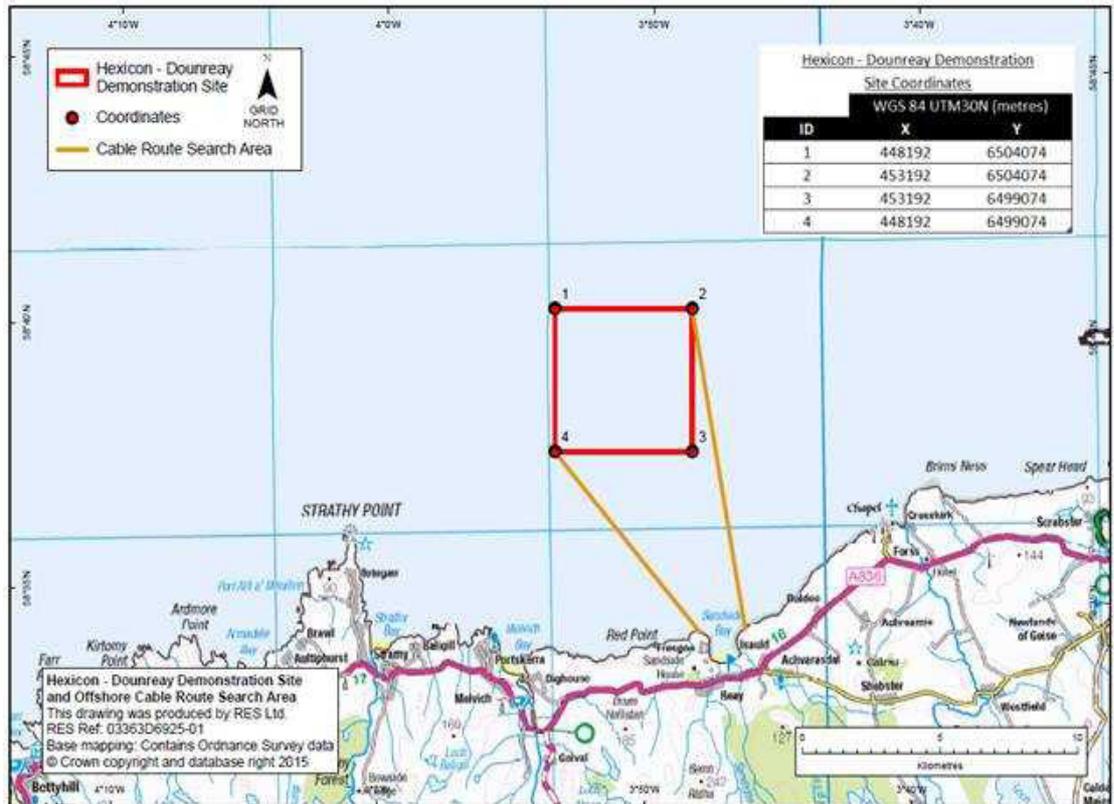


Plate 1: Map showing extent of Dounreay Demonstration Site and Cable Corridor Search Area (source: 1.01 Schedule I - Hexicon EIA Scoping and ES production SOW.docx.pdf, Figure 1)

The marine historic environment encompasses not only shipwrecks, but also other evidence of human exploitation of maritime resources, such as shipyards, piers, fish traps, anchor sites and submerged landscapes where human beings and early hominids previously lived or hunted on terrain which was at that time dry land, or where they exploited fish and shellfish on the coast which is now submerged (*Marine (Scotland) Act 2010*, section 73, paragraph 5).

This report includes:

- A review of existing data sources to identify known sites in the area, and the potential for unidentified marine cultural heritage sites and areas;
- A review of the cultural heritage sites identified during the marine geophysics assessment; and
- A summary of the results of the DBA and marine geophysics, in Appendices 1 – 2.

2.0 Aims and Objectives of the Assessment

The technical baseline assessment will identify any potential marine historic environment assets or constraints. This will also help inform the decision-making process for the design layout, potential routes and location of the proposed development prior to the EIA and production of the ES chapter.

This baseline assessment aims to:

- Review existing databases on the marine historic environment in the area, including cultural heritage sites and landscapes, relative sea-level change, submerged cultural remains, wrecks and subsea features; to identify known sites in the area and the potential for unidentified sites and landscapes;
- Analyse the marine geophysical survey data acquired by Marine Scotland, assessing its quality and identifying any evidence of marine cultural material or subsea remains;
- Categorise sites in terms of importance (or sensitivity) and local, regional, national or international relative importance; and
- Identify any known or likely sensitive sites or areas and the potential for unknown remains in the development area.

3.0 Assessment Methodology

3.1 Desk-Based Assessment

The DBA was conducted to identify potential submerged cultural heritage in the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area. It was completed in accordance with the Chartered Institute for Archaeologists (CIfA) *Standard and Guidance for historic environment desk-based assessment* (revised December 2014) and reviewed key data sources of known submerged sites within the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area (**Figure 1**). Any items / sites identified in the wider area (as defined in Section 1.0) that could be close to these areas are also detailed in this report. This is because the positions of many of these sites are unknown. The descriptions of their circumstance of loss indicate they could be located within the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area and thus be impacted.

The principal reference sources examined for this assessment were:

- The National Monuments Record of Scotland, using the Canmore database website;
- Statutory lists, registers and designated areas, including List of Scheduled Ancient Monuments, Designated Wrecks and Historic Marine Protected Areas;
- UK Hydrographic Office (UKHO) wreck register and relevant nautical charts;
- Heath / Ferguson private wreck database, which contains material not published by Ferguson (see Ferguson 1991) and has been added to by Heath and Ferguson as new discoveries of wreck sites have been made;
- Larn, R & Larn, B 1998 *The Ship Wreck Index of Great Britain & Ireland Vol.4 Scotland* (SIBI);
- Whittaker IG 1998 *Off Scotland: a comprehensive record of maritime and aviation losses in Scottish waters*, Edinburgh.

Other readily available archaeological and historical reports, databases and publications were consulted for information about the study area and, where used, are cited in the report.

3.2 Subsea survey methods

3.2.1 Geographic Information Systems (GIS) data

An ArcGIS *.mxd project was created. All Hexicon AB data supplied in ArcGIS *.shp file format were added to the ArcGIS *.mxd project. All data was inspected systematically by an experienced marine archaeologist. A shapefile was created for anomalies observed in the MBES geophysical survey datasets in the ArcGIS *.mxd project.

3.2.2 Multi-beam echosounder

Marine Scotland conducted a Multibeam EchoSounder (MBES) geophysical survey of the Farr Point area. This was an extension of the previous Armadale MBES survey. It was conducted between the Kyle of Tongue and 8 miles west of Thurso by

the Marine Scotland Science Vessel the MRV *Scotia* in 2014. This surveyed area includes the proposed Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area.

The data was collected and processed in WGS 1984 UTM 30N and has been corrected to chart datum. It was cleaned to a 2m resolution. There was a tidal discrepancy between adjacent lines in some sections due to an intermittent signal loss with the motion and heading sensors.

The MBES data was accessed from the Marine Scotland website (<http://www.gov.scot/Topics/marine/science/MSInteractive/datatype/Bathymetry/data/farr-point>) as post processed XYZ data in *.txt file format which gives coordinate and depth information. Digital Terrain Models (DTM) in *.sd file format were created by gridding the XYZ data within Fledermaus. The size of the *.txt file was excessive for gridding in Fledermaus at the surveyed resolution of 2m so software programme GSplit 3 was used to create 7 *.sd files for viewing in Fledermaus. These were colour matched with each other to enable easy comparison of bathymetry data in Fledermaus and ArcGIS. To enable comparison of supplied bathymetric data alongside all of the GIS data, a GeoTIFF of each individual Fledermaus *.sd DTM was exported at as high a resolution as possible. This was then imported into ArcGIS.

Although the individual *.sd files initially worked they subsequently became corrupt. The reviewer decided to grid the complete *.txt file at 4m resolution. Although of a lower resolution than the actual supplied survey data the reviewer concluded that this was still acceptable for identifying and analysing any anomalies present within the surveyed data.

GIS shapefile data was then imported into Fledermaus 7.2.2e and was then overlaid onto the DTM.

3.2.3 Seabed images

Marine Scotland dropcam images taken during the 2014 MBES survey covers the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area and this has been examined and utilised alongside the MBES survey data to ground-truth the existing survey data.

The Marine Scotland dropcam footage was accessed from the Marine Scotland website (<http://www.gov.scot/Topics/marine/science/MSInteractive/datatype/TV>) as

*.kmz files for reviewing in Google Earth.

3.3 Assessment of Importance

The importance attributed to each area, site or feature identified is determined following the criteria outlined in **Table 1**, which incorporate general guidelines used by statutory authorities and agencies such as the Scottish Government and Historic Scotland, outlined in *Scottish Historic Environment Policy (SHEP) 2011*, Planning Advice Note (PAN 2/2011) *Planning and Archaeology*, the *Marine (Scotland) Act 2010*, English Heritage *Designation Selection Guide: Ships and Boats, Prehistory to Present* (2012) and Wessex Archaeology's three-part *Assessing Boats and Ships 1860-1950* (2011). It should be noted that a site that has not been statutorily designated can still be of high importance. Features for which further information is unavailable are recorded as of uncertain importance. The weight given to historic environment considerations will depend on a number of factors (PAN 2/2011 paragraph 6) including:

- The relative rarity of the feature concerned;
- The completeness of the feature / whether it is a particularly good example of its type;
- The historical or cultural associations of the feature;
- The value given to the feature by the local community;
- The potential value of the feature as an in situ educational or research resource; and
- The potential value of retaining the feature for tourism or place-making.

Level of importance (sensitivity)	Criteria
Very High	Archaeological and historical sites or areas, submerged prehistoric landscapes and deposits, wrecks, or cargos of international importance, such as World Heritage Sites, and may also include some Designated Wrecks or Historic Marine Protected Areas that are not only of national but of international importance. Shipwrecks dating to the prehistoric, Norse and medieval periods are rare and therefore of very high importance. This may also include vessels and aircraft lost in

Level of importance (sensitivity)	Criteria
	international conflicts, which may have involved large losses in life. Cargos with very high intrinsic, contextual or associative characteristics.
High	Archaeological and historical site or areas, wrecks and cargos of national importance, Designated Wrecks and Historic MPAs. Vessels and aircraft lost in conflict, or which may have involved loss of life. Up to 1913 the shipping industry was a major element in Britain's world influence and wrecks up to this period may (though not necessarily) be of high importance if involved in national and international trade; wrecks and cargos with high intrinsic, contextual or associative characteristics (e.g. rarity, evidence of technological change).
Medium	Archaeological and historical sites or areas, wrecks and cargos of regional importance. This would involve shipwrecks, anchorages and fishing areas prior to 1913 involved in regional industry and trade; wrecks and cargos with moderate intrinsic, contextual or associative characteristics.
Low	Locally important sites or areas, wrecks and cargos. Shipwrecks dating from after 1913 relating to fishing, ferrying or local coastwise trade. Wrecks and cargos with low intrinsic, contextual or associative characteristics.
Negligible	Features that have been recorded but assessed as of no archaeological or historical interest, such as recent wrecks, or have been so damaged they no longer have any historic merit.
Uncertain	Features that cannot be identified without detailed work, but potentially of some interest. Also, for example, if the date of construction and rarity of a vessel is not known, but potentially of some interest. Find spots, which may represent an isolated find, or could represent the location of a hitherto unknown site. Unidentified geophysical anomalies are also of uncertain importance and have been assessed further in Table 2.

Table 1: Definitions of importance of marine archaeological and historical sites

Most of the anomalies recorded in the analysis of the geophysical datasets could not be assigned a level of importance based on the criteria outlined in Table 1 as very little is known about them. The potential for these anomalies to be anthropogenic is therefore outlined in Table 2. Note that though classed as 'high', 'medium' and 'low', levels of geophysical potential do not imply a historical value to the anomalies – an

anomaly may be of high geophysical potential (i.e. it looks anthropogenic) but may not be of historical importance.

Level of geophysical potential	Description
Low	Anomaly is likely to be a natural formation such as a sand dune or bedrock formation. It could also be a processing error of the geophysical data.
Medium	Anomaly lies in an area of intensive human activity such as near ports or areas of peat and other features relating to submerged landscapes. It would also be considered for an anomaly that is possibly anthropogenic but has no definite identification.
High	Anomaly looks anthropogenic; or there is identifiable cultural material; or it is in the area of a known archaeological site, or another anomaly identified to be high potential.

Table 2: Definitions of level of potential of geophysical anomalies

3.4 Study Limitations

All key data sources were reviewed for this report, although there remains the low possibility that there may be sites or features of archaeological significance that have not been identified.

The Royal Commission for Ancient and Historical Monuments for Scotland (RCAHMS, soon to become part of Historic Environment Scotland) runs the Maritime Project of the National Monuments Record of Scotland (NMRS), which seeks to document maritime sites, defined as ships, boats and crashed aircraft, but not built structures or prehistoric sites (unpublished paper issued by MP of NMRS, 2002). The information in the archive record is largely drawn from Whittaker (1998) and Larn and Larn (1998). These books contain some inaccuracies in the locations of wreck sites, which have been duplicated into the NMRS. If any of these are relevant to the report, they are noted and are corrected as far as possible.

The resolution limitations of the subsea survey data downloaded from the Marine Scotland website in relation to their applicability for identifying marine historic environment features within the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area are summarised below:

- The general quality of the MBES data was suitable for detecting anomalies, with the caveat that the resolution of the MBES data is, on

its own, not suitable to provide a positive identification of a feature – i.e. confirming that an anomaly is a shipwreck;

- The MBES data includes numerous banding, rippling and other survey artefacts caused by swell and tidal effects. These survey artefacts are present heading southwest to northeast across the area and these artefacts are roughly spaced 130 to 180m apart. This limits the ability to identify any anomalies immediately alongside these survey artefacts;
- The survey artefacts makes it difficult to ascertain with any certainty what the nature of the seabed is, whether it is exposed bedrock or other material such as sands and silts overlying bedrock. The initial indications from the MBES is that the seabed is comprised of flat bedrock covered by sediments. The depths of these layers of sediment (and therefore if there is potential for any historic environment material to be buried within or below them) cannot be ascertained from the MBES survey data;
- The extreme northeast corner of the Hexicon – Dounreay Demonstration Site is not covered by the Marine Scotland MBES data. This data gap is in the configuration of an upside-down, right angle triangle measuring 0.6 km west to east at the northeast corner of the Hexicon – Dounreay Demonstration Site and then 2.8km north to south;
- The eastern edge of the Cable Corridor Search Area for a width of 0.5km is not covered by the Marine Scotland MBES data. There is a data gap towards the northwest corner of the Cable Corridor Search Area which takes the configuration of an upside-down, right angle triangle measuring 0.7km west to east and then 1.8km north to south; and
- Where the Cable Corridor Search Area approaches Sandside Bay there is currently no MBES data in waters shallower than 27m, for a distance of 2km to the coastline.

Any data gaps can be made good through mitigation or management strategies. Therefore, despite the above limitations to the study, the DBA sources and geophysical data analysed were sufficient to be able to provide an adequate baseline assessment on which to base a robust EIA and ES.

4.0 DBA and Geophysical Assessment Results

The locations of all sites and anomalies identified by the DBA and the geophysical data assessment are shown in **Figure 1**. These are discussed below.

4.1 Shipwrecks

There are no charted wrecks within the Demonstration Site or Cable Corridor Search Area. There are no Historic Marine Protected Areas or designated wrecks and military remains in the area. The nearest charted wreck is the pre-dreadnought Battleship HMS *King Edward VII* which is 3.5km to the north of the northern edge of the Hexicon – Dounreay Demonstration Site.

Eleven shipwreck sites are listed on the Canmore database and Whittaker (1998) that may be in or close to the area, because the precise locations of their sinking are unknown and descriptions included within details of their circumstance of loss indicate the possibility. These are summarised in **Appendix 2** and are shown in **Figure 1**. None has been identified from the MBES survey data, but there is a lack of complete coverage of MBES survey data for the Hexicon–Dounreay Demonstration Site and Cable Corridor Search Area, on the east edge of the area and the southern 2km into Sandside Bay. Thus it cannot be ruled out that these wrecks lie within the area

One wreck is considered to be of **high importance** because there was a loss of life and there is the potential that some of the crew went down with the ship. This is the HMT *Orsino* (Canmore 214438), a requisitioned steam trawler left Loch Eribol for Stromness to patrol the swept channel off the north coast of Scotland on the 28th Sept 1916 but failed to reach her destination. In October a section of the wheelhouse washed ashore in the Bay of Ireland with shell fragments embedded. (ADM.1/8468/232). Six men died in the attack by U55 and four were taken prisoner by the U Boat. Canmore has HMT *Orsino* listed as 'Between Loch Eribol And Stromness'; 'Between Loch Eriboll And The Islands'; 'Pentland Firth' and its actual position remains unknown. U55's KTB (Kriegstagebücher) (War Day Book) shows that the attack took place in grid square 043 alpha (Figure 2). Although this is just to the east of the area of search and cable route study area, it is possible that with the poor visibility, the U-boat was not 100% sure of her position and HMT *Orsino* may have been sunk in the area of the development site or cable route. Also in pencil on the inner margin of the KTB page it states 10 miles from Thurso. This again places HMT *Orsino* east of the proposed area. If identified, this vessel is of high importance

as none of the six men killed in the attack were recovered and the vessel would be considered a war grave.

Within the Marine Scotland MBES data there is an anomaly 4.6km northeast of the Hexicon – Dounreay Demonstration Site with dimensions that make it a possible target for HMT *Orsino*. However, without ground-truthing it is also possible that this could be another unnamed vessel, or perhaps a large glacial erratic. The lack of complete MBES survey coverage for the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area means that HMT *Orsino* could lie within the unsurveyed part of the Hexicon – Dounreay Demonstration Site and Cable Corridor Search.

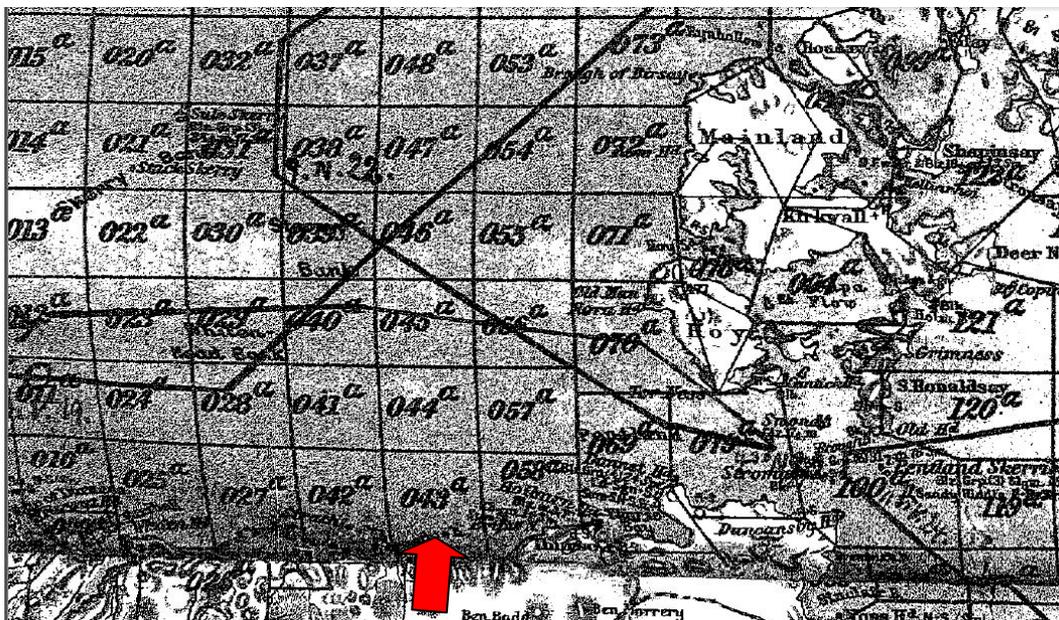


Plate 2: KTB Chart showing location of grid square 043 alpha where U55 reported attacking HMT *Orsino* (ML U55/11/12)

Eight late 18th to early 20th-century wrecks are considered of **low importance** as their listed cargos are only considered to be of local importance; there are good historical records for their various methods of construction; and it is highly likely that they were at least part salvaged and the rest has broken up due to being in the breaking wave regime at the shoreline. All eight vessels (the Unknown Sloop, *Anglia*, *Elizabeth Miller*, *Belvedere*, *Lady Kyth*, *Pearl*, *Young Alexander* and an unknown vessel recorded in 1847 as parts of the masts of a vessel standing out of the water) have unconfirmed positions in and around Sandside Bay, and thus within the Cable Corridor Search Area.

Two wrecks are considered of **negligible importance** as they are modern vessels of no historical interest. These are the Trawler BF 394 *Arnisdale* (Canmore 288543), a fishing vessel wrecked below Dounreay 13th April 1984; and the Fishing Vessel *Audrey* (Canmore 288544), stranded between Sandside bay and Dounreay 30th July 1992.

As a maritime nation with a reliance on marine based trade and exchange, there have been countless shipwrecks around UK waters from all periods – many of which remain unreported. As such there is a **high probability** for unknown, unrecorded vessels to have sunk in the project area. Remains of such vessels and their associated artefacts may not be visible in geophysical data – constructed from materials that do not provide strong geophysical or magnetic returns or buried beneath the surface of the seabed. However, the likelihood for the project to encounter such remains is reduced by the nature of the seabed and the tidal conditions within the development area.

The seabed across most of the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area comprises mainly flat seabed which is not conducive to good preservation, though some cultural material may survive trapped in the few gullies that are present further to the south in the Hexicon – Dounreay Demonstration Site. The survival of wrecks, wreckage and associated artefacts, particularly in shallower waters, is also affected by the strong tides and severe winter storms that frequent the area. Thus there is considered to be **low potential** for the project to impact on significant unknown wrecks or their associated artefacts.

4.2 Non-sub Contacts

A Non-sub Contact is a sonar contact detected during wartime submarine searches that are not submarines. The identity of these contacts is unclear – they have the potential to be shipwrecks or other anthropogenic features, or they can be natural. Two Non Sub Contacts had been reported outside the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area. These were subsequently investigated and are now listed as dead by the UKHO. Non-sub Contact (UKHO 939) is 1.9km east of the Hexicon Dounreay Demonstration Site while Non-sub Contact (UKHO 945) is 4.3km to the northeast of the Hexicon Dounreay Demonstration Site and, therefore, they are not discussed any further.

4.3 Aviation Losses

There are no known aircraft losses in the proposed area but a number of aircraft have gone “missing” off the north coast of Scotland so the possibility remains of finding one here. Any aircraft found is automatically protected under the Protection of Military Remains Act 1986 if lost on active service. These would be considered of **high importance**.

4.4 Unexploded Ordnance

One of the largest German minefields was laid to the north of Mainland Scotland by surface raider **SMS Möwe** in January 1916. This was known to the British as the Whitten Head Field and had over 250 mines. By the end of April 1916 the Royal Navy had accounted for 70 of these mines and considered the field cleared. However, there is the possibility that live mines from the Whitten Head minefield could have drifted into the area of search either as a result of minesweeping operations or mines having broken free of their moorings; therefore there is the potential for unexploded ordnance in the development area.

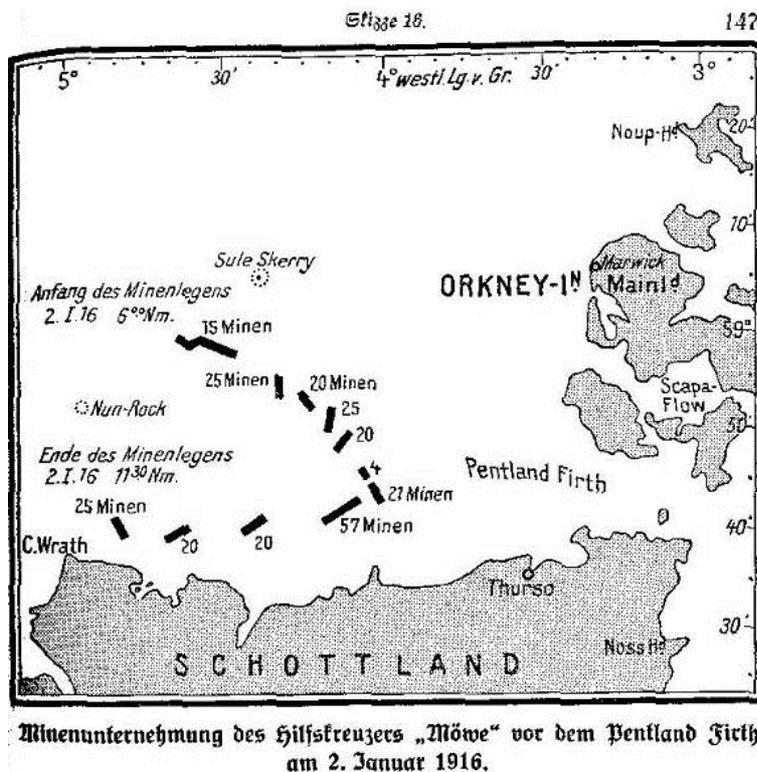


Plate 3: The Whitten Head Field.

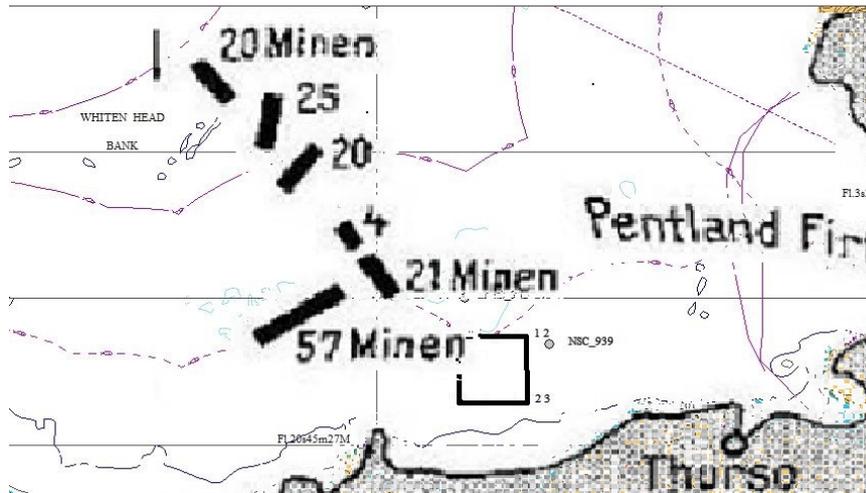


Plate 4: The Whitten Head Möwe minefield overlaid on the chart showing the proximity to the proposed area.

4.5 Multi-beam echosounder anomalies

The MBES data and dropcam images shows the survey area to be flat seabed with some smaller areas of ripples and sand waves that tend to be concentrated along the Cable Corridor Area of Search and in areas more sheltered from the tide. The inshore section of the Cable Corridor Area of Search comprises flat seabed, covered by sediments, the depth of which cannot be clarified with the Marine Scotland MBES and dropcam survey data (and therefore if there is potential for any historic environment material to be buried within or below them).

Two MBES anomalies were observed in the geophysical assessment (MBES01 and MBES02) that fall within the Hexicon – Dounreay Demonstration Site. No anomalies were identified within the Cable Corridor Search Area. The distribution of these anomalies is shown in **Figure 1**. One anomaly, MBES01 was considered to be of **medium geophysical potential** (possibly anthropogenic) while MBES02 was considered to be of **low geophysical potential**. Images, measurements and descriptions of each anomaly are provided in **Appendix 2**.

4.6 Potential for submerged landscapes and cultural remains

Hominids and humans have occupied the UK Continental Shelf (UKCS) at various times for more than 700,000 years, but finds showing this are incredibly rare. Although in general terms, the potential for submerged prehistoric archaeology and landscapes across wide areas of the UKCS is high (Wessex Archaeology 2009, 9),

the potential for site preservation in areas of the shelf deeper than 80m is low (Flemming 2003: 16).

The study area falls within Zone 4 of the Strategic Environmental Assessment of the Continental Shelf (SEA4, Flemming 2003). The potential for the survival of submerged landscapes and prehistoric sites in the study area is influenced by various physical factors, processes and topography with sheltered areas with lower seabed water movements, deep sediment deposits in rocky gullies and depressions and sea caves often providing conditions suitable for good site preservation (Flemming 2003: 15 – 21).

The Marine Scotland MBES survey data and dropcam images indicate that the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area comprises flat seabed with bedrock covered by sediments, largely comprising silty fine sand with patches of mixed gravel, pebbles, cobbles, shells and occasional boulders. Without further marine geophysical (Sub-bottom profile) data and/or coring, it is not possible to tell from the currently available data how thick the sediments are, and thus we cannot tell how the substrate might affect the preservation of any cultural heritage remains, or if there is potential for remains or palaeolandscape deposits to be buried below the seabed surface.

However, there is **low potential** for the preservation/identification of submerged landscapes and prehistoric sites in the area of the Hexicon Dounreay Demonstration Site, which is located in waters deeper than 50m, since Flemming (2003: 6; Figure 4 and Figure 6) indicates that relative sea level in this area was only 40-50m lower at the end of the last Ice Age. However the Cable Corridor Search Area has depths shallower than 50m and therefore has the potential for preservation of submerged prehistoric artefacts and palaeo-landscape remains. This will be especially true closer to the shore in Sandside Bay.

If the sediments in Sandside Bay are stable, then there is a **moderately high probability** that there will be evidence of submerged landscapes, submerged peat and postglacial tsunami deposits beneath the sands in the bay, the intertidal zone and possibly the dunes. This is all potential evidence of the historic environment and for human activity in the area. Evidence of tsunami deposits dated approximately between 6507–6260 cal BC and 6228–6029 cal BC, have been found at the mouth of Strath Halladale only 8km west of Sandside Bay (Dawson & Smith 2000; Smith et al 2004).

5.0 DBA and Geophysical Survey results by area

5.1 Hexicon - Dounreay Demonstration Site

There are no Historic Marine Protected Areas or designated wrecks and military remains in the Site. There are no charted ship or aircraft wreck sites (i.e. with known locations) in the area.

There may be one shipwreck of **high importance** (HMT *Orsino*) somewhere within the area. There could be unknown wrecks, aircraft and unexploded wartime ordnance in the area. However, none is known and none has been identified in the available survey data.

Two MBES anomalies were observed in the geophysical assessment (MBES01 and MBES02) that fall within the Hexicon – Dounreay Demonstration Site. One anomaly, MBES01 was considered to be of **medium geophysical potential** (possibly anthropogenic) while MBES02 was considered to be of **low geophysical potential**

As noted in section 4.6 there is a **low probability** for the preservation of submerged landscapes, palaeoenvironmental evidence and prehistoric cultural remains in the Hexicon – Dounreay Demonstration Site due to the water depth in the area.

No data was available to be able to assess the extreme northeast corner of the Hexicon – Dounreay Demonstration Site, which is not covered by the Marine Scotland MBES data. This data gap is in the configuration of an upside-down, right angle triangle measuring 0.6 km west to east at the northeast corner of the Hexicon – Dounreay Demonstration Site and then 2.8km north to south.

5.2 Cable Corridor Search Area

There are no Historic Marine Protected Areas or designated wrecks and military remains in the Cable Corridor Search Area. There are no charted ship or aircraft wreck sites (i.e. with known locations) in the area.

There may be one shipwreck of **high importance** (HMT *Orsino*) somewhere within the area. There could be unknown wrecks, aircraft and unexploded wartime ordnance in the area. However, none is known and none has been identified in the available survey data.

There are nine wrecks dating from the late 18th to the 20th century that are recorded as located in or close to Sandside Bay, or towards Dounreay, at the south end of the

search area. However, none has a known location. There is no available survey data for Sandside Bay to be able to further assess the likelihood. If present, eight shipwrecks (the Unknown Sloop, *Anglia*, *Elizabeth Miller*, *Belvedere*, *Audrey*, *Lady Kyth*, *Pearl*, *Young Alexander* and an unknown vessel recorded in 1847 as parts of the masts of a vessel standing out of the water) are likely to be of **low importance** due to there being good historical records for their various methods of construction, low interest cargo, likely salvage and breaking up in the highly dynamic breaking wave regime along the shoreline. The other two wrecks, the Trawler *Arnisdale* and the Fishing Vessel *Audrey*, are of **negligible importance** as they are modern vessels of no historical interest.

No MBES anomalies were recorded in the Cable Corridor Search Area. However, the eastern edge of the Cable Corridor Search Area for a width of 0.5km is not covered by the Marine Scotland MBES data, and where the Cable Corridor Search Area approaches Sandside Bay there is no MBES data in waters shallower than 27m, for a distance of 2km to the coastline.

As noted in Section 4.6, it is possible that areas of preservation of submerged landscapes, palaeo-environmental evidence and prehistoric cultural remains may lie in the Cable Corridor Search Area, which has depths shallower than 50m. Items may be present in the gullies, and in sediments around the bedrock outcrops around the nearshore section.

If the sediments in Sandside Bay are stable, then there is a **moderately high probability** that there will be evidence of submerged landscapes, submerged peat and postglacial tsunami deposits beneath the sands in the bay, the intertidal zone and possibly the dunes. This is all potential evidence of the historic environment and for human activity in the area. Evidence of tsunami deposits dated approximately between 6507–6260 cal BC and 6228–6029 cal BC, have been found at the mouth of Strath Halladale only 8km west of Sandside Bay (Dawson & Smith 2000; Smith et al 2004).

6.0 Summary

There are no Historic Marine Protected Areas, designated wrecks or designated military remains in the Development Site or Cable Corridor Search Area. There are no charted ship or aircraft wreck sites (i.e. with known locations) in either area.

Eleven potential shipwreck sites were identified during the DBA. Their positions are

unknown, derived from the unverified location of loss indicated in Whittaker (1998). Thus there is the potential that some remains could be within the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area, especially in the area of Sandside Bay.

One shipwreck (HMT *Orsino*) would be considered of **high importance** as it is a war grave (lost during World War I).

Eight shipwrecks (the Unknown Sloop, *Anglia*, *Elizabeth Miller*, *Belvedere*, *Lady Kyth*, *Pearl*, *Young Alexander* and an unknown vessel recorded in 1847 as parts of the masts of a vessel standing out of the water) are considered of **low importance** because we have good historical records for the construction of the types of vessels, they were not carrying cargo of any intrinsic importance, and it is highly likely that they were at least part salvaged and the rest has broken up due to being in the breaking wave regime at the shoreline. Two shipwrecks (Trawler BF 394 *Arnisdale* and Fishing Vessel *Audrey*) are considered of **negligible importance** as they are modern vessels of no historical interest.

There is a **high probability** for unknown, unrecorded vessels to have sunk in the project area that may not be visible in geophysical data – constructed from materials that do not provide strong geophysical or magnetic returns or buried beneath the surface of the seabed.

However, the likelihood for the project to encounter such remains is reduced by the nature of the seabed and the tidal conditions within the development area. The seabed across most of the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area comprises mainly flat seabed (although confirmation that the flat-looking seabed comprises thin sediments and sand which is not which is not conducive to good preservation would be useful), though some cultural material may survive trapped in the few gullies that are present further to the south in the Hexicon – Dounreay Demonstration Site. The survival of wrecks, wreckage and associated artefacts, particularly in shallower waters, is also affected by the strong tides and severe winter storms that frequent the area. Thus there is considered to be **low potential** for the project to impact on significant unknown wrecks or their associated artefacts.

Although there are no known crashed aircraft within the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area, should any remains be identified within the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area

these remains would be considered of **high importance** if lost on active service and would be protected under the Protection of Military Remains Act.

Two MBES anomalies were noted in the assessment of the geophysical data. Of these one MBES anomaly, MBES01 was considered to be potentially anthropogenic (**medium potential**).

The Marine Scotland MBES survey data and dropcam images indicate that the Hexicon – Dounreay Demonstration Site and Cable Corridor Search Area comprises flat seabed with bedrock covered by sediments, largely comprising silty fine sand with patches of mixed gravel, pebbles, cobbles, shells and occasional boulders. Without further marine geophysical (Sub-bottom profile) data and/or coring, it is not possible to tell from the currently available data how thick the sediments are, and thus we cannot tell how the substrate might affect the preservation of any cultural heritage remains, or if there is potential for remains or palaeolandscape deposits to be buried below the seabed surface.

However, there is **low potential** for the preservation/identification of submerged landscapes and prehistoric sites in the area of the Hexicon Dounreay Demonstration Site, which is located in waters deeper than 50m, since Flemming (2003: 6; Figure 4 and Figure 6) indicates that relative sea level in this area was only 40-50m lower at the end of the last Ice Age. However the Cable Corridor Search Area has depths shallower than 50m and therefore has the potential for preservation of submerged prehistoric artefacts and palaeo-landscape remains. This will be especially true closer to the shore in Sandside Bay.

If the sediments in Sandside Bay are stable, then there is a **moderately high probability** that there will be evidence of submerged landscapes, submerged peat and postglacial tsunami deposits beneath the sands in the bay, the intertidal zone and possibly the dunes. This is all potential evidence of the historic environment and for human activity in the area. Evidence of tsunami deposits dated approximately between 6507–6260 cal BC and 6228–6029 cal BC, have been found at the mouth of Strath Halladale only 8km west of Sandside Bay (Dawson & Smith 2000; Smith et al 2004).

7.0 References

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8.0 Acronyms

ARGOS	Aviation Research Group – Orkney & Shetland
CIfA	Chartered Institute for Archaeologist
DBA	Desk Based Assessment
DTM	Digital Terrain Model
EIA	Environment Impact Assessment
ES	Environmental Statement
GIS	Geographical Information System
HS Scotland)	Historic Scotland (soon to become part of Historic Environment Scotland)
KTB	Kriegstagebücher (U-Boat Chart)
MBES	Multi Beam EchoSounder
NMRS	National Monuments Record of Scotland
ORCA	Orkney Research Centre for Archaeology
RCAHMS	Royal Commission on the Ancient and Historical Monuments of Scotland (soon to become part of Historic Environment Scotland)
SULA	Scientific and Underwater Logistics And
UHI	University of the Highlands and Islands
UKHO	United Kingdom Hydrographic Office

Appendix 1: Potential sites identified by DBA

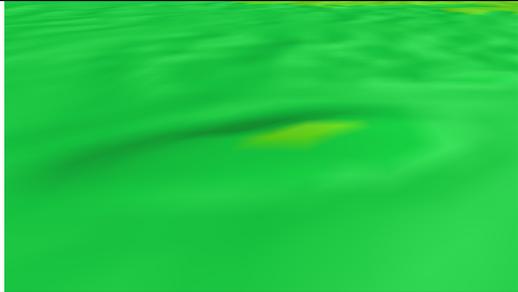
Name	UKHO Wreck Number	CANMORE	Description	Circumstance of loss	Date Lost	Lat (WGS84)	Long (WGS84)	Proximity to development	Source	Importance	Reason
Unknown sloop		288558	Sloop	Vessel was wrecked at Bay of Sandside	Between 1781 and 1788			Possibly within Cable Corridor Search Area, around Sandside Bay	1	Low	Good records of construction, low interest cargo, likely condition
<i>Anglia</i>		221415	Snow with cargo of wood	Wrecked in Sandside Bay	29 th October 1830			Possibly within Cable Corridor Search Area, around Sandside Bay	1,2	Low	Good records of construction, low interest cargo, likely condition
<i>Elizabeth Miller</i>		222083	Ketch	This vessel stranded at Isold Head, Sandside Bay	19 th July 1906			Possibly within Cable Corridor Search Area, around Sandside Bay	1,2	Low	Good records of construction, low interest cargo, likely condition
<i>Belvedere</i>		264566	Schooner	Carrying a cargo of manure. Drove ashore around Sandside Bay after missing entrance to harbour	2 nd April 1874			Possibly within Cable Corridor Search Area, around Sandside Bay	1	Low	Good records of construction, low interest cargo, likely condition
Unknown		277239	Unknown	Part of the masts of a vessel standing out of the water, has been discovered in Sandside Bay	10 th Sept 1847			Possibly within Cable Corridor Search Area, around Sandside Bay	Canmore	Low	Good records of construction, low interest cargo, likely condition
<i>Audrey</i>		288544	Fishing Vessel	This vessel stranded between Sandside Bay and Dounreay.	30 th July 1992			Possibly within Cable Corridor Search Area, around Sandside Bay	1	Negligible	Modern
<i>Lady Kyth</i>		288557	Sloop	Vessel was lost at Sandside. Registration: Inverness. Built 1833. 20 tons burthen. Length: 11m. Beam: 4m.	1854			Possibly within Cable Corridor Search Area, around Sandside Bay	1	Low	Good records of construction, low interest cargo, likely condition
<i>Pearl</i>		222076	Schooner	Carrying a cargo of pit props schooner <i>Pearl</i> stranded at Sandside Bay	12 th December 1904			Possibly within Cable Corridor Search Area, around Sandside Bay	1,2	Low	Good records of construction, low interest cargo, likely condition
<i>Young Alexander</i>		221581	Sloop	Carrying a cargo of pavement. Driven on shore in Sandside Bay during a severe gale	4 th January 1841			Possibly within Cable Corridor Search Area, around Sandside Bay	1,2	Low	Good records of construction, low interest cargo, likely condition
Arnisdale	1157	288543	Trawler BF 394	Trawler wrecked ashore below Dounreay	13 th April 1984	58°34'.776 N	003°45'.088 W	Possibly within Cable Corridor Search Area, around Sandside Bay	1,6	Negligible	Modern
HMD <i>Orsino</i>		214438	Requisitioned Drifter. Steel. 172 tons, Length = 33m Royal Navy	Sunk by <i>U55</i>	28 th Sept 1916			Uncertain	1,2,3,4,5	High	War Grave

Non Sub Contact	939		Now listed as dead	REPD NSC IN POSN 584100N, 034630W ON 29.4.45. . ACCURATE TO WITHIN 200YDS. 11.1.85 PEAK OF A GRAVEL WAVE WITH LEAST E/S DEPTH 69 IN GEN DEPTH 84MTRS LOCATED IN 584010N, 034621W. THOUGHT TO HAVE BEEN THIS REPORTED NON-SUB CONTACT. (BUE SUBSEA		58°40'.142 N	003°46'.439 W	0.994 NM to the east of square but was not found by BUE	6	Unknown	Unknown
Non Sub Contact	945		Now listed as dead	ROSYTH LIST RAUM 22 REPD SNS IN POSN 584200N, 034500W ON 29.4.45. C IN C ROSYTH REPD NSC IN POSN 584200N, 034500W. ACCURATE TO WITHIN 2000YDS. 11.1.85 NOTHING FOUND. BUE SUBSEA,		58°42'.000 N	003°45'.000 W	1.5 NM north of the northern end of proposed square. Not found by BUE	6	Unknown	Unknown

Sources

1 = Whittaker (1998); 2 = Larn & Larn (1998); 3 = Baird (2003); 4 = Lloyds Register; 5 = UKHO 6= Hepper (2006)

Appendix 2: MBES anomalies

Anomaly	MBES01	
		
Source	X:\MarineArchaeology\ORCA Marine Projects\647_Dounreay_Floating_Windfarm_ES\Geomatics\GIS\647_MS_Farr_Point_4m_250915.scene	
WGS84 UTM Zone 30N	448513 E	6499604 N
Dimensions	41.9 m x 23.6 m	
Description	Low linear mound. The mound has a slight plateau surrounding the central linear component of the anomaly. Mound is aligned southwest to northeast 2.5 m in height in 72 m of water.	
Level of geophysical potential	Medium	
Proximity to Development	Hexicon - Dounreay Demonstration Site	

Anomaly	MBES02	
		
Source	X:\MarineArchaeology\ORCA Marine Projects\647_Dounreay_Floating_Windfarm_ES\Geomatics\GIS\647_MS_Farr_Point_4m_250915.scene	
WGS84 UTM Zone 30N	448597 E	6499639 N
Dimensions	29 m	
Description	Low circular mound. The mound has a slight plateau surrounding the central component of the anomaly. 0.7 m in height in 73 m of water.	
Level of geophysical potential	Low	
Proximity to Development	Hexicon - Dounreay Demonstration Site	

