

# Aflandshage Wind farm

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Unexploded Ordnance  
Risk Assessment  
GEUS

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WAHA01-GEN-PRO-05-000016, HOFOR WIND A/S

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# Indhold

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<b>1</b>	<b>Introduction</b>	<b>3</b>
1.1	Aflandshage Wind farm area	3
<b>2</b>	<b>Desktop study</b>	<b>4</b>
<b>3</b>	<b>UXO threats and hazard items</b>	<b>4</b>
3.1	UXO	5
3.2	HSE focus areas	6
<b>4</b>	<b>UXO Risk Assessment and mitigation</b>	<b>6</b>
<b>5</b>	<b>Results and Conclusion</b>	<b>6</b>
<b>6</b>	<b>References</b>	<b>7</b>

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# 1 Introduction

As a sub-adviser to NIRAS, GEUS has conducted a desktop study to clarify the presence of unexploded ordnance (UXO), at the proposed wind farm sites Aflandshage and Nordre Flint including cable corridors. The work is part of an EIA contract between HOFOR and NIRAS as a feasibility study for the two wind farms, and consist of two site-specific documents.

UXO, along the Danish coastline, is both the result of previously military action and planned post-war dumping. In historical times, many sea battles has taken place at sea around Copenhagen, and a lot of old warships with military equipment are left at the seabed in Køge Bugt and Øresund. Furthermore, it is a heavily trafficked maritime area and numerous artefacts from these activities are left at the seabed beside possibly UXO's. They are all considered as potential hazards or objects of archaeological interest and is included in this document.

The purpose of this desktop study is to describe potential presence of these subjects and especially the possibility of presence of UXO within the survey areas for wind farms. This study also has focus on the potential risk regarding survey activities in the shallow water areas and heavy ship traffic zones.

## 1.1 Aflandshage Wind farm area

The proposed Aflandshage wind farm site and cable corridor are partially located in Køge Bugt and Østersøen (Figure 1). The wind farm area is located approximately 8 km northeast of Stevn, and 10 km. south of Amager, and the wind farm occupy an area of roughly 42 km<sup>2</sup>.

The cable corridor connect the wind farm from the northwestern corner of the wind farm area to Avedøre Holme. It covers an area of 12 km<sup>2</sup>.

Shallow water in the survey area should not the ability to conduct the survey activities except at the landfall site at Avedøre Holme.

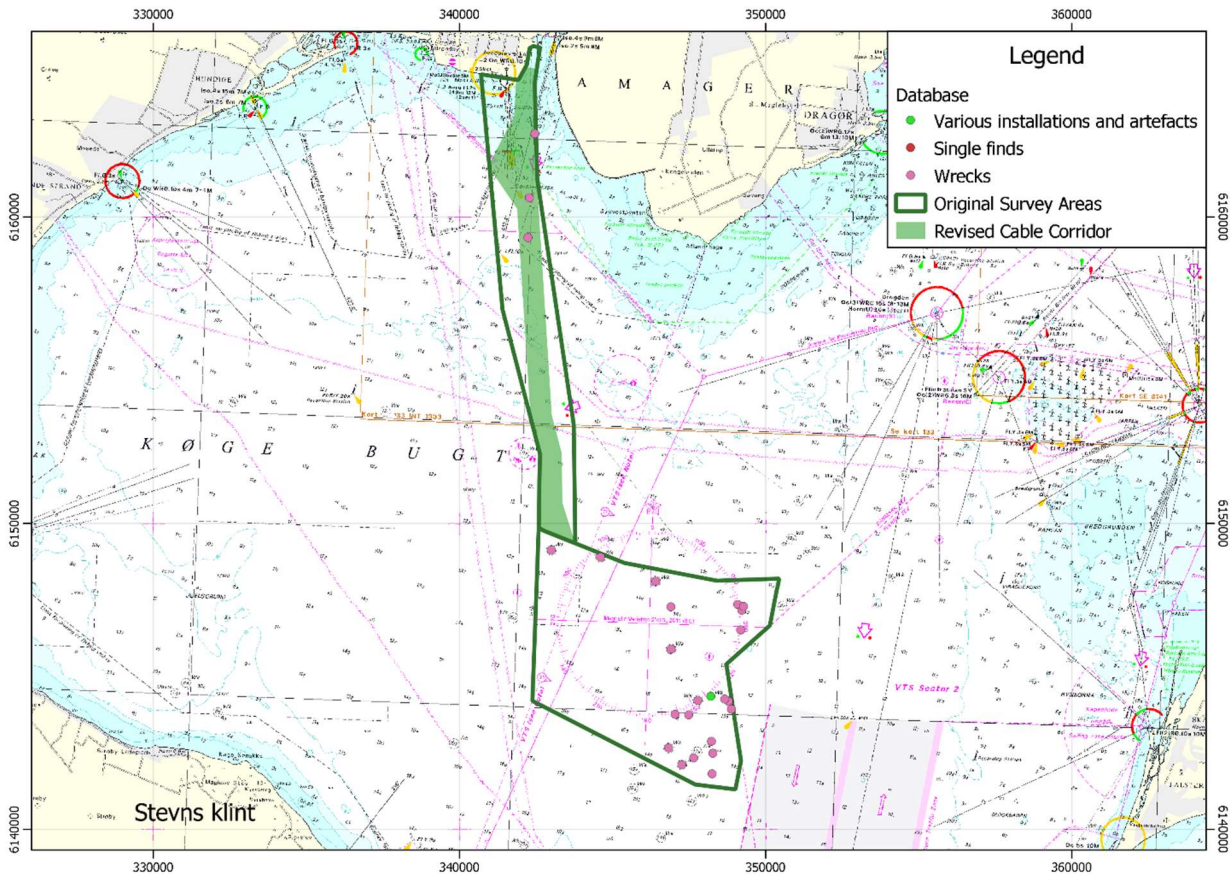


Figure 1.1 Map of Aflandshage wind farm site and cable corridor (both marked in green). The cultural and historical sites marked by colors corresponding to the type of find.

## 2 Desktop study

The study includes existing literature from previous investigations of cable routes, site investigations, marine archaeological investigations and survey activities from previous raw material investigations. It covers the regional areal descriptions of UXO and marine archeological artefacts previously located in the area. The literature is mostly in Danish, so the reference list for further information.

- The study material included in this document is focused but not fully covered on the following materials:
- Databases
- Consultation from the Danish Department of defense (Værnfælles Forsvarskommando)
- Careful run-through of sea charts of the area.
- Previous experiences from survey activities in the area.
- Raw material investigations.

## 3 UXO threats and hazard items

The offshore area around Copenhagen and in particular the ship navigation routes are and have been heavily trafficked since the city was founded more than eight hundred years ago. The area has been exposed to multiple sea battles, and bombardment of Copenhagen. It has left bombs and shipwrecks from these battles. Mines have also been deployed in the area during the two world wars.

The major artefacts already located in the area of interest is summarized in the table below. Included herein is the cultural and historical objects, as they constitute a large part of the overall volume of artefacts.

UXO	
Type	Objects
Modern UXO	<ul style="list-style-type: none"> <li>• Artillery bombs</li> <li>• Buoyant mines</li> </ul>
Older UXO	<ul style="list-style-type: none"> <li>• Canon balls</li> </ul>
HSE	
Type	Objects
Human infrastructure	<ul style="list-style-type: none"> <li>• Dredging and dumping material</li> <li>• Infrastructure and installations</li> </ul>
Cultural and historical	<ul style="list-style-type: none"> <li>• Newer wrecks</li> <li>• Old wrecks</li> <li>• Anchor</li> <li>• Others</li> </ul>
Natural	<ul style="list-style-type: none"> <li>• Boulders</li> <li>• Shallow ground</li> <li>• Currents</li> </ul>

Table 3.1

A revision of available databases have yielded a query of registered cultural artefacts and wrecks. The database is available from the Agency for Culture and Palaces (Slots- og kulturstyrelsen), and includes historical wrecks, modern wrecks, Stone Age settlements, planes etc.

The scheme below lists the number of objects known from the area of interest, and is subdivided into wind farm sites and cable corridors.

	Wreck	Single finds	Aircraft	Various installations and artefacts
Aflandshage Cabel rute	3	0	0	0
Aflandshage	21	1	0	1

Table 3.2

Some of the artefacts are dated back to the 1600's others are more modern. None of the objects are considered an explosive hazard. Those objects registered and deemed a hazard, have been removed. The majority of the objects are of modern age 1800-now. (Kulturarv.dk, 2020)

### 3.1 UXO

The research included in this study have yielded few cases of UXO's in the area of interest. UXO's (Older cannonballs) have been located close by an old wreck "Dannebrog" by Vikingskibsmuseet (Jørgen Dencker & Mikkel H. Thomsen, 2011), and was exposed off in a safe manner by the Mine clearance team from the Danish defense. They were deemed safe to handle, after they were flushed through.

It has been advised by the department of defence that bombs and buoyant mines could be found in the survey area (Forsvarets Ejendomsstyrrelse, 2017). The Danish and German fleet mined the Øresund strait at the start of World War 1 (Natmus.dk, 2020). Mines like these have been discovered south of Aflandshage Windfarm in Faxe Bugt (Stevns.netavis.dk, 2014), and north of Nordre Flint Windfarm at Helsingør (Benjamin Asmussen: "Den tyske besættelse af Kronborg 1940-45"), which means that mines are unlikely to be discovered in the study area, but precaution must be taken regardless..

### **3.2 HSE focus areas**

Health and safety is of highest importance when conducting survey activities in maritime environments. Shallow water is the main concern in the study area, besides UXOs. However, shallow waters only occurs in the shore area of Avedøre Holme, and is therefore not considered a significant hazard in this area. Overall, there is very little risk in conducting survey activities in the area of Aflandshage Wind farm.

## **4 UXO Risk Assessment and mitigation**

UXO risk in the proposed Aflandshage Wind farm site and the adjoining cable corridor are considered low. The main concern is World War 1 era mines, that was deployed in the area, but since have been removed, and this therefore does not influence the work on the seafloor. GEUS has previously acquired geophysical data in the area without identifying UXOs (Lomholt & Mathiassen, 1992). Wrecks of the 1800's are also a potential for UXO hazards, as the armament from these ships also could be explosive, although this is very unlikely as seen at the "Dannebrog" wreck (Jørgen Dencker & Mikkel H. Thomsen, 2011).

Risk mitigation could be taken by collecting magnetometer data, which could locate the biggest hazards like old mines and the likes, further, including magnetometer data in the survey survey have the advantage of aiding the archaeological investigations in their efforts to locate historical and cultural artefacts.

## **5 Results and Conclusion**

In the reports and databases investigated during this Desktop study we have not identified documented presence of UXO, but the study shows that the risks regarding UXO's cannot be excluded. Large amounts of cultural and historical sites have been registered, and more is probably to be found in the survey area.

Even though the risks of encountering UXO are deemed low, the consultancy from the department of defense suggest an UXO survey, because of possible artillery grenades and anchored mines. Based on the risk assessments and mitigation it is recommended, that a magnetometer dataset should be acquired together with the other survey activities. This will not only make it possibly to map large UXO's, but also benefit the archeologist efforts in uncovering historical and cultural artefacts as an UXO survey is quite comprehensive and should await the result of the combined side scan sonar, multibeam and magnetometer survey.

## 6 References

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