# *KRIEGERS FLAK 2*
# *Archaeological Analysis of Kriegers Flak 2 North and South Wind-farms and Associated Cable Corridors*
# *VIR 3050*

***John Howworth***

November 2023

Cover illustration: Kriegers Flak 2, North & South. © Vikingeskibsmuseet.

Vikingeskibsmuseet, Vindeboder 12, 4000 Roskilde. Telefon: 46 30 02 00, Fax: 46 30 02 01,

email: museum@vikingeskibsmuseet.dk www.vikingeskibsmuseet.dk

**VIR 3050**

**KRIEGERS FLAK 2**

**STED- OG LOK. NR. 401740-198**

# Archaeological Analysis of Kriegers Flak2 North and South and Associated Cable Corridors

## *Contents*



## *Abstract*


Energinet has requested that the Viking Ship Museum (VIR) prepare an archaeological analysis for the proposed Kriegers Flak windfarms and associated cable corridors.

There is a high potential for finding maritime cultural historical objects (CHOs) on the seabed within the windfarm areas and cable corridors. Within the windfarm areas, there is a low expectation of finding stone-age activity but a high likelihood within the cable corridors, specifically in the most sheltered areas in Faxe Bay.


## *Dansk resumé*


Energinet har anmodet Vikingeskibsmuseet (VIR) om at udarbejde en Arkæologisk analyse for vindmøllepark Kriegers Flak 2 med tilhørende kabelkorridorer.

Der er et stort potentiale for at finde maritime kulturhistoriske objekter (CHOs) på havbunden inden for vindmølleparkområderne og kabelkorridorer. Der er en lav forventning om at finde stenalderaktivitet i vindmølleparkområderne, men der er stor sandsynlighed i kabelkorridorerne, specielt i de mest beskyttede områder i Faxe Bugt.


## *Introduction*

Energinet is planning offshore windfarms with associated cable corridors in the Baltic Sea: Kriegers Flak 2 North and Kriegers Flak 2 South located northeast and southeast from the island of Møn in southwest Denmark (Figure 1).

This report analyses the archaeological potential for the affected areas. The potential for the discovery of maritime archaeological artifacts and sites such as shipwrecks and associated debris will be studied along with the potential of discovering prehistoric settlements, specifically from the Mesolithic period.

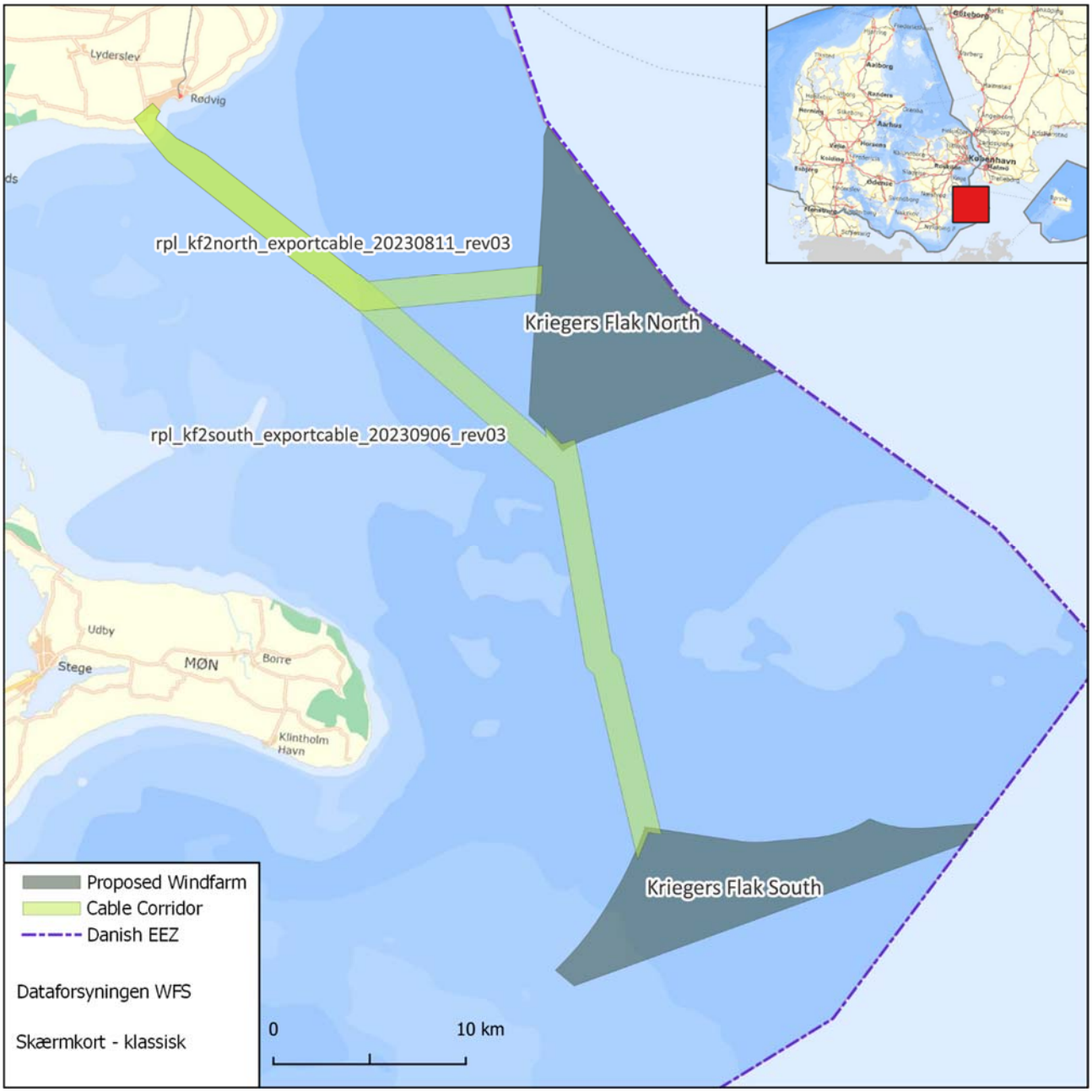


**Figure 1. Overview of the proposed Kriegers Flak offshore windfarms and associated cable corridors. Illustration: John Howorth © Vikingeskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

**Table 1. Abbreviations used in the text.**

| | | |
|---|---|---|
| BP | Before Present (years before 1950) | |
| CHO | Cultural historical object | Kulturhistorisk objekt |
| EEZ | Exclusive Economic Zone | Eksklusiv økonomisk zone |
| GIS | Geographical information system | Geografisk informationssystem |
| HF | High frequency | Højfrekvent |
| MBES | Multibeam echo sounder | Flerstråleekkolod |
| SGU | Geological Survey of Sweden | Sveriges Geologiska Undersökning |
| SSS | Sidescan Sonar | Sideseende sonar |
| VIR | Viking Ship Museum, Roskilde | Vikingeskibsmuseet i Roskilde |

## Topography, terrain and geology

The two windfarm areas lie to the northeast and southeast of the island of Møn. Cable corridors connect the two windfarms to the mainland near the town of Rødvig.

Kriegers Flak 2 North is located in water 25 - 35 m deep and is relatively flat. The seabed sediment is mostly muddy sand with an area of till/diamicton along the western edge. Kriegers Flak 2 South slopes from around 18 m deep in the west to around 41 m deep in the east. The seabed sediment in the west is sand which becomes muddy sand towards the east. The cable corridors are at their deepest in the south, where they join with Kriegers Flak 2 South, at 31 m below sea level. They then gradually rise as they head northwards towards landfall. The seabed sediment along the cable corridors is a mixture of sand and muddy sand in the south and parts of the north. The mid-section mainly consists of till/diamicton. At landfall, the cable corridors cross an area of sedimentary rock.

## Methodology

Information from various sources was imported to a mapping project in QGIS (v.3.32.3-Lima) where it was used to evaluate the likelihood for the presence of cultural historical objects (CHOs) within the windfarm areas and the cable corridors for Kriegers Flak 2. These sources are:

- Danish national registry of CHO finds *Fund og Fortidsminder* (FF) (https://www.kulturarv.dk/ffreg/).
- *Søfartsstyrelsens vragregister* – The Danish Maritime Authority's Register for Wrecks.
- *Holddatabasen* – a database from the Agency for Culture and Palaces which contains a list of potential wrecks where the positions have not yet been further investigated.
- *Vragguiden* – Denmark's largest online wreck database for and by recreational divers.

Data from the archives at VIR were also used to evaluate the presence of CHOs, specifically, the Baltic Pipe project (VIR2813) and the Energy Island Bornholm, Interconnector Transect (VIR 2937).

To aid analysis for stone-age potential of the area, maps from a shoreline displacement model created by the Geological Survey of Sweden (SGU) (SGUs Kartvisare) were downloaded, georeferenced and digitised in the QGIS project. It should be noted that the SGU model was specifically designed for Swedish shoreline displacement and Kriegers Flak 2 is located at the very limit of this model within Danish territory. Therefore, the model should not be taken as an accurate representation of the shoreline in the periods shown (Figure 4) but can be used for illustrative purposes and to give an idea of how the coastline has changed through prehistory.

## Potential for Cultural Historical Objects

The Baltic Sea and Øresund have been busy shipping routes throughout history and there is a high likelihood that objects of cultural importance will be found on the seabed within the windfarm areas and cable corridors.

This report includes CHOs that sit within 200 m of the proposed windfarms and cable corridors in addition to those within the affected areas themselves. The reason for this is that the location data is not always secure and protected monuments often require a 200 m protection zone. Within the areas affected by Kriegers Flak 2, there is a total of 90 objects registered with Fund og Fortidsminder, 9 objects registered in the Danish Maritime Authority's (DMA) Register for Wrecks, 19 in Vragguiden, and 35 entries in Holddatabasen.

Many of these records have missing or uncertain location data and may not actually lie within the windfarm areas or cable corridors. Some objects are reported as being salvaged and may no longer

lie on the seabed, although it is possible that pieces of salvaged wrecks or related debris may still lie in or close to the location. Many have no secure dating, and several that can be dated are too recent to be classed as protected monuments.

Within Kriegers Flak 2 North and South, there is a total of 20 records in Fund og Fortidsminder that remain once duplicates, salvaged wrecks, and objects not currently protected by the Museums Act are disregarded.

Out of 60 records found within the cable corridors, 22 are either reported as salvaged or are too recent to be classed as protected monuments. Of the remaining 38, 33 are shared between two administrative points. Administrative points are usually reports of groundings, foundered ships or chance finds where the exact location is uncertain. This leaves 5 CHOs with fairly secure location data within the cable corridors.

There are 25 records from Fund og Fortidsminder that remain after all deductions (Table 2 and Figure 2)

**Table 2 List of Fund og Fortidsminder records found within 200m of Kriegers Flak 2 North and South and associated cable corridors**

| System No. | Place No. | Location No. | Date | Type |
|---|---|---|---|---|
| 137323 | 401740 | 7 | 1661 - 2009 | Anchor |
| 154350 | 401740 | 15 | 1890 - 1899 | Wreck |
| 171469 | 401740 | 18 | 1900 - 1999 | Cargo |
| 177994 | 401740 | 38 | 1850 -1899 | Wreck |
| 182808 | 401740 | 63 | 1850 -1899 | Wreck |
| 183384 | 401740 | 69 | 1661 - 2009 | Wreck |
| 183385 | 401740 | 70 | 1850 -1899 | Wreck |
| 183797 | 401740 | 76 | 1900 - 1999 | Wreck |
| 183953 | 401740 | 78 | Undated | Wreck |
| 183956 | 401740 | 79 | 1900 - 1999 | Wreck |
| 183957 | 401740 | 80 | 1900 - 1999 | Aircraft |
| 183959 | 401740 | 82 | 1900 - 1999 | Aircraft |
| 184008 | 401740 | 103 | 1850 -1899 | Wreck |
| 184984 | 401740 | 119 | 1920 - 1929 | Wreck |
| 186760 | 401740 | 137 | 1910 - 1919 | Wreck |
| 186774 | 401730 | 121 | 1914 - 1918 | Wreck |
| 245393 | 401740 | 180 | Undated | Wreck |
| 245599 | 401740 | 181 | 1067 - 2022 | Wreck |
| 245601 | 401740 | 183 | 1067 - 2022 | Wreck part |
| 245602 | 401740 | 184 | 1067 - 2022 | Wreck |
| 245609 | 401740 | 189 | 1500 - 1945 | Anchor |
| 245610 | 401740 | 190 | 1067 - 2022 | Wreck |
| 245611 | 401740 | 191 | 1500 - 1945 | Anchor |
| 245613 | 401740 | 193 | 1893 - 1923 | Wreck part |
| 245618 | 401740 | 196 | 1661 - 2022 | Wreck part |

One record in Fund og Fortidsminder relates to that of stone-age finds recovered close to the coast at Rødvig, this is mentioned in more detail in the Stone-Age Potential chapter.

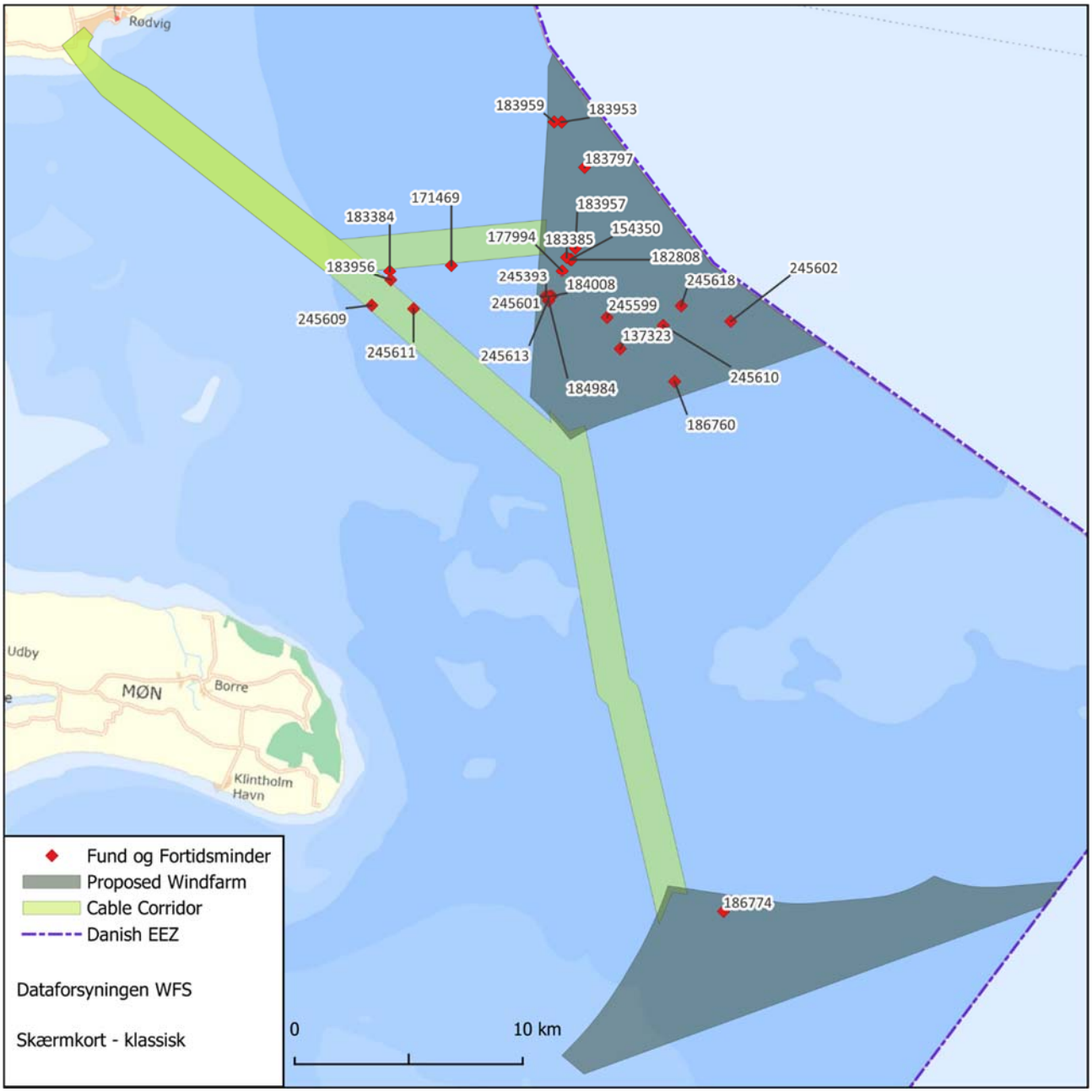


**Figure 2. Overview of objects protected under the Museums Act registered with Fund og Fortidsminder within the wind farm areas and associated cable corridors. Illustration: John Howorth © Vikingeskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

The other sources (DMA's Register for Wrecks, Vragguiden and Holddatabasen) were examined and again any duplicates, salvaged wrecks or those which are too recent to be protected by the Museums Act were removed along with any that correlate with records in Fund og Fortidsminder. After this process, 10 objects remain (Figure 3).

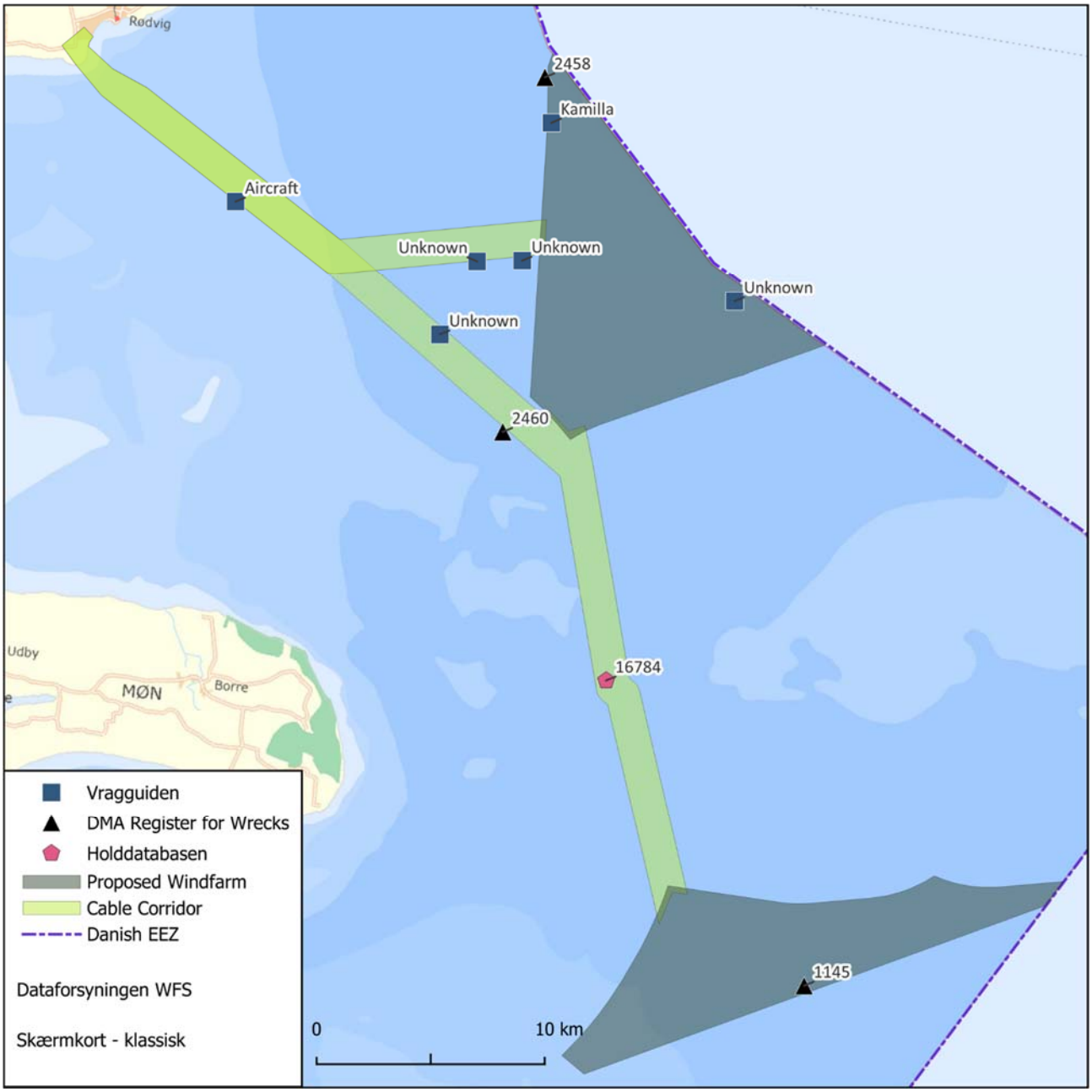


**Figure 3. Overview of potential CHOs from other databases. Records which are too recent or are correlate with Fund og Fortidsminder have been removed. Illustration: John Howorth © Vikingeskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

Several potential CHOs were also observed in the side scan sonar (SSS) data for the Interconnector Transect for the Energy Island Bornholm project (Howorth, 2023). At the time of writing, these objects have not been investigated further, although several correlate with known records of objects which are not protected under the Museums Act. It is likely that any sonar data from within the Kriegers Flak 2 North area will detect objects already seen in both the Baltic Pipeline and Energy Island Bornholm Interconnector Transect.

## *Stone-Age Potential*

The potential to find stone-age human activity within the windfarm areas and cable corridors depends on several factors: the depth of the seabed; conditions for preservation; and submarine topography.

The geological history of the Baltic Sea is complex and the water levels in the area fluctuated after the initial deglaciation of the area approximately 16000 to 15000 years BP due to a combination of rising water levels, isostatic rebound, and periodic damming of the lake by ice (Jensen & Bennike, 2022). There were two periods of lowstand water levels following deglaciation. The water levels were at their lowest in the second of these periods at around 11000 years BP, which correlates with the end of the Palaeolithic and beginning of the Mesolithic period. At this time, the water levels were between 35 and 40 m below current sea level. This would mean that most of the windfarm areas and the cable corridors would have been dry land at this time, only the deepest areas towards the eastern side of Kriegers Flak 2 South may have remained submerged (Figure 4). It is possible that settlements may have been present along the coastline and at the edge of lakes during this period.

The period of lowstand did not last long until water levels rose rapidly again and, by 10000 years BP, the areas for the windfarms and most of the cable route would have been inundated (Figure 4).

Preservation of possible Mesolithic sites in the windfarm areas is not expected to be good. The windfarm sites and the outer parts of the cable corridors are exposed to a long fetch and high energy environment (Jensen & Bennike, 2022) which will disturb and redeposit any possible archaeology. Sub bottom profiler (SBP) data and any core samples may show whether there are any surviving deposits that could yield archaeological information and multibeam echosounder (MBES) data may show terrain suitable for stone-age settlement.

The westernmost parts of the cable corridor have the most potential for preserved stone-age archaeology. These areas are in the shallowest water and were therefore dry land for a longer period and shorelines were not as rapidly inundated by rising sea levels. The westernmost parts are also sheltered from the long fetch and high energy environment that the windfarm areas are subject to, this means preservation of archaeology is likely to be better.

During the Baltic Pipe archaeological investigation (Jonsson & H. Thomsen, 2022), preserved tree stumps and evidence for a more extensive forest environment was found on the seabed in Faxe Bay, it is possible that more will be found in the western parts of the cable corridors.

A record in Fund og Fortidsminder, system number 152378, refers to a number of flint tools which were recovered over two decades, between 1955 and 1975, close to Rødvig during aggregate extraction work. Although there is no specific location attached to these finds, their presence is evidence for prehistoric human activity in the area close to the current coastline.

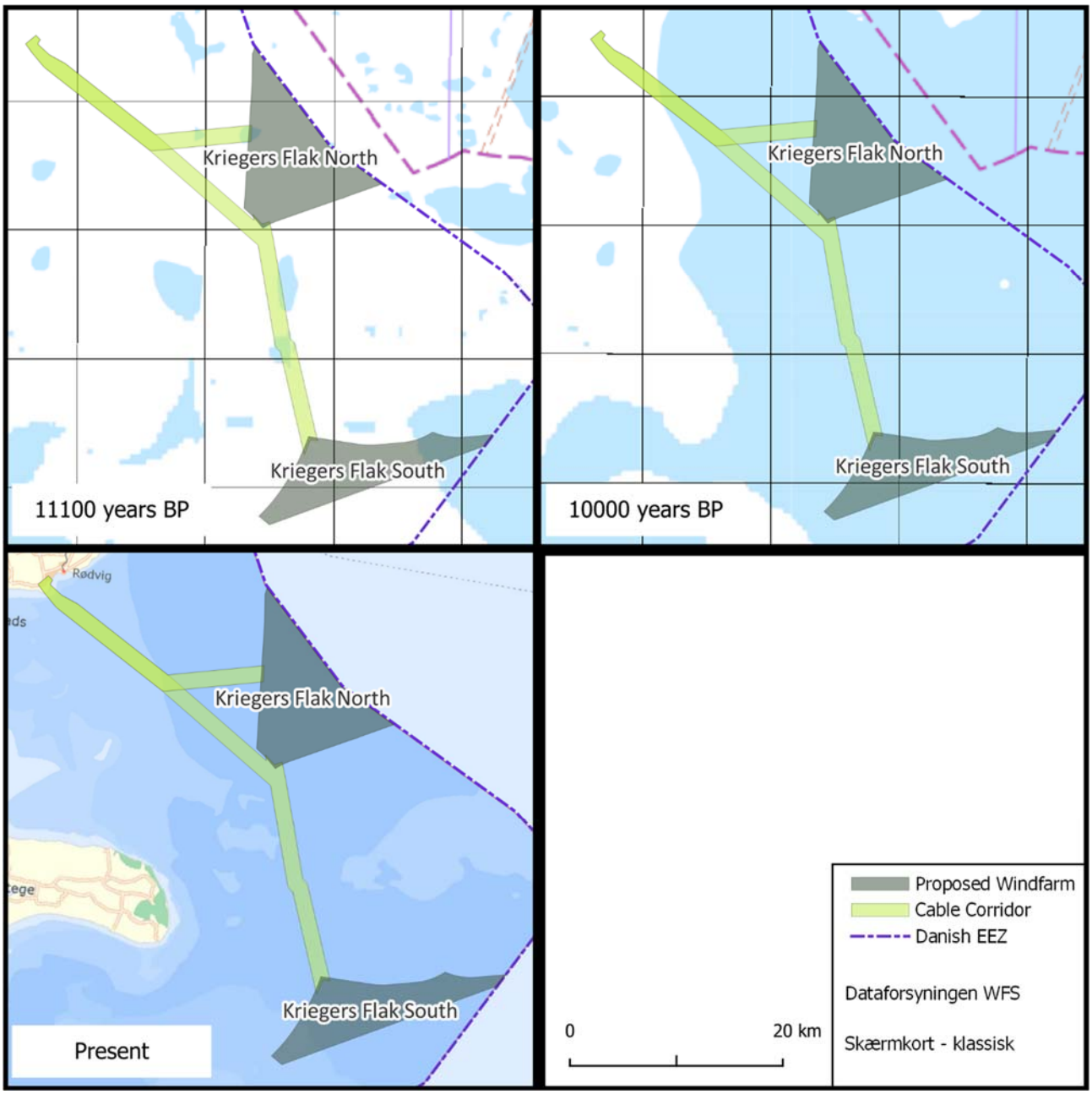


**Figure 4. Shore displacement from 11100 years BP to 10000 years BP and present shoreline. The white areas in the first two images represent dry land. The images use data acquired from the Geological Survey of Sweden's (SGU) shore displacement model. It should be noted that he model is designed for the Swedish coastline and therefore this is for illustrative purposes rather than an accurate representation. (See Methodology above.) Illustration: John Howorth © Vikingeskibsmuseet. Contains data from Styrelsen for Dataforsyning og Effektivisering.**

## *Conclusion*

There is a high probability for finding maritime CHOs on the seabed in the areas covered by the proposed windfarm and associated cable corridors. There are potentially 25 protected CHOs recorded with Fund og Fortidsminder and 10 objects recorded in other databases. Furthermore, it is likely that other potential CHOs will be discovered via side scan sonar and MBES.

The stone-age potential for the windfarm areas, Kriegers Flak 2 North and South, is low. The areas lie in deep water and would have been inundated by rising sea levels relatively rapidly. The areas are exposed to a long fetch and high energy environments which would disturb and redeposit any

archaeology. However, it is still possible that sonar and SBP data along with any core samples could highlight areas with potential.

There is a much higher potential to find stone-age human activity in the cable corridors, specifically in areas close to landfall. This is due to the fact that they are sheltered from the long fetch and high energy environments and lie in shallower water which would have been dry land for longer periods. Finds of worked flint have been recovered from the seabed close to the coast and evidence for a forested landscape means that there is potential for areas that were suitable for settlement. Further geophysical survey data, i.e. MBES and SBP, may reveal features in the submarine topography conducive for prehistoric settlement, any coring samples may give evidence of organic sediments or possible cultural layers.

## Bibliography

Howorth, J. (2023). *Energy Island Bornholm: Geoarchaeological Analysis of Energy Island Bornholm Interconnector Transects.* Roskilde: Vikingeskibsmuseet.

Jensen, J. B., & Bennike, O. (2022). *Geological Screening of Kriegers Flak North and South: Geological seabed screening in relation to possible location of windfarm areas.* GEUS.

Jonsson, M., & H. Thomsen, M. (2022). *Baltic Pipe, Danish Baltic Sector: Screening of geophysical data and target inspections for the proposed Baltic Pipe gas pipeline - Anchor corridor.* Roskilde: Vikingeskibsmuseet.