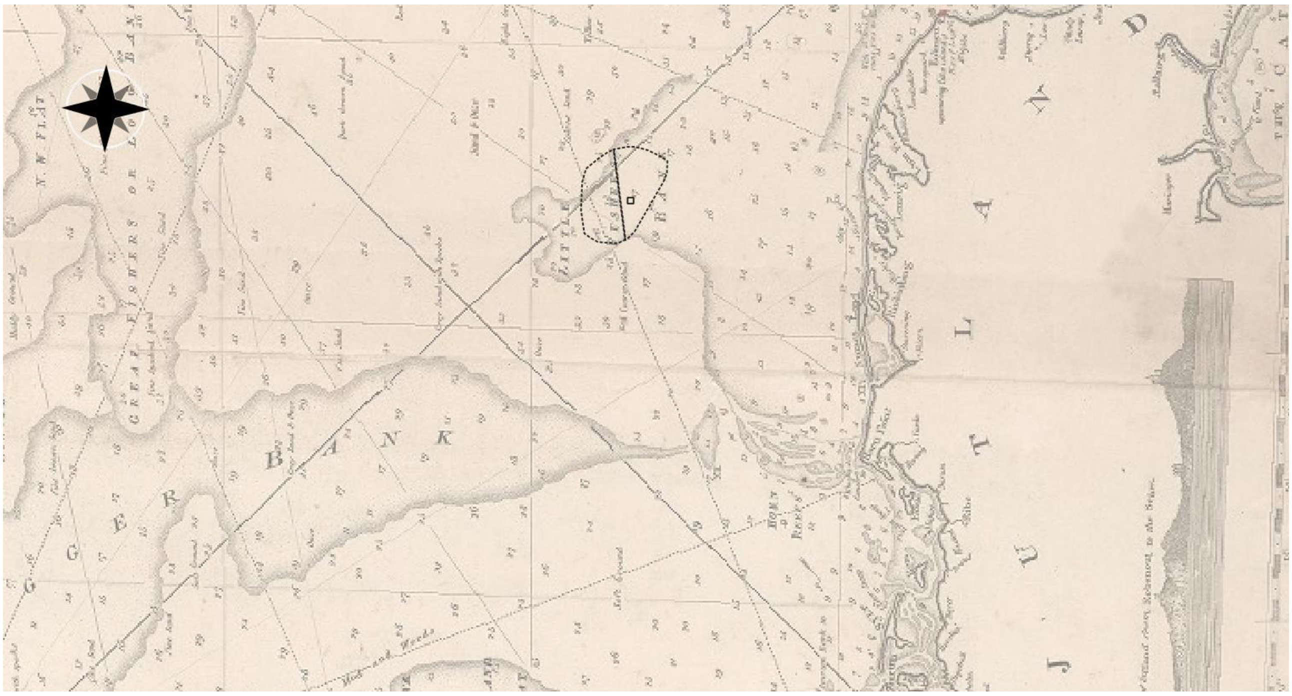
North Sea OWF Zone
Maritime archaeology
Geo-archaeological analysis, report



2023

Marinarkæologi Jylland

Final version for publication

Nordjyllands Kystmuseum

MOMU
MOESGAARD MUSEUM

De Kulturhistoriske Museer
Holstebro Kommune

1. Summary

This report comprises a Phase II desk-based geophysical analysis of the North Sea OWF Zone East and West locations with regards to submerged cultural heritage impact assessment.

With regards to the potential of the area for prehistoric Stone Age archaeological sites, MAJ concludes that the chances of damaging such sites during all phases of the OWF project are small. The geological horizons H10 and H20, that are of geological interest, have only been uncovered by the ice sheet at the end of the Last Ice Age and covered by rising sea levels relatively shortly after. Due to the lack of detailed information about the geology and geomorphology of the area in the period after the retraction of the ice sheet to pinpoint locations with good chances of traces of human activity, the difficulty of access to the relevant sediment layers and the likely scarcity of Palaeolithic and Mesolithic sites, MAJ sees archaeological preliminary surveys as possible, but unfeasible. The area around the location of the CPT BH-1010 has been judged to have potential to find traces of prehistoric human activity.

Seven shipwrecks and the wreck of a submarine have been identified in the OWF area. These wrecks are of interest for maritime archaeology for various reasons and MAJ recommends appropriate mitigation of them. In total 243 anomalies, both SSS and MAG, are recommended for investigation. These ROV and/or diver investigations can be combined with UXO/EOD operations.

MAJ recommends that maritime archaeology mitigation forms a part not only of the planning and construction, but the operational and the decommissioning phases of the OWF.

Figure 1 Cover picture: Position of the Energy Island and OWF on a historical chart by Imray 1852

Table of contents

List of figures

List of tables

List of abbreviations and definitions

BC	Before Christ
BH	Borehole
BSU	Base Seismic Unit
CE	Current Events
CPT	Cone Penetration Test
DKM	De Kulturhistoriske Museer i Holstebro
EI	Energy Island
EOD	Explosive Ordnance Disposal
GEUS	Geological Survey of Denmark and Greenland
GIS	Geographic Information System
HF	High Frequency
LF	Low Frequency
MAG	Magnetometer
MAJ	Marinarkæologi Jylland
MASL	Meters Above Sea Level
MBES	Multibeam Echo Sounder
MMO	Man Made Object
MOMU	Moesgaard Museum
NKM	Nordjyllands Kystmuseum
OWF	Offshore Wind Farm
P2P	Peak to peak
ROV	Remotely Operated Vehicle
SBP	Sub-Bottom Profiler
SLIP	Sea Level Index Point
SLKS	Slots- og Kulturstyrelsen
SOW	Scope Of Work
SSS	Side Scan Sonar
UXO	Unexploded Ordnance
WWI	World War One
WWII	World War Two

2. Introduction

2.1. Project information

Energinet is establishing offshore energy infrastructure in the Danish North Sea to supply offshore wind energy to the Danish mainland and to neighbouring countries via an offshore energy hub - an artificial Energy Island about 100 km outside of Thorsminde, off western Jutland.

The construction of the Energy Island and the erection of wind turbines may impact maritime archaeological find locations. Furthermore, anchoring and jacking-up of vessels used during construction work can damage cultural heritage in the affected areas. The project site for the North Sea OWF is 1052,235 km^2 and the work could potentially endanger maritime archaeological objects such as shipwrecks, wreckage and Palaeolithic and Early Mesolithic find locations.

Energinet has asked the maritime archaeological museums in the collaboration Maritime Archaeology Jutland (MAJ) to carry out a Phase I and Phase II desk based cultural heritage impact assessment of the proposed construction area of the North Sea OWF Zone to evaluate the extent to which this project will affect objects and areas protected by Section 28 of the Danish Museum Act. Although the area of investigation lies outside of Danish territorial waters and thus the Danish Museum Act does not have jurisdiction, an agreement was made between Energinet and MAJ, with the involvement of the Agency for Culture and Palaces (SLKS), that the archaeological investigation will proceed according to the above legal framework. This analysis seeks to determine the presence of cultural heritage, such as traces of human activity from the Palaeolithic period or cultural-historical objects such as shipwrecks.

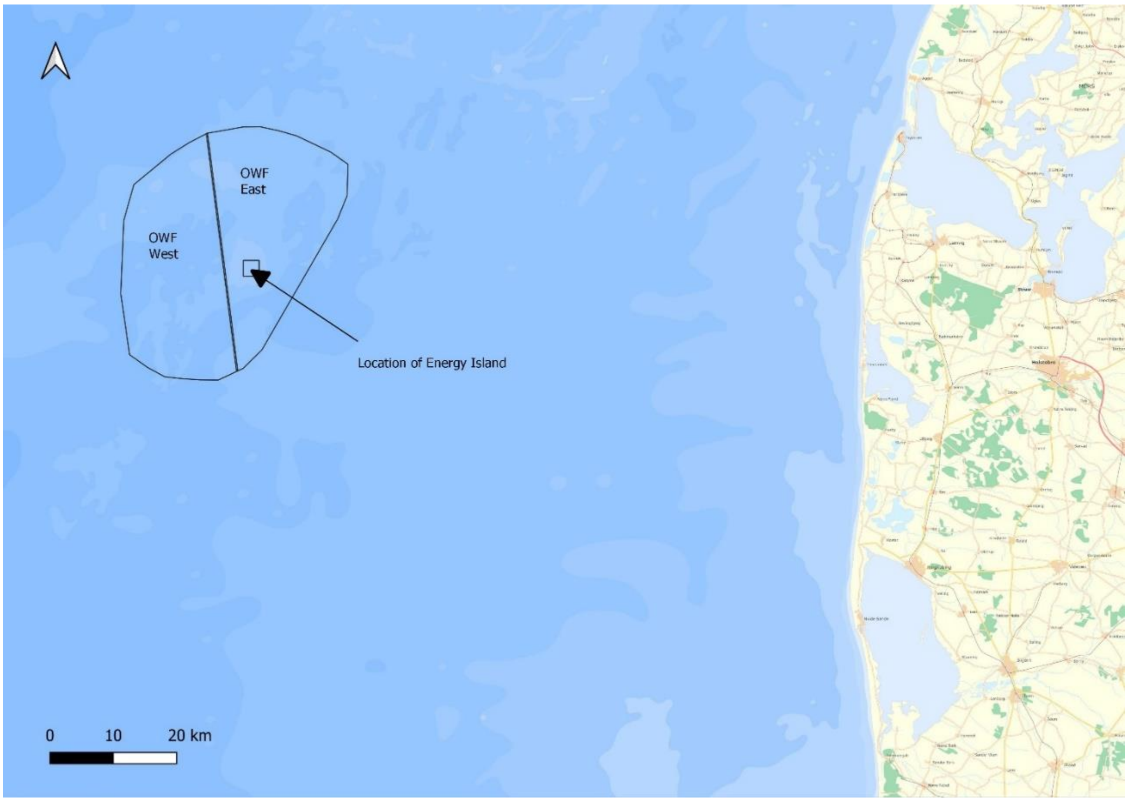


Figure 2 Position of Energy Island, OWF Zone East and OWF Zone West

2.2. Administrative and other data

Accountable museum:	Marinarkæologi Jylland (MAJ)
Museum contact:	Peter Moe Astrup, Daniel Dalicsek
Report responsibility:	Peter Moe Astrup, Daniel Dalicsek
Report finish date:	
Participating archaeologists:	PMA (MM), AJ (DKM), JHL (NJK), DD (MM)
Stone Age responsibility:	PMA
Historical archaeology responsibility:	AJ, JHL, DD
Name of site:	OWF Zone, Nordsøen
Site and location number (FF):	400110a Nordsøen V: 106
MAJ collaboration case no.:	MAJ2021-50 Energiø, Nordsøen
DKM case no.:	DKM 21007
SLKSs case no.:	
Approved budget incl. sales tax:	
Date of approval of budget:	
Type of budget:	Geoarchaeological analysis
Period of investigation:	
Date of project description	
Contractor name	Energinet
Contractor address	Tonne Kjærsvej 65, 7000 Fredericia
Contractor type	Public
Contractor CVR no.	
Coordinates:	X 346581.0 Y 6267032.0
Geographic coordinate system:	Euref89 UTM zone 32N
Water depth:	
Area of investigation:	1052,235 km²

2.3. Assessment objectives

The object of this Phase II cultural heritage impact assessment is to review and analyse the survey data collected by MMT and Fugro and provided by Energinet. The report should provide an accurate analysis of encountering and damaging cultural heritage and the character of this cultural heritage during the construction of the Energy Island (EI).

Archaeological study phase	Description
Phase I	Desk based background study of maps, historic records, archives, previous project results and databases.
Phase II	Geoarchaeological analysis of survey results, and if not provided by the client, gathering of data using non-intrusive methods.
Phase III	Survey excavation of potential locations.
Phase IV	Full scale excavation.

2.4. Scope of work

The cultural heritage impact assessment should be performed in 2022 and completed by 31st December 2022. The report should cover the full area of investigation and include all available data.

2.4.1. Deviations to scope of work

The deadline for the delivery of this report has been extended to January 2023.

2.5. Purpose of document

The purpose of this document is to provide an overview over submerged cultural heritage at the OWF Zone and serve as the base document for further archaeological investigations as well as to outline risks in connection with the construction for Energinet.

2.6. Reference documents

Document Number	Title	Author
103783-ENN-MMT-SUR-REP-SURWPA-A REVISION A	GEOPHYSICAL SURVEY REPORT – ENERGY ISLAND	MMT
103783 GS All Blocks 2021_10_15	GRAB SAMPLE REPORT	MMT
103783-ENN-MMT-WPA-EI-MAG-Anomaly-List	MAGNETIC ANOMALY LIST	MMT/ENERGINET
103783-ENN-MMT-WPA-EI-MBES-SSS-Contact-List_Images	SIDE-SCAN SONAR ANOMALY LIST	MMT/ENERGINET
EES1228-Energy Island-RPS-UXO-MTL_00	UXO ANOMALY LIST	RPS/ENERGINET
1306_uxo_threat_and_risk_assessment_artificial_island	DESK STUDY FOR POTENTIAL UXO CONTAMINATION ENERGY ISLAND - NORTH SEA ARTIFICIAL ISLAND	RPS

1307_uxo_survey_report.pdf	UXO SURVEY REPORT – ARTIFICIAL ISLAND PROJECT SITE	RPS
1302_marine_archaeology_archaeological_analysis_desk_study.pdf	ARKIVALSK KONTROL OG ARKÆOLOGISK ANALYSE AF ANLÆGSOMRÅDET FORUD FOR ETABLERING AF ENERGI-Ø MED TILHØRENDE VINDMØLLEPARK I NORDSØEN	MAJ
1309_risk_sign-off_documentation_report.pdf	ENERGINET - ENERGY ISLAND – NORTH SEA ALARP CERTIFICATE	RPS/ENERGINET

3. Survey methods and data gathering

This report is based on the geophysical survey data delivered by Energinet in accordance with PROJEKTBESKRIVELSE AF ARKÆOLOGISK OG GEOARKÆOLOGISK ANALYSE I FORBINDELSE MED ENERGIØ OG 3 GW HAVVINDMØLLEPARK I NORDSØEN. 21. JUNI 2021 J. NR. MAJ2021-50.

A detailed report on the methods for geophysical data acquisition, processing, transformation and interpretation is found in GEOPHYSICAL SURVEY REPORT WP-A ENERGY ISLAND | 103783-ENN-MMT-SUR-REP-SURWPAEI JANUARY 2022 by MMT and F176286-REP-GEOP-001 04 | Geophysical Results Report by Fugro.

MAJ received the data collected by MMT and Fugro from Energinet as seen in Table 1.

The location of the Energy Island was based on as defined in North_Sea_OWF_Zone_East.shp and North_Sea_OWF_Zone_West.shp.

For the analysis of Stone Age potential, the following databases were reviewed among others:

- Danish central register of cultural historical properties, Fund og Fortidsminder, Slots- og Kulturstyrelsen, https://www.kulturarv.dk/ffreg/
- National borings database (Jupiter) (geus.dk)

For the historical cultural heritage analysis, the following databases were reviewed among others:

- Danish central register of cultural historical properties, Fund og Fortidsminder, Slots- og Kulturstyrelsen, https://www.kulturarv.dk/ffreg/
- Danish sports divers´ wreck database, Vragguiden, https://www.vragguiden.dk
- Royal Navy Loss List database, MAST Maritime Archaeology Sea Trust, https://www.thisismast.org/research/royal-navy-loss-list-search.html
- Royal Navy Wooden Shipwrecks Database (V1.3 07 Jul 2018), 3H Consulting, http://www.3hconsulting.com/rnshipwrecks.html

Raster geodatabase:	Bathymetry - Gridded soundings, 0.25m resolution
	Bathymetry - Gridded soundings, 1.00m resolution
	Bathymetry - Gridded soundings, 5.00m resolution
	Bathymetry - backscatter 32bit geotiff stored in esri file geodatabase (amplitude populated channels)
	Generated elevation grids relative to vertical datum for each interpreted horizon in 5 m resolution
	Generated depth below seabed (BSB) grids for each interpreted horizon in 5 m resolution
	Generated Isochore (layer thickness) grids for each interpreted soil unit in 5 m resolution
File geodatabase	Track plots for all instruments as TSG object TRACKS_LIN, indicate equipment carrier and equipment type in attributes.
	Bathymetry - Bathymetric contour curves with 50cm interval, as TSG object CONTOURS_LIN
	SSS Anomaly target list, as TSG object SSS_ANOMALY_PTS, anomaly characteristics provided in attributes.
	MAG Anomaly target list, as TSG object MAG_ANOMALY_PTS, anomaly characteristics provided in attributes
	SBP and UHRS Anomaly target list, as TSG object SBP_ANOMALY_PTS, anomaly characteristics provided in attributes.
	Seabed Surface Geology, as TSG object SEABED_GEOLOGY_POL, indicate surface geological unit in attributes
	Seabed Surface Features, as TSG object SEABED_SURFACE_PTS, indicate surface forms in attributes
	Seabed Surface Features, as TSG object SEABED_SURFACE_LIN, indicate surface forms in attributes
	Seabed Surface Features, as TSG object SEABED_SURFACE_POL, indicate surface forms in attributes
	Seabed Substrate type, as TSG object SEABED_SUBSTRATE_POL, indicate substrate type in attributes.
	Man-Made-Objects, as TSG object MMO_PTS, indicate MMO type in attributes.
	Man-Made-Objects, as TSG object MMO_POL, indicate MMO type in attributes.
	Man-Made-Objects, as TSG object MMO_LIN, indicate MMO type in attributes.
	Grab sample positions, as TSG object GEOTECHNIC_PTS, indicate sampling characteristics in attributes.
Bathy data	Bathymetry - Gridded soundings, 0.25m resolution, (X,Y,Z) values in ASCII format (tiled following the UTM grid).
	Bathymetry - Gridded soundings, 1.00m resolution, (X,Y,Z) values in ASCII format (tiled following the UTM grid).
	Bathymetry - Gridded soundings, 5.00m resolution, (X,Y,Z) values in ASCII format (untiled).
SSS data	Side scan sonar data as XTF-files with corrected navigation, High frequency
	Side scan sonar data as XTF-files with corrected navigation, Low frequency
	Navigation files, CSV-format
	Target Catalogues
	SonarWiz 7 project including the bottomtracked and suitably processed .XTF files and SSS and Magnetometer targets
Mag data	MAG measurements, CSV-format
SBP & 2DUHRS data	Interpretation of the processed seismic data. These data include interpretation points for digitized horizons identified in the seismic recordings (point list file in CSV-format).
	Generated elevation grids relative to vertical datum for each interpreted horizon in 5 m resolution as (X,Y,Z) values in ASCII format (Z as the horizon elevation in meter)*
	Generated depth below seabed (BSB) grids for each interpreted horizon in 5 m resolution as (X,Y,Z) values in ASCII format (Z as the horizon depth BSB in meter)*
	Generated Isochore (layer thickness) grids for each interpreted soil unit in 5 m resolution as (X,Y,Z) values in ASCII format (Z as the layer thickness in meter)*
Grab sampling data	Grab sample classification, MS-Excel spread sheet
	Grab sample laboratory analysis, overview table and result tables, MS-Excel spread sheet.
Report	Operations Report
	Geophysical site survey Report (charts as enclosures)

Table 1 List of MBES, SSS, MAG, SBP, 2D UHRS, interpretations data delivered to MAJ

4. Historical overview of the Energy Island and OWF site

Stone Age

Archaeological, as well as geoarchaeological research, indicate that the area that is now covered by the North Sea was part of a large prehistoric plain, until ca. 9000 BC. The area, termed Doggerland, stretched from what is today Denmark to the British Isles. Debate is ongoing as to how rapidly, and whether gradually or in a catastrophic event, but the area was flooded and became inhabitable and the sea impenetrable during the Palaeolithic and Mesolithic periods. During the period of possible occupation Doggerland provided open hunting and fishing grounds for prehistoric humans, an area of seasonal or permanent settlement and a migration route to and from the British Isles and Scandinavia.

Antiquity

There are little to no records on seafaring on the North Sea in the pre-Roman Germanic periods. The Roman geographer and historian Pliny the Elder wrote in the 1st century AD about the northern European region. In his Book 4 Chapter 27 he describes today´s northern German coast as well as some regions of Scandinavia (Pliny, 1.4.27). The activity of the Roman Empire in Germania during the Julio-Claudian period and the extensive archaeological evidence for trade with the northern barbarians and movement of goods and people throughout the region make it clear that there was seafaring along Jutland´s west coast and thereby the construction area. The wreck of a Roman seagoing merchant vessel, Blackfriars I, was discovered in London in 1962. In 2018, a Roman anchor was discovered during survey works for Scottish Power Renewables´ East Anglia ONE OWF, 40km from the English coast in the North Sea (Scottish Power 2022).

Maritime finds from this period outside of the Mediterranean are nevertheless rare and any such finding is considered highly unlikely. Their rarity however, makes them incredibly valuable to science.

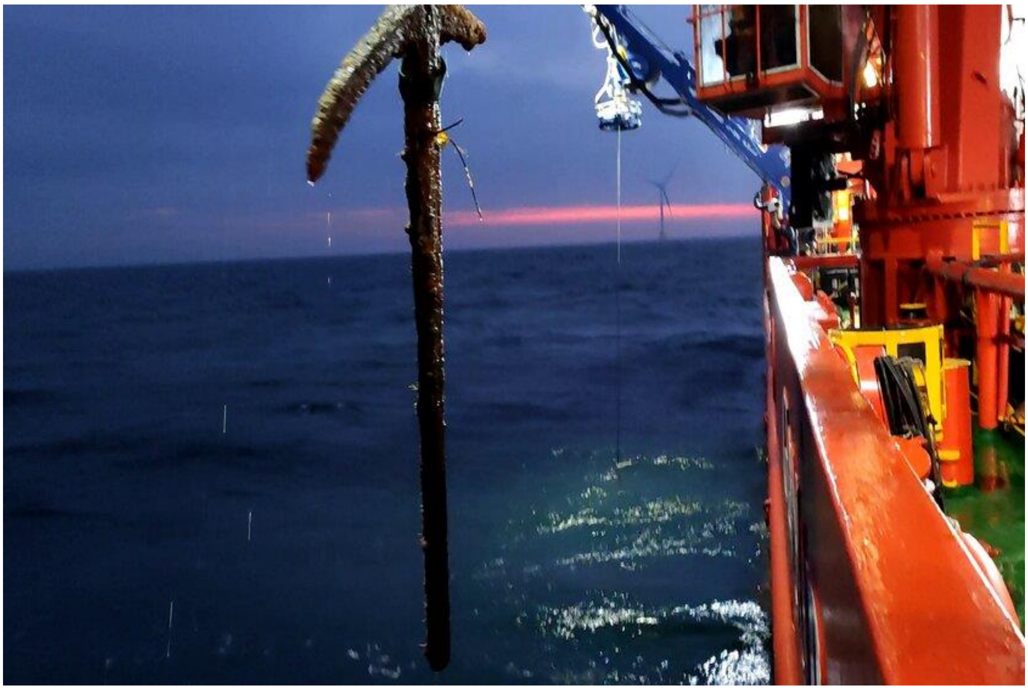


Figure 3 Recovery of the Roman anchor in the North Sea (Scottish Power 2022)

Post-Roman Iron Age

Trade and mobility declined after the fall of the Roman Empire and there is unlikely to have been any substantial maritime transport in the area.

Viking Age

The first documented Scandinavian raid on the British Isles was on Lindisfarne in 793 CE. There are substantial archaeological and historical arguments for offshore seafaring before this date as well in the period. The 9th-11th centuries were characterized by a large amount of maritime transport across the area. Large Viking fleets left Scandinavia for the British Isles, and the Islands of the North Atlantic (Faroe Isles, Iceland, Greenland) were settled and incorporated into the maritime trade network. The number of vessels and wreckings are difficult to estimate, but range in the hundreds. Wrecks in the deeper offshore part of the area are likely to have been destroyed upon impact with the seabed, leaving behind a scattered debris field, especially if the ship sustained structural damage in a violent storm. Near the coast, shipwrecks could have been covered by sediment. As some Viking ships, especially of the Norwegian types, contained mostly wooden fasteners (dowels, trenails and joints), they are likely not to give a magnetic anomaly signal or a very weak one if they are buried in the sediment. Especially the area around Thyborøn and the entrance to Limfjorden can be interesting, as this was an important landing point already during the Viking Age. Nevertheless, the chances of a wreck from the Viking period surviving in these conditions are small and finding such a wreck is deemed unlikely.

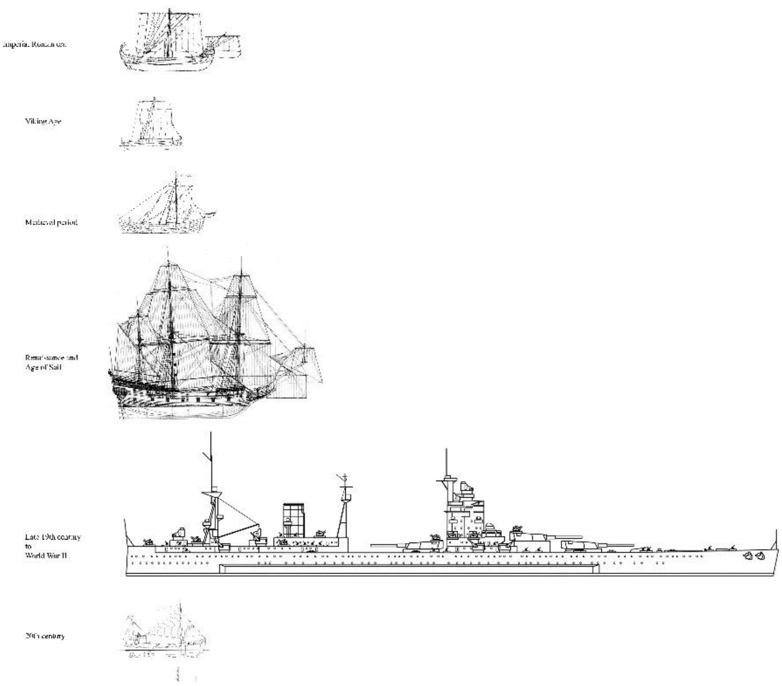


Figure 4 An illustration over the development of ship types over time (to approximate scale)

Medieval Period

Seafaring on the North Sea in the Middle Ages was dominated by the Hanseatic League, which controlled most of the trade in and out of the Baltic Sea. Throughout the period following the Norman conquest of Britain the Dutch cities started to gain in importance for the North Sea trade and the Hanseatic League gradually lost its power from the 15th century onwards. The main ship types of the era were the hulks and the cog. Examples of these are scarce and of immense scientific and cultural historical value. Considering the volume of trade across the North Sea in this period with these vessels, it is likely there are wrecks and debris fields in the North Sea but stumbling upon them would be exceptional. The large oak timbers and the iron fasteners of these vessels would probably show up on a magnetometer survey.

Post-medieval and Renaissance Period

After the decline of the Hanseatic League various actors took over the trade across the North Sea, mainly the Dutch, but also the Danes. Despite the ever-changing political situation and wars, trade steadily increased and grew in volume. Advances in shipbuilding technology meant an increasing amount and size of ships. With the 16th century new routes opened up to and from the Americas. Navigation and charts became steadily better in the period, as well as records of shipping and wrecking and the administrative and legal frameworks concerning these. This is the first period where, if a wreck were found, its identification would be possible.

19th century

At the opening of the 19th century, the North Sea was dominated by the British Royal Navy and politically by the Napoleonic Wars. Very detailed records on North Sea seafaring exist from this period onwards which can give us a good indication of the number of ships lost in the area, probably numbering in the low thousands. Among the most famous are the grounding of HMS St George and HMS Defence on the Danish west coast (Dalicsek 2016). Vessels from the 19th century, especially the larger ones, should be visible on the magnetometer survey and potentially on the SSS survey as well. From the wide scale introduction of the steam engine the boilers of these ships are usually detectable on bottom surveys.

Figure 5 Chart showing the strandings on the coasts of Denmark and on the Swedish coast between Marstrand and Carlskrona during the period from 1st January 1858 to 31st December 1885 (Hohlenberg 1885)

20th century

Although according to the Danish Museum Act, the cut-off date for a historical wrecking is 100 years prior to current date, this timeframe now encompasses WWI and, during the project scope of the Energy Island and the OWF, WWII as well. It is also without question that shipwrecks and wrecks of aircraft from WWII have an important role in international cultural heritage and their management shouldn´t be neglected. It is mostly these military vessels that are of archaeological concern, as well as they fall within the scope of the UXO survey. Their identification is almost entirely possible and as anomalies they should be visible both on SSS and magnetometer surveys. They pose a challenge in the management aspect as they can fall within special legal categories international, whereby disturbing or removing them should be closely monitored and cleared with relevant authorities at home and abroad. One of the most important naval battles of the 20th century took place in and around the Energy Island area. The Battle of Jutland took place during the 31st of May to 1st of June 1916 and resulted in the loss of 25 warships, where the last wrecks were identified as late as 2016 (Jakobsen 2018).

The wrecks of the later 20th century probably make up more than any other category, as the increase in trade and deep-sea fishing resulted in increased traffic in the region. These wrecks in themselves are not protected by the Danish Museum Act, however their registration and inspection are important for maritime archaeology. They represent examples of decay processes and the natural site transforming effects can be recorded on them, thereby helping the protection, management and exploration of historical shipwrecks. Therefore, in the case of such wrecks an ROV dive survey would be utmost beneficial, both for the cultural heritage and the environmental impact assessments.

5. Overview of previous works in the area

There have been several large-scale offshore wind farm projects surrounding the area. Beside these, there are various underground cables crossing the planned construction zone. The area has been an important fishing ground and since the 20th century industrial scale trawling has had a major destructive impact on the seabed. The recent decades also saw dredging for raw material extraction offshore.

To the south of the proposed construction zone lie the offshore wind parks Horns Rev 1-3. There were no comments regarding underwater cultural heritage for the construction of Horns Rev 1. A desk-based phase I cultural heritage impact assessment was conducted for Horns Rev 2, but no findings were made. The construction was permitted under the condition, as specified in the Danish Museum Act, that in case of accidental finds during construction works the relevant museum and the Agency for Culture and Palaces (SLKS) will be informed, and the works stopped immediately (Tilladelse til etablering af elproduktionsanlæg samt internt ledningsnet ved Horns Rev 2 19. Marts 2007 J.nr. 022531/78033-0007). A similar process was followed for the construction process of Horns Rev 3, but here a phase II instrumental survey and a phase III preliminary search were made. This resulted in a single anomaly that was then protected by a 200m radius exclusion zone. (Tilladelse til etablering af elproduktionsanlægget Horns Rev 3 samt internt ledningsnet (etableringstilladelse) 21. maj 2015)

At the inshore minor wind park Rønland at Thyborøn the desk-based study did not show shipwreck finds, despite archival examples of loose finds in the area. (Godkendelse af 8 vindmøller på havet ved Rønland 19. juli 2002 J.nr. 5337-0022)

At the coastal wind park Vesterhav Nord, south of Thyborøn, the desk-based study showed possible wrecks and other anomalies in the area, where further inspection and/or exclusion zones were recommended. (Kulturhistorisk vurdering af geofysiske data vedr. Vesterhavet Nord Havvindmøllepark 2014 DKM 20.697, KUAS 2013-7.26.01-0009)

To the southeast of the proposed construction are lies the Thor offshore wind park, currently under construction. During the planning and permission process the archaeological analyses found 430 anomalies. The Agency for Culture and Palaces recommended further inspection and/or exclusion zones in the case of 292 of them. Areas of Stone Age potential were also identified and the relocation of individual windmills within the are avoided these sites (Thor offshore wind farm, North Sea, Archaeological analysis 30. August 2019 DKM 20.959 MAJ 2019-21 SLKS 19/04719).

Planned wind parks in the area include Odin, immediately to the north of the windmill area and Jyske Banke to the northeast. Both of which await a cultural heritage impact assessment.

The closest area for raw material extraction from the seabed is 562-LC Jyske Rev A, where no archaeological finds were made as of yet as a result of the works. (Primær tilladelse til indvinding af råstoffer i fællesområde 562-LC Jyske Rev A 1. december 2015 J.nr. NST-7322-01889)

In 2018 an archaeological screening of geophysical data was carried out prior to the laying of the transatlantic fibre cable Havfruen. MAJ identified two potential archaeological objects on the seabed and these were mitigated by the establishment of exclusion zones of 100m radius around the anomalies, in order to secure that no archaeological objects were damaged. (Havfruekabel, Nordsøen, Geoarkæologisk analyse af geofysiske data for transatlantisk fiberkabel: Rev 0 Marts 2019 DKM 20.942 MAJ 2018-69 SLKS 18/10175)

The Royal Danish Navy has following WWII demined the area, but there is still a high potential for UXO. In their process of disposing of underwater hazards, both the navy and the maritime authority have likely destroyed some historic wrecks, or wrecks that would today be considered of importance to cultural heritage studies.

Gert Norman Andersen and his commercial diving company JD-Contractor A/S have been an unalienable part of the development of Danish maritime archaeology. They have been active in exploring the seabed for historic shipwrecks, especially those of the two World Wars. In 2015, nautical archaeologist and historian Dr Innes McCartney of Bournemouth University joined JD-Contractor A/S when they identified the last remaining wrecks from the Battle of Jutland as well as carrying out dives and high resolution multibeam imaging.

6. The North Sea OWF Zone East´s impact on potential underwater heritage

The impact of the OWF and the mitigation of these impacts is assessed according to the project´s phases.

Planning and Construction phase

The causes for damaging impacts on submerged cultural heritage during the planning and construction phases are:

- Vessel anchoring
- Jack-up
- Trenching
- Dredging
- Foundations
- Propwash
- EOD
- Surveying and coring

Propwash from vessels in connection with the establishment of the OWF in the water depths at the site (26m or deeper) is negligible.

The seismic and instrumental surveys do not pose a threat to submerged cultural heritage. According to the written scheme of investigation outlining the agreement between Energinet and MAJ in PROJEKTBESKRIVELSE AF ARKÆOLOGISK OG GEOARKÆOLOGISK ANALYSE I FORBINDELSE MED ENERGIØ OG 3 GW HAVVINDMØLLEPARK I NORDSØEN. 21. JUNI 2021 J. NR. MAJ2021-50, MAJ had access to all coring data and has been sufficiently involved in the planning process for the intrusive geophysical surveys, that they do not have adverse effects on submerged cultural heritage.

Vessels engaged in the construction will use various drag-embedment anchors and spud legs for jack-up vessels and rigs. These anchors and spud legs can damage shipwrecks and wrecks of aircraft, and depending on the sediment type, can penetrate the seabed deep enough to damage Stone Age sites. Slack anchor chains and mooring lines can also damage sites when dragged across the seafloor. Archaeological Exclusion Zones must be established and adhered to for the construction phase to avoid damaging archaeological sites. Communicating these AEZs to sub-contractors is the responsibility of Energinet.

It is yet undecided what type of foundations the offshore wind turbines will be established on. The most common support structures (especially the foundation types) will be reviewed here from the viewpoint of maritime archaeology.

Monopile

These types of foundations are hollow tubes driven vertically into the seabed to a penetration depth of up to 40m. The monopile installation does not require seabed preparation but is sensitive to scour. Scour protection is made up of large stones and boulders around the foundation and can be up to five times the diameter of the pile.

Gravity base

If gravity foundations are used the seabed will need preparation i.e. loose material will have to be taken away and possibly replaced by gravel. In addition, the area covered by a single gravity base is considerably larger than that of a monopile foundation.

Tripod

The pile diameters used in this arrangement are much smaller compared to the monopile. However, penetration depths are of similar size depending on seabed conditions (e.g. some 10 – 20 m). For the tripod no seabed preparation is needed.

Suction bucket

Suction bucket foundations, otherwise known as suction caisson or suction pile foundations, can be divided into single-bucket and multi-bucket caisson foundations. Suction bucket jackets have a large overall footprint and a low suction bucket 'length to diameter' ratio (L/D ratio), meaning that they generally cover a large spatial area whilst maintaining a small embedment into the soil. Depending on the seabed and soil composition, preparation is needed and scour protection around the caissons is essential.

Catenary and taut moorings

Floating support structures for offshore wind turbines can be moored to the seabed using catenary or taut moorings. The anchors can be various embedded anchors (e.g. suction-embedded plate anchors, suction caissons, anchor piles) and the mooring lines (catenary chain or taut wire synthetic fibre rope) are to be connected to them.

The installation of the anchors and the moorings requires extensive works on the seabed. Catenary moorings drag along the bottom and taut moorings are also first installed as slack lines and tensioned afterwards.

Dredging and trenching

Basically, there are two different methods for burying sea cables, dredging and trenching. Dredging involves excavating a trench and depositing the excavated material either alongside the trench or in a different area of the seabed, the trench is filled back by the natural movement of the seabed. The cable is laid after the dredging process. In the trenching process the cable is laid either before or during trenching. The sediment is washed away underneath the cable, thus causing the cable to sink into the trench.

Suction dredgers excavate the sediment and pump it into barges or into the loading bay of the ship. The sediment is then deposited in a different sea area. As the cable is laid after the dredging is completed, the trench must have a large width and gently sloping sides to prevent it silting up due to lateral movement of sediment. The trench bottom also must have a minimum width to make sure that the cable hits the trench during laying.

A flow dredger washes the sediment away by pumping water through a jet pipe against the sea floor, rather than sucking it away. The sediment settles on both sides of the trench.

In contrast to dredging, in trenching the submarine cable is laid before or during the excavation process. There are two trenching methods, plough trenching and jet trenching. Both methods use pumps and jet pipes to dissolve sediments in a narrow trench, so that the cable can be placed or left to sink to the bottom. The trench produced is far narrower (e.g. 1m at the bottom) than that produced by dredging, and is steep-sided.

The jet trenching method involves the cable being laid down on the sea floor first and then washed into the ground by a strong water jet from a trenching device, which blasts aside the sediment from underneath the cable. Jet trenching may be carried out by either a ship with jet pipes, a sledge, or an ROV.

The second means of jet trenching involves pulling a sledge equipped with a jet sword over the sea floor along the previously laid cable. The sledge is pulled by a ship and guided by the cable itself.

Cables might also have to be covered y large concrete mats for protection.

Operational and maintenance phase

- Vessel anchoring
- Jack-up
- Cable maintenance
- Foundation maintenance
- Propwash
- Scour
- Increased fishing/trawling in areas outside the OWF

During the operational and maintenance phase the main threats posed to maritime archaeology are similar as during the construction phase.

However, the established offshore wind turbines and infrastructure create new hydrographic conditions that could affect submerged cultural heritage.

With the OWF occupying a large area, the trawling fleet will miss fishing territories and trawling will intensify in other areas, further damaging wrecks there. The wrecks in close vicinity to the edge of the OWF will also be under threat as marine life increases in the protection of the OWF and around the foundations, attracting more fishing close to the area.

Decommissioning phase

- Vessel anchoring
- Jack-up
- Trenching
- Dredging
- Foundations
- Propwash

The threats to submerged cultural heritage during the decommissioning phase are de facto the same as during the construction phase.

Benefits

- Exclusion zones
- Survey

The construction and existence of the OWF brings about several advantages for maritime archaeology. Extensive and detailed mapping surveys provide data that research projects would rarely have the chance to gather. AEZs protect shipwrecks in-situ from vessel operations and trawling.

7. Submerged Stone Age potential

7.1. Registered cultural heritage finds

"Doggerland" is the designation given to the now submerged landscape between England, Denmark, and the Netherlands. Some of the first evidence that sea levels in the North Sea were once lower came in the form of tree stumps and peat layers in the tidal zone along the English coasts (Reid 1913). Based on these observations, Reid produced some of the first maps of how the area might have appeared during the Stone Age. In 1931 a fisherman made one of the first archaeological finds that confirmed humans had once lived in the area that is now the North Sea when he recovered a 10,000-year-old, fine-toothed bone point in a clump of peat ca. 25 km from the English coast at Norfolk (Coles 1998). This type of evidence convinced archaeologists that the North Sea area was once occupied by people and since then investigation of these submerged landscapes has proceeded apace. Geophysical data and bore/CPT samples produced by the oil industry provided the basis for interdisciplinary projects/collaborations such as the Palaeolandscapes Project (Gaffney, Thomson, and Fitch 2007) and Lost Frontiers (Gaffney et al. 2017), which aimed to reconstruct the submerged landscapes and clarify their archaeological potential.

In recent years multiple investigations have been conducted in Danish parts of the North Sea in conjunction with raw material extraction and the construction of offshore wind parks and gas pipelines (e.g. Viking Link; Baltic pipe and Thor). Our knowledge of the inundated Stone Age landscapes and contemporary coastlines has progressively increased as a result of these investigations (especially geoarchaeological studies). However, it is still unclear what the coasts were like during the Stone Age. Were there large, broad, exposed sandy beaches (like today), or were there more sheltered coasts resembling those of the inner Danish waters? Presumably, the area holds great archaeological potential, even though investigations are still in their early stages and have not yet produced in situ archaeological remains.

There are no prehistoric finds registered in the central register of culture-historical properties (Fund og Fortidsminder) in the area proposed for the OWF area. However, a Danish fisher brought up a worked antler tool from a depth of 30-40m (Figure 6), dated to around 7040-6700 BC. The precise findspot is unknown (Andersen 2005). A lightly water-rolled flint blade was also found during sand pumping near Horn's Reef, though its precise find location is also unknown.

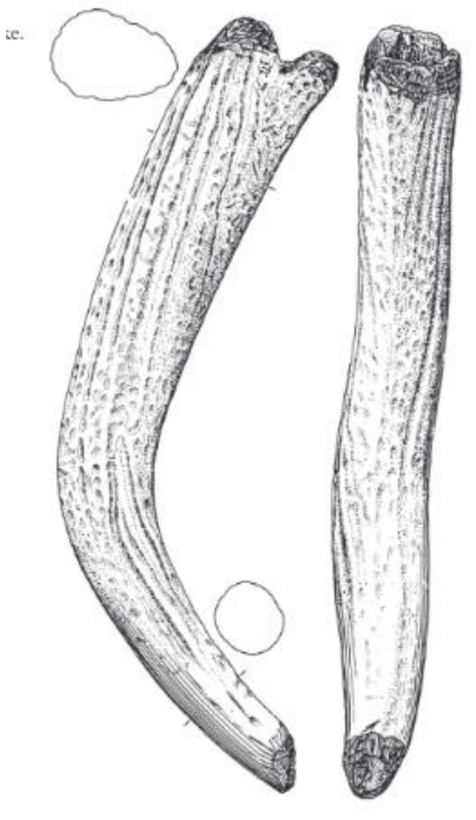


Figure 6 Antler tool from the North Sea (Andersen 2005)

7.2. Topographic potential for traces of early Stone Age activity

Large parts of Denmark were covered by a thick layer of ice during the Late Pleistocene. But ca. 20,000 years ago the ice began to retreat, partly because of melting due to increasing temperatures and partly because of glaciers calving icebergs into the sea. Enormous quantities of glacial meltwater were released into the world's oceans throughout the Mesolithic period that ended about 6000 years ago. Studies have shown that global sea levels have risen 130m since the Late Glacial Maximum ca. 20,000 years ago (Fairbanks 1989; Lambeck et al. 2014). Peat layers described in core logs from the OWF area are also evidence of sea levels previously being lower than today. However, sea level changes during the Stone Age are still not precisely described in the North Sea region. A central question for the geoarchaeological analysis of the OWF area is therefore the archaeological potential of the deepest and least investigated areas of the project, which are furthest from the modern coast. Based on water depths at the proposed location (-27.0masl or deeper), it is clear that any possible preserved Stone Age sites will date to the Late Palaeolithic or Early Mesolithic. The Late Palaeolithic dates to ca. 12800 – 9500 BC, while the Mesolithic dates to ca. 9500-4000 BC (see cultural developments in the Mesolithic, Figure 7).

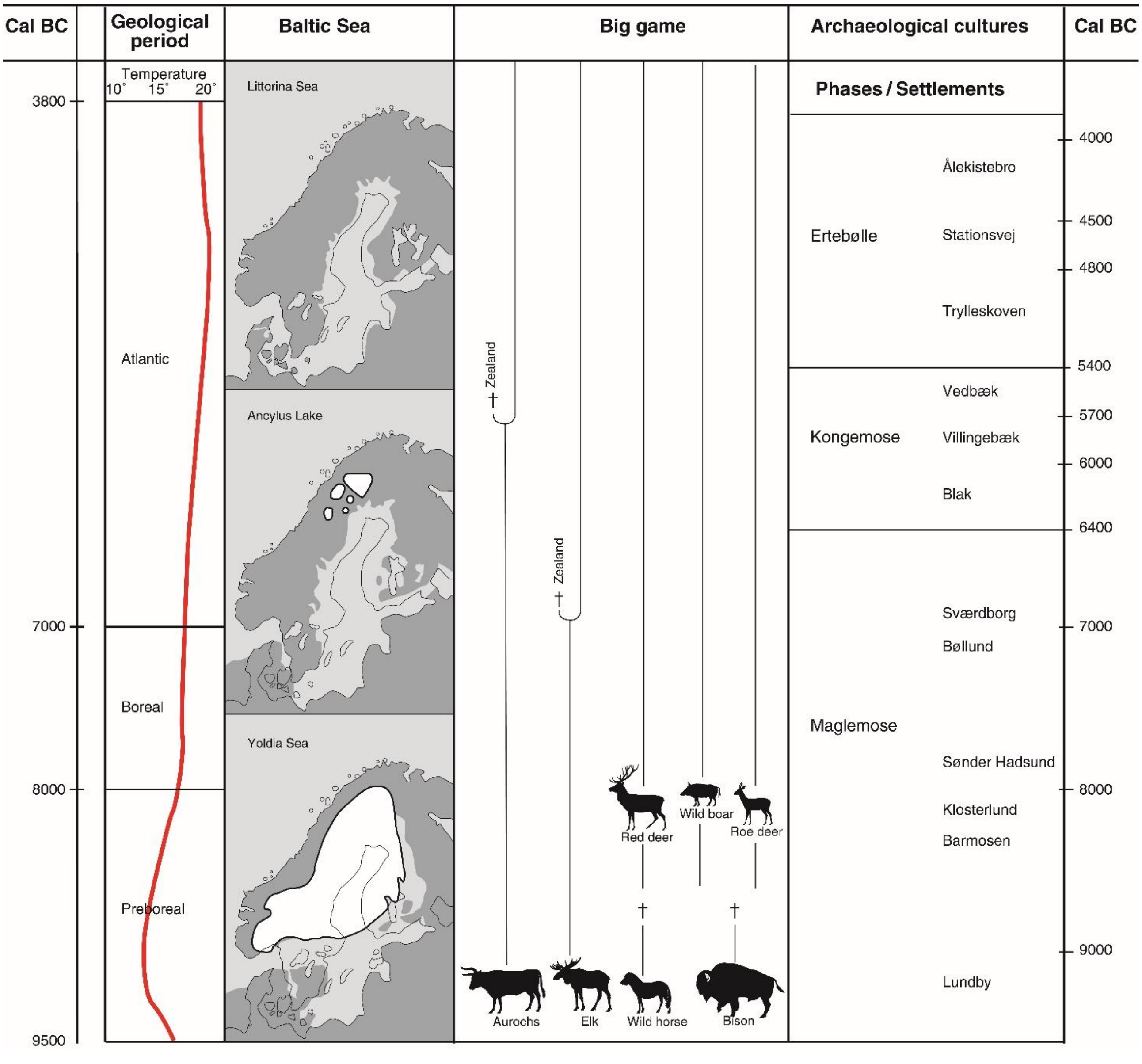


Figure 7 Schematic of cultural and natural developments in South Scandinavia in calibrated years BC. (Astrup 2018)

Many years of archaeological investigations have shown that Stone Age people did not randomly occupy landscapes. Rather, they chose their locations strategically based on a range of parameters in order to secure access to necessary resources, cultivate social networks, and maintain demographic viability. By reconstructing the now submerged landscapes as they appeared at various points in the past, it is possible to pinpoint areas that were better suited than others to obtain the necessary conditions for prehistoric lifestyles. Creating a detailed picture of the prehistoric landscape(s) is therefore vital to understanding where the coming construction work is at its highest risk of destroying potential archaeological localities. Evaluating an area's potential to have Stone Age settlements is typically based on topographic variables like the presence of lakes, streams, and coasts. However, in practice, different periods varied widely in their requirements for specific natural features and their accompanying resources. While the majority of the source material for our understanding of prehistoric hunter-gatherers in Denmark in the millennia prior to the Neolithic comes from coastal settlements, as of this writing it is unclear to what extent Late Palaeolithic and Early Mesolithic people also prioritized these areas.

In the area to be occupied by the OWF, potential Stone Age settlements (coastal as well as inland) are now on (or under) the sea floor – a location that is both difficult and expensive to survey. It is precisely here, however, that the last 30 years of underwater archaeology has shown the potential for making major scientific advances in the Danish inshore waterways. This is primarily due to two factors that can be characterized as "Preservation" and "Knowledge lacunae":

7.3. Preservation

Conditions of preservation on submerged settlements are renowned for being extremely good for organic materials such as wood and bones (see examples in Andersen 2013). This is the result of continuously rising sea levels that inundated coastal settlements. In the process, the archaeological layers and materials were enclosed in anoxic surroundings that have remained that way to the present day. Because of the special environment in these submerged cultural layers, oxygen was not present in sufficient amounts to allow the onset of decay, creating a sort of time capsule. Previous investigations of submerged settlements from the Kongemose and Ertebølle cultures have provided completely new insights into the types of wooden implements used in the Stone Age. This provides the example for the huge scientific potential that submerged and buried Stone Age sites in the North Sea could hold.

7.4. Knowledge lacunae

Submerged Stone Age landscapes on the sea floor represent one of the last unexplored areas in the Danish archaeological milieu. Because of this, they likely contain information that can fill some gaps in our knowledge that have remained unanswered by archaeological investigations since recognition of the various phases/periods of the Stone Age. It is still unknown, for example, what role coasts played in the Maglemose culture (9500-6400 BC), as the subsistence economy of that period is almost exclusively known from archaeological remains found at inland sites far from them. To detect the earliest traces of coastal exploitation in Denmark, in recent years Moesgaard Museum has attempted to locate Maglemose culture sites near or at the archaic coastline that are now submerged in Aarhus Bay. Aarhus Bay is of special interest because it consists of sheltered waters where potential Maglemose culture settlements occur in water depths that are shallower than in more southern areas of Denmark. In 2017, 23 locations in the bay were tested and one produced dispersed flint flakes and blades at a depth of -6.0masl. Based on this, a small excavation was conducted two months later to determine if there could be remains of a coastal settlement. This investigation showed that immediately below the seabed there was an in-situ deposit with worked flint (including diagnostic microliths) and organic materials that have been C14 dated to the latest part of the Maglemose culture (Astrup 2018). The find layer represents a coastal settlement and later investigations have recovered fish bones from the site that show the exploitation of marine species, demonstrating a coastal fishery already during the Maglemose period. Targeted diving investigations in archaic coastal areas are therefore a prerequisite for resolving important research questions such as:

- How widespread was coastal settlement in the Late Palaeolithic and Maglemose cultures?
- How important a role did marine resources play in subsistence and what methods were used to collect them?
- Were coastal settlements occupied longer than those inland? Did the same people use both types of sites, or were there some groups who occupied the coast while others remained inland?

The above points serve to illustrate that there is much we still do not know about life along the coasts in the Maglemose culture. Thus, it is a difficult task to decide where in the landscape people settled. However, this does not change the fact that it is absolutely crucial to have as detailed an understanding of the landscape as possible, since it formed the basis of life for the people who lived in the construction area. In light of this, the next section of the report aims to step-by-step recreate a detailed picture of the now submerged cultural landscape. The goal is to be able to evaluate which areas have the greatest potential for prehistoric settlements and whether they will today still contain preserved remains. In concrete terms this means constructing a model of past sea levels and using the geophysical data to identify relevant archaic terrain.

8. Modelling sea levels

8.1. Collection of data

It is vital to understand the development of the landscape in a given region to be able to identify the parts of a project area that have the greatest archaeological potential. One might be tempted to think that it is a simple task to reconstruct archaic coastlines in the North Sea region. However, this is not the case, and one of the most important reasons is that the extent of glacial isostatic rebound throughout the area is not yet clear. Because of differences in the rate at which land has rebounded in the North Sea basin from when it was pressed down by the weight of glaciers, it is simply impossible to reconstruct archaic coastlines across larger areas based on the modern bathymetric data.

Additionally, from the area where the OWF will be built, there are so few dated samples from cores and logs that the relative sea level rise cannot be determined. It will therefore be vital to develop a shoreline displacement curve based on local data from the Energy Island area. In order to determine relative prehistoric sea levels, it is crucial to have access to well-dated material. We have compiled an overview of dated samples from the North Sea judged to be representative of the project area (See Appendix 16.3). This involves samples that were either directly above or below the sea surface during the Late Palaeolithic and Mesolithic periods and can thus be used to bracket sea levels and coastlines at various points in the past. At some depth and age intervals there are few points that can be used to determine sea levels. To rectify this, an agreement was reached between Energinet and MAJ to date about 25 new samples from the Energy Island and OWF areas to enable poorly covered intervals to be addressed with much greater precision.

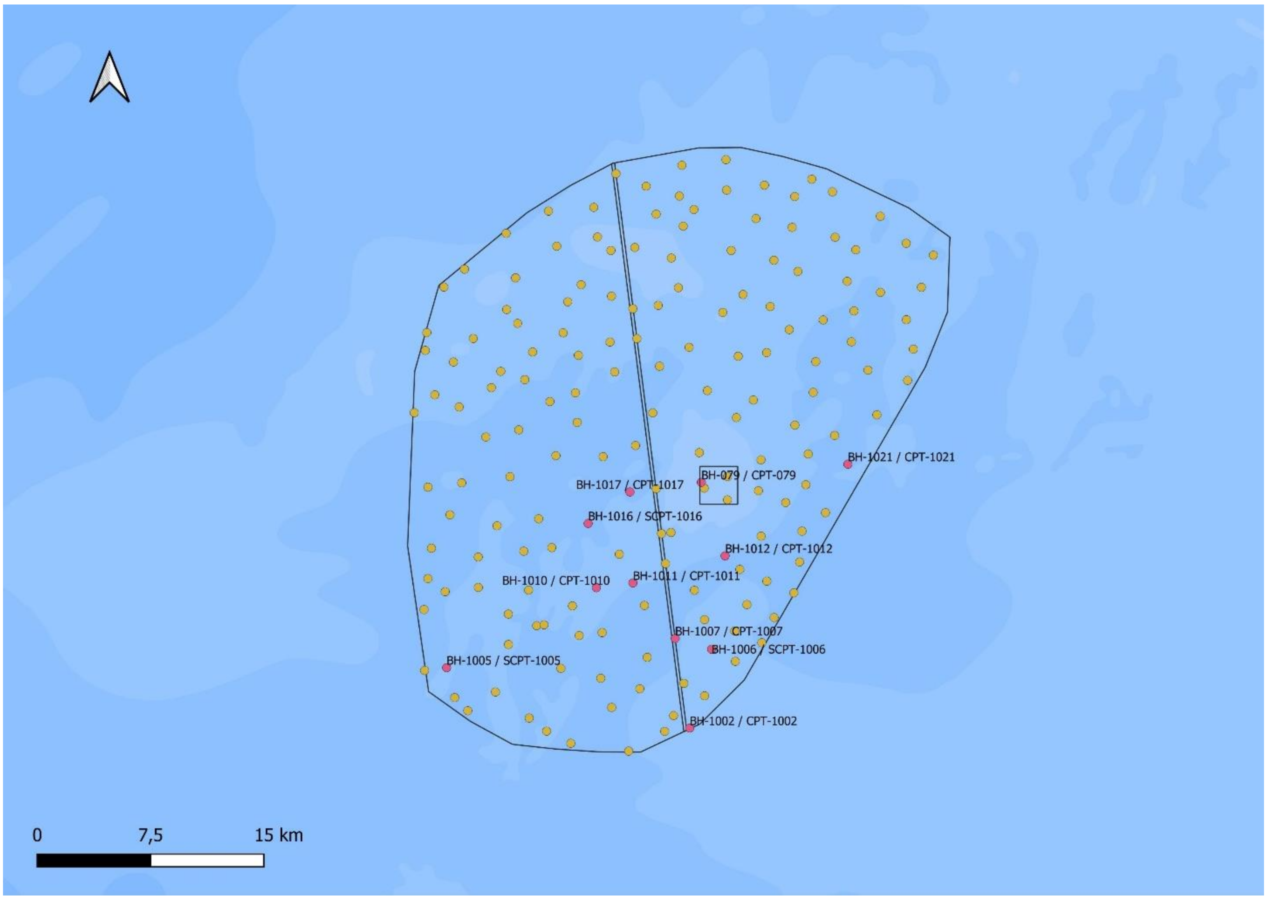


Figure 8 Logs (shown in pink) from which material was sent for C14 dating.

115 CPTs and 48 borings have been made in the OWF area, with an additional 104 CPTs on the Energy Island site, (Figure 8). All Fugro's logs were reviewed to identify samples from various depths for dating that are needed to produce a new shoreline displacement curve. MAJ requested 24 sediment samples from either marine or terrestrial layers based on Fugro's logs. The samples were sieved at Moesgaard Museum with the goal of recovering material best suited for dating. From the marine samples, primarily marine molluscs were chosen for dating, while from the peat layers it was either peat or wood. All the shells were photographed before they were sent for rapid dating (Table 3). Marine geologist Ole Bennike from GEUS performed species identifications based on the photographs to determine whether the shells come from marine, brackish, or freshwater environments. He ascertained that there were exclusively marine molluscs, which suggests their findspot was below sea level at the time of deposition (personal communication). It is often difficult to exclude if shells have been redeposited from where the animals originally lived/died and that pertains to the shells used in this study. Fragmented shells can indicate that layers are reworked/redeposited. On 2nd September 2022, MAJ delivered 25 samples to the Aarhus AMS centre and the museum received the results of these on 7th October 2022.

8.2. Modelling sea levels – creating a shoreline displacement curve

A shoreline displacement curve shows relative sea levels at various points in time in relation to the current level. The curve that was made for this project is based on both existing dated samples (for example, those produced in connection with the Thor offshore windmill project) and others collected specifically for the Energy Island project. In order for samples to be included in the analysis they must meet the following criteria: 1) provide information about prehistoric sea levels, 2) were recovered in a secure context, (in situ),

3) vertical placement information is available, and 4) the sample is absolutely dated (e.g. with radiocarbon dating). Table 2 shows samples from the planned Energy Island and OWF areas sent for dating in connection with the geoarchaeological analysis. Terrestrial samples are green and marine samples are blue. Grey samples are believed to come either from water-deposited layers along the contemporary coast or near a lakeshore. The table also shows what material was dated and its vertical location (masl). The last column shows how much sediment overlays the dated sample.

Sample information	Layer	Dated material	ETRS 89 zone 32 N	ETRS 89 zone 32 E	Sample elevation (m)	Sediment cover (m)
P1 : BH-1012 : sample 04BagA	Sand	Shell	6258709	349662	-39.6	3
P2 : BH-1012 : sample 05BagB	Sand	Shell	6258709	349662	-40.9	4.3
P3 : BH-079 : sample 04BagB	Sand	Shell	6263564	348090	-30.15	2.25
P4 : BH-079 : sample 05BagB	Sand	Shell	6263564	348090	-30.65	2.75
P5 : BH-079 : sample 10BagB	Sand	Shell	6263564	348090	-33.1	5.2
P6 : BH-1002 : sample 53BagA	Peat	Peat	6247314	347315	-89.2	50.5
P7 : BH-1002 : sample 53BagA	Peat	Wood	6247314	347315	-89.2	50.5
P8 : BH-1005 : sample 07BagA	Peat	Wood	6251314	331240	-47.4	5.5
P9 : BH-1005 : sample 07BagA	Peat	Wood	6251314	331240	-47.4	5.5
P10 : BH-1005 : sample 54BagB	Peat	Wood	6251314	331240	-93.95	52.05
P11 : BH-1005 : sample 54BagB	Peat	Wood	6251314	331240	-93.95	52.05
P12 : BH-1005 : sample 55BagA	Peat	Wood	6251314	331240	-94.9	53
P13 : BH-1006 : sample 09BagA	Sand or peat	Organic mat.	6252531	348762	-49.6	8
P14 : BH-1007 : sample 30BagB	Peat	Wood	6253246	346355	-64.3	23.7
P15 : BH-1007 : sample 31BagA	Peat	Wood	6253246	346355	-65.1	24.5
P16 : BH-1010 : sample 08BagC	Peat	Peat	6256600	341141	-41.9	6.9
P17 : BH-1010 : sample 08BagC	Peat	Peat	6256600	341141	-41.9	6.9
P18 : BH-1011 : sample 03BagA	Sand	Wood	6256918	343560	-38.2	2
P19 : BH-1011 : sample 03BagA	Sand	Shell	6256918	343560	-38.2	2
P20 : BH-1016 : sample 69BagA	Peat	Wood	6260855	340604	-109.8	67.21
P21 : BH-1016 : sample 69BagA	Peat	Wood	6260855	340604	-109.8	67.21
P22 : BH-1017 : sample 17BagA	Sand	Shell	6262939	343364	-54.4	11
P23 : BH-1017 : sample 18BagA	Sand	Wood	6262939	343364	-54.9	11.5
P24 : BH-1017 : sample 18BagB	Sand	Wood	6262939	343364	-55.1	11.7
P25 : BH-1021 : sample 45BagC	Sand	Shell	6264770	357783	-85.8	44.3

Table 2 Samples sent for dating. Terrestrial samples: green, Marine samples: blue, Water-deposited shoreline/coastal samples: grey

 P1	 P2
 P3	 P4
 P5	 P19
 P22	 P25

Table 3 Shells that were sent for dating. All the shells were determined to come from animals that lived in marine surroundings by marine geologist Ole Bennike.

The shoreline displacement curve was created by entering the uncalibrated C14 dates and vertical placement information (masl) into an Excel spreadsheet, after which it was imported into the computer program OxCal V.4.4 and calibrated. The dates were modelled in OxCal after age and vertical location using the depth model function. Samples are calibrated and shown in the shoreline displacement curve with a 95.4% confidence interval. Previous dates that were done at the radiocarbon lab in Copenhagen on marine samples have a built-in correction for the marine reservoir effect so no additional correction was done for this study. The marine samples that were dated at the AMS laboratory in Aarhus and other laboratories are corrected with a reservoir effect of 400 years. All the dates are calibrated after the new IntCal 20 curve (Reimer et al. 2020) and plotted in the curve by comparing the vertical location versus age.

The shoreline displacement curve shows marine samples in blue (for example, marine shells), terrestrial samples in green, and grey is used for samples that come from sand layers that could come from the coast or a lakeshore. All the fixed points on the curve were assigned a number (R_Data) that can be referenced in Appendix 16.3 (column "id") and Figure 9 so it is possible to see additional information about the individual samples that are dated. The curve clearly shows that sea levels rose dramatically during the Holocene period. This indicates that the possible land surface found at around -40.0masl can only have been dry land in the period from the last glaciation up until ca. 8500 BC. After this it was transgressed by rising sea levels and the presence of potential archaeological settlements from both the Kongemose (6400-5400 BC) and Ertebølle (5400-4000 BC) cultures can therefore be excluded.

It is not possible to determine sea levels more precisely than ± 2-3m because the samples' vertical reference does not typically correlate precisely with that in the past. On top of that is the uncertainty associated with dating shells and peat, combined with the still long intervals where there are few dates to use for determining sea levels. Another issue that affects placement of the curve is the isostatic rebound that has changed the vertical position of the samples used in the shoreline displacement reconstructions. In general, lands to the NE of the planned Energy Island location have been lifted more than those to the SW. Thus, it is problematic to include points from a wide geographic area. Because the degree of difference in rebound within the area is not known precisely, it is not corrected for in this curve.

Figure 9 shows the shoreline displacement curve where the dashed line gives the hypothesized sea level in the planned Energy Island location during the Holocene. The numbers refer to Table 2 and Appendix 16.3, where additional information is provided about the individual SLIPs.

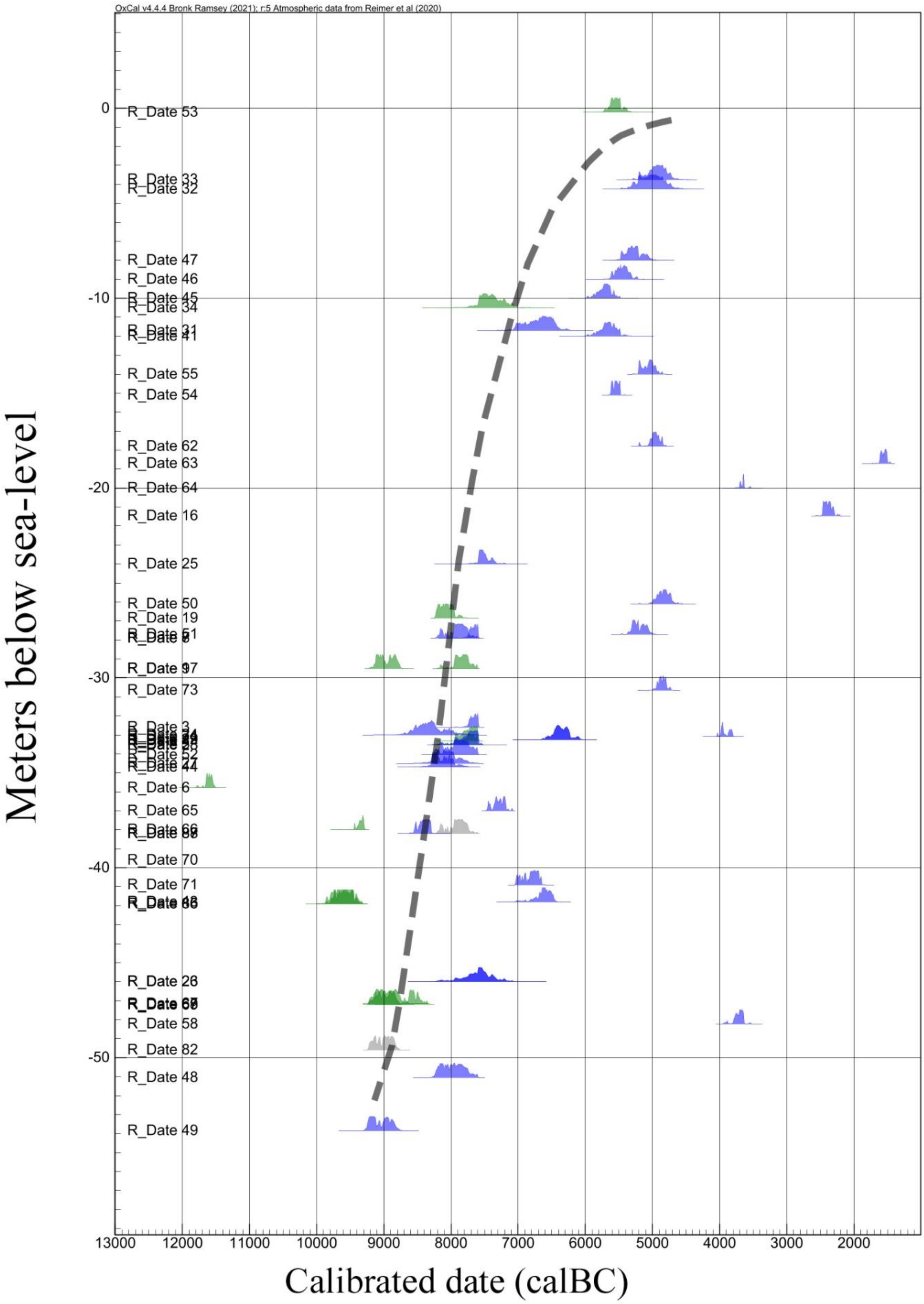


Figure 9 Shoreline displacement curve where the dashed line gives the hypothesized sea level in the planned OWF area during the Holocene. Peter Moe Astrup.

9. Sub-bottom seismology and landscape correction

MAJ received a large dataset with seismological data and interpreted surfaces/horizons from Energinet. The museum applied the interpreted horizons (H10 and H20) that were provided in geotiff format to the geoarchaeological analysis. Fugro identified a total of 13 seismic units that constitute the geological model of the area. Figure 10 below shows a the seismostratigraphic interpretation, displaying the mapped horizons and the interpreted seismic units. The horizons that bound the seismic units represent seismostratigraphic boundaries and mark the base of the deposits they define. As such, these boundaries have chronostratigraphic and kinetostratigraphic meaning, and should not be interpreted in lithostratigraphic terms. The bases and units are numbered sequentially based on their stratigraphic position, and have an alphanumeric naming convention (e.g., H10 corresponds to the base of seismic unit U10). The deepest and oldest seismic unit is referred to Base Seismic Unit (BSU). The top of the Base Seismic Unit is defined by a composite surface produced from the amalgamation of the deepest mapped horizons. The bottom of the Base Seismic Unit corresponds to the processing “last knee” that is an artificial, linear boundary near the terminus of the seismic record. The labelling scheme in Figure 10 was applied to all seismic examples in this report. The horizons generally mark the bottom of the unit they are named after.

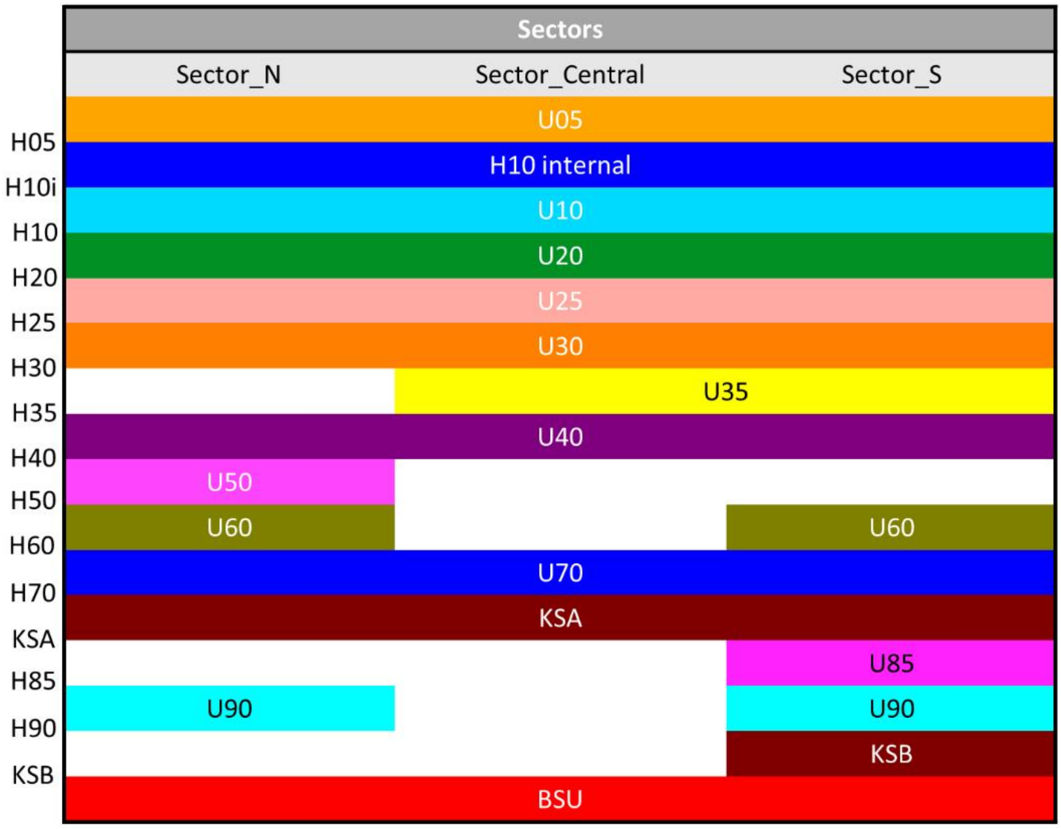


Figure 10 North-south profile with seismostratigraphic interpretation, displaying the mapped horizons and the interpreted seismic units. (MMT 2022 GEOPHYSICAL SURVEY REPORT – ENERGY ISLAND)

As highlighted by MMT (GEOPHYSICAL SURVEY REPORT – ENERGY ISLAND), it is not possible to arrive at precise dates for units/horizons. It can be said that H05 and H10 are assumed to date to the Holocene. Overall, MMT is of the opinion that units/horizons are either linked to glacial processes or those connected to changes in sea levels and shoreline displacement. Their report (p. 255) states, “Sediment deposition above H35 appears to be dominated by high frequency sea-level fluctuations, related to eustatic-isostatic and autogenic processes, away from any glacial influence. An overall transgressive sequence infilled the basins, starting with the deposition of U35 fluvial bedforms at the base, followed by the finer deposits of U30. As the sea level rose, flooding of the basins led to the deposition of the lower section of unit U25, likely within a transgressive estuary setting, no longer constrained by the basins' margins. The increase of small channel-incisions within the upper deposits of U25 suggests the occurrence of a regressive event/fluctuation (at least in relative terms). The deposits of U20 consist of infills of small basins and/or channels, which could be related to a restricted marine tidal deposition and partially to a subaerial fluvial infill. Above the ravinement surface of H10 (likely a wave cut) rests the last and most recent U10 deposits. This unit is made up of the recent transgressive deposits (possibly some high-stand) and includes the modern seabed marine sandy deposits."

U05 represents a Holocene sand layer at a water depth between -26.4 and -43.7masl. It has a thickness of up to 3.9m and is only found on top of U10. U10 is slightly deeper, between -31.7 and -51.8masl, with a thickness of up to 18.1m. H10 is interpreted as a transgression ravinement deposition that apparently consists mostly of sand with an admixture of silt and gravel. U10 has the appearance of a marine deposition created during the Holocene. U20 represents fill of old crevices and basins, found at depths of -32.6 to -92.5masl and with a thickness of up to 48.9m (Figure 11). It is assumed that U20 formed in marine conditions, but it is not stated in the geophysical report (GEOPHYSICAL SURVEY REPORT – ENERGY ISLAND) when it was formed. In addition, U20/H20 was not registered in the island area so it was not possible to use it to correct the modern bathymetric model.

When correcting for the changes (sediment transport, erosion/accumulation) that have occurred in the OWF area since the Stone Age it is vital to use the most suitable horizon. If there are, for example, traces of buried valleys/lakes/depressions in a horizon it is crucial to correct for them or else there is a risk of giving these areas a misleading influence on the results (and lead possible marine archaeological investigations to the wrong places). MMT considers U05 and U10 (horizons H05, H10 and H20) to have been formed during the Holocene after the area was transgressed. Therefore, the surface of H10 and H20 seems to be a better reflection of the prehistoric landscape than the modern seabed.

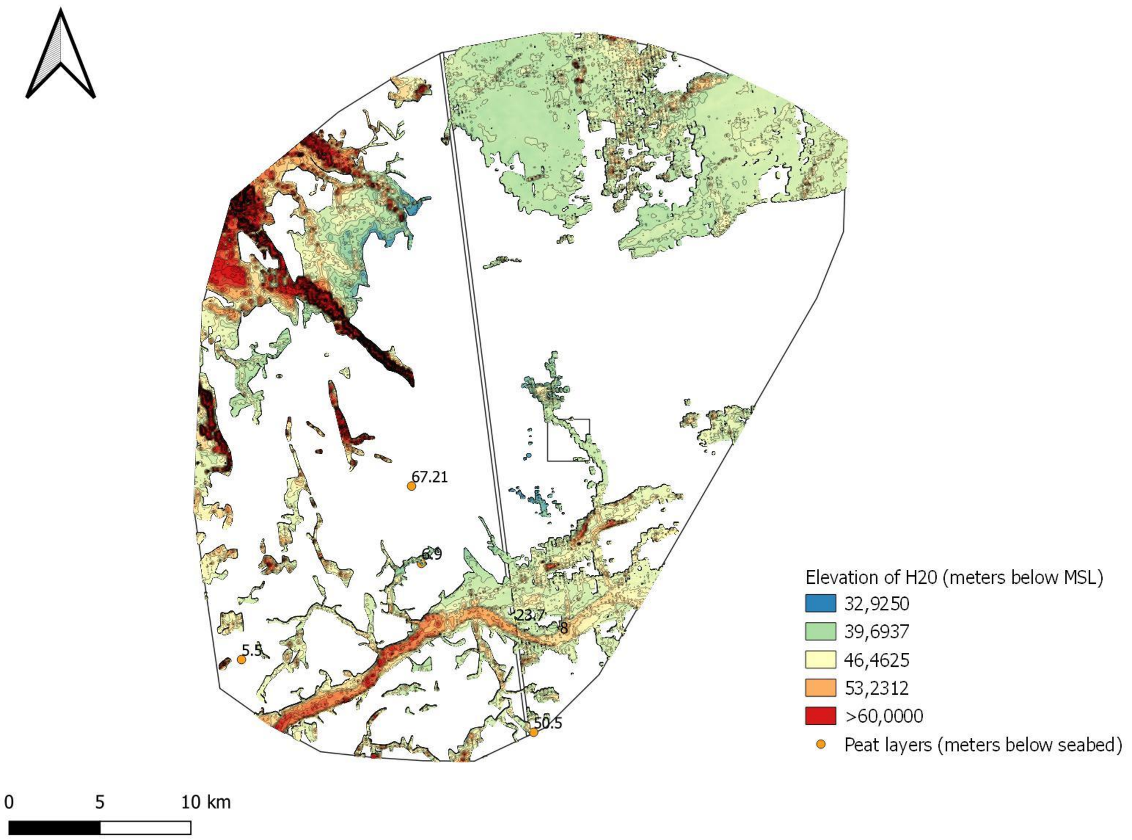


Figure 11 H20 along with documented peat layers. H20 shows buried valleys and other features in parts of the OWF area.

In this analysis we chose to use both H10 and H20 to correct the current depth information. The reason being that MMT dates both horizons to the Holocene period.

On Figure 11 H20 is shown along with the documented peat layers. It is possible to see several major (now buried) channels that existed in the area until the area was transgressed, and the channels were filled with marine sediment. The model depicts the elevation and the H20 surface in meters below MSL and shows how deep below the modern seabed peat layers have been proven to exist. From the map it is also evident that most of the peat layers are in the channels.

- Two samples from a peat layer registered 5.5m below the seabed in log BH-1005 have been dated to 46208-44994 and 48074-46551 cal. BC respectively. The samples have been collected from a depth of -47.4masl and show the archaeological potential of this area is limited.
- Two samples from a peat layer registered 6.9m below the seabed in log BH-1010 have been dated to 9865-9393 and 9796-9367 cal. BC respectively. The samples have been collected from a depth of -40.1masl and show that a channel was active in the early Holocene. The areas around the dated peat layer can therefore be said to have an archaeological potential.
- Organic material registered 8.0m below the seabed in log BH-1006 has been dated to 9224-8816 cal. BC. The sample have been collected from a depth of -49.6masl. It is not clear if the layer represents a lacustrine, marine- or brackish environment. But the organic material (possibly sandy peat) has been formed in the Holocene period.

- Two samples from a peat layer registered 23.7m below the seabed in log BH-1007 have been dated to 46115-44924 cal. BC and ca. 503373 cal. BC (date may extend out of range). The samples have been collected from a depth of -64 to -65masl and show that this area holds limited archaeological potential.
- Two samples from a peat layer registered 50.5m below the seabed in log BH-1002 have been dated to 46827-45522 cal. BC and 50210 cal. BC (date may extend out of range). The samples have been collected from a depth of -89.2masl and show that the area holds limited archaeological potential.
- Two samples from a peat layer registered 67m below the seabed in log BH-1016 have been dated to 46761-45431 cal. BC and 52751-48061 cal. BC (date may extend out of range). The samples have been collected from a depth of -109.8masl and show that this area holds limited archaeological potential.

The peat layer in log BH-1010 shows that sea-level was -40masl around 9796-9367 cal. BC. However, a marine shell from -38masl in core log C-1011 (AAR-35665) dated to 8547-8293 cal. BC suggests the peat layer was transgressed less than 600 years later. It is therefore reasonable to assume that sea-levels have reached ca. -40masl around 9000 cal. BC. Thus, in Figure 12 H20 has been used to draw a coastline corresponding to an elevation of -40masl.

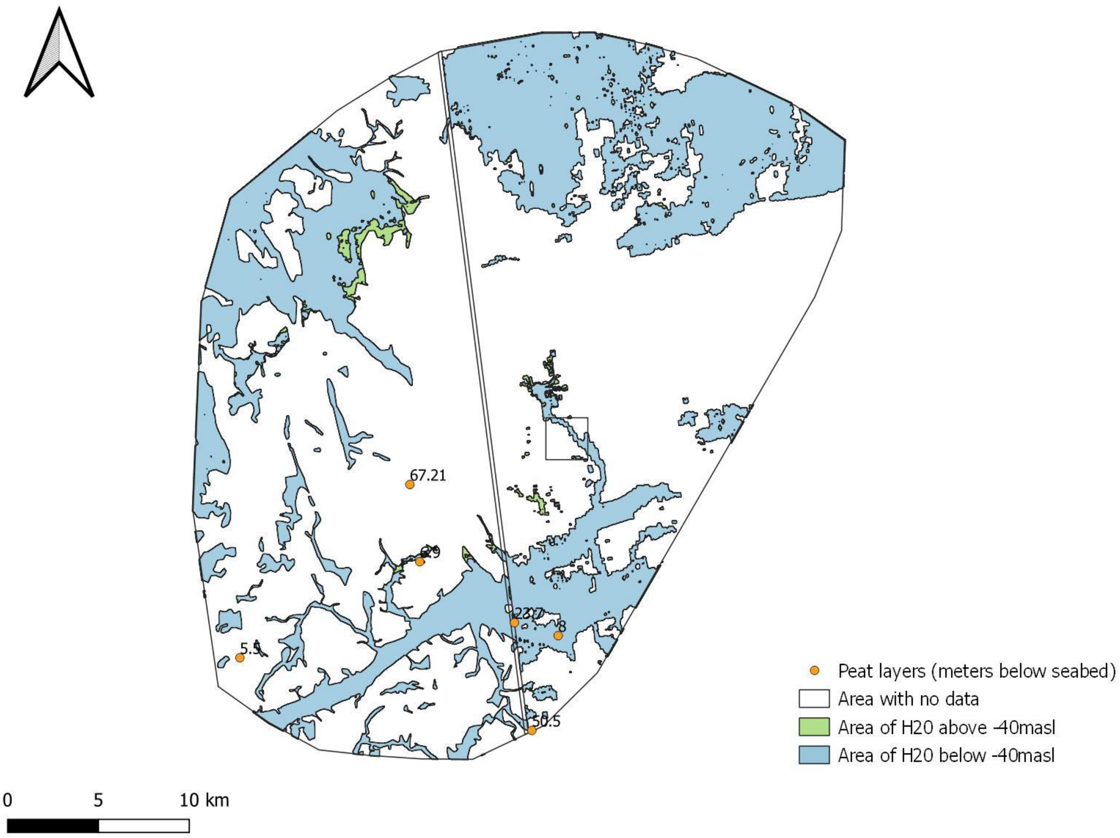


Figure 12 Areas above -40masl in H20 that might have represented a terrestrial surface around 9000 cal. BC.

Figure 13 Shoreline model if H10 represents a former terrestrial surface.

Only a small fraction of H20 is located above -40masl. This suggests that most of the H20 land surface was flooded around 9000 cal. BC. Thus, it seems reasonable to argue that the ocean/shoreline were located close to the mapped areas in Figure 13 and that parts of the outline of the visible changes might also have worked as coastal barriers prior to 8500 cal. BC.

Figure 14 shows that U10 has a thickness of up to 11.5m. According to the geophysical interpretations H10 shows the minimum possible distance from the modern seabed to any layers with archaeological Stone Age potential. It can, for example, be seen that approximately 11.5m of sediment is deposited around the Energy Island location. Yet in many other areas there is only a very thin sediment cover (less than 2m). The model therefore also shows where it is difficult to reach layers with archaeological stone Age potential and where it is unlikely that cables etc. will cause any damage to Stone Age sites.

It can be assumed that the differences in levels were greater in the Stone Age than today, because over time material from the highest levels would be deposited in the lower ones. The lowest/deepest areas recognized on the bathymetric chart (along with horizons) are especially interesting because they can be thought to represent lake basins that are filled with sediment. The material that is deposited over the archaic lake basins, peat layers, etc. both preserves them and makes them difficult to research. Higher areas on slopes are more exposed and subject to erosion but are also better suited to diver reconnaissance precisely because settlement traces are not buried under a thick layer of sediment.

Identification of the areas with the greatest Holocene layer formation shows both 1) where archaeological materials can have avoided erosion, 2) where it would be difficult to access layers using divers, and 3) where layers are too deep to be affected by construction work. Therefore, archaeological surveys should be planned in the areas best suited for settlement where past sedimentation allows such investigations without extreme difficulty in accessing the layers. The artificial island is proposed to be constructed in an area where between 10 to 15m of sediment accumulated during the Holocene (Figure 14). Figure 14 can therefore also be used to identify where archaeological materials can be expected to have been eroded away and/or buried under younger sediments. The critical period experienced by a settlement/deposit regarding its future preservation is the time when the waves first begin to wash over it and the following centuries when they break over the area. Factors that can have a positive effect on the preservation of a site include: 1) a gentle slope on the seabed and coastline so wave action is minimized in the surf, 2) sheltered waters where waves cannot build over long distances, 3) deposition in peat or compact sediments that protect the material during transgressions. These considerations show that preservation or destruction of a given archaeological locality (whether inland or at the coast) depends on the local topography and environment at that location. CPT log samples provide the opportunity to deduce where possible settlements will today be protected under later sediments or else eroded away.

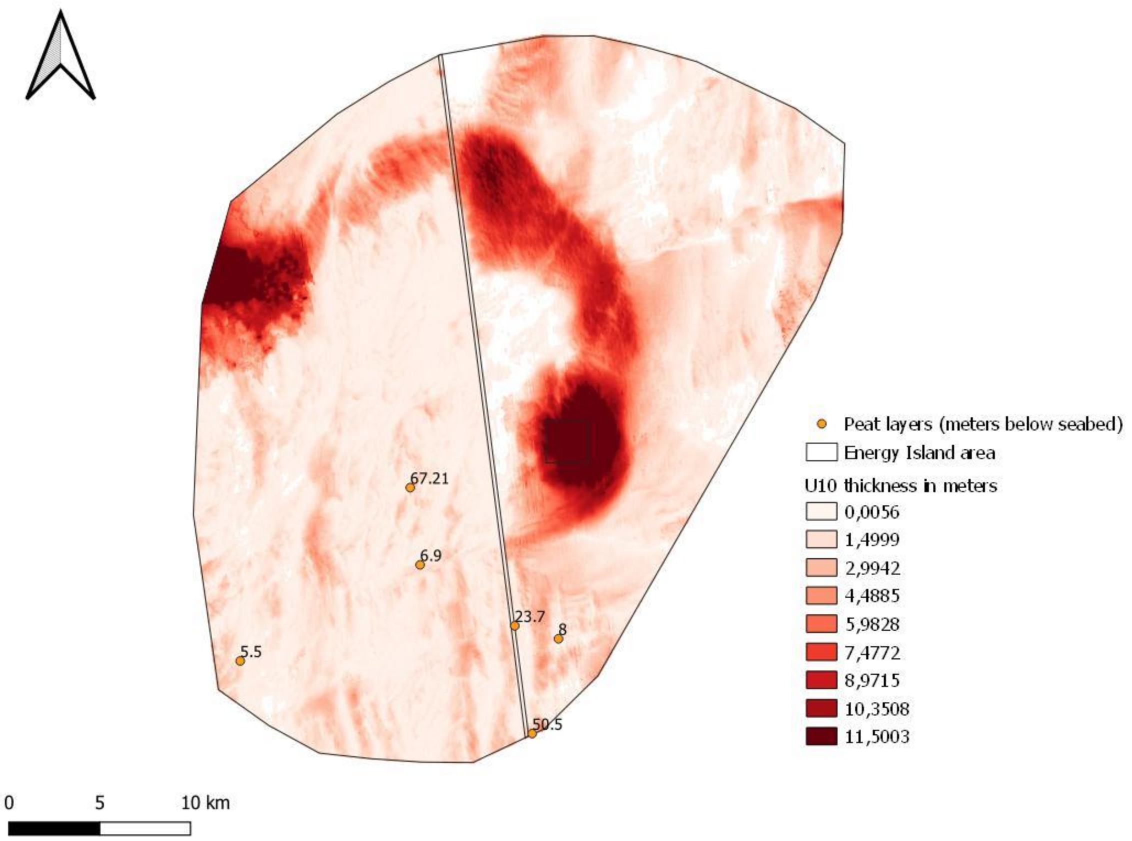


Figure 14 Location of the OWF in relation to the thickness of U10

10. Conclusions and recommendations regarding the Stone Age potential in the project area

The geoarchaeological analyses show that there is little likelihood that survey efforts will lead to the discovery of Stone Age archaeological material. Only in two logs (B1010 and B1006 - out of 48 in the OWF area) has it been possible to demonstrate traces of Holocene land/peat surfaces. The layers over H10 are assumed to have been formed after the sea transgressed the area and are not believed to have any in-situ Stone Age archaeological potential. The two horizons (and cores) suggest that prehistoric archaeological deposits in most of the OWF area is covered by thick layers of sediments. It will be very difficult to conduct marine archaeological investigations at a water depth of 40m and under 10-15m of sediment and the methods available for such an investigation would result in the removal of so much context information that any possible finds would lose so much of their scientific value that they could not justify the costs.

Normally in a geoarchaeological analysis the reconstructed landscape would be used with topographic models (e.g., the fishing site model) to designate areas where it is believed there is an especially high likelihood of human activities. However, the available geological data from the OWF area only provide very limited information about the most favourable topographical locations in the area. The reason being that potential settlements lie at water depths of ca. 40m, which means that they would have occurred so far back in time (min 10.000 years ago) that it is not clear if the topographical models apply. It is simply uncertain whether settlement occurred at the coasts in this timeframe. Another reason that the topographic model is judged to be an unsuitable tool to find settlements within the OWF area is that we still know too little about the area's original topography and environment. It is unknown whether the coastal zone resembled that of today with large, exposed beaches subjected to powerful surf and significant tidal effects (and with long stretches uninterrupted by bays or lagoons), or if it to a greater extent resembled the landscapes and environments found today in the inner Danish waters such as the Belts. A third possibility is that part of the region consisted of tidal mudflats like those now found in the German Bight.

The channels visible in H20 may very well have contained rivers, lakes etc. It is in such environments most of the preboreal sites in Denmark have been recorded previously. The moraine plateau and outwash plains of southwestern Jutland contain (compared with the rest of Denmark) relatively sparse amounts of archaeological material that can be dated to the early Mesolithic period (9500-6400 BC). It is not known whether to expect the same pattern (and density) of settlement in the North Sea area as in western Jutland or if there were more sites in proximity to the coasts. Possible Stone Age sites in the area would date to the Late Palaeolithic or Early Mesolithic, as it was inundated by rising sea levels ca. 9500-8500 BC. As there are few sites known from these periods in the rest of Denmark it seems unlikely that a small sampling program will succeed in finding significant additional archaeological material (not least considering the methods that would have to be employed to recover such material).

The geoarchaeological analysis concludes that construction works pose a threat to prehistoric settlement sites around the location of the coring sample BH-1010. This area is deemed to have been located near the coast with access to freshwater (lakes and rivers) and therefore a preferred place to have a settlement site. These conclusions warrant a preliminary survey of the area. However, the density of the windmills and the character of the construction works (See Chapter 6. above), the chances of a direct impact on a settlement site are minimal. We cannot exclude the possibility of very old settlements but do not believe there is justification for attempting to detect them. Based on this we do not advise Energinet to make any investigations in the OWF area to locate Stone Age sites.

Nevertheless, any possibility that arises in connection with the planned construction works should be used to conduct archaeological suction dredging surveys at 3-5 locations, or watching briefs of suction dredging operation in the area around B-1010 to collect archaeological data for future impact assessments.

11. Submerged historical archaeological potential

11.1. Methodology

The SSS and MAG data were analysed by the MAJ maritime archaeologists Anders Jensen, Jan Hammer Larsen and Daniel Peter Dalicsek. The high and low frequency side scan sonar data as XTF-files with corrected navigation were reviewed in the software SonarWiz 7.

The dataset for OWF East and OWF West were structured very differently.

The data for OWF East was reviewed and the SSS anomalies categorised by MMT as other than "Boulder" (i.e. "Debris", "Fishing gear", "Other", "Wire", "Wreck") were exported from SonarWiz 7 to QGIS 3.16.16 in GeoTIFF format. The anomalies were then sorted in QGIS and received a confidence level 1-5. The anomalies with the highest potential for archaeological importance were given the confidence level 1, whereas those with the lowest potential were given the confidence level 5. The SSS anomalies were also cross-checked with the MAG anomalies provided in table 103783-ENN-MMT-WPA-MAG-Anomaly-List.xlsx. MAG anomalies with a P2P value of 40 nT ≤ from the aforementioned list were selected as anomalies for archaeological investigation as well. The P2P value is decreased from what was applied at the planned Energy Island location after the review of research specific to detecting shipwrecks with magnetometer (Michael 2011, personal communication). The investigations in the planned EI area showed most targets buried and likely wooden shipwrecks broke into larger fragments that were then buried. Therefore, 40nT threshold offers a better chance of finding artefacts or artefact assemblages.

The anomalies were combined in a joined list where beside the TARGETID each object has a unique OBJECTID. The OBJECTID is made up of a number followed by a letter, where the number denotes the anomaly and the letter the individual anomalies in the group. Where SSS anomalies and MAG anomalies are related, the SSS anomaly is the parent, and where SSS anomalies are related, the SSS anomaly with the lowest TARGETID is the parent and the others are children. Anomalies were grouped according to individual assessment. In the table the CONFLEVEL denotes the confidence level as described above.

The data for OWF West was reviewed and the SSS anomalies categorised by Fugro as other than "Boulder" (i.e. "Suspected Debris", "Unidentified", "Wreck") were exported from SonarWiz 7 to QGIS 3.16.16 in GeoTIFF format. However, the file path for the anomalies in the individual SonarWiz project files was corrupted, so there is a possibility that Sonar anomalies were not exported as GeoTIFF. This has been manually double-checked, but there is a potential uncertainty. The MAG data was only provided in raw format in 450 individual .csv files containing every measurement and no MAG anomaly list. The csv files were then combined and imported as spreadsheets into QGIS 3.16.16. As the data is raw, all MAG measurements with a value 20 nT ≤ or -20 nT ≥ were selected as anomalies, giving a P2P value of 40 nT or above. Linear anomalies (deemed pipelines and/or subsea cables) were removed and the remaining anomalies were grouped. Each MAG point with the above values got an individual Object ID that. The point with the lowest Object ID became the parent for the points grouped into MAG anomalies. Where MAG anomalies coincide with SSS anomalies, the SSS anomaly is the parent in the relation.

11.2. Wrecks

Wreck number	Database	Description	Easting	Northing
EA_R_SSS_00580	ENC	M/V Fallwind	340612.44	6263664.83
EA_P_SSS_00591	ENC	L409 Sally	337224.95	6279528.76
Wreck_86	EnergyIslandWrecks20200305.xlsx	HMS Tarpon	348872.32	6284050.79
Wreck_85	EnergyIslandWrecks20200305.xlsx	Unknown wreck only iron scrap left	349894.57	6284281.50
400110a-23	Fund- og Fortidsminder	Fishing vessel sunk 1972	357251.00	6262212.25
400110a-36	Fund- og Fortidsminder	Unknown wreck sunk in 1920	332258.18	6253842.22
Wreck_94	EnergyIslandWrecks20200305.xlsx	Unknown wooden wreck only cargo	347304.23	6253253.91
Uknown wreck	SSS S_RE_B05_0547	Unknown wreck with ballast mound	358715.58	6272109.03

The known wrecks were recorded in the SSS anomaly lists. The wrecks marked in the Danish central register of cultural historical properties as 400110a-23 and 400110a-36 were not visible as an SSS anomaly. However, the positions in the database are most likely imprecise and both positions have MAG anomalies within a 500m radius. One new shipwreck, listed as “Unknown wreck” in the table above, was discovered in the OWF Zone East.

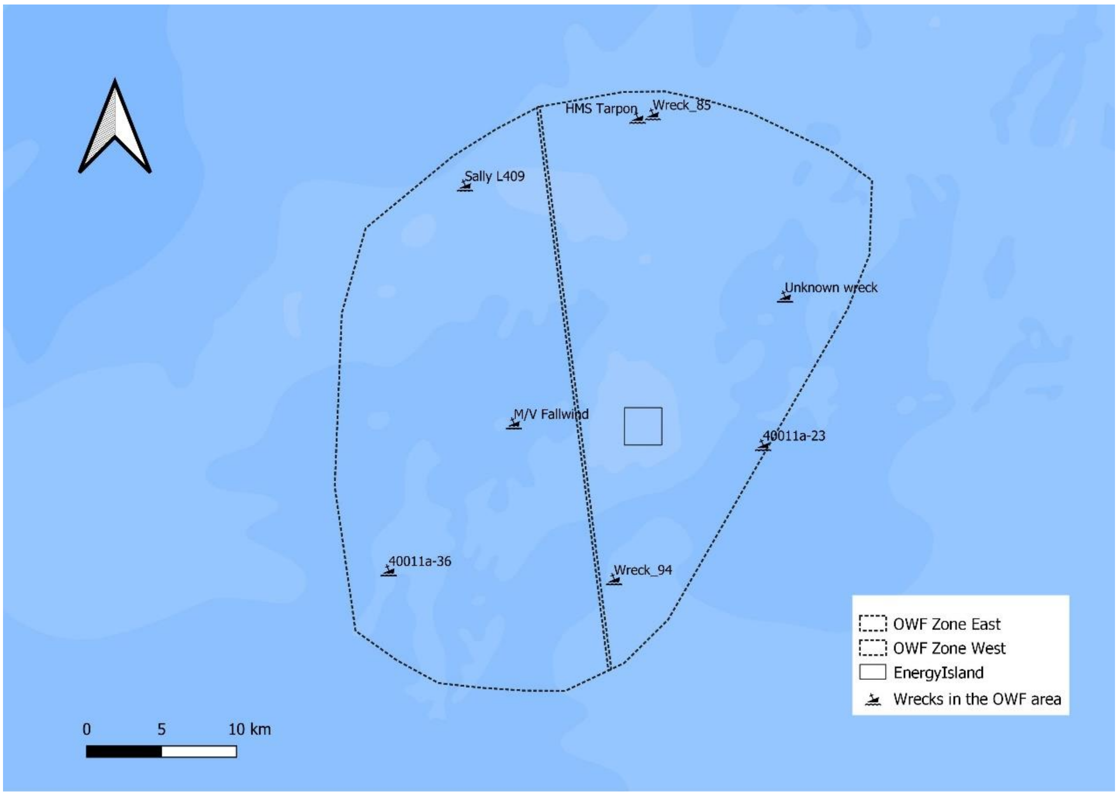


Figure 15 Map over wreck locations in the OWF zone

MAJ recommends an ROV survey of sites Wreck_85, Wreck_94 and the “Unknown wreck” to determine the precise nature of the wrecks and further mitigation.

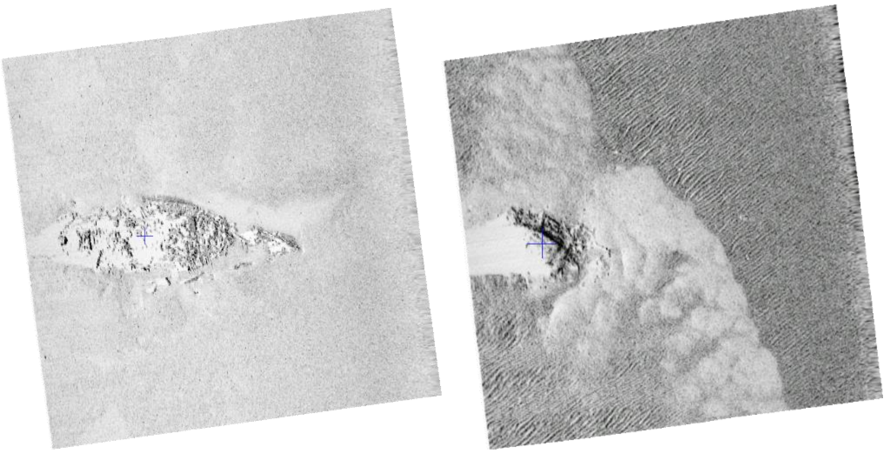


Figure 16 Wreck_85 (left) and Wreck_94 (right) on SSS imagery

Wreck_85 is an unknown wreck with only iron scrap left, the wreck area being 52.3m long and 18.4m wide.

Wreck_94 is an unknown wooden wreck, 21.2m long and 6.7m wide.

The “Unknown wreck” is 13.9m long and 5.4m wide.

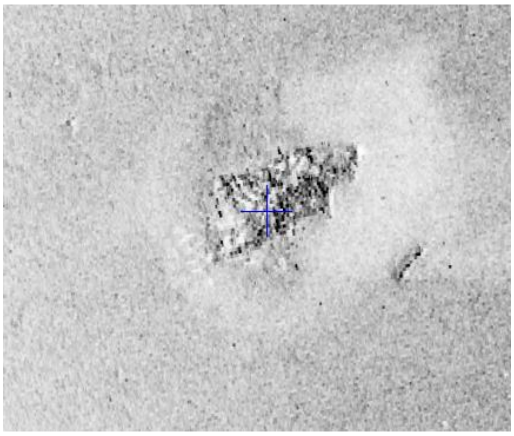


Figure 17 The "Unknown wreck"

MAJ recommends an ROV survey of Wreck_86 (HMS Tarpon) due to its historical significance. Should the wreck site undergo a UXO (or other type of) investigation, this could be combined with the maritime archaeology site investigation. In relation to the wreck of HMS Tarpon, besides other relevant legislation, the UK Protection of Military Remains Act 1986 applies as well. Should any work be carried out at the site, this needs to be consulted in advance with the UK Ministry of Defence.

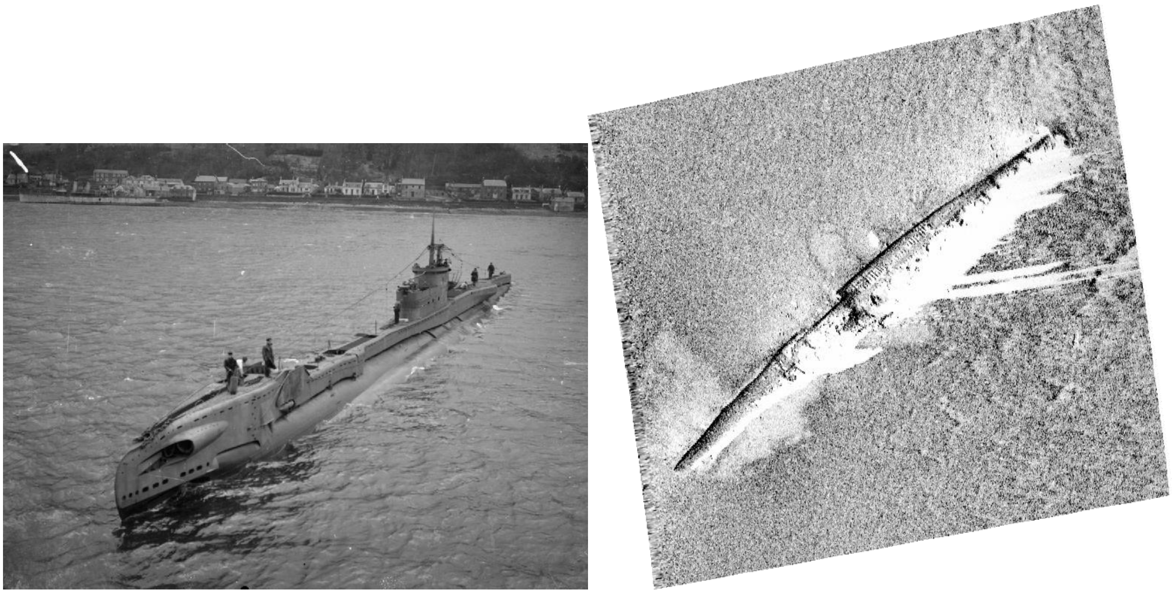


Figure 18 HMS Tudor, the sister ship of HMS Tarpon (Credit: Imperial War Museum) and HMS Tarpon on the SSS imagery

The inspection of modern shipwrecks prior and post-construction can provide valuable information on site formation processes and help develop better mitigation policies. Thus MAJ would request access to any relevant data gathered about the wrecks L409 Sally, M/V Fallwind and 400110a-23 in the scope of the project (including survey data and documentation from a possible removal project).

Figure 19 L409 Sally on SSS imagery

EA_P_SSS_00591 is likely the wreck of the fishing vessel L409 Sally of approx. 20GRT that sank 0456 on the 5th of April 2000 after a collision with the Swedish fishing vessel L425 Klazina Vera. All hands were rescued. The wreck is partially covered and 49.0m long and 11.9m wide.

Figure 20 M/V Fallwind sailing (Credit: Charlie Hill) and as a wreck on SSS imagery

EA_R_SSS_00580 is the wreck of the cargo vessel M/V Fallwind of 499 GRT that sank in 1988 after it started listing in the North Sea. The ship was 74.7m long, 12.5m wide and had a draught of 3.7m.

11.3. SSS anomalies

SSS data was analysed by the MAJ maritime archaeologists Anders Jensen, Jan Hammer Larsen and Daniel Peter Dalicsek. The high and low frequency side scan sonar data as XTF-files with corrected navigation were reviewed in the software SonarWiz 7.

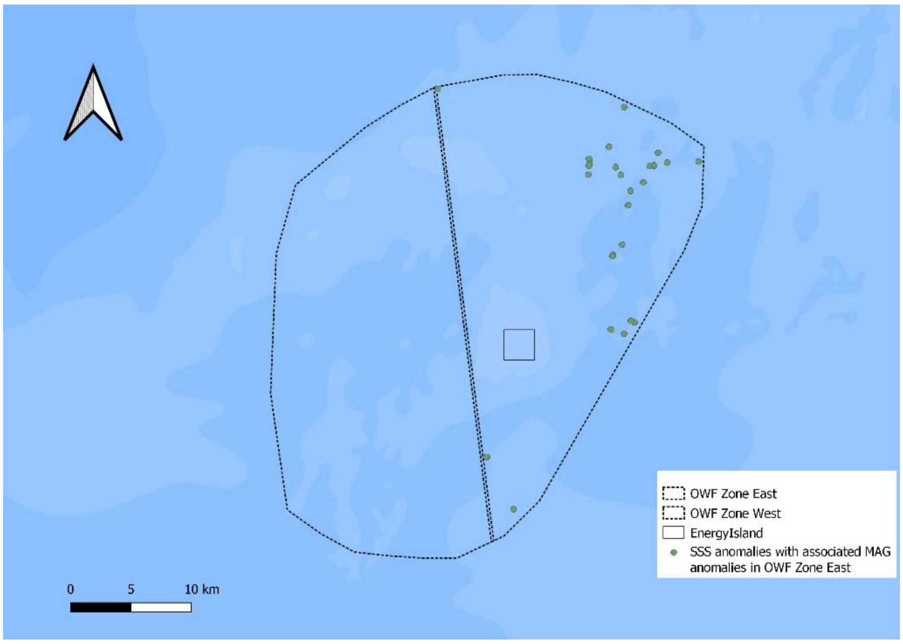


Figure 21 OWF East SSS anomalies with high potential or with associated MAG anomalies

In the OWF Zone East 197 sites were selected based on SSS anomalies. Four of these individual anomalies or anomaly groups are connected to shipwrecks. 22 SSS anomalies had a MAG anomaly associated with them and 17 SSS anomalies were deemed as MMO with high archaeological potential. Four additional MBES anomalies associated with MAG anomalies are listed along the SSS anomalies.

150 SSS anomalies were classified as of low archaeological potential, where an investigation would not be feasible.

The SSS anomalies for OWF Zone East are in Appendix 16.1-16.4.

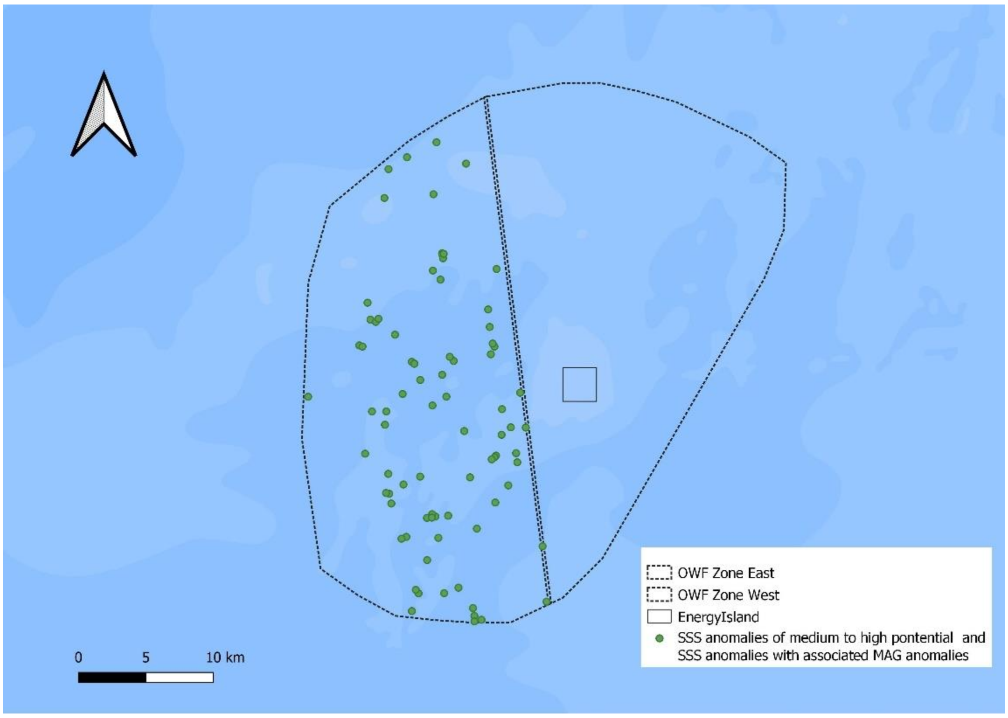


Figure 22 OWF West SSS anomalies

In OWF Zone West 80 sites were selected based on SSS anomalies. Two of these individual anomalies and anomaly groups relate to the modern shipwrecks MV Fallwind and L409 Sally. 77 SSS anomaly sites are deemed as of potential archaeological objects and one site has been listed as of low archaeological potential, where investigation would not be feasible.

The SSS anomalies for OWF Zone West are in Appendix 16.7-16.10.

11.4. MAG anomalies

The MAG anomalies were reviewed by the MAJ maritime archaeologists Anders Jensen, Jan Hammer Larsen and Daniel Peter Dalicsek. The selection method is described above.

In the OWF Zone East, 91 MAG anomalies were selected. 21 of these anomalies relate to the five shipwreck sites. 26 MAG anomalies relate to SSS or MBES anomalies. 25 MAG anomalies have P2P values of 50nT or greater. An additional 19 locations had P2P values of 40nT or greater.

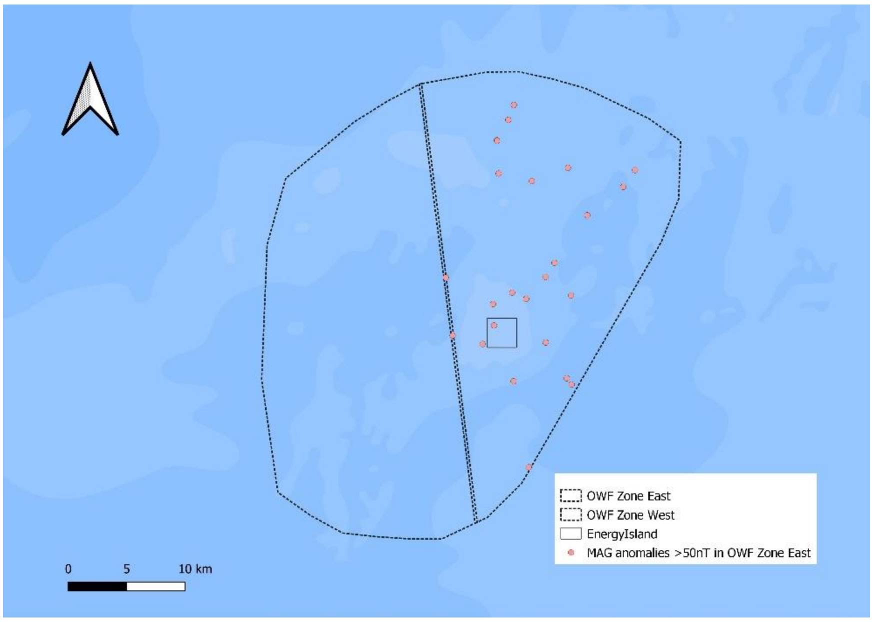


Figure 23 OWF Zone East MAG anomalies

In the zone OWF Zone West 139 MAG anomalies were selected. Nine of these relate to the three shipwreck sites, including the one denoting the potential site for 400110a-36. Two MAG anomalies relate to SSS anomalies. 93 anomalies have P2P values of 50nT or greater. 35 MAG anomalies have P2P values of 40nT-50nT.

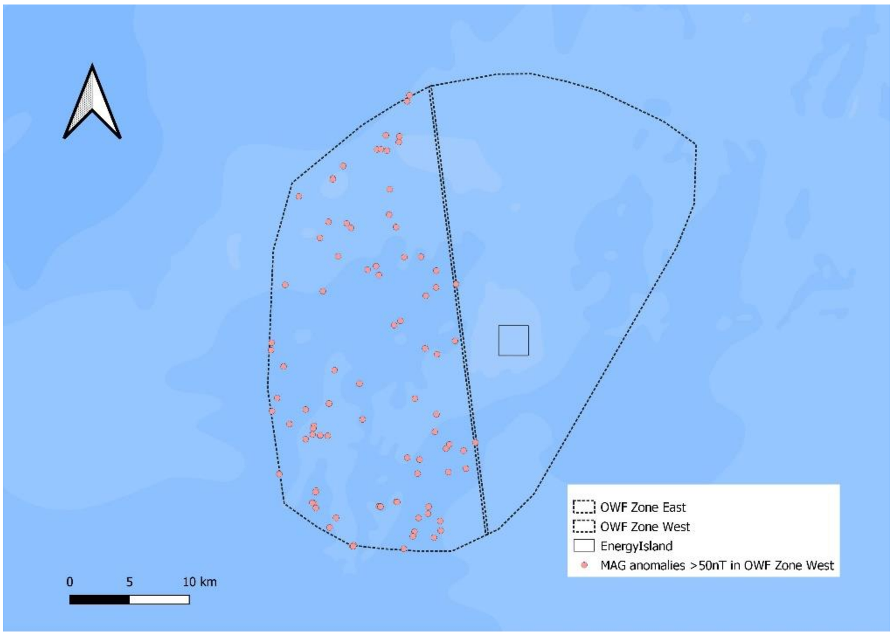


Figure 24 OWF West MAG anomalies

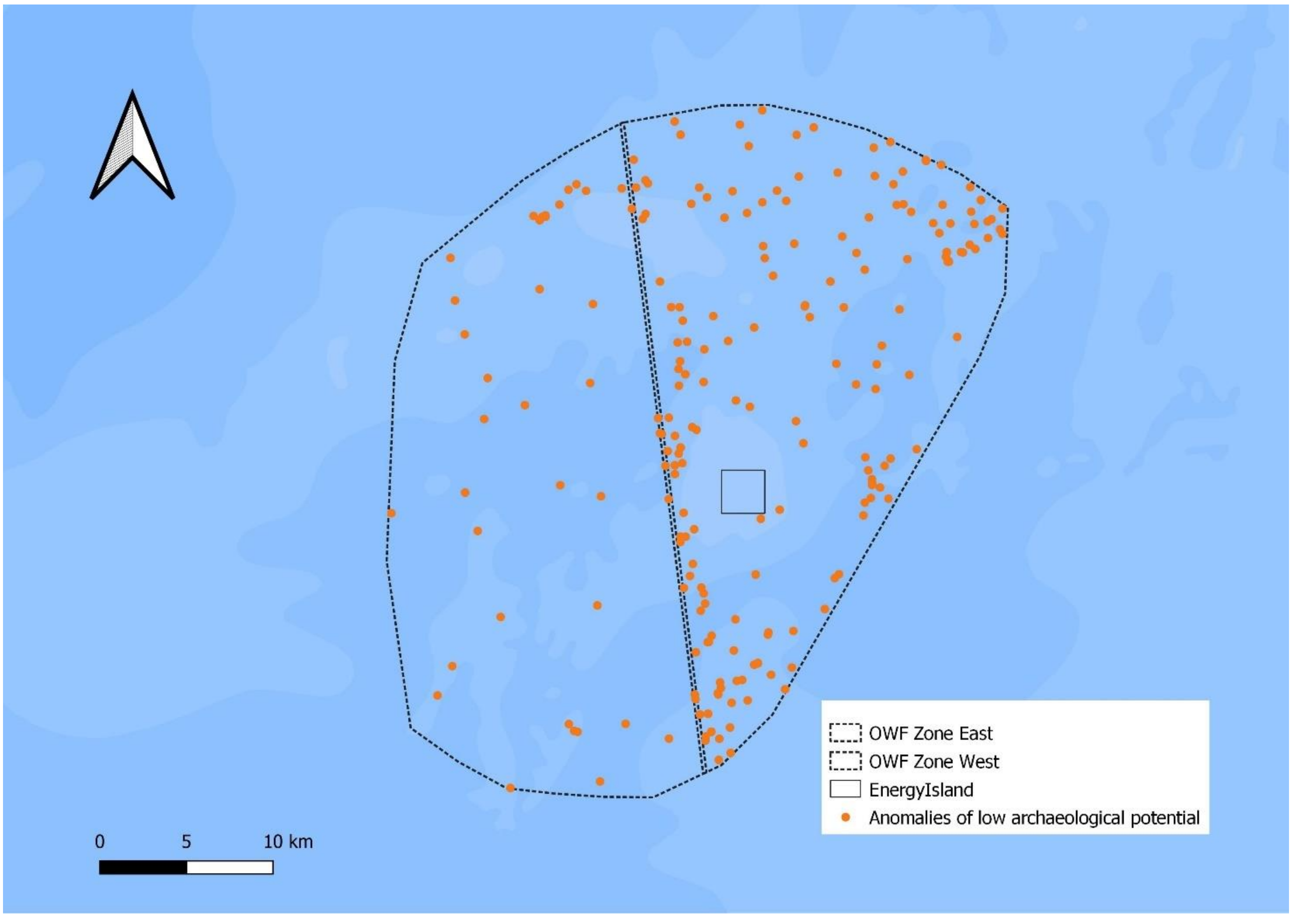


Figure 25 SSS Anomalies with low archaeological potential and MAG anomalies of 40-50nT

12. Conclusion on historical maritime archaeology

The review and analyses of the geophysical survey found shipwrecks, shipwreck debris and wrecks of a submarine in the area.

The list of targets for primary inspection includes 243 anomalies or anomaly groups. This list is made up of shipwreck sites, SSS anomalies associated with MAG anomalies, SSS anomalies judged to have archaeological potential and MAG anomalies of 50nT P2P values or greater and excludes modern wreck sites.

These anomalies should be visually inspected (ROV dives, high resolution MBES). If the anomaly sites are not inspected further, an exclusion zone of at least 100m radius is advised around the locations. The exclusion zone for sites identified as wrecks shall be at least 200m radius.

It is advised that MAJ archaeologists partake in the UXO/EOD inspection and removal campaigns, if those take place.

For practical reasons MAJ considers SSS anomalies of low potential and MAG anomalies between 40-50nT not feasible to investigate, but a 50m radius exclusion zone is advised.

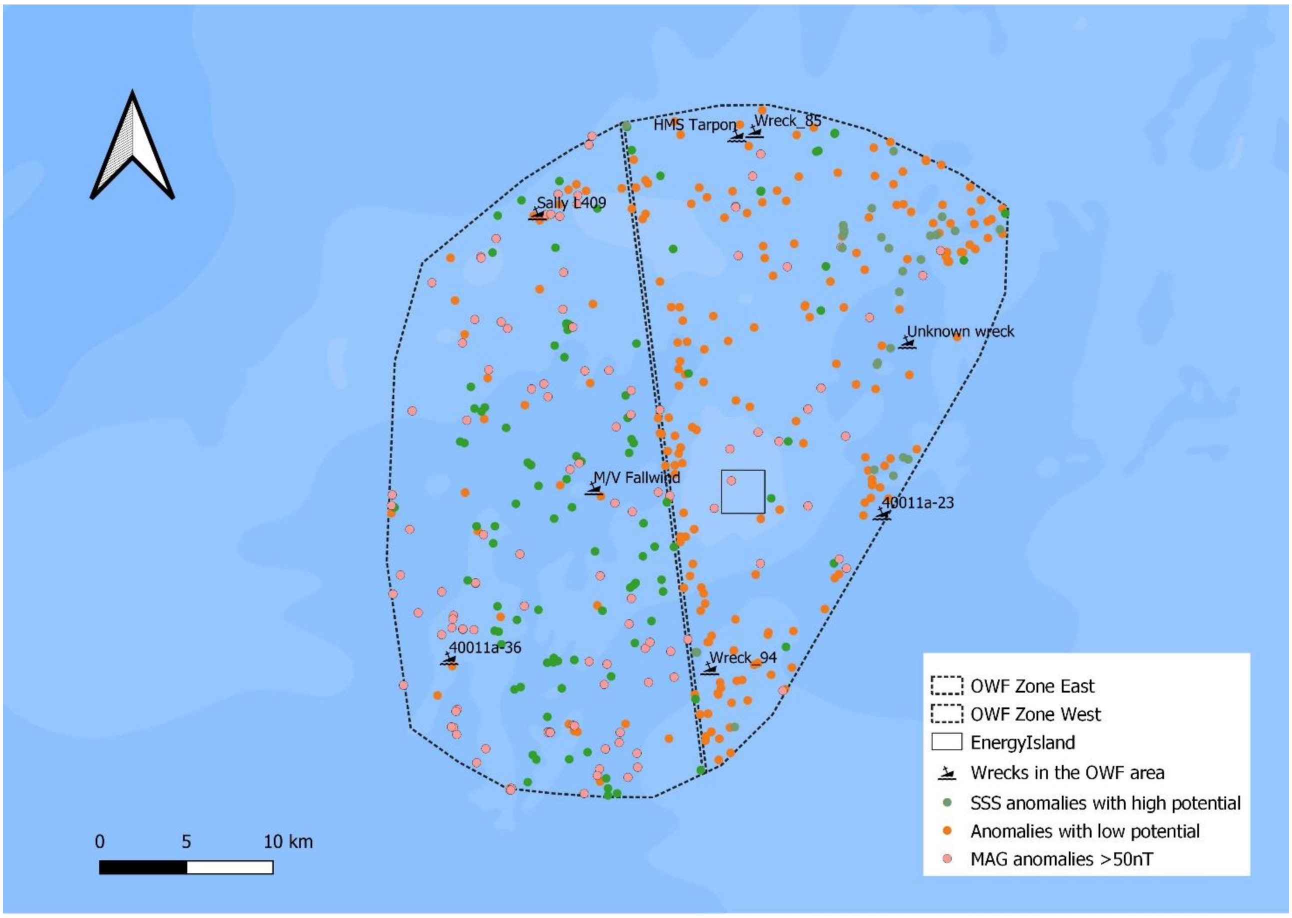


Figure 26 OWF East and OWF West with all selected anomalies

13. Target investigation

If avoidance is not possible or proves impractical, the target should be investigated to identify whether it is of archaeological character. Target investigation is generally conducted by deploying divers or ROV's or a combination of both. Consideration needs to be given as to whether the target is located on the surface or buried and additionally to the visibility on site.

Work class ROV's are considered a safe and practical way to investigate targets as they can be equipped with cameras and survey equipment and with dredge pumps for excavation.

If ROV's are to be used, MAJ recommends the following equipment/requirements should be met during any investigation, as a minimum:

- Work Class ROV as a minimum
- Capable of operating within the following conditions:
    - significant wave height min 2.5 m
    - wind 12 m/s
    - 2 knots current, fully laden (i.e. all equipment operating)
- ROV HD camera system (2 per ROV)
- Inertial Nav System (INS)
- Doppler velocity log
- Digital Edge HD recording system (or equivalent)
- Adequate manipulators and grinders to conduct the required operations
- Depth sensor accurate to +/- 1 m
- Ability to carry out excursions at least 150 m from the vessel
- Obstacle avoidance sonars
- USBL system, IXSea Gaps or equivalent
- Dredge pump capable of efficiently excavating sediments given the seabed conditions
- Metal detector (e.g. innovatum/gradiometer (7pin) or TSS pipe tracker (2 m array minimum)) for target relocation

Optional:

- High Resolution Sub-Bottom Imager (e.g. Pangeo SBI)
- ARIS Sonar (or equivalent)

The configuration of the camera system should allow for variations in view, strobe orientation and focal length in order to maximise data quality with respect to the prevailing conditions. A method of determining scale for the field of view should be evident in the video frame. The video should be supplied with its own source of illumination, which will be no less than 100 W (equivalent) and suitable to provide colour-balanced scene illumination at depth. The video shall be digitally recorded on board the vessel with a means to review, replay, capture and extract data digitally immediately after acquisition.

Due to certain factors the use of divers can be advantageous. The divers would use hand-held locators (metal detectors) to relocate the target and diver operated air lifts to expose buried objects. However, if targets are buried deeply i.e. more than 1 m then it may be preferable to use remote operated excavation equipment due to the safety implications of diving near excavations and the risk of hole collapse.

If divers are to be used, MAJ recommends the following equipment to be deployed during the investigations as a minimum, but in accordance with the client´s operating procedures on underwater works:

- Divers must have archaeology familiarisation and search training/experience
- Surface Supplied Diving (as opposed to SCUBA). If SCUBA is proposed, justification for this method should be provided
- Diver to surface communications
- Diver to vessel live and recordable video link, via the diver's helmet
- Diver held metal detectors capable of detecting to 2 m below seabed
- Digital Edge HD recording system (or equivalent)
- USBL system (IXSea Gaps or better)

A method of determining scale for the field of view should be evident in the video frame. The video should be supplied with its own source of illumination, which will be no less than 100 W (equivalent) and suitable to provide colour-balanced scene illumination at depth. The video shall be digitally recorded on board the vessel with a means to review, replay, capture and extract data digitally immediately after acquisition.

14. Conclusions

MAJ has reviewed the data provided by Energinet and completed a desk-based geoarchaeological analysis of the geophysical survey. MAJ concludes that there is a small chance for finding Stone Age settlement sites and the slim likelihood does not warrant a preliminary survey excavation. MAJ has identified large scale shipwrecks and shipwreck debris in the OWF area, and has identified SSS and magnetic anomalies within the area for further investigation.

15. Literature:

- Andersen, S. H. (2005) "En glittestok fra Dogger Banke i Nordsøen", *Kuml*, 54(54), s. 9–16. doi: 10.7146/kuml.v54i54.97309.
- Andersen, S. H. (2013) Tybrind Vig. Submerged Mesolithic settlements in Denmark.
- Astrup, P. M. 2018. *Sea-level change in Mesolithic southern Scandinavia. Long- and short-term effects on society and the environment*. Jutland Archaeological Society Publications Vol 106, 2018.
- Bendixen, C., Jensen, J. B., Boldreel, L. O., Clausen, O. R., Bennike, O., Seidenkrantz, M.-S., Nyberg, J. & Hubscher, C. 2015. The Holocene Great Belt connection to the southern Kattegat, Scandinavia: Ancylus Lake drainage and Early Littorina Sea transgression. *Boreas*. 10.1111/bor.12154. ISSN 0300-9483.
- Bennike, O., Jensen, J. B., Lemke, W., Kuijpers, A. & Lomholt, S. 2004. Late- and postglacial history of the Great Belt, Denmark. Boreas 33, 18–33.
- Bennike, O., Jensen. J. B., Nørgaard-Pedersen, N., Andresen. K. J., Seidenkrantz, M.-S., Moros, M. & Wagner, B. 2021. When were the straits between the Baltic Sea and the Kattegat inundated by the sea during the Holocene? *Boreas*. https://doi.org/10.1111/bor.12525.
- Coles, B. J. 1998. Doggerland: a Speculative Survey. *Proceedings of the Prehistoric Society* 64: 45-81.
- Dalicsek, D.P. 2016, The Navigational Instruments from the HMS St George, Syddansk Univeristet
- Davidson, F. P. et al. (2011) Macro-engineering: MIT Brunel lectures on global infrastructure. Cambridge, England ;: Woodhead Publishing.
- Fairbanks, R.G. 1989, A 17,000-year glacio-eustatic sea level record: influnce of glacial melting rates on the Younger Dryas event and deep-ocean circulation. Nature, vol. 342, pp. 637-642.
- Figure 4:
    - Bonino, M. 2015, Navi mercantili e barche di età romana, p.45
    - Bornmalm, L. and Lagerqvist, B. 2022, From Rustic Fishing Boats to Steel Trawlers: The development of fishing vessels on the west coast of Sweden, 1850–1980, The Mariner's Mirror, 108:1, p.75
    - Brown, D.K. 1999, The Grand Fleet: Warship Design and Development 1906–1922
    - Crumlin-Pedersen, O. 2000, To be or not to be a cog: the Bremen Cog in perspective, International Journal of Nautical Archaeology, 29:2, p.241
    - Probst, N.M.
    - Slim 3D, Stockphoto
    - Vikingeskibsmuseet i Roskilde
- Gaffney, V., Allaby, R., Bates, R., Bates, M., Ch´ng, E., Fitch, S., Garwood, P., Momber, G., Murgatroyd, P., Pallen, M., Ramsey, E., Smith, D., Smith, O., 2017. Doggerland and the Lost Frontiers Project (2015-2020). In *Under the Sea: Archaeology and Palaeolandscapes of the Continental Shelf*, eds. G. Bailey., J. Harff and D. Sakellariou, 305-309. Coastal Research Library.
- Gaffney, V., Thomson, K., and S. Fitch. 2007. *Mapping Doggerland. The Mesolithic Landscapes of the Southern North Sea*. Archaeopress.
- Hohlenberg, J. (1885). Chart showing the strandings on the coasts of Denmark and on the Swedish coast between Marstrand and Carlskrona during the period from 1st January 1858 to 31st December 1885. Available at: http://www.kb.dk/maps/kortsa/2012/jul/kortatlas/object67921/da/ (Accessed 20 September 2022)
- Imray, James, Blachford, W., 1852, A new and improved chart of the North Sea or German Ocean, London, Available at:

https://www.davidrumsey.com/luna/servlet/detail/RUMSEY~8~1~296993~90068582:A-new-and-improved-chart-of-the-Nor# Accessed: 04 October 2022

- Jakobsen, K. (2018) Jyllandsslaget og første verdenskrig i Nordsøen. Thyborøn: Sea War Museum.
- Jensen, J. B., og Bennike, O., 2020. General geology of southern Kattegat, the Hesselø wind farm area. Report for Energinet Eltransmission A/S. Rapport 2020/53.
- Lambeck, K., Rouby, H., Purcell, Y.S. & Sambridge, M. 2014: Sea-level and global ice volumes from the Last Glacial Maximum to the Holocene. Proceedings of the National Academy of the United States of America (PNAS) 111, 15296–15303.
- McCartney, Innes, Jutland 1916: The Archaeology of a Naval Battlefield, Available at:https://www.eiva.com/about/eiva-log/jutland-1916-the-archaeology-of-a-naval-battlefield (Accessed: 20 September 2022)
- Michael, Chris (2011) Magnetic imaging of shipwrecks
- Normann, G. (2010) Skibsvrag ved vestkysten. [Nyt oplag]. Ringkøbing: Bollerup Boghandel.
- Pliny the Elder, The Natural History of Pliny, Volume 1 Book IV Chapter 27, Available at: https://www.gutenberg.org/ebooks/57493 (Accessed: 15 September 2022)
- Reid, C. 1913. *Submerged Forests*. London: Cambridge University Press.
- Reimer, P. et al. 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0-55 cal kB. Radiocarbon 62, doi: 10.1017/RDC.2020.41.
- Scottish Power, 'Incredibly rare' underwater discovery could anchor windfarm's place in history Available at: https://www.scottishpower.com/news/pages/incredibly_rare_underwater_discovery_could_anchor_windfarms_place_in_history.aspx (Accessed: 30 September 2022)
- Skriver, C., P.M. Astrup og P, Borup. 2018. Hjarnø Sund – all year, all inclusive. A submerged Late Mesolithic coastal site with organic remains. Journal of Danish Archaeology. pp. 1-23.
- Tarbensen Christensen, C. et al. (1995) De nærer sig af vrag: blandt strandfogeder, bjergere og redningsmænd imellem Nymindegab og Thorsminde. 1. oplag. Kbh: [Foreningen Danmarks Folkeminder].

16. Appendices

16.1. OWF East Anomalies associated with wreck

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	P2P (nT)	Associated SSS	Associated MAG	EQUIP_TYPE
S_FR_B03_0006	5	6284050,96	348875,51	HMS Tarpon submarine (Client ID = Wreck_86)		S_FR_B03_0006		SSS
M-0120	574	6284028,23	348836,46	Associated with HMS Tarpon Submarine Wreck	737,6	S_FR_B03_0006		MAG
M-0707	968	6284078,29	348909,24	Associated with HMS Tarpon Submarine Wreck	602,1	S_FR_B03_0006		MAG
S_FR_B03_0069	47	6284268,86	349881,86	Known wreck (Client ID = Wreck_85)				SSS
S_FR_B03_0015	8	6284132,73	349986,98	Associated with Wreck_85		S_FR_B03_0069		SSS
S_FR_B03_0028	18	6284730,05	350438,49	Associated with Wreck_85,cluster of 3 shadows, anchor?		S_FR_B03_0030		SSS
S_FR_B03_0029	19	6284726,83	350439,08	Associated with Wreck_85,cluster of 3 shadows, anchor?		S_FR_B03_0028		SSS
S_FR_B03_0030	20	6284728,71	350440,18	Associated with Wreck_85,cluster of 3 shadows, anchor?		S_FR_B03_0028		SSS
S_FR_B03_0064	43	6284118,71	350241,95	Associated with Wreck_85, M-0098, 2.24m			M-0098	SSS
M-0098	554	6284116,77	350243,09	Associated with Wreck_85, S_FR_B03_0064, 2.24m	20,4	S_FR_B03_0064		MAG
S_RE_B04_0001	336	6284563,56	350793,41	Associated with Wreck_85, individual object				SSS
M-0725	981	6284266,57	349871,88	Associated with Wreck_85	4794,5	S_FR_B03_0069		MAG
M-0726	982	6284119,75	349890,09	Associated with Wreck_85	7	S_FR_B03_0069		MAG
M-0763	1002	6284112,9	349824,65	Associated with Wreck_85	6	S_FR_B03_0069		MAG
M-0764	1003	6284168,92	349816,84	Associated with Wreck_85	9,4	S_FR_B03_0069		MAG
M-0765	1004	6284259,99	349942,62	Associated with Wreck_85	71,2	S_FR_B03_0069		MAG
M-0766	1005	6284312,47	350006,78	Associated with Wreck_85	9,2	S_FR_B03_0069		MAG
M-0767	1006	6284396,56	350067,42	Associated with Wreck_85	6,4	S_FR_B03_0069		MAG
M-0768	1007	6284512,38	350122,29	Associated with Wreck_85	5,1	S_FR_B03_0069		MAG
S_RE_B01_0324	213	6253311,32	347322,99	Known wreck (Client ID = Wreck_94), M-0328, 2.55m			M-0328	SSS
S_RE_B01_0240	202	6253082,06	346917,06	Associated with wreck_94 or geology/boulder				SSS
S_RE_B01_0327	214	6253331,26	347338,88	Associated with wreck_94		S_RE_B01_0324		SSS
S_RE_B01_0330	216	6253313,15	347364,56	Associated with wreck_94		S_RE_B01_0324		SSS
S_RE_B01_0981	255	6253204,02	347202,99	Associated with wreck_94				SSS
M-0328	753	6253311,33	347320,44	Associated with wreck_94, S_RE_B01_0324, 2.55m	11140,2	S_RE_B01_0324		MAG
M-0054	510	6253290	347393,21	Associated with wreck_94	11,6	S_RE_B01_0324		MAG
M-0300	743	6253353,57	347281,99	Associated with wreck_94	11,4	S_RE_B01_0324		MAG
M-0337	760	6252985,78	347502,5	Associated with wreck_94	5,4	S_RE_B01_0324		MAG
M-0338	761	6253145,43	347340,34	Associated with wreck_94	5,5	S_RE_B01_0324		MAG
M-0364	782	6253211,23	347544,47	Associated with wreck_94	4,7	S_RE_B01_0324		MAG
S_RE_B05_0547	438	6272109,03	358715,58	"Unknown wreck"				SSS
S_RE_B05_0549	439	6272104,95	358725,93	Associated with "Unknown wreck"		S_RE_B05_0547		SSS
M-0186	637	6272101,91	358756,87	Associated with "Unknown wreck"	12	S_RE_B05_0547		MAG
M-1016	1165	6272052,68	358835,97	Associated with "Unknown wreck"	4,5	S_RE_B05_0547		MAG
M-1020	1168	6272110,79	358686,55	Associated with "Unknown wreck"	45,6	S_RE_B05_0547		MAG
M-0192	643	6262434,75	357660,11	Might be 40011a-23	93,9			MAG

16.2. OWF East SSS Anomalies with MAG anomalies

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	P2P (nT)	Associated SSS	Associated MAG	EQUIP_TYPE
S_FR_B06_0345	104	6278208,75	360399,94	debris/boulder field M-0266, 4.28m S_FR_B06_0347			M-0266	SSS
M-0266	713	6278211,89	360397,03	S_FR_B06_0345, 4.28m	11	S_FR_B06_0345		MAG
S_FR_B06_0347	105	6278223,66	360407,64	debris/boulder field M-0266, 15.28m		S_FR_B06_0345		SSS
S_FR_B06_0363	110	6279258,7	360730,68	boulder field M-0245, 3.60m			M-0245	SSS
M-0245	692	6279261,62	360732,79	S_FR_B06_0363, 3.60m	12,4	S_FR_B06_0363		MAG
S_FR_B06_0727	131	6278530,61	364087,72	large boulder with depression/scour			M-0240	SSS
M-0240	687	6278531,82	364079,86		48	S_FR_B06_0727		MAG
S_RE_B01_0173	195	6254101,78	346510,67	square object			M-0039	SSS
M-0039	495	6254099,92	346584,57		768,2	S_RE_B01_0173		MAG
S_RE_B01_0704	240	6249781,92	348758,48	M-0361, 4.59m large boulder			M-0361	SSS
M-0361	779	6249785,66	348755,82	MB_B01_025411, 1.51m and S_RE_B01_0704, 4.59m	6,9	S_RE_B01_0704		MAG
S_RE_B05_0280	321	6270715,36	356969,46	Possible scar NMH, M-0276, 3.85m		S_RE_B05_0278	M-0276	SSS
M-0276	720	6270719,19	356969,08	scar, S_RE_B05_0280, 3.85m	32,5	S_RE_B05_0278		MAG
M-0168	619	6270835,92	357016,27	S_RE_B05_0280, 117.95m	40,4	S_RE_B05_0278		MAG
S_RE_B05_0033	385	6277459,58	354974,79	boulder? M-0933, 1.87m			M-0933	SSS
M-0933	1106	6277459,71	354972,93	Likely linear anomaly, S_RE_B05_0033, 1.87m	9,4	S_RE_B05_0033		MAG
S_RE_B05_0034	386	6278766,97	355022,04	boulder?			M-0949	SSS
M-0949	1116	6278771,96	355016,75		430,3	S_RE_B05_0034		MAG
S_RE_B05_0038	387	6278200,73	355015,1	geology? M-0188, 3.94m			M-0188	SSS
M-0188	639	6278198,42	355018,29	Likely linear anomaly, S_RE_B05_0038, 3.94m and MB_B05_68348, 4	13,8	S_RE_B05_0038		MAG
S_RE_B05_0042	388	6278509,77	355067,73	Elongated			M-0948	SSS
M-0948	1115	6278515,45	355049,59	Likely linear anomaly	64	S_RE_B05_0042		MAG
S_RE_B05_0043	389	6278369,81	355071,35	Possible boulder, M-0951, 3.33m			M-0951	SSS
M-0951	1118	6278371,18	355068,32	Likely linear anomaly, MB_B05_004317, 3.89m and S_RE_B05_0043,	13,1	S_RE_B05_0043		MAG
S_RE_B05_0199	400	6279751,74	356668,74	Angular, M-0248, 1.39m			M-0248	SSS
M-0248	695	6279752,84	356669,6	S_RE_B05_0199, 1.39m	11,2	S_RE_B05_0199		MAG
S_RE_B05_0281	407	6278070,19	357225,38	geology or subbottom M-1003, 4.76m			M-1003	SSS
M-1003	1154	6278073,86	357222,36	S_RE_B05_0281, 4.76m	26,9	S_RE_B05_0281		MAG
S_RE_B05_0336	415	6277438,9	357659,41	buried M-0199, 3.03m			M-0199	SSS
M-0199	650	6277440	357656,59	S_RE_B05_0336, 3.03m	19,7	S_RE_B05_0336		MAG
S_RE_B05_0400	421	6271668,02	357755,16	Within depression NMH, M-0204, 4.26m			M-0204	SSS
M-0204	655	6271672,22	357754,47	S_RE_B05_0400, 4.26m	48,3	S_RE_B05_0400		MAG
S_RE_B05_0464	429	6274918,88	358253,82	strong magnetic buried			M-0261	SSS
M-0261	708	6274914,83	358261,51	Likely linear anomaly	101,9	S_RE_B05_0464		MAG
S_RE_B05_0468	430	6264302,44	357917,71	Slight sediment disturbance, M-0978, 1.15m			M-0978	SSS
M-0978	1137	6264301,29	357917,64	S_RE_B05_0468, 1.15m	12,2	S_RE_B05_0468		MAG
S_RE_B05_0491	434	6276112,36	358462	boulder			M-0172	SSS
M-0172	623	6276121,79	358458,58	MB_B05_016950, 4.30m	19,6	MB_B05_016950		MAG
S_RE_B05_0546	437	6265362,08	358488,63	M-0997, 3.12m			M-0997	SSS
M-0997	1149	6265358,99	358488,16	S_RE_B05_0546, 3.12m	36,7	S_RE_B05_0546		MAG
S_RE_B05_0563	441	6265243,28	358785,09	Possible boulder, M-0171, 3.53m			M-0171	SSS
M-0171	622	6265246,43	358783,48	Likely linear anomaly, S_RE_B05_0563, 3.53m	15,6	S_RE_B05_0563		MAG
S_RE_B05_0574	444	6276788,97	359503,93	M-1042, 0.68m			M-1042	SSS
M-1042	1182	6276789	359504,61	S_RE_B05_0574, 0.68m	23,1	S_RE_B05_0574		MAG
S_RE_B06_0005	452	6278444,07	361480,8	Linear debris, M-1078, 2.68m near scar			M-1078	SSS
M-1078	1209	6278441,47	361481,44	S_RE_B06_0005, 2.68m	8,5	S_RE_B06_0005		MAG
M-0010	466	6284542	342498,48	MB_B01_034316, 3.15m and MB_B01_025656, 0.96m	16,6	MB_B01_025656		MAG
M-0267	714	6278167,04	360046,24	S_FR_B06_0357, 2.14m	49,1	S_FR_B06_0357		MAG
M-0284	728	6264648,3	356818,19	Likely linear anomaly, MB_B05_000021, 0.83m	53,6	MB_B05_000021		MAG

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	P2P (nT)	Associated SSS	Associated MAG	EQUIP_TYPE
M-1029	1171	6283047,35	357930,43	MB_B05_017172, 4.79m and MB_B05_017080, 4.58m and MB_B05_010612	54,9	MB_B05_010612		MAG

16.3. OWF East MMO Anomalies with high to medium potential

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	Associated SSS	EQUIP_TYPE
S_FR_B03_0024	14	6280735,76	350255,06	debris cluster with S_FR_B03_0025	S_FR_B03_0027	SSS
S_FR_B03_0025	15	6280722,56	350254,89	cluster with S_FR_B03_0024	S_FR_B03_0024	SSS
S_FR_B03_0026	16	6280726,3	350258,84	Linear debris with cluster S_FR_B03_0024 and S_FR_B03_0025	S_FR_B03_0024	SSS
S_FR_B03_0027	17	6280757,38	350279,65	cluster with S_FR_B03_0024 and cluster with S_FR_B03_0026	S_FR_B03_0024	SSS
S_FR_B03_0047	32	6262996,15	350864,71	Possible chain NMH		SSS
S_FR_B03_0050	35	6266283,16	351843,11	isolated object, round with scour/depression		SSS
S_FR_B03_0086	51	6254410,8	351717,03	Possible fishing gear with debris to south		SSS
S_FR_B06_0553	125	6276745,79	361983,44	Possible debris field		SSS
S_FR_B06_0793	133	6279446,99	364374,96	Anchor?		SSS
S_RE_B01_0004	143	6284444	342537,2	Square object		SSS
S_RE_B01_0006	144	6283107,94	342810,54	Square object		SSS
S_RE_B01_0153	186	6270210,91	346089,29	Linear debris		SSS
S_RE_B01_1083	268	6281622,86	344464,25	Possible sediment mound wreck shpae?		SSS
S_RE_B01_1085	269	6277399,51	345201,02	Possible debris		SSS
S_RE_B04_0374	350	6283021,13	353467,39	plate? debris Possible fishing gear S_RE_B04_0438		SSS
S_RE_B04_0438	351	6283072,58	353586,81	Possible fishing gear S_RE_B04_0374		SSS
S_RE_B04_0709	352	6273844,15	353732,36	Strong return, seems boulder field, but with a straight edge		SSS
S_RE_B04_0832	353	6276396,29	354023,62	Linear debris		SSS
S_RE_B04_1270	362	6259244,69	354490,31	debris, object and linear and depression S_RE_B04_1271		SSS
S_RE_B04_1271	363	6259246,69	354490,61	debris	S_RE_B04_1270	SSS
S_RE_B05_0007	380	6284059,39	354522,77	Possible fishing gear with rope/chain, sure anomaly, but modern		SSS
S_FR_B05_0775	74	6284071,76	354526,65	Possible fishing gear with rope/chain. NMH.	S_RE_B05_0007	SSS
S_FR_B05_0776	75	6284094,82	354542,44	Possible fishing gear with rope/chain	S_RE_B05_0007	SSS

16.4. OWF East Anomalies with low potential

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	Associated SSS	EQUIP_TYPE
S_FR_B03_0009	7	6279475,8	349467,29	Object 2x2m		SSS
S_FR_B03_0021	11	6272864,53	349877,66	Isolated object sticking up		SSS
S_FR_B03_0022	12	6285412,14	350344,22	Object sticking up and having a surface with depression/scour		SSS
S_FR_B03_0033	23	6277564,45	350397,78	round and linear		SSS
S_FR_B03_0035	24	6276869,94	350490,91	Linear debris		SSS
S_FR_B03_0049	34	6262336,58	351354,78	isolated object sticking up		SSS
S_FR_B03_0055	38	6251966,09	351666,85	isolated object, M-0286 156.35m, trawl scar close by		SSS
S_FR_B03_0059	41	6266175,58	352722,39	Possible net NMH		SSS
S_FR_B03_0074	48	6268284,62	349627,44	Possible debris field		SSS
S_FR_B03_0076	49	6279207,49	348166,62	isolated object with depression		SSS
S_FR_B03_0108	62	6280096,27	350352,39	Possible linear debris NMH		SSS
S_FR_B03_0112	63	6275852,03	350971,65	Linear debris		SSS
S_FR_B03_0124	65	6267449,6	352295,26	debris in trawl mark		SSS
S_FR_B03_0127	66	6256597,39	353956,68	isolated object with marks in the sediment nearby		SSS
S_FR_B04_2288	69	6280178,37	351728,82	round objct with long shadow, possible boulder		SSS
S_FR_B04_2353	70	6273464,08	353090	isolated object 2x1m		SSS

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	Associated SSS	EQUIP_TYPE
S_FR_B04_2690	71	6275517,62	354279,06	isolated object 2x1m		SSS
S_FR_B04_2697	72	6262010,07	356185,96	object with deep marks in the sediment		SSS
S_FR_B06_0051	78	6277229,35	360996,94	cluster of buried debris S_FR_B06_0052		SSS
S_FR_B06_0052	79	6277204,5	361009,63	cluster of buried debris S_FR_B06_0051	S_FR_B06_0051	SSS
S_FR_B06_0056	83	6276705,16	361077,28	debris field 70x50m		SSS
S_FR_B06_0057	84	6276703,43	361075,11	debris field 70x50m	S_FR_B06_0056	SSS
S_FR_B06_0058	85	6276703,36	361105,1	debris field 70x50m	S_FR_B06_0056	SSS
S_FR_B06_0059	86	6276660,15	361121,97	debris field 70x50m	S_FR_B06_0056	SSS
S_FR_B06_0080	87	6276663,7	361055,35	debris field 70x50m	S_FR_B06_0056	SSS
S_FR_B06_0081	88	6276952,46	360946,29	isolated object		SSS
S_FR_B06_0243	94	6278891,05	360218,07	possible sediment		SSS
S_FR_B06_0331	101	6277221,38	361819,74	object in trawl mark 1,5m		SSS
S_FR_B06_0431	114	6282257	360684,08	possible sediment		SSS
S_FR_B06_0458	117	6280972,03	362353,14	possible boulder/sediment		SSS
S_FR_B06_0490	118	6280234,32	362969,48	individual debris buried by ripples cluster of objects to SE		SSS
S_FR_B06_0491	119	6280216,44	362971,18		S_FR_B06_0490	SSS
S_FR_B06_0544	121	6279734,38	364218,75	Elongated		SSS
S_FR_B06_0552	124	6277197,44	361934,02	isolated object semi-buried, chain to E?		SSS
S_FR_B06_0572	127	6277647,28	362322,84	individual object		SSS
S_FR_B06_0583	128	6277397,12	362648,39	debris field with fishing gear		SSS
S_FR_B06_0729	132	6278274,4	364217,59	possible boulder and sediment but with right angle		SSS
S_FR_B06_0828	135	6278984,78	363360,36	isolated object		SSS
S_FR_B06_0838	136	6278842,17	362592,05	object buried by ripples clusters to NE and SW		SSS
S_FR_B06_0894	139	6282537,06	359788,74	anchor chain or possible sediment S_FR_B06_0895		SSS
S_FR_B06_0895	140	6282487,54	359806,41	52.22m S_FR_B06_0894	S_FR_B06_0894	SSS
S_FR_B06_0897	141	6279123,09	363583,29	object with scour		SSS
S_FR_B06_1015	142	6278317,37	360571,64	possible sediment		SSS
S_RE_B01_0007	145	6279722,19	342815,65	close to trawl scar		SSS
S_RE_B01_0008	146	6282556,68	342922,73	Elongated in debris field		SSS
S_RE_B01_0009	147	6280944,91	343052,31	scar or sediment		SSS
S_RE_B01_0010	148	6280946,05	343053,47	scar or sediment	S_RE_B01_0009	SSS
S_RE_B01_0020	149	6279132,95	343438,26	object or scar		SSS
S_RE_B01_0025	150	6279422,67	343607,28	Appears to have moved since last survey line		SSS
S_RE_B01_0029	151	6281192,59	343739,18	possible debris S_RE_B01_0030		SSS
S_RE_B01_0030	152	6281191,04	343740,07	possible debris S_RE_B01_0029	S_RE_B01_0029	SSS
S_RE_B01_0089	157	6274042,21	345086,9	clear object with depression around 2x2m		SSS
S_RE_B01_0090	158	6264867,62	344757,81	possible geology		SSS
S_RE_B01_0093	159	6265717,29	344887,16	anchor?		SSS
S_RE_B01_0106	162	6271997,37	345461,23	boulder		SSS
S_RE_B01_0108	163	6274036,46	345574,98	sediment		SSS
S_RE_B01_0109	164	6266601,12	345303,5	debris with depression		SSS
S_RE_B01_0111	165	6264903,34	345302,2	Cluster S_RE_B01_0113		SSS
S_RE_B01_0113	166	6264906,53	345306,49	Cluster	S_RE_B01_0111	SSS
S_RE_B01_0114	167	6270466,1	345510,17	strange sediment		SSS
S_RE_B01_0116	168	6264393,85	345305,59	rectangular object		SSS
S_RE_B01_0117	169	6269502,09	345533,85	sediment		SSS
S_RE_B01_0118	170	6270910,93	345604,45	unidentified		SSS
S_RE_B01_0119	171	6273260,78	345754,51	sediment geology		SSS
S_RE_B01_0125	172	6265933,86	345622,66	geology S_RE_B01_0126		SSS
S_RE_B01_0126	173	6265924,66	345637,45		S_RE_B01_0125	SSS
S_RE_B01_0137	177	6265027,24	345731,29	Possible debris		SSS

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	Associated SSS	EQUIP_TYPE
S_RE_B01_0141	179	6272042,36	346004,49	anomaly in sand waves		SSS
S_RE_B01_0144	180	6260784,12	345624,48	Linear debris		SSS
S_RE_B01_0145	181	6260472,36	345614,97	Possible debris		SSS
S_RE_B01_0154	187	6262157,79	345805,58	possible fishing gear		SSS
S_RE_B01_0159	190	6257820,35	345822,16	Elongated		SSS
S_RE_B01_0160	191	6267109,24	346302,58	possible sediment, depression		SSS
S_RE_B01_0165	193	6266952,3	346546,74	individual object		SSS
S_RE_B01_0173	195	6254101,78	346510,67	square object		SSS
S_RE_B01_0175	197	6251658,84	346451,62	Linear debris		SSS
S_RE_B01_0178	198	6251397,17	346489,75	Possible debris or boulder cluster		SSS
S_RE_B01_0216	200	6250504,53	346747,25	Possible debris within depression S_RE_B01_0217		SSS
S_RE_B01_0217	201	6250506,51	346748,9	Possible debris within depression	S_RE_B01_0216	SSS
S_RE_B05_0273	204	6269309,99	356890,21	Possible debris near scars		SSS
S_RE_B01_0309	206	6254694,91	347258,49	debris or scar		SSS
S_RE_B01_0310	207	6248997,09	347063,3	debris with S_RE_B01_0311		SSS
S_RE_B01_0311	208	6249005,37	347064,21	debris	S_RE_B01_0310	SSS
S_RE_B01_0314	209	6249238,42	347084,87	debris		SSS
S_RE_B01_0322	211	6250549,09	347213,97	Possible debris or boulder cluster		SSS
S_RE_B01_0323	212	6250548,49	347221,73	Possible debris or boulder cluster	S_RE_B01_0322	SSS
S_RE_B01_0329	215	6255057,06	347425,06	individual object		SSS
S_RE_B01_0333	218	6249503,93	347401,89	boulder cluster?		SSS
S_RE_B01_0334	219	6249522,26	347403,59	boulder cluster?	S_RE_B01_0333	SSS
S_RE_B01_0337	222	6251732,71	347782,91	boulder?		SSS
S_RE_B01_0338	223	6251662,76	347803,28	sediment		SSS
S_RE_B01_0339	224	6252362,53	347912,83	anchor?		SSS
S_RE_B01_0343	226	6252030,86	347954,93	object		SSS
S_RE_B01_0344	227	6249105,64	347865,17	scar		SSS
S_RE_B01_0345	228	6247885,11	347830,93	object		SSS
S_RE_B01_0358	233	6248289,65	348517,61	Linear debris		SSS
S_RE_B01_0682	238	6267627,86	344328,96	Possible fishing gear		SSS
S_RE_B01_0684	239	6266755,59	344439,16	Possible fishing gear		SSS
S_RE_B01_0705	241	6249750,99	348484,5	possible geology		SSS
S_RE_B01_0724	242	6262951,96	344937,54	possible geology or buried object		SSS
S_RE_B01_0777	243	6266709,68	344541,61	Possible debris weak return		SSS
S_RE_B01_0888	247	6267653,62	344949,36	Possible linear debris or sediment		SSS
S_RE_B01_0895	248	6258507,83	346171,57	Possible linear debris or sediment		SSS
S_RE_B01_0923	250	6259204,74	346334,61	Possible debris or scar		SSS
S_RE_B01_0936	251	6265574,96	345516,86	Possible linear debris or sediment		SSS
S_RE_B01_0949	252	6281369,6	343598,52	Possible debris NMH		SSS
S_RE_B01_0957	253	6275514,78	344442,19	Possible debris weak return, anchor?		SSS
S_RE_B01_0980	254	6256501,65	346792,17	Possible debris		SSS
S_RE_B01_0995	258	6261207,51	346414,02	Possible debris		SSS
S_RE_B01_1013	260	6257842	346828,17	Possible linear debris or sediment		SSS
S_RE_B01_1014	261	6257499,75	346966,98	Possible debris weak return		SSS
S_RE_B01_1015	262	6256911,75	347045,69	Possible debris or scar		SSS
S_RE_B01_1069	267	6270162,13	345901,8	Possible debris		SSS
S_RE_B02_0023	283	6284763,64	345287,12	debris field		SSS
S_RE_B02_0025	284	6284000,18	345628,76	debris with S_RE_B02_0026		SSS
S_RE_B02_0026	285	6283998,89	345629,32		S_RE_B02_0025	SSS
S_RE_B02_0027	286	6280006,5	346247,1	possible sediment scar		SSS
S_RE_B02_0029	288	6280384,09	347154,65	possible sediment geology		SSS

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	Associated SSS	EQUIP_TYPE
S_RE_B02_0031	290	6271603,15	347001,06	debris field		SSS
S_RE_B02_0032	291	6269715,04	346961,72	debris with scour		SSS
S_RE_B02_0035	293	6273522,19	347519,36	possible fishing gear		SSS
S_RE_B02_0046	300	6254203,21	348705,08	Strong return debris S_RE_B02_0047		SSS
S_RE_B02_0047	301	6254201,71	348706,33	Possible debris	S_RE_B02_0046	SSS
S_RE_B02_0048	302	6256002,49	348797,78	boulder		SSS
S_RE_B02_0049	303	6252448,12	348872,89	circular object		SSS
S_RE_B02_0091	309	6251318,99	349504,47	Linear debris		SSS
S_RE_B02_0129	313	6253379,4	349875,14	close to trawl marks		SSS
S_RE_B02_0141	314	6253478,81	350088,63	possible debris with S_RE_B02_0142 144 145		SSS
S_RE_B02_0142	315	6253478,24	350089,51	possible debris	S_RE_B02_0141	SSS
S_RE_B02_0144	316	6253484,38	350090,51	possible debris	S_RE_B02_0141	SSS
S_RE_B02_0145	317	6253456,06	350094,78	possible debris	S_RE_B02_0141	SSS
S_RE_B02_0165	319	6255122,06	350672,52	possible debris		SSS
S_RE_B02_0166	320	6255250,09	350703,23	possible debris		SSS
S_RE_B02_0304	328	6252502,24	349190,03	geology		SSS
S_RE_B02_0397	330	6280944,86	346705,36	Linear debris with scour		SSS
S_RE_B02_0406	333	6272085,38	348372,4	possible scar		SSS
S_RE_B02_0408	334	6258590,72	349964,36	possible geology		SSS
S_RE_B02_0409	335	6258590,76	349966,7		S_RE_B02_0408	SSS
S_RE_B04_0006	337	6280769,44	351198,32	object with scour		SSS
S_RE_B04_0111	341	6283989,17	352330	Linear debris, possible UXO		SSS
S_RE_B04_0153	342	6281581,56	352453,59	linear debris		SSS
S_RE_B04_0340	346	6274079,94	352799	geology in depression		SSS
S_RE_B04_0346	347	6274152,74	352824,81	geology in depression		SSS
S_RE_B04_0360	348	6284423,36	353318	debris anchor?		SSS
S_RE_B04_1291	364	6258387,24	354530,56	boulder		SSS
S_RE_B04_1342	366	6258609,12	354775,68	buried object, linear		SSS
S_RE_B04_1372	372	6262746,06	356268,6	beside long linear scar/anomaly		SSS
S_RE_B04_1377	373	6264610,63	356465,61	Cluster		SSS
S_RE_B04_1408	375	6263015,44	356617,38	boulder		SSS
S_RE_B04_1416	376	6264096,24	356679,06	boulder with scour S_RE_B05_0267		SSS
S_RE_B05_0267	403	6264098,67	356678,3	boulder	S_RE_B04_1416	SSS
S_RE_B04_1421	377	6263765,19	356685,04	debris		SSS
S_RE_B04_1422	378	6263880,04	356690,12	linear object with depression		SSS
S_RE_B05_0016	382	6281810,26	354706,67	unidentified		SSS
S_RE_B05_0028	384	6278120,65	354965,27	Possible boulder		SSS
S_RE_B05_0121	392	6277168,59	355788,36	geology		SSS
S_RE_B05_0170	397	6276204,11	356264,71	Possible boulder		SSS
S_RE_B05_0183	398	6279224,62	356504,76	object		SSS
S_RE_B05_0198	399	6283251,67	356783,46	Elongated with scouring		SSS
S_RE_B05_0213	401	6281618,09	356845,25	Possible boulder		SSS
S_RE_B01_0300	406	6254685,29	347190,06	Within depression strong return small shadow S_RE_B01_0309		SSS
S_RE_B05_0309	410	6271813,89	357249,21	subbottom		SSS
S_RE_B05_0323	411	6283582,42	357742,55	Elongated strong return		SSS
S_RE_B05_0331	414	6263622,4	357146,46	Possible debris strong return		SSS
S_RE_B05_0366	418	6281139,23	357922,7	elongated		SSS
S_RE_B05_0374	420	6264873,47	357414,06			SSS
S_RE_B05_0412	423	6279944,81	358108,92	Possible debris or boulder		SSS
S_RE_B05_0434	424	6262976,07	357630,73	strong return		SSS
S_RE_B05_0442	426	6265289,87	357751,69	Possible debris or boulder		SSS

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	Associated SSS	EQUIP_TYPE
S_RE_B05_0461	428	6281872,1	358464,51	Elongated		SSS
S_RE_B05_0544	436	6279542,45	358946,56	Elongated		SSS
S_RE_B05_0557	440	6270122,16	358836,29	Linear debris		SSS
S_RE_B05_0580	446	6265831,66	359264,24	Elongated		SSS
S_RE_B06_0002	449	6279953,09	360758,67	Elongated boulder		SSS
S_RE_B06_0004	451	6278873,75	361212,06	boulder with scour		SSS
S_RE_B06_0007	453	6279550,24	362411,61	Cluster geology		SSS
S_RE_B06_0008	454	6278030,59	363376,94	Debris or very large boulder		SSS
S_RE_B05_0278	405	6270732,95	356958,79	scar?		SSS
S_RE_B01_0158	189	6260782,52	345926,5	possible sediment mound		SSS

16.5. OWF East MAG Anomalies ≥50nT

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	P2P (nT)	EQUIP_TYPE
M-0008	464	6263145,99	345009,87		141,4	MAG
M-0067	523	6264010,33	348567,08		116,2	MAG
M-0072	528	6259229,83	350236,17		51,3	MAG
M-0101	557	6262557,44	352987,67		50,8	MAG
M-0127	581	6277504,85	354895,36	Likely linear anomaly	53,7	MAG
M-0223	672	6277304,87	360636,13		53,6	MAG
M-0278	722	6268113,42	344431,32		50,6	MAG
M-0282	726	6266818,46	350110,59		348,3	MAG
M-0286	730	6251879,47	351536,72		51,5	MAG
M-0430	830	6262421,56	347572,05		52,6	MAG
M-0501	864	6265841,02	348478,13		51,2	MAG
M-0657	941	6277014,56	348961,78		107,8	MAG
M-0682	951	6279865,88	348808,31		159,7	MAG
M-0683	952	6279812,26	348815,08		59,5	MAG
M-0699	964	6266286,91	351312,77		79,9	MAG
M-0715	972	6281606,36	349785,91		70,2	MAG
M-0728	983	6282883,8	350259,17		71,1	MAG
M-0795	1025	6276373,8	351794,3		129,7	MAG
M-0804	1033	6268153,08	352981,19		63,4	MAG
M-0852	1060	6259486,88	354789,21		100,8	MAG
M-0855	1063	6269364,76	353744,26		50,7	MAG
M-0883	1077	6258954,84	355210,15		58,9	MAG
M-0891	1085	6266583,16	355155,67		104,5	MAG
M-0971	1132	6273441,07	356542,21		87,8	MAG
M-1043	1183	6275871,82	359620,52		184,4	MAG

16.6. OWF East MAG Anomalies ≥40nT

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	P2P (nT)	EQUIP_TYPE
M-0065	521	6251183,01	348578,2		42,1	MAG
M-0078	534	6268645,98	348824,7		44,4	MAG
M-0114	568	6253221,4	352056,64		46,8	MAG
M-0240	687	6278531,82	364079,86		48	MAG
M-0247	694	6279985,21	358498,3	Long wavelength	48,3	MAG
M-0262	709	6273908,37	358270,45		43,8	MAG
M-0263	710	6272316,93	361602,79		47,1	MAG

TARGETID	OBJECTID	Latitude	Longitude	COMMENT	P2P (nT)	EQUIP_TYPE
M-0295	738	6252802,54	350855,83		47,1	MAG
M-0595	909	6261810,96	350259,6		40,6	MAG
M-0658	942	6280735,22	348628,94		43,5	MAG
M-0687	956	6255331,39	352143,27		47,7	MAG
M-0714	971	6284582,52	349054,66		42,3	MAG
M-0769	1008	6283345,76	349565,51		43,5	MAG
M-0832	1043	6277705,18	352189,75		43	MAG
M-0890	1084	6270765,37	354624,12		48,1	MAG
M-0928	1103	6265366,22	356300,28		41,1	MAG
M-0929	1104	6269576,33	355763,53		49,9	MAG
M-0931	1105	6274020,17	355056,83		44,2	MAG
M-1030	1172	6276810,61	358724,55		48,4	MAG

16.7. OWF West anomalies associated with wrecks

Line_name	Object ID	Latitude	Longitude	COMMENT	P2P (nT)	Associated SSS	Associated MAG
EAR1198P01	357	6263724,89	340573,85	M/V Fallwind Wreck debris	1335,98	EA_R_SSS_00580	
EAR1196P01	379	6263490,31	340478,48	M/V Fallwind Wreck debris	617,069	EA_R_SSS_00580	
EAR1199P01	399	6263627,23	340651,11	M/V Fallwind Wreck debris	427,773	EA_R_SSS_00580	
EAR1195J02	654	6263875,93	340353,23	M/V Fallwind Wreck debris	75,892		
EAR1195P01	840	6263908,34	340362,27	M/V Fallwind Wreck debris	45,405		
EAR1195J02	899	6263925,41	340347,12	M/V Fallwind Wreck debris	40,473		
EAR1199P01	5034	6263754,26	340634,62	M/V Fallwind Wreck debris	691,987	EA_R_SSS_00580	
EA_R_SSS_00190		6263719,349	340565,591	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_00191		6263495,952	340482,444	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_00579		6263736,32	340584,054	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_00581		6263704,876	340594,059	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_00582		6263688,602	340620,462	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_00645		6263626,436	340649,073	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_00646		6263645,264	340645,481	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_00647		6263650,23	340644,531	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_01362		6263489,364	340712,988	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_01364		6263723,302	340570,476	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_01365		6263727,745	340574,708	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_01511		6263669,863	340453,149	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_01512		6263420,775	340398,56	M/V Fallwind Wreck debris		EA_R_SSS_00580	
EA_R_SSS_00580		6263664,835	340612,439	M/V Fallwind Wreck debris			EAR1198P01
EAP2177P01	190	6279522	337240,29	L409 Sally debris	188,739	EA_P_SSS_00591	
EA_P_SSS_00591		6279528,756	337224,948	L409 Sally debris			EAP2177P01
EA_P_SSS_01584		6279537,868	337267,837	L409 Sally debris		EA_P_SSS_00591	
EA_P_SSS_00004		6279572,816	337257,071	L409 Sally debris		EA_P_SSS_00591	
EA_P_SSS_00002		6279574,968	337265,393	L409 Sally debris		EA_P_SSS_00591	
EAD1048P01	1411	6253299,98	332449,28	Might be associated with 40011a-36	48,856		

16.8. OWF West SSS anomalies with high to medium potential

TARGETID	Latitude	Longitude	COMMENT	Associated SSS	Associated MAG
EA_C_SSS_02132	6262471,316	329114,298	Unidentified		
EA_F_SSS_00101	6258252,635	333343,454	Debris_Suspected Debris		
EA_G_SSS_00079	6254560,931	335282,874	Debris_Suspected Debris		

TARGETID	Latitude	Longitude	COMMENT	Associated SSS	Associated MAG
EA_G_SSS_00082	6266274,735	332906,389	Debris_Suspected Debris		
EA_G_SSS_00170	6255290,118	335122,352	Debris_Suspected Debris		
EA_G_SSS_00144	6255343,438	334891,629	Seabed Mound		
EA_G_SSS_00326	6266187,505	333143,859	Seabed Mound		
EA_G_SSS_00322	6261381,716	333848,095	Unidentified		
EA_H_SSS_00005	6256758,178	335056,578	Debris_Suspected Debris		
EA_H_SSS_00043	6269434,238	333521,221	Debris_Suspected Debris		
EA_H_SSS_00156	6252091,761	336392,202	Debris_Suspected Debris		
EA_H_SSS_00175	6246598,458	336802,601	Debris_Suspected Debris		
EA_H_SSS_00278	6261382,602	334911,688	Isolated Depression_Pockmark		
EA_H_SSS_00410	6268184,286	333730,575	Isolated Depression_Pockmark		
EA_H_SSS_00454	6268012,529	334131,654	Isolated Depression_Pockmark		
EA_H_SSS_00128	6268245,371	334329,146	Seabed Mound		
EA_H_SSS_00245	6251954,464	336037,754	Seabed Mound		
EA_H_SSS_00422	6260395,588	334809,929	Seabed Mound		
EA_J_SSS_00230	6247904,652	337298,617	Debris_Suspected Debris		
EA_J_SSS_00387	6248171,008	337095,483	Debris_Suspected Debris		
EA_J_SSS_00550	6255973,835	336182,645	Debris_Suspected Debris		
EA_K_SSS_00065	6256552,755	337418,994	Debris_Suspected Debris		
EA_K_SSS_00226	6250371,658	337935,647	Debris_Suspected Debris		
EA_K_SSS_00299	6277192,457	334769,161	Debris_Suspected Debris		
EA_K_SSS_00531	6253495,105	337924,437	Debris_Suspected Debris		
EA_K_SSS_00245	6267069,155	335556,218	Seabed Mound		
EA_K_SSS_00730	6262680,269	336120,735	Seabed Mound		
EA_M_SSS_00019	6252018,421	338767,247	Debris_Suspected Debris		
EA_M_SSS_00034	6253595,94	338545,438	Debris_Suspected Debris		
EA_M_SSS_00084	6253773,919	338304,527	Debris_Suspected Debris		
EA_M_SSS_00138	6263713,87	337426,222	Debris_Suspected Debris		
EA_M_SSS_00277	6265059,289	336797,087	Debris_Suspected Debris		
EA_M_SSS_00386	6264919,803	336987,865	Debris_Suspected Debris	EA_M_SSS_00277	
EA_M_SSS_00512	6279327,157	335072,624	Debris_Suspected Debris		
EA_M_SSS_00574	6253515,325	338281,818	Debris_Suspected Debris		
EA_M_SSS_00587	6264915,836	336989,196	Debris_Suspected Debris	EA_M_SSS_00277	
EA_M_SSS_00065	6247921,284	339198,626	Seabed Mound		
EA_M_SSS_00585	6264931,361	336985,57	Seabed Mound	EA_M_SSS_00277	
EA_M_SSS_00586	6264910,124	336986,283	Seabed Mound	EA_M_SSS_00277	
EA_N_SSS_00270	6261826,177	338329,131	Debris_Suspected Debris		
EA_N_SSS_00430	6253662,546	339493,985	Debris_Suspected Debris		
EA_N_SSS_00485	6280211,941	336442,832	Debris_Suspected Debris		
EA_N_SSS_00871	6253655,882	339493,029	Debris_Suspected Debris	EA_N_SSS_00430	
EA_N_SSS_01428	6248327,333	340259,207	Unidentified		
EA_P_SSS_00033	6246238,878	341436,232	Debris_Suspected Debris		
EA_P_SSS_00038	6246815,033	341333,443	Debris_Suspected Debris		
EA_P_SSS_00135	6262478,556	339360,369	Debris_Suspected Debris		
EA_P_SSS_01033	6264100,02	339053,677	Debris_Suspected Debris		
EA_P_SSS_01098	6245831,077	341438,659	Debris_Suspected Debris		
EA_Q_SSS_00019	6273095,816	339041,608	Debris_Suspected Debris		
EA_Q_SSS_00021	6273012,85	339050,155	Debris_Suspected Debris	EA_Q_SSS_00019	
EA_Q_SSS_00080	6259929,766	340686,366	Debris_Suspected Debris		
EA_Q_SSS_00083	6256500,98	341116,769	Debris_Suspected Debris		
EA_Q_SSS_00087	6252705,191	341619,864	Debris_Suspected Debris		

TARGETID	Latitude	Longitude	COMMENT	Associated SSS	Associated MAG
EA_Q_SSS_00631	6271817,812	338360,113	Debris_Suspected Debris		
EA_Q_SSS_01002	6271145,474	338924,075	Debris_Suspected Debris		
EA_Q_SSS_01172	6277473,308	338404,546	Debris_Suspected Debris		
EA_Q_SSS_00493	6245949,731	341966,841	Debris_Suspected Debris		
EA_Q_SSS_02169	6265124,004	339902,466	Debris_Suspected Debris		
EA_Q_SSS_02182	6272727,104	339113,809	Debris_Suspected Debris		
EA_R_SSS_00724	6273051,634	339165,566	Debris_Suspected Debris	EA_Q_SSS_00019	
EA_R_SSS_00862	6281319,565	338632,052	Debris_Suspected Debris		
EA_S_SSS_00394	6254635,225	342989,262	Debris_Suspected Debris		
EA_T_SSS_00023	6258109,744	343036,419	Debris_Suspected Debris		
EA_T_SSS_00727	6257991,448	342931,71	Debris_Suspected Debris		
EA_T_SSS_01533	6257834,274	342720,704	Debris_Suspected Debris		
EA_U_SSS_00400	6266186,272	342919,92	Debris_Suspected Debris		
EA_U_SSS_00366	6267643,094	342573,599	Debris_Suspected Debris		
EA_U_SSS_00112	6279736,865	340821,337	Debris_Suspected Debris		
EA_U_SSS_00486	6255904,546	343950,155	Debris_Suspected Debris		
EA_U_SSS_00476	6259648,24	343453,853	Debris_Suspected Debris		
EA_U_SSS_00470	6261554,097	343487,021	Debris_Suspected Debris		
EA_U_SSS_00394	6266409,967	342795,364	Debris_Suspected Debris		
EA_U_SSS_00405	6265620,009	342657,114	Debris_Suspected Debris		
EA_U_SSS_00347	6268936,556	342456,526	Debris_Suspected Debris		
EA_V_SSS_00154	6258291,822	344530,086	Debris_Suspected Debris		
EA_V_SSS_00601	6271934,834	343081,548	Debris_Suspected Debris		
EA_V_SSS_00745	6260204,768	344137,26	Unidentified		EAV1247P02
EA_Y_SSS_00345	6251397,935	346491,066	Debris_Suspected Debris		EAY1267P01
EA_Y_SSS_00389	6247292,205	346787,218	Debris_Suspected Debris		
EA_Y_SSS_00416	6262767,68	344831,66	Debris_Suspected Debris		
EA_Y_SSS_00796	6260187,651	345247,915	Debris_Suspected Debris		
EA_V_SSS_00154	6257614,066	344618,337	Debris		
EA_Q_SSS_00912	6265426,961	339617,02	Debris		

16.9. OWF West MAG Anomalies ≥50nT

Line_name	OBJECTID	Latitude	Longitude	P2P (nT)
EAD1042P01	1	6249761,13	332523,69	298,905
EAD1040P01	19	6249787,59	332392,96	196,698
EAC6025P01	79	6261200,39	329993,33	73,395
EAC6001P01	98	6252197,25	329630,46	61,261
EAD1044P01	109	6249349,88	332700,59	55,422
EAC2013P01	121	6263196,18	328985,16	51,641
EAD1042P01	127	6255117,22	331838,13	50,997
EAQ1188P01	235	6265028,75	339778,45	57,816
EAQ1190P01	238	6253413,9	341382,83	55,322
EAQ1186P01	245	6279382,13	337825,14	54,142
EAQ1191P01	580	6273917,12	338832,84	117,085
EAR1198P01	615	6272882,26	339408,88	95,202
EAR1194P01	653	6258516,03	340989,4	75,974
EAQ2185P01	709	6252240,83	341216,8	58,619
EAQ1191P01	716	6279402,32	338136,39	57,239
EAQ1192P01	756	6248887,37	342081,84	52,119
EAR1199P01	778	6279285,76	338653,74	51,028

Line_name	OBJECTID	Latitude	Longitude	P2P (nT)
EAS1218P01	906	6280486,59	339696,46	107,298
EAT1226P01	984	6270390,97	341488,57	165,458
EAT1231P01	991	6262223,96	342844,22	150,055
EAT1220P01	1006	6257209,22	342790,37	123,405
EAT1226P01	1032	6252363,47	343783,44	87,533
EAT1227P01	1035	6254333,12	343594,62	85,762
EAU1232P01	1137	6254679,88	343868,83	150,55
EAV1250P02	1175	6254155,8	345061,91	145,306
EAU6241P01	1191	6267829,55	342758,19	116,993
EAY1268P01	1201	6268110,5	344436,62	109,85
EAV1244P02	1215	6269224,86	342774,72	98,863
EAY2257P01	1267	6263346,88	344340,38	62,781
EAE1055P01	1328	6256235,54	332519,6	96,95
EAD1047P01	1345	6257596,51	331838,77	77,795
EAE1062P02	1350	6255417,46	333062,02	76,218
EAE1059P01	1370	6247720,95	333851,23	63,342
EAE1062P02	1395	6255446,89	333058,19	51,41
EAD2041P01	1402	6268042,65	330131,16	50,235
EAF2069P01	1452	6248529,11	334379,64	332,071
EAF1072P01	1477	6255404,43	333697,61	153,464
EAG1088P01	1485	6246238,39	335867,28	141,389
EAG1086P01	1492	6246153,56	335753,69	139,306
EAF1079P01	1512	6258085,87	333795,85	135,925
EAG1087P01	1607	6246139,39	335821,18	95,929
EAF1079P01	1728	6258110,85	333792,81	63,685
EAF1074P01	1761	6275455,08	331270,95	56,825
EAH2109P03	2207	6273327,85	333742,78	52,875
EAJ6121P01	2340	6256773,41	336607,64	61,87
EAJ1122P01	2350	6276962,77	334101,1	54,418
EAJ1116P01	2352	6270427,77	334555,6	54,1
EAK1138P01	2362	6277998,33	334979,37	52,389
EAM1152R02	2404	6249887,45	339437,95	68,294
EAK2133P01	2428	6273183,07	335273,63	51,386
EAN1154P01	2432	6245938,38	340062,28	50,277
EAP1179P01	2550	6264668,31	339254,05	116,027
EAP1178J01	2561	6248518,09	341290,96	75,124
EAP1167P01	2567	6268865,77	337967,96	69,061
EAN2153P01	2597	6249853,11	339502,55	52,093
EAC1011P01	2670	6262580,42	328941,17	104,919
EAC1023P01	2774	6256383,59	330479,4	53,138
EAC1011P01	2808	6258570,27	329450,94	52,844
EAC1002R01	2921	6257463,7	329022,86	108,193
EAD1047J01	3182	6250805,24	332734,07	68,072
EAD1046P01	3618	6250688,12	332657,09	57,45
EAR1200P01	5248	6280563,7	338555,97	225,124
EAR1196P01	5397	6276052,18	338875,9	50,542
EAR1196P01	5514	6246875,52	342594,26	535,953
EAR1194P01	5729	6249469,9	342139,82	76,019
EAR1204P01	5897	6270356,87	340105,51	61,411
EAR1206P01	5981	6247459,6	343147,48	371,756
EAS1216P01	6662	6262717,78	341836,1	74,109

Line_name	OBJECTID	Latitude	Longitude	P2P (nT)
EAS1216P01	6694	6279996,19	339640,36	88,449
EAS1215P01	6927	6255735,95	342659,96	176,383
EAS1207P01	7048	6248264,74	343107,27	88,468
EAT1226P01	7501	6267120,48	341906,97	109,912
EAU1238P01	7755	6283920,89	340519,95	85,661
EAU1234P01	8117	6283411,23	340335,84	96,46
EAV1250P02	8721	6252661,96	345257,36	54,888
EAY1267P01	8821	6254842,06	346054,6	145,207
EAE1054P01	9073	6256024,17	332480,78	82,695
EAE1052P02	9104	6255509,74	332422,12	59,91
EAG1090P01	9277	6267506,97	333284,34	69,356
EAG1095P01	10196	6271971,13	333033,48	52,906
EAG1092P01	10722	6260895,46	334252,07	157,336
EAK1128P02	11081	6249501,71	337973,42	94,004
EAK1128P02	11132	6249482,33	337975,76	77,052
EAJ1122P01	11300	6276875,89	334112,8	99,2
EAJ1123P01	11870	6259771,8	336349,73	58,231
EAK1138P01	11913	6272808,43	335638,65	88,833
EAK1130P01	12036	6249485,4	338102,7	70,053
EAK1130P01	12113	6249459,33	338106,04	83,945
EAP1171P01	14105	6247364,35	340955,47	147,108
EAN2153P01	14186	6269310,25	337026,9	50,052
EAP1168P01	14424	6246985,86	340815,07	52,787
EAN2165R01	14482	6269605,17	337739,97	61,001
EAP1174P01	14872	6253567,28	340351,39	63,491

16.10. OWF West Anomalies with low potential

Line_name	OBJECTID	Latitude	Longitude	COMMENT	P2P (nT)
EAC1031R01	151	6251606,76	331596,41		47,05
EAQ1180P01	270	6279089,88	337488,22		48,94
EAQ1186P01	285	6279342,48	337830,33		46,382
EAQ1180P01	289	6279057,8	337492,42		46,236
EAQ1183P01	310	6279258,84	337651,53		44,559
EAR1200P01	880	6279964,75	338633,03		41,923
EAS1218P01	943	6281134,51	339616,3		46,082
EAS1210P01	959	6280821,18	339154,9		43,242
EAT1226P01	1127	6280755,79	340170,98		42,134
EAU1238P01	1157	6249113,77	344955,76		47,909
EAY1259P01	1303	6280899,95	342233,58		45,584
EAD1048P01	1411	6253299,98	332449,28		48,856
EAG1087P01	1822	6261110,91	333915,04		48,041
EAF1080P02	1828	6263327,39	333187,35		47,575
EAH1098P01	2231	6272466,91	333163,65		49,98
EAH1098P01	2317	6256142,4	335239,29		41,913
EAM1152R02	2462	6249557,55	339480,25		41,641
EAP1175P01	2636	6279308,55	337139,52		42,781
EAP1168P01	2645	6263752,81	338680,36		41,781
EAP1172P01	2649	6275076,25	337490,39		41,578
EAP1170P02	2655	6246637,4	340982,61		41,186
EAC1010P01	2695	6262135,02	328932,54		44,118

Line_name	OBJECTID	Latitude	Longitude	COMMENT	P2P (nT)
EAQ1188P01	3726	6256806,21	340825,13		41,902
EAQ1186P01	4195	6279267,97	337839,82		40,802
EAR1200P01	5357	6249965,47	342451,89		41,117
EAR1204P01	5923	6263115,1	341031,99		40,18
EAS1207J02	6491	6269651,72	340407,77		44,698
EAT1219P01	7602	6274217,43	340569,26		40,318
EAG1087P01	9852	6246261,87	335804,48		49,838
EAG1094P01	9977	6276882,63	332344,75		41,357
EAH1106P01	10349	6267577,16	334287,71		43,987
EAJ1114P01	12001	6269941,32	334490,26		47,065
EAM6145P02	12729	6268377,82	336639,53		42,807
EAN1155P01	12781	6249504,29	339676,74		41,702
EAM1148P01	13023	6249951,99	339177,31		46,797
EA_G_SSS_00295		6274422,76	332604,18	Unidentified, Low priority	

16.11. Coring data

Sample	Lab-number	Placename / core	Euref 89 zone 32 N (East)	Euref 89 zone 32 N (North)	Water depth	Sample elevation masl	Sediment	Dated sample	Species	Environmet	Uncalibrated 14C measurement bp	Reservoir correction	Reservoir corrected age bp	uncertainty (±)	Sediment cover above SLIP (m)	Id (Number in sea-level curve)	Calibrated age interval (BC)(2σ), start	Calibrated age interval (BC)(2σ), end	Smaple elevation used in sea-level curve
R1	AAR-31695	282-VC-R2-004	429513,50	6252964,50	-27	-31,50	Marine sediments	Shell	*Spisula species*	Marine	42654 ± 420	400	42254	420	4.0-5.0	1	43713	42425	-31,50
R2	AAR-31696	282-VC-R2-004	429513,50	6252964,50	-27	-32,70	Marine sediments	Shell	*Spisula soldia*	Marine	43350 ± 577	400	42950	577	5.0-5.55	2	44613	42622	-32,70
R3	AAR-31697	282-VC-OWF-B1-007	404742,50	6233577,20	-31	-32,60	Marine sediments	Shell	*Cerestoderma edula*	Marine	9060 ± 41	400	8660	41	1.0-2.25	3	7763	7587	-32,60
R4	AAR-31698	282-VC-OWF-B1-007	404742,50	6233577,20	-31	-33,31	PEAT	PLANT	Reeds? Phragmites stemps	Terrestrial	8687 ± 39	0	8687	39	2.25-2.37	4	7813	7592	-33,31
R5	AAR-31699	282-VC-OWF-B1-007	404742,50	6233577,20	-31	-33,50	PEAT	PLANT	Reeds?	Terrestrial	8752 ± 49	0	8752	49	2.37-2.68	5	8161	7599	-33,50
R6	AAR-31700	282-VC-OWF-B1-007	404742,50	6233577,20	-31	-35,79	PEAT	Wood	Tvig with bark	Terrestrial	11704 ± 44	0	11704	44	4.68-4.90	6	11789	11513	-35,79
R7	AAR-31701	282-VC-OWF-B2-005	416054,80	6243508,70	-26	-27,90		Wood	Woodfragment (waterworn)	Coastal	8664 ± 38	0	8664	38	1.40-2.40	7	7753	7589	-27,9
R8	AAR-31702	282-VC-OWF-B2-005	416054,80	6243508,70	-26	-27,90	Marine sediments	SHELL	*Cerestoderma edule*	Marine	9205 ± 48	400	8805	48	1.40-2.40	8	8201	7659	-27,90
R9	AAR-31703	282-VC-OWF-B2-005	416054,80	6243508,70	-26	-29,52	PEAT	WOOD	Wood fragment	Terrestrial	8776 ± 43	0	8776	43	3.40-3.64	9	8166	7606	-29,52
R10	AAR-31704	282-VC-OWF-B3-003	419910,50	6255663,59	-27	-30,58	Marine sediments	SHELL	Ubestemt marin	Marine	45983 ± 641 **)	400	45583	641	3.42-3.75	10	47755	44495	-30,58
R11	AAR-31705	282-VC-OWF-B4-010	425338,60	6233562,90	-25	-27,13	Marine sediments	SHELL	Ubestemt marin, *Tellina*	Marine	42385 ± 424	400	41961	424	2.04-2.22	11	43512	42207	-27,13
R12	AAR-31706	282-VC-OWF-B4-010	425338,60	6233562,90	-25	-27,57		WOOD	Woodfragment	?	47495 **)	0	0	0	2.22-2.93	12	out of range	out of range	-27,57
R13	AAR-31707	282-VC-OWF-B4-010	425338,60	6233562,90	-25	-27,57	Marine sediments	SHELL	Ubestemt art (waterworn)	Marine	43285 ± 502	400	42885	502	2.22-2.93	13	44257	42633	-27,57
R14	AAR-31708	282-VC-OWF-B4-010	425338,60	6233562,90	-25	-28,31	Marine sediments	SHELL	*Actica islantica*	Marine	45073 ± 544 **)	400	44673	544	2.93-3.70	14	45838	43473	-28,31
R15	AAR-31709	282-VC-R3-025	433415,60	6249849,00	-26	-27,64	PEAT	WOOD	Woodfragments	?	46280 **)	0	0	0	1.60-1.69	15	out of range	out of range	-27,64
R16	AAR-31710	282-VC-R5-065	438420,40	6235163,09	-20	-21,46	Marine sediments	SHELL	*Actica islantica*	Marine	4303 ± 32	400	3903	32	1.41-1.51	16	2471	2287	-21,46
R17	AAR-31711	282-VC-OWF-B1-004	410789,00	6244688,50	-29	-29,51	PEAT	WOOD	Wood, tvig with bark	Terrestrial	9558 ± 40	0	9558	40	0.40-0.62	17	9147	8767	-29,51
R18	AAR-31712	282-VC-R3-018	425756,60	6245074,50	-28,7	-29,89	Marine sediments	SHELL	*Cerestoderma edule*	Marine	43060 ± 415	400	42660	415	1.11-1.28	18	43960	42652	-29,89
R19	AAR-31713	282-VC-OWF-B1-ARC-004	405491,30	6238662,20	-25,9	-26,85	MUD/PEAT	WOOD	Wood fragment	Terrestrial	8887 ± 38	0	8887	38	0.90-1.00	19	8235	7851	-26,85
R20	AAR-31714	282-VC-R2-015A	441963,00	6256286,00	-16,5	-20,00	CLAY/SILT	WOOD	Wood fragment	?	out of range	0	0	0	3.35-3.66	20	out of range	out of range	-20,00
R21	AAR-31715	282-VC-R5-056A	428135,63	6237873,75	-26,4	-28,45	CLAY/SILT	SHELL	*Cerestoderma edula*	Marine	41259 ± 397	400	40859	397	2.00-2.10	21	42563	41176	-28,45
	AAR-1819	Jyske Rev, core 562003	406899,00	6305681,00	?	-33,25	Marine sediments	SHELL	*Tellina fabula*	Marine	7920 ± 110	400	7520	110	?	22	6594	6089	-33,25
	AAR-1818	Jutland Bank	390814,63	6319068,16	?	46,00	Marine sediments	SHELL	*Littorina littorea*	Marine	8930 ± 150	400	8530	150	?	23	8170	7177	46,00
380	AAR-1828	Jyske rev. Agger II	388205,79	6325515,11	?	-33,00	Marine sediments	SHELL	?	Marine	9500 ± 140	400	9100	140	?	24	8706	7829	-33,00

Sample	Lab-number	Placename / core	Euref 89 zone 32 N (East)	Euref 89 zone 32 N (North)	Water depth	Sample elevation masl	Sediment	Dated sample	Species	Environmet	Uncalibrated 14C measurement bp	Reservoir correction	Reservoir corrected age bp	uncertainty (±)	Sediment cover above SLIP (m)	Id (Number in sea-level curve)	Calibrated age interval (BC)(2σ), start	Calibrated age interval (BC)(2σ), end	Smaple elevation used in sea-level curve
381	AAR-1827	Jyske rev. Agger I	380441,63	6329025,36	?	-24,00	Marine sediments	SHELL	?	Marine	8870 ± 90	400	8470	90	?	25	7712	7197	-24,00
382	AAR-1818	Jyske rev. Agger II	390814,63	6319068,16	?	-46,00	Marine sediments	SHELL	*Littorina littorea*	Marine	8930 ± 150	400	8530	150	?	26	8170	7177	-46,00
383	AAR-1822	Jyske rev, Boring 562011	442651,06	6296145,57	?	-34,50	Marine sediment	SHELL	*Cardium edule*	Marine	9350 ± 100	400	8950	100	3,45	27	8311	7739	-34,50
384	AAR-1820	Jyske rev, Boring 562010	442651,06	6296145,57	?	-33,54	Marine sediment	SHELL	*Cardium edule*	Marine	9080 ± 90	400	8680	90	5,50	28	8169	7541	-33,54
385	AAR-1819	Jyske rev, Boring 562003	442651,06	6296145,57	?	-33,25	Marine sediment	SHELL	*Tellina fabula*	Marine	7920 ± 110	400	7520	110	2,43	29	6594	6089	-33,25
	AAR-1821	Jutland Bank, 562010-V	420286,82	6289188,13	?	?	Marine sediment	SHELL	*Nucula nitida*	Marine	9090 ± 90	400	8690	90	2,50	30	8171	7550	?
1056	K-6149	Strande I	448797,41	6270636,90	?	-11,70	Marine sediments	SHELL	?	Marine	7780 ± 155	0	7780	155	?	31	7068	6271	-11,70
1057	K-6148	Strande I	448797,41	6270636,90	?	-4,25	Marine sediments	SHELL	*Ostrea edulis*	Marine	6090 ± 140	0	6090	140	?	32	5357	4690	-4,25
1058	K-6147	Strande I	448797,41	6270636,90	?	-3,75	Marine sediments	SHELL	*Ostrea edulis*	Marine	6020 ± 100	0	6020	100	?	33	5211	4710	-3,75
1059	K-6150	Strande II, freshwater	448797,41	6270636,90	?	-10,50		Gytja	Gyttja	Lacustrine	8400 ± 144	0	8400	144	?	34	7716	7065	-10,50
695	AAR-2593	Nissum Bredning	460179,93	6282325,67	?	?	Marine sediments	FORAMS	*Ammonia beccari*	Marine	7065 ± 60	400	6665	60	2,15	35	5876	5326	?
696	AAR-2594	Nissum Bredning	460451,71	6278613,04	?	?	Marine sediments	FORAMS	*Ammonia beccari*	Marine	7160 ± 60	400	6760	60	1,95	36	5764	5557	?
697	AAR-2595	Nissum Bredning	460451,71	6278613,04	?	?	Marine sediments	FORAMS	*Ammonia beccari*	Marine	7230 ± 80	400	6830	80	2,55	37	5895	5566	?
698	AAR-2596	Nissum Bredning	463216,42	6279329,42	?	?	Marine sediments	FORAMS	*Ammonia beccari*	Marine	3280 ± 60	400	2880	60	1,85	38	1256	905	?
699	AAR-2597	Nissum Bredning	463216,42	6279329,49	?	?	Marine sediments	FORAMS	*Ammonia beccari*	Marine	3930 ± 65	400	3530	65	3,00	39	2110	1645	?
700	AAR-2598	Nissum Bredning	459037,32	6269907,08	?	?	Marine sediments	FORAMS	*Ammonia beccari*	Marine	6200 ± 75	400	5800	75	0,80	40	4835	4458	?
	K-4596	Dødemandsbjerg, corring	446277,58	6232216,86	?	-12,00	Marine sediment	SHELL	*Ostrea edulis*	Marine	6740 ± 130	0	6740	130	12,50	41	5970	5416	-12,00
	K-3421	Stauning Pynt	460212,17	6200474,87	?	?		PEAT	?	Terrestrial	6470 ± 100	0	6470	100	1,10	42	5621	5219	?
	AAR-3289	North sea, Jyske Rev	385479,61	6310262,37	?	-41,80	Marine sediments	SHELL	Div. species	Marine	8180 ± 80	400	7780	80	3,60	43	7023	6444	-41,80
	AAR-3296	Jyske Rev (Agger clay)	438316,49	6296310,92	?	-34,70	Marine sediments	SHELL	Div. species	Marine	9380 ± 90	400	8980	90	6,00	44	8385	7796	-34,70
	K-4502	Rønland, corring E 66 from -9,5 to -10,5	450522,75	6280142,58	?	-10,00	Marine sediments	SHELL	*Ostrea edulis*	Marine	6800 ± 105	0	6800	105	11,50	45	5967	5485	-10,00
	K-4503	Rønland, corring E 66 from -8,5 to -9,5,	450522,75	6280142,58	?	-9,00	Marine sediments	SHELL	*Ostrea edulis*	Marine	6500 ± 100	0	6500	100	10,50	46	5626	5225	-9,00
	K-4504	Rønland, corring E 66 from -7,5 to -8,5	450522,75	6280142,58	?	-8,00	Marine sediments	SHELL	*Ostrea edulis*	Marine	6320 ± 100	0	6320	100	9,50	47	5478	5043	-8,00
	AAR-3281	Jyske Rev	410315,70	6326534,19	?	-51,05	Marine sediments	SHELL	Div. species	Marine	9240 ± 80	400	8840	80	2,10	48	8239	7658	-51,05
	AAR-3290	Jyske Rev	410315,70	6326534,19	?	-53,85	Marine sediments	SHELL	*Abra prismatica*	Marine	10050 ± 70	400	9650	70	4,95	49	9256	8813	-53,85

Sample	Lab-number	Placename / core	Euref 89 zone 32 N (East)	Euref 89 zone 32 N (North)	Water depth	Sample elevation masl	Sediment	Dated sample	Species	Environmet	Uncalibrated 14C measurement bp	Reservoir correction	Reservoir corrected age bp	uncertainty (±)	Sediment cover above SLIP (m)	Id (Number in sea-level curve)	Calibrated age interval (BC)(2σ), start	Calibrated age interval (BC)(2σ), end	Smaple elevation used in sea-level curve
	AAR-3294	Jyske Rev (Agger clay)	390255,01	6301780,16	?	-26,10	Marine sediments	SHELL	*Corbula gibba*	Marine	6350 ± 70	400	5950	70	3,10	50	5026	4680	-26,10
	AAR-3295	Jyske Rev (Agger clay)	390255,01	6301780,16	?	-27,70	Marine sediments	SHELL	*Corbula gibba*	Marine	6650 ± 65	400	6250	65	4,70	51	5363	5037	-27,70
	AAR-3298	Jyske Rev (Agger clay)	438316,49	6296310,92	?	-34,05	Marine sediments	SHELL	*Mytilus edulis*	Marine	9190 ± 75	400	8790	75	5,35	52	8199	7605	-34,05
	K-4552	Dover Odde, cultural layer	466979,47	6285892,91	?	-0,20	Archaeological site	Cultural deposit	Hazelnut	Terrestrial	6610 ± 100	0	6610	100	?	53	5716	5375	-0,20
	AAR-7299	North sea, N of Horns Rev	441930,99	6215858,99	?	-15,10	Marine sediments	SHELL	*Scrobicularia plana*	Marine	7005 ± 47	400	6605	47	1,53	54	5621	5479	-15,10
	AAR-7297	North sea, N of Horns Rev	441930,99	6215858,99	?	-14,00	Marine sediments	SHELL	*Cerastoderma edule*	Marine	6517 ± 50	400	6117	50	0,54	55	5212	4906	-14,00
	AAR-1825	North sea, 578001-IX	336810,04	6238090,95		?	Marine sediments	SHELL	*Cyprina islandica*	Marine	7700 ± 70	400	7300	70	6,00	56	6367	6020	?
	AAR-1826	North sea, 578001-X	336810,04	6238090,95		?	Marine sediments	SHELL	*Macoma baltica*	Marine	9400 ± 100	400	9000	100	6,00	57	8458	7816	?
	AAR-3293	Lille Fisker Banke.	336810,04	6238090,95		-48,23	Marine sediments	SHELL	*Acanthocardia echinata*	Marine	5325 ± 55	400	4925	55	4,23	58	3934	3543	-48,23
	AAR-7183	Horns Rev	446472,20	6181894,88		?	Marine sediments	SHELL	*Spisula solida*	Marine	5670 ± 50	400	5270	50	?	59	4241	3979	?
	AAR-7184	North sea, N of Horns Rev	446472,20	6181894,88		?	Marine sediments	SHELL	*Spisula solida*	Marine	5695 ± 60	400	5295	60	?	60	4319	3983	?
	AAR-7185	North sea, N of Horns Rev	446472,20	6181894,88		?	Marine sediments	SHELL	*Spisula solida*	Marine	5520 ± 45	400	5120	45	?	61	4039	3794	?
	UBA-32860	B0203VC, VIKING LINK	443802,32	6181000,41	?	-17,80	Marine sediments	SHELL	*Scrobicularia*	Marine/brackish	6457±43	400	6057	43	1.6-1.8	62	5204	4837	-17,8
	UBA-32861	B0220VC, VIKING LINK	412834,39	6184743,08	?	-18,70	Marine sediments	SHELL	*Scrobicularia*	Marine/brackish	3687±30	400	3287	30	1.7-2.0	63	1622	1499	-18,7
	UBA-32862	B0226VC, VIKING LINK	408051,08	6185061,82	?	-19,89	Marine sediments	SHELL	*Scrobicularia*	Marine/brackish	5277±32	400	4877	32	1.6-3.0	64	3760	3536	-20
	Beta-479843	Beta-479843, Baltic Pipe	368159,00	6186111,95	?	-37,29	Marine sediments	SHELL	*Macoma baltica*	Marine/brackish	8660±30	400	8260	30	3.10-3.17	65	7459	7089	-37
	Beta-479081	Beta-479081, Baltic pipe	368159,00	6186111,95	?	-37,70	PEAT			Terrestrial	9900±30	0	9900	30	3.38-3.80	66	9447	9287	-38
	KIA-51169	DOG 2	321417,46	6248391,46	-42,1	-47,16	PEAT	BULK SAMPLE		Terrestrial	9547 ± 60	0	9547	60	5.06-5.07	67	9202	8716	-47,16
	KIA-51170	DOG 2	321417,46	6248391,46	-42,1	-47,20	PEAT	BULK SAMPLE		Terrestrial	9311 ± 51	0	9311	51	5.10-5.11	68	8712	8346	-47,2
	KIA-51171	DOG 2	321417,46	6248391,46	-42,1	-47,23	PEAT	BULK SAMPLE		Terrestrial	9595 ± 51	0	9595	51	5,13	69	9219	8802	-47,23
	AAR-35647	Energiø, Northsea P1 : BH-1012 : sample 04BagA : 03.00 Expected age:	349662	6258709		-39,6	Marine sand	Shell		Marine	2671 ± 30	400	2271	30	3	70	398	208	-39,6
	AAR-35648	Energiø, Northsea. P2 : BH-1012 : sample 05BagB : 04.30 Expected age:	349662	6258709		-40,9	Marine sand	Shell	*Cardium*	Marine	8320 ± 41	400	7920	41	4,3	71	7034	6651	-40,9

Sample	Lab-number	Placename / core	Euref 89 zone 32 N (East)	Euref 89 zone 32 N (North)	Water depth	Sample elevation masl	Sediment	Dated sample	Species	Environmet	Uncalibrated 14C measurement bp	Reservoir correction	Reservoir corrected age bp	uncertainty (±)	Sediment cover above SLIP (m)	Id (Number in sea-level curve)	Calibrated age interval (BC)(2σ), start	Calibrated age interval (BC)(2σ), end	Smaple elevation used in sea-level curve
	AAR-35649	Energiø, Northsea. P3 : BH-079 : sample 04BagB : 02.25	348090	6263564		-30,15	Marine sand	Shell		Marine	36268 ± 769	400	35868	769	2,25	72	40137	37707	-30,15
	AAR-35650	Energiø, Northsea. P4 : BH-079 : sample 05BagB : 02.75	348090	6263564		-30,65	Marine sand	Shell		Marine	6372 ± 37	400	5972	37	2,75	73	4985	4727	-30,65
	AAR-35651	Energiø, Northsea. P5 : BH-079 : sample 10BagB : 05.20	348090	6263564		-33,1	Marine sand	Shell		Marine	5533 ± 38	400	5133	38	5,2	74	4041	3800	-33,1
	AAR-35652	Energiø, Northsea. P6 : BH-1002 : sample 53BagA : 50.50	347315	6247314		-89,2	Peat	Peat		Terrestrial	>47906	0	47906		50,5	75	out of range	out of range	-89,2
	AAR-35653	Energiø, Northsea. P7 : BH-1002 : sample 53BagA : 50.50	347315	6247314		-89,2	Peat	Wood		Terrestrial	>45847	0	45847		50,5	76	46827	45522	-89,2
	AAR-35654	Energiø, Northsea. P8 : BH-1005 : sample 07BagA : 05.50	331240	6251314		-47,4	Peat	Wood		Terrestrial	>45244	0	45244		5,5	77	46208	44994	-47,4
	AAR-35655	Energiø, Northsea. P9 : BH-1005 : sample 07BagA : 05.50	331240	6251314		-47,4	Peat	Wood		Terrestrial	>46893	0	46893		5,5	78	48074	46551	-47,4
	AAR-35656	Energiø, Northsea. P10 : BH-1005 : sample 54BagB : 52.05	331240	6251314		-93,95	Peat	Wood		Terrestrial	>45123	0	45123		52,05	79	46115	44923	-93,95
	AAR-35657	Energiø, Northsea.P11 : BH-1005 : sample 54BagB : 52.05	331240	6251314		-93,95	Peat	Wood		Terrestrial	>44060	0	44060		52,05	80	44837	43986	-93,95
	AAR-35658	Energiø, Northsea. P12 : BH-1005 : sample 55BagA : 53.00	331240	6251314		-94,9	Peat	Wood		Terrestrial	>42942	0	42942		53	81	43839	43057	-94,9
	AAR-35659	Energiø, Northsea. P13 : BH-1006 : sample 09BagA : 08.00	348762	6252531		-49,6	Sand or peat	Organic material		?	9608 ± 44	0	9608	44	8	82	9224	8816	-49,6
	AAR-35660	Energiø, Northsea. P14 : BH-1007 : sample 30BagB : 23.70	346355	6253246		-64,3	Peat	Wood		Terrestrial	>45124	0	45124		23,7	83	46115	44924	-64,3
	AAR-35661	Energiø, Northsea. P15 : BH-1007 : sample 30BagB : 24.50	346355	6253246		-65,1	Peat	Wood		Terrestrial	>49867	0	49867		24,5	84	out of range	out of range	-65,1
	AAR-35662	Energiø, Northsea. P16 : BH-1010 : sample 08BagC : 06.90	341141	6256600		-41,9	Peat	Peat		Terrestrial	10055 ± 49	0	10055	49	6,9	85	9865	9393	-41,9
	AAR-35663	Energiø, Northsea. P17 : BH-1010 :	341141	6256600		-41,9	Peat	Peat		Terrestrial	10025 ± 43	0	10025	43	6,9	86	9796	9367	-41,9

Sample	Lab-number	Placename / core	Euref 89 zone 32 N (East)	Euref 89 zone 32 N (North)	Water depth	Sample elevation masl	Sediment	Dated sample	Species	Environmet	Uncalibrated 14C measurement bp	Reservoir correction	Reservoir corrected age bp	uncertainty (±)	Sediment cover above SLIP (m)	Id (Number in sea-level curve)	Calibrated age interval (BC)(2σ), start	Calibrated age interval (BC)(2σ), end	Smaple elevation used in sea-level curve
		sample 08BagC : 06.90																	
	AAR-35664	Energiø, Northsea. P18 : BH-1011 : sample 03BagA : 02.00	343560	6256918		-38,2	SAND	Wood		Terrestrial	8807 ± 47	0	8807	47	2	87	8201	7679	-38,2
	AAR-35665	Energiø, Northsea. P19 : BH-1011 : sample 03BagA : 02.00	343560	6256918		-38,2	SAND	Shell		Marine	9592 ± 47	400	9192	47	2	88	8547	8293	-38,2
	AAR-35666	Energiø, Northsea. P20 : BH-1016 : sample 69BagA : 67.00	340604	6260855		-109,8	Peat	Wood		Terrestrial	>48336	0	48336		67	89	out of range	out of range	-109,8
	AAR-35667	Energiø, Northsea. P21 : BH-1016 : sample 69BagA : 67.00	340604	6260855		-109,8	Peat	Wood		Terrestrial	>45765	0	45765		67	90	46761	45431	-109,8
	AAR-35668	Energiø, Northsea. P22 : BH-1017 : sample 17BagA : 11.00	343364	6262939		-54,4	SAND	Shell		Marine	>48000	400	48000		11	91	out of range	out of range	-54,4
	AAR-35669	Energiø, Northsea. P23 : BH-1017 : sample 18BagA : 11.50	343364	6262939		-54,9	SAND	Wood		Terrestrial	>47708	0	47708		11,5	92	out of range	out of range	-54,9
	AAR-35670	Energiø, Northsea. P24 : BH-1017 : sample 18BagB : 11.70	343364	6262939		-55,1	SAND	Wood		Terrestrial	>51096	0	51096		11,7	93	out of range	out of range	-55,1
	AAR-35671	Energiø, Northsea. P25 : BH-1021 : sample 45BagC : 44.30	357783	6264770		-85,8	SAND	Shell		Marine	>45900	400	45900		44,3	94	46874	45574	-85,8