Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Environmental Statement

Volume 1

Chapter 14 - Offshore Archaeology and Cultural Heritage

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Glossary of Acronyms

AEZ	Archaeological Exclusion Zones
AONB	Area of Outstanding Natural Beauty
BEIS	Department for Business, Energy and Industrial Strategy
CIfA	Chartered Institute of Archaeologists
CHIA	Cultural Heritage Impact Assessment
CIA	Cumulative Impact Assessment
CITiZAN	Coastal and Intertidal Zone Archaeology Network
CTV	Crew Transfer Vessel
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DEFRA	Department for the Environment, Food and Rural Affairs
DEP	Dudgeon Extension Project
DOW	Dudgeon Offshore Wind Farm
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
EU	European Union
GBS	Gravity Base Structure
GIS	Geographical Information System
HDD	Horizontal Directional Drilling
HSC	Historic Seascape Character
HVAC	High-Voltage Alternating Current
IEMA	Institute of Environmental Management and Assessment
IHBC	Institute of Historic Building Conservation
IPMP	In-Principle Monitoring Plan

JNAPC	Joint Nautical Archaeology Policy Committee
KA	Kilo annum (thousand years ago)
km	Kilometre
MBES	Magnetometer and Multibeam Bathymetry
MHWS	Mean High Water Springs
MHCLG	Ministry of Housing, Communities and Local Government
MLWS	Mean Low Water Springs
MIS	Marine Isotope Stage
MPS	Marine Policy Statement
MW	Megawatts
NGI	Norwegian Geotechnical Institute
NHER	Norfolk Historic Environment Record
NHLE	National Heritage List for England
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
ORPAD	Offshore Renewables Protocol for Archaeological Discoveries
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
NRHE	National Record of the Historic Environment
PEIR	Preliminary Environmental Information Report
PPG	Planning Practice Guidance
ROV	Remote Operated Vehicle
RBINS	Royal Institute for Natural Sciences
SBP	Sub-bottom Profiler
SOW	Sheringham Shoal Offshore Wind Farm
SEP	Sheringham Shoal Extension Project
SSS	Side Scan Sonar
UKHO	United Kingdom Hydrographic Office

UN	United Nations
UXO	Unexploded Ordnance
WCS	Worst-case Scenario
WSI	Written Scheme of Investigation
WWI	World War I
WWII	World War II

Glossary of Terms

Aviation archaeology	The remains of crashed aircraft and archaeological material associated with historic aviation activities.
Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
DEP offshore site	The Dudgeon Offshore Wind Farm Extension consisting of the DEP wind farm site, interlink cable corridors and offshore export cable corridor (up to mean high water springs).
DEP wind farm site	The offshore area of DEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area. This is also the collective term for the DEP North and South array areas.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the EIA and HRA for certain topics.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Geoarchaeology	The application of earth science principles and techniques to the understanding of the archaeological record. Includes the study of soils and sediments and of natural physical processes that affect archaeological sites such as geomorphology, the formation of sites through geological processes and the effects on buried sites and artefacts.
Glacial/interglacial	A glacial period is a period of time within an ice age that is marked by colder temperatures and glacier advances. Interglacial correspond to periods of warmer climate between glacial periods. There are three main periods of glaciation within the last 1 million years, the Elsterian, the Saalian and the Weichselian which ended about 12,000 years ago. The Holocene period corresponds to the current interglacial.
Historic Seascape Character	The attributes that contribute to the formation of the historic character of the seascape
Horizontal directional drilling (HDD) zones	The areas within the onshore cable route which would house HDD entry or exit points.
Infield cables	Cables which link the wind turbine generators to the offshore substation platform(s).
Interlink cable corridor	This is the area which will contain the interlink cables between offshore substation platform/s and the adjacent Offshore Temporary Works Area.

Interlink cables	Cables linking two separate project areas. This can be cables linking: 1) DEP South array area and DEP North array area 2) DEP South array area and SEP 3) DEP North array area and SEP 1 is relevant if DEP is constructed in isolation or first in a phased development. 2 and 3 are relevant where both SEP and DEP are built.
Landfall	The point at the coastline at which the offshore export cables are brought onshore and connected to the onshore export cables.
Marine isotope stage	Marine isotope stages are alternating warm and cool periods in the Earth's paleoclimate, deduced from oxygen isotope data reflecting changes in temperature derived from data from deep sea core samples.
Maritime archaeology	The remains of boats and ships and archaeological material associated with prehistoric and historic maritime activities.
Mesolithic	10000 to 4000 BC The Middle Stone Age, falling between the Palaeolithic and Neolithic and marking the beginning of a move from a hunter gatherer society towards a food producing society.
Offshore cable corridors	This is the area which will contain the offshore export cables or interlink cables, including the adjacent Offshore Temporary Works Area.
Offshore export cable corridor	This is the area which will contain the offshore export cables between offshore substation platform/s and landfall, including the adjacent Offshore Temporary Works Area.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall. 220 – 230kV.
Offshore substation platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Onshore cable corridor	The area between the landfall and the onshore substation sites, within which the onshore cable circuits will be installed along with other temporary works for construction.

Onshore export cables	The cables which would bring electricity from the landfall to the onshore substation. 220 – 230kV.
Onshore Substation	Compound containing electrical equipment to enable connection to the National Grid.
Offshore Temporary Works Area	An Offshore Temporary Works Area within the offshore order limits in which vessels are permitted to carry out activities during construction, operation and decommissioning encompassing a 200m buffer around the wind farm sites and a 750m buffer around the offshore cable corridors. No permanent infrastructure would be installed within the Offshore Temporary Works Area.
Order Limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
Palaeoenvironmental analysis	The study of sediments and the organic remains of plants and animals to reconstruct the environment of a past geological age.
Palaeogeographic features	Features seen within sub-bottom profiler data (buried) and multibeam bathymetry data (sea floor) interpreted as representing prehistoric physical landscape features such as former river channels (palaeochannels).
Palaeolithic	500000 to 10000 BC The Old Stone Age defined by the practice of hunting and gathering and the use of chipped flint tools. This period is usually divided into Lower, Middle and Upper Palaeolithic.
Sea bed features	Features seen on the seafloor in the sidescan sonar or multibeam bathymetry data which are interpreted to represent heritage assets, or potential heritage assets. Also includes magnetic anomalies which may represent shallow buried ferrous material of archaeological interest.
Sea bed prehistory	Archaeological remains on the sea bed corresponding to the activities of prehistoric populations that may have inhabited what is now the sea bed when sea levels were lower.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
SEP offshore site	Sheringham Shoal Offshore Wind Farm Extension consisting of the SEP wind farm site and offshore export cable corridor (up to mean high water springs).

SEP wind farm site	The offshore area of SEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area.
Study area	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
The Applicant	Equinor New Energy Limited.

14 OFFSHORE ARCHAEOLOGY AND CULTURAL HERITAGE

14.1 Introduction

1. This chapter of the Environmental Statement (ES) describes the potential impacts of the proposed Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and Dudgeon Offshore Wind Farm Extension Project (DEP) on Offshore Archaeology and Cultural Heritage. The chapter provides an overview of the existing environment for the proposed offshore and intertidal development area, followed by an assessment of the potential impacts and associated mitigation for the construction, operation, and decommissioning phases of SEP and DEP.

2. The existing environment, as set out in this ES chapter (**Section 14.5**), provides an account of the known archaeological and cultural heritage resource (including designated and non-designated heritage assets), a summary of the potential for previously unrecorded heritage assets and finds to be present within the offshore sites and a review of the historic seascape character. The known and potential offshore and intertidal archaeological resource is identified with respect to:

   - Sea bed prehistory (i.e. archaeological remains on the sea bed corresponding to the activities of prehistoric populations that may have inhabited what is now the sea bed when sea levels were lower);
   - Maritime archaeology (i.e. the remains of boats and ships and archaeological material associated with prehistoric and historic maritime activities);
   - Aviation archaeology (i.e. the remains of crashed aircraft and archaeological material associated with historic aviation activities);
   - Historic seascape character (i.e. the attributes that contribute to the formation of the historic character of the seascape); and
   - Buried archaeology (including palaeoenvironmental deposits) within the intertidal zone below Mean High Water Springs (MHWS).

3. This assessment has been undertaken with specific reference to the relevant legislation and guidance, of which the primary sources are the National Planning Policy Framework (NPPF), the Marine Policy Statement (MPS) (and the East Inshore and East Offshore Marine Plans), and National Policy Statements (NPS). Details of these and the methodology used for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) are presented in **Chapter 5 EIA Methodology** and **Section 14.4**. Impacts to offshore archaeology and cultural heritage are assessed with reference to Principles of Cultural Heritage Impact Assessment in the UK, jointly authored by the Institute of Environmental Management and Assessment (IEMA), the Institute of Historic Building Conservation (IHBC) and the Chartered Institute of Archaeologists (CIfA) and published in July 2021. The relationship between these principles and the overarching approach to EIA is described in **Section 14.4**.

4. The assessment should be read in conjunction with following linked chapters:

   - **Chapter 6 Marine Geology, Oceanography and Physical Processes**;
   - **Chapter 21 Onshore Archaeology and Cultural Heritage**;

5. Additional information to support the Offshore Archaeology and Cultural Heritage assessment includes:

- **Appendix 14.1 Archaeological Assessment of Geophysical Data**;
- **Appendix 14.2 Archaeological Assessment of Geophysical Data – Addendum**; and
- **Appendix 14.3 Stage 1 Geoarchaeological Assessment of 2021 Geotechnical Data**.

14.2 Consultation

6. Consultation with regard to Offshore Archaeology and Cultural Heritage has been undertaken in line with the general process described in **Chapter 5 EIA Methodology** and the **Consultation Report** (document reference 5.1). The key elements to date have included scoping, the ongoing Evidence Plan Process (EPP) via the Archaeology and Cultural Heritage Expert Topic Group (ETG) (onshore and offshore) and the Preliminary Environmental Information Report (PEIR).

7. The feedback received throughout this process has been considered in preparing the ES. This chapter has been updated following consultation in order to produce the final assessment submitted within the Development Consent Order (DCO) application. **Table 14-1** provides a summary of the consultation responses received to date relevant to this topic, and details of how the Applicant has had regard to the comments and how these have been addressed within this chapter.

8. The consultation process is described further in **Chapter 5 EIA Methodology**. Full details of the consultation process are presented in the **Consultation Report** (document reference 5.1), which is submitted as part of the DCO application.

Table 14-1: Consultation Responses

Consultee	Date/ Document	Comment	Project Response
The Planning Inspectorate	November 2019 Scoping Opinion	Section 2.9.2.2 of the Scoping Report notes the potential for direct impacts to occur if archaeological material is present within the footprint of works required for routine maintenance activities which disturb the sea bed. However, it notes that many areas would have been disturbed during construction therefore there would be limited scope for further impact. It is unclear whether the Applicant intends to assess this matter, particularly as Table 2-23 proposes to scope this in, however Table 6-1 proposes to scope this out. The Applicant should ensure that the ES assesses this matter where significant effects are likely.	Potential impacts during operation are assessed in **Section 14.6.2**.
The Planning Inspectorate	November 2019 Scoping Opinion	The ES should describe how impacts to unknown assets that may be discovered during pre-construction or construction activity would be mitigated.	Proposed approaches to mitigation are summarised in **Section 14.6**.
The Planning Inspectorate	November 2019 Scoping Opinion	The Inspectorate recommends that the Applicant makes effort to agree the survey methodology with relevant consultation bodies including Historic England. The Applicant should produce a preliminary deposit model as part of the desk-based assessment to identify areas of archaeology potential and identify gaps in knowledge. The approach to developing this model should be discussed with Historic England and other relevant consultation bodies in effort to agree the approach.	The approach to survey was discussed with Historic England as part of the EPP. A preliminary deposit model is presented in **Section 14.5.1**.
The Planning Inspectorate	November 2019 Scoping Opinion	Figure 2.9.1 identifies four different sea bed features, however, does not provide an explanation as to what these are. The Applicant should ensure that any features identified on figures within the ES are clearly identifiable.	All features shown on the figures which support this chapter are clearly labelled and identified and discussed in the text.

Consultee	Date/ Document	Comment	Project Response
The Planning Inspectorate	November 2019 Scoping Opinion	The ES should confirm whether any Archaeological Exclusion Zones would be required, and if so, identify their anticipated location and explain the mechanism through which they would be secured.	Archaeological Exclusion Zones (AEZs) form part of the proposed mitigation summarised in **Section 14.6** and are illustrated on **Figures 3-5** of **Appendix 14.1**
Historic England	January 2020 ETG Meeting Minutes	It was agreed that an offshore specific archaeology 'Method Statement' document to set out the approach to assessment at the EIA stage would not be required, as this would simply be repeating much of the Scoping Report and Scoping Opinion	Approach to assessment established through EPP and established industry practice for offshore renewables as set out in **Section 14.4.**
Historic England	January 2020 ETG Meeting Minutes	Will there be further interpretation of the anomalies along the boundaries of the Sheringham Shoal Offshore Wind Farm (OWF) undertaken as part of the current project.	The results of previous archaeological assessments of geophysical survey data have been reviewed and fully integrated with the archaeological assessment carried out for the SEP and DEP (see

Consultee	Date/ Document	Comment	Project Response
			Appendix 14.1, **Appendix 14.2** and **Section 14.5.2**).
Historic England	January 2020 ETG Meeting Minutes	When preparing reports and documents for the PEIR and Environmental Statement (ES), care should be taken to ensure that sufficient guidance is provided for the delivery of method statements and subsequent archaeological investigations as necessary to adequately mitigate potential impact to wrecks, aircraft crash sites and palaeolandscape features, for example.	The mechanism by which the approach to archaeological investigations to be undertaken post-consent was agreed through Method Statements and is set out in the **Outline Written Scheme of Investigation (WSI)** (document reference 9.11), which is submitted alongside the DCO application.
Historic England	January 2020 ETG Meeting Minutes	If any geotechnical investigations are being undertaken at any stage of the project there should be provisions to include archaeological objectives. This commitment will have to be included at every stage of the project. Although it is understood that there are currently no plans to undertake geotechnical surveys pre-consent, these should be considered essential alongside geophysical survey results in any subsequent programme of survey and investigation.	Geotechnical investigations have been undertaken in Q4 2021, with geoarchaeological objectives included in the scope as set out in **Appendix 14.3**.

Consultee	Date/ Document	Comment	Project Response
			A commitment to including archaeological objectives in planned surveys post consent forms part of the proposed mitigation summarised in **Section 14.6**. The approach to post-application/post-consent geoarchaeological assessment is set out in the **Outline WSI (Offshore)** (document reference: 9.11).
Historic England	January 2020 ETG Meeting Minutes	Detailed information will be needed to guide the strategy for the mitigation of impacts submitted with DCO application, including submission of an Outline WSI for offshore archaeology.	The results of the archaeological assessment of geophysical data, and the desk-based assessment undertaken to inform mitigation requirements are included in **Appendix 14.1**, **Appendix 14.2** and **Section 14.5.**

Consultee	Date/ Document	Comment	Project Response
			An **Outline WSI (Offshore)** (document reference: 9.11) is submitted alongside the DCO application.
Historic England	January 2020 ETG Meeting Minutes	Historic Seascape Characterisation (HSC) will be an important part of the assessment. The national GIS datasets for HSC produced by Historic England are a point in time source of data and will require updating by the proposed project in accordance with the published methodology for HSC. This will include the changes to seascape since the national HSC was undertaken to reflect the current character.	HSC is discussed in **Section 14.5.4**.
Historic England	January 2020 ETG Meeting Minutes	With regard to Cumulative Impact Assessment an effort should be made to identify opportunities and involve stakeholders, including The Crown Estate to understand the wider future and leasing plans so that this could be included in the assessment as well.	The results of CIA are presented in **Section 14.7**.
Historic England	January 2020 ETG Meeting Minutes	CITiZAN (Coastal and Intertidal Zone Archaeological Network) could contain some useful information and should be used to inform the assessment at the landfall.	CITiZAN was used as a source of information for the assessment of intertidal archaeology in **Section 14.5.2.3**.
Historic England	July 2021 ETG Meeting Minutes	It is the responsibility of the project to demonstrate that the approach to geophysical data acquisition and assessment was sufficient.	It is acknowledged that there are gaps in the most recent survey coverage, although with the addition of historic datasets, the geophysical data

Consultee	Date/ Document	Comment	Project Response
			assessment is considered to provide an accurate characterisation of the archaeological potential of the study area, appropriate to the purposes of EIA. Data gaps and the associated risks are highlighted in **Section 14.4.2.1**.
Historic England	July 2021 ETG Meeting Minutes	Requested a WSI that informs the critical period between consent and final design. This document should give clarity to how the data gaps will be filled and, where possible, figures should be submitted which illustrate assets/areas/data and data gaps uncertainties so that it is clear to any consultant/contractor involved with taking work forward post-consent.	The **Outline WSI (Offshore)** (document reference: 9.11) submitted with the DCO application sets out how the archaeological assessments of post-consent survey data will inform final design and includes both a description and figures illustrating the data gaps and requirements with regard to the commitment to

Consultee	Date/ Document	Comment	Project Response
			addressing data gaps post-consent.
Historic England	July 2021 ETG Meeting Minutes	The programme of archaeological work should draw on published academic research and align with existing research frameworks. Opportunity exists to further knowledge, and mitigation measures will be required to protect these opportunities.	The **Outline WSI (Offshore)** (document reference: 9.11) submitted with the DCO application includes a requirement to establish objectives for archaeological work packages with reference to the most up to date and relevant academic research and research frameworks at the time that the works are to be carried out.
Historic England	July 2021 ETG Meeting Minutes	A well thought out argument should be made in relation to what is known and perceived to be the historic seascape character of the area. A scenario of offshore wind farms should be included as the national HSC (as a point intime study) does not include such schemes. The assessment should provide a narrative of the capacity of the historic character to accommodate change. Considered that the arrangement and physical appearance of the infrastructure should be given further attention rather than a purely quantitative assessment.	The worst-case scenario (**Section 14.3.2**) has been amended to consider qualitatively how the project could change the historic seascape character, rather

Consultee	Date/ Document	Comment	Project Response
			than being based just on the number and type of new infrastructure elements. The Historic Seascape Character (HSC) as relevant to SEP and DEP has also been updated to include schemes and activities within the study area that were not present when the national HSC was developed (**Section 14.5.4**).
Historic England	April 2022 ETG Minutes	Attention should be paid to the potential for unknown (pre-20th century) assets as well as known wrecks recorded by the UKHO within Offshore Temporary Works Areas.	Details of additional desk-based assessment, including consideration of known wrecks and the potential for unknown wrecks, are included in **Section 14.5.2**.
Historic England	April 2022 ETG Minutes	The WSI will have to be rigorous and detail how data will be collected and tailored to the project and must include the detail of the acquired and planned survey data and assessment rather than just representing a generic document.	The **Outline WSI (Offshore)** (document reference: 9.11)

Consultee	Date/ Document	Comment	Project Response
			submitted with the DCO application sets out how the design of post-consent surveys will incorporate archaeological objectives, including the identification of data gaps and requirements with regard to addressing these data gaps post-consent.
Historic England	June 2021, Section 42 Response Letter Section 16.1 Introduction	We wish to note that paragraph 2 of the introduction should also have referenced the published East Marine Plans as relevant to this proposed project, as detailed subsequently in paragraph 37.	Reference to the East Inshore and East Offshore Marine Plans has now been included in **Section 14.1** with detail provided in **Table 14-4**.
Historic England	June 2021, Section 42 Response Letter Section 16.2 Consultation	In paragraph 15 the following statement is made “The worst-case scenario for the disturbance of setting and character equates to the maximum intrusive effect (e.g. number and type of new infrastructure elements, height of infrastructure) for the longest duration.” We consider it important that this assumption is examined further and redetermined in any ES produced: for ‘character’ as a component of seascape it is essential that consideration of “maximum intrusive effect” is reassessed in reference to concepts of capacity for a seascape to accommodate change as could occur due to DEP and/or SEP; and	Further narrative regarding the worst-case scenario for character as a component of seascape is

Consultee	Date/ Document	Comment	Project Response
		for consideration of 'setting' it is important to qualify heritage assets for which setting contributes to their significance whether such heritage assets are submerged, buried, exposed be it on the sea bed, within the intertidal area or adjacent coastal margin.	provided in **Section 14.5.4**. Further narrative is also provided regarding heritage assets for which setting contributes to their significance in **Section 14.5**.
Historic England	June 2021, Section 42 Response Letter Section 16.2 Consultation	We also note that Maximum footprint of 56 WTGs is assumed to be the worst-case scenario without consideration of whether fewer, but larger WTGs may have more optimal location restrictions which could jeopardise more known or presently unknown heritage assets and places. The worst-case scenario for "Non-physical impacts to the setting of heritage assets and historic seascape character" (during impact period "operation") focusses on the maximum intrusive effect of up to 56 WTGs and 2 OSPs in consideration of installed infrastructure and operation and maintenance activities for the longest duration. It is our advice that such consideration requires referral to the capacity of spatially identified historic seascape character areas to accommodate change and there might not be a direct linear relationship that dictates number of WTGs as equating to a worst-case scenario. For example, do fewer, although physically larger, yet more dispersed WTGs represent characteristics, which corresponds with the legacy of other energy-related industrial infrastructure located in the southern North Sea?	Further narrative regarding the worst-case scenario for character as a component of seascape is provided in **Section 14.5.4**. It is noted that the maximum number of turbines for SEP and DEP has been reduced from 56 to 53.
Historic England	June 2021, Section 42 Response Letter	Paragraph 23 states that "…there is no embedded mitigation relevant to the Offshore Archaeology and Cultural Heritage" although other mitigation measures are proposed. We suggest that in any ES produced that an explanation is provided about how agreed avoidance for identified features of historic or archaeological may be considered as embedded mitigation. However, we note that Paragraph 24	An additional explanation concerning the application of additional (as

Consultee	Date/ Document	Comment	Project Response
	Section 16.3.3 Summary of Mitigation Embedded in the Design	states that an Outline archaeological Written Scheme of Investigation (WSI) setting out the method for all proposed mitigation will be prepared as part of the DCO application, but which was not included within this PEIR consultation exercise.	opposed to embedded) mitigation is provided in **Section 14.3.3.** The **Outline WSI (Offshore)** (document reference: 9.11) is submitted with the DCO application.
Historic England	June 2021, Section 42 Response Letter Section 16.3.3 Summary of Mitigation Embedded in the Design	Table 16-6 (Summary of acquired geophysical data) – summarises the acquired geophysics data. It is noted that the Side Scan Sonar (SSS) data was classed as being of 'variable' quality, which may impact the ability to identify smaller objects. It was concluded in Section 16.4.2.1 that the data was suitable for archaeological purposes (paragraph 45), but it should be noted that there is the potential for remains to be present that have not been identified or resolved through the geophysical survey campaign. We are aware that further detail is provided within Appendices 16.1 (Archaeological Assessment of Geophysical Data) and 16.2 (Addendum: Archaeological Geophysics), for which we have also provided comments.	Data gaps and the associated risks are highlighted in **Section 14.4.2.1**. The potential for further remains to be present, including smaller objects, will be addressed through the archaeological assessment of further geophysical data to be acquired post-consent. This commitment is captured in the **Outline WSI (Offshore)**

Consultee	Date/ Document	Comment	Project Response
			(document reference: 9.11).
Historic England	June 2021, Section 42 Response Letter Section 16.3.3 Summary of Mitigation Embedded in the Design	We acknowledge the statement included in paragraph 47 that parts of the project area were not covered by the 2019/2020 surveys and we note the explanation provided about other sources of data that were used. We also note the conclusion that those disparate data sets were of sufficient accuracy to characterise the archaeological potential of the proposed development areas. In terms of spatial currency of available data, we note the statement made in paragraph 109 regarding the identification of mobile sand waves. It is therefore an important matter that adequate attention is given to the risk of encountering presently unknown, buried archaeological materials in dynamic sea bed areas.	Data gaps and the associated risks are highlighted in **Section 14.4.2.1**. The potential for further remains to be present, including smaller objects, will be addressed through the archaeological assessment of further geophysical data to be acquired post-consent. This commitment is captured in the **Outline WSI (Offshore)** (document reference: 9.11).
Historic England	June 2021, Section 42 Response Letter Section 16.4.3.2 Heritage Significance and Heritage Importance	Paragraph 54 includes a bullet point about “the perceived heritage importance of identified assets”. However, importance is scaled, not perceived using defined criteria (e.g. national or international importance) and therefore this bullet point would need to be revised in any ES prepared for submission.	The impact assessment methodology has been updated to take account of recently published guidance on cultural heritage impact assessment

Consultee	Date/ Document	Comment	Project Response
			and this bullet point has been removed from **Section 14.4.3**.
Historic England	June 2021, Section 42 Response Letter Section 16.5.1 Summary of previous geoarchaeological assessments for Dudgeon and Sheringham Shoal OWFs	Paragraph 91 and Table 16.12 state that geotechnical investigations were not carried out to inform the EIA, although previous geoarchaeological assessments have been included in this PEIR. However, it would be helpful to know the spread of these cores across the proposed development areas and whether gaps can be identified, which are spatially relevant to the Projects which should be the focus for attention. For example, where previous geophysical surveys and geotechnical investigations have identified several channel features thought to have formed during periods of low sea level when the area would have been exposed to a terrestrial landscape. We also consider it important that paragraph 97 acknowledges the significance of the Pleistocene and Holocene deposits of the coastal zone at Weybourne and the proximity of the Projects' study area to one of the most important stretches of coastline for Palaeolithic archaeology in the British Isles.	Geotechnical investigations have been undertaken in Q4 2021, with geoarchaeological objectives included in the scope as set out in **Appendix 14.3**. Further detail has also been provided regarding previously mapped palaeolandscape features identified from previous surveys with regard to Cumulative Impact Assessment in **Section 14.7.3**.
Historic England	June 2021, Section 42 Response Letter Section 16.5.2 Maritime and Aviation Archaeology	The use of available geophysical data to indicate the presence of sea bed features which are considered to be of archaeological interest or potential archaeological interest is noted (as categorised in Tables 16.15 and 16.16). It is also important to note the considerable number of anomalies which are given the identification code "A2" ("uncertain origin of possible archaeological interest") as explained in	The approach to investigating sea bed features in order to establish their archaeological interest (e.g.

Consultee	Date/ Document	Comment	Project Response
		paragraphs 128-129, these anomalies will require examination in any Outline WSI prepared in support a DCO application.	through the use of drop-down cameras or diver / Remotely Operated Vehicle (ROV) survey) is set out in the **Outline WSI (Offshore)** (document reference: 9.11).
Historic England	June 2021, Section 42 Response Letter Section 16.5.3 Intertidal Archaeology	We must highlight the following matters for attention in any ES prepared: detail must be provided about how depth of HDD beneath the intertidal zone will be determined to avoid impact to sedimentary sequences of archaeological interest; and attention must be given to the proposed exit below MLWS and the requirement for a “transition zone” as described in Chapter 5 and any risk of encountering archaeological materials in the shallow subtidal area especially given the research interest directed at discovering material in this zone over recent years e.g. Bynoe R. (2018) The submerged archaeology of the North Sea: Enhancing the Lower Palaeolithic record of northwest Europe”. Quaternary Science Reviews 191(2):1-14	The depth of sedimentary sequences of archaeological interest at the landfall, and the potential presence of Palaeolithic material within the shallow subtidal area, will be further clarified through the geoarchaeological assessment of geotechnical data acquired post-application/post-consent, and will inform the design of Horizontal Directional Drilling (HDD) and

Consultee	Date/ Document	Comment	Project Response
			nearshore cable installation.
Historic England	June 2021, Section 42 Response Letter Section 16.5.4 Historic Seascape Character and setting	We see that use was made of the consolidated national Historic Seascape Character (HSC) GIS dataset, as described in paragraph 153. However, while attention is given to the setting of identified subtidal wreck sites, there is no apparent attention to an assessment of change as could be introduced by the Projects. We request that such analysis is included in any ES produced.	An assessment of change to the historic seascape character is provided in **Section 14.5.4**.
Historic England	June 2021, Section 42 Response Letter Section 16.5.4 Historic Seascape Character and setting	In paragraph 169 we noted the determination of shipwreck associated with First and Second World Wars as "…heritage assets of medium importance." It is important for us to explain that we do not necessarily differentiate between heritage assets. The definition of a heritage asset is that it has been positively identified as holding a degree of significance. Its significance is related to its heritage interest, which includes archaeological, architectural, artistic or historic factors, which of course, may change over time.	In accordance with the revised impact assessment methodology, the significance of heritage assets are described in **Sections 14.5.1.2**, **14.5.2.2** and **14.5.3.2.**
Historic England	June 2021, Section 42 Response Letter Section 16.6 Potential impacts	It is also stated that due to the use of HDD to install the cable ducts within the intertidal zone, that there will be no direct impact on archaeological material (paragraphs 179 & 181). However, we noticed the very general reference to "…passing below the beach deposits…" it is therefore essential that all parties are clear that geo-archaeological evaluation studies are completed to a standard that can demonstrate if sedimentary sequences of particular archaeological interest, e.g. Cromer Forest bed Formation (CFbF) are present or not.	The depth of sedimentary sequences of archaeological interest, and the potential presence of Paleolithic material within the shallow subtidal area, will be further clarified through the geoarchaeological assessment of

Consultee	Date/ Document	Comment	Project Response
			geotechnical data post-application/post-consent, and will inform the design of HDD and nearshore cable installation.
Historic England	June 2021, Section 42 Response Letter Section 16.6.1.1.5 Mitigation	To deliver micro-siting, further investigation of these [A2] anomalies would be required as part of high-resolution geophysical survey work which could be undertaken as part of the UXO investigations. It is therefore of critical importance that survey programmes that support planning and design of the Projects clarify the nature and extent of the anomalies. We therefore note the attention given to implementing procedures in accordance with an agreed archaeological WSI to optimise survey data acquisition, especially If features cannot be avoided to inform the additional work required to establish the archaeological interest of the features, using approaches such as ROV and/or diver surveys. Additional mitigation work may then be required (post-consent) which will be agreed with Historic England. In summary, we recommend that: an outline WSI accompanies the ES which sets out how archaeological advice will inform survey programmes conducted post-consent (should permission be obtained), but pre-commencement of any construction activities; and (draft) deemed Marine Licences provide for the preparation of WSIs to inform all phases of construction (should consent be obtained).	The **Outline WSI (Offshore)** (document reference: 9.11) is submitted with the DCO application. This sets out the approach to further investigation to inform micro-siting and provision of additional mitigation should avoidance not be possible. As secured within the **Draft DCO** (document reference 3.1), a final WSI (Offshore) will be produced post consent in accordance with

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			the Outline WSI (Offshore).
Historic England	June 2021, Section 42 Response Letter Sections 16.6.1.1.6 and 16.6.1.1.7 Residual Impacts	As you will appreciate it is not possible for us to concur at this stage if micro-siting is not possible that "…the residual magnitude and significance will be reduced or offset to levels considered non-significant in EIA terms…". This comment needs to be addressed by the applicant.	This statement has been amended (see **Paragraph 244** and **Paragraph 245**).
Historic England	June 2021, Section 42 Response Letter Section 16.6.1.2 Magnitude of impact	Paragraph 208 explains that "It is anticipated that HDD will pass beneath Quaternary deposits of potential archaeological interest…" In order to confirm such an assumption a detailed programme of geo-archaeological investigation will need to be provided for through agreed mitigation measures that accompany any DCO application.	Geotechnical investigations have been undertaken in Q4 2021, with geoarchaeological objectives included in the scope as set out in **Appendix 14.3**. A commitment to including archaeological objectives in planned surveys post-consent forms part of the proposed mitigation summarised in **Section 14.6**. The approach to post-application/post-consent geoarchaeological

Consultee	Date/ Document	Comment	Project Response
			assessment is set out in the **Outline WSI (Offshore)** (document reference: 9.11).
Historic England	June 2021, Section 42 Response Letter Section 16.6.1.2.5 Mitigation	We recommend that any outline WSI produced in support of a DCO application, states that commissioned geo-archaeologists are given direct access to the cores rather than isolated deposits as this allows for greater reliability and confidence in the resulting conclusions. We also appreciate that a strategy will be developed to deal with unexpected discoveries, establishing a protocol for archaeological discoveries (paragraph 221) and are pleased to see that the protocol will be agreed in consultation with Historic England.	Direct access to cores is included as part of the approach to geoarchaeological assessment set out in the **Outline WSI (Offshore)** (document reference 9.11).
Historic England	June 2021, Section 42 Response Letter Section 16.6.1.2.5 Mitigation	It is acknowledged in Section 16.6.1.3 that the proposed development has the potential to impact local and regional hydrodynamic and sedimentary processes, which in turn could impact the historic environment by exposing them to marine processes (paragraph 228). Table 16-23 summarises the predicted effects based on the worst-case scenario, where it is concluded that the effects would be of a low or negligible magnitude. We would recommend that these conclusions are reassessed following the completion of the additional work (high-resolution geophysical work, geotechnical/geoarchaeological assessments etc.), as this will provide more information about the nature and extent of both the known and unknown archaeological remains present within the area of proposed works.	Should heritage assets vulnerable to changes associated with local and regional hydrodynamic and sedimentary processes be identified, following the completion of the additional work post-consent, these will be considered on a case by case basis and will be subject to archaeological

Consultee	Date/ Document	Comment	Project Response
			monitoring in accordance with provisions set out in the **Outline WSI (Offshore)** (document reference 9.11).
Historic England	June 2021, Section 42 Response Letter Section 16.6.1.4 Setting and HSC	We note the summary narrative provided in Table 16.24 regarding the "assessed capacity to accommodate change" and the identification of "Potential beneficial change" i.e. society generally welcoming development of renewable energy infrastructure which should be objectively assessed in reference to published material e.g. Bugnot A.B. et al. (2020) Current and projected global extent of marine built structures. Nature sustainability (published online 31/08/2020).	The public benefit of SEP and DEP is considered in the **Planning Statement** (document reference 9.1).
Historic England	June 2021, Section 42 Response Letter Section 16.6.1.4 Setting and HSC	In reference to character sub-type "Palaeolandscape component" we note the assessed capacity is one of "Potential beneficial change" in connection to production of publicly available data to support analysis and interpretation. In respect to consideration of this exercise as narrative approach to identify different perspectives, we recommend the ES also considers this character sub-type as both known and potential resource and the implications of loss of access which could be permanent.	The known and potential palaeolandscape resource is described in **Section 14.5.1**. The maintenance of access within operational areas is discussed with respect to the character sub-type in **Section 14.5.4**.
Historic England	June 2021, Section 42 Response Letter Section 16.7 Cumulative Impacts	In paragraph 293 the following statement is made: "However, as the extent of the potential heritage assets, prehistoric landscapes or historic seascapes which could be subject to cumulative impact are undefined, it is not possible to identify which plans, projects and activities would, or would not, have the potential to have a cumulative impact with the proposed projects."	The HSC geo-spatial data has been mapped against identified

Consultee	Date/ Document	Comment	Project Response
		We consider this to be a matter that requires re-assessment within the ES, for example, in reference to the detail already provided in section 16.5.4 regarding the use of HSC geo-spatial data, “Impact 4” as described in Table 16-26 and the explanation provided in paragraph 294.	projects on **Figure 14.2**.
Historic England	June 2021, Section 42 Response Letter Section 16.8 Transboundary Impacts	We concur with the assessment of the situation provided and it is relevant that impact assessment considers how access to the archaeological resource could be impacted across the North Sea, especially in reference to published professional research frameworks.	Noted.
Historic England	June 2021, Section 42 Response Letter Section 16.11 Potential Monitoring Requirements	We are pleased to see that a monitoring plan will be prepared and submitted alongside the DCO (paragraph 312). We add that it would be helpful if DCO documentation e.g. In-Principle Monitoring Plan (IPMP) set out the timeframes for monitoring requirements to be conducted and reported.	The **In-Principle Monitoring Plan** (document reference 9.5) submitted with the DCO application describes the anticipated marine archaeological and cultural heritage monitoring requirements and associated timeframes.
Historic England	June 2021, Section 42 Response Letter Section 16.11 Potential Monitoring Requirements	We also note confirmation of the use of a protocol system, as described in paragraph 321. In reference to Table 16.30 (summary of potential impacts) we reserve our position regarding the realisation of “residual impact” for construction, operation or decommissioning phases of either/or of the Projects in reference to the enactment of mitigation measures as a component of any statutory consent obtained for this proposed project.	Noted. The statement regarding residual impact has been amended (see Paragraph 244 and Paragraph 245).

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Historic England	June 2021, Section 42 Response Letter Appendix 16.1: Archaeological Assessment of Geophysical Data Section 2.3 Geophysical data processing	It is important to note that the line spacings used for the offshore geophysics surveys were larger than recommended for archaeological assessments in the Historic England document 'Marine Geophysics: Data Acquisition, Processing and Interpretation (2013).	Data gaps and the associated risks are highlighted in **Section 14.4.2.1**.
Historic England	June 2021, Section 42 Response Letter Appendix 16.1: Archaeological Assessment of Geophysical Data Section 2.3 Geophysical data processing	In addition, in Section 2.3.6, it is stated that initially, only 25% of SbP survey lines were assessed; additional lines were interpreted in order to more accurately map the extents of these features. It is therefore possible that smaller features may not have been identified following this work if they fell between the survey lines.	Data gaps and the associated risks are highlighted in **Section 14.4.2.1**. The approach to post-application/post-consent archaeological assessment is set out in the **Outline WSI (Offshore)** (document reference 9.11).
Historic England	June 2021, Section 42 Response Letter Appendix 16.1: Archaeological Assessment of Geophysical Data Section 2.3 Geophysical data processing	We would therefore recommend that this document is referred to when planning future geophysics campaigns: [redacted]	Reference is made to the relevant Historic England guidance in planning future survey campaigns in the **Outline WSI (Offshore)**

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			(document reference 9.11).
Historic England	June 2021, Section 42 Response Letter Appendix 16.1: Archaeological Assessment of Geophysical Data Section 2.4 Geophysical data – data quality	An assessment of the quality of the information obtained from the geophysical survey work generally classed the data as being 'good' (criteria defined in Table 6). However, the Side Scan Sonar (SSS) nearshore data was classed as being of 'variable' quality as it was affected by weather noise. It was concluded that the SSS data could be used to identify larger objects, such as wrecks, but that it was more difficult to identify smaller objects.	Data gaps and the associated risks are highlighted in **Section 14.4.2.1**.
Historic England	June 2021, Section 42 Response Letter Appendix 16.1: Archaeological Assessment of Geophysical Data Section 2.4 Geophysical data – data quality	It was also noted that the Magnetometry data obtained from the Projects areas was of 'average' quality due to the background noise in the data (Section 2.4.10). This coupled with the large line spacings of 75m meant that it was felt that smaller objects may not have been picked up in the data. This suggests that there is the potential for previously unknown features and remains to have been missed at this stage.	Data gaps and the associated risks are highlighted in **Section 14.4.2.1**.
Historic England	June 2021, Section 42 Response Letter Appendix 16.1: Archaeological Assessment of Geophysical Data Section 3 Palaeogeographic assessment	It is noted that due to the penetration of the Parametric Sonar data, the shallow nature of some of the features and the acoustic similarities between Unit 6b and the underlying Units 6a and 5, that it was not possible to accurately map the full extent of the features, particularly the Botney Cut features (Section 3.2.4). We recommend these areas should be targeted using additional techniques, such as boreholes to help characterise and understand the features and their associated features? It was stated that there was the possibility that the units associated with the Botney Cut had a more complex depositional history, which will need to be considered when developing research questions and the strategies used to investigate them (Section 3.2.12).	Geotechnical investigations have been undertaken in Q4 2021, with geoarchaeological objectives included in the scope as set out in **Appendix 14.3**.
Historic England	June 2021, Section 42 Response Letter	We note the attention given to archaeological discrimination viz. Tables 9 to 18 in reference to available data types. However, we are aware of data limitations and	A strategy for addressing A2

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	Appendix 16.1: Archaeological Assessment of Geophysical Data Section 4 Sea bed feature assessment	gaps in the information presented and that most anomalies have been classified as "A2" (428 out of 470 anomalies in total), being of uncertain origin of possible archaeological interest. It was noted in Chapter 16 of the main PEIR document that AEZs will not be recommended for A2 anomalies. Therefore, a strategy would need to be developed in order to characterise and understand the nature of these anomalies if they cannot be avoided (Section 5.1.14), and to define whether they are of archaeological interest. If they are, a mitigation strategy would also need to be developed and detailed within the ES and documents such as the Outline Offshore Archaeological WSI.	anomalies is detailed in **Section 14.6.1.1.5** and set out in the **Outline WSI (Offshore)** (document reference 9.11).
Historic England	June 2021, Section 42 Response Letter Appendix 16.1: Archaeological Assessment of Geophysical Data Section 5 Conclusions and recommendations	We agree with the recommendations made in Sections 5.1.3 and 5.1.4 that the archaeological contractor should be consulted to advice on potential samples that will be acquired for archaeological purposes. It is therefore important that the Outline archaeological WSI prepared for this proposed project explains how such matters will be addressed and delivered in consultation with local and national curators.	Geotechnical investigations have been undertaken in Q4 2021, with geoarchaeological objectives included in the scope as set out in **Appendix 14.3**. The approach to integrating archaeological objectives with future, planned geotechnical surveys is set out in the **Outline WSI (Offshore)** (document reference 9.11).

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Historic England	June 2021, Section 42 Response Letter Appendix 16.2 Addendum: Archaeological Geophysics	The report did not include information about the line spacings used when the data was originally collected, and it was noted that not all the additional areas have full geophysics coverage. In addition, the full suite of geophysics techniques was not used for some of the additional cable corridors (Section 2.4.3). It is therefore possible that additional previously unknown features of archaeological interest may be present in these areas (Section 2.4.5). This is a matter that we consider needs to be addressed.	It is acknowledged that there are gaps in the most recent survey coverage, although with the addition of historic datasets, the geophysical data assessment is considered to provide an accurate characterisation of the archaeological potential of the study area, appropriate for the purposes of EIA. Data gaps and the associated risks are highlighted in **Section 14.4.2.1**. The potential for further remains to be present will be addressed through the archaeological assessment of further geophysical data to be acquired post-consent. This commitment is captured in the

Consultee	Date/ Document	Comment	Project Response
			Outline WSI (Offshore) (document reference 9.11).
Historic England	June 2021, Section 42 Response Letter Appendix 16.2 Addendum: Archaeological Geophysics	Similar issues noted in Appendix 16.2 regarding the penetration of the Parametric Sonar data, the shallow nature of some of the features and the acoustic similarities between Unit 6b and the underlying Units 6a and 5: it was stated that it was not possible to accurately map the full extent of the features, particularly the Botney Cut features (Section 3.2.15). Additional work would therefore be needed to clarify and characterise the nature of the events/features recorded in these areas.	Geotechnical investigations have been undertaken in Q4 2021, with geoarchaeological objectives included in the scope as set out in **Appendix 14.3**.
Historic England	June 2021, Section 42 Response Letter Appendix 16.2 Addendum: Archaeological Geophysics	It was noted in Chapter 16 of the main PEIR document that AEZs will not be recommended for A2 anomalies. Therefore, a strategy will need to be developed to characterise and understand the nature of these anomalies if they cannot be avoided (Section 5.1.7), and whether they are of archaeological interest. If they are, a mitigation strategy will also need to be developed.	A strategy for addressing A2 anomalies is detailed in **Section 14.6.1.1.5** and set out in the **Outline WSI (Offshore)** (document reference 9.11).
The following comments were made following targeted consultation (4th April 2022) on the SEP and DEP Offshore Temporary Works Order Limits Environmental Report			
Historic England	18th May 2022, Targeted Consultation Response Letter	We therefore concur with the matters summarised for inclusion with any Outline WSI such as avoidance through Archaeological Exclusion Zones; geophysics and geoarchaeology assessment methodology; and application of a reporting protocol for discoveries will be inclusive of the proposed additional temporary works area buffer zone. We also welcome the commitment made in paragraph 23 that the Archaeology Expert Topic Group (ETG) will be consulted on the revised Outline WSI as part of the ongoing Evidence Plan Process.	The **Outline WSI (Offshore)** (document reference: 9.11) includes consideration of the offshore

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			temporary works area following the amendment to the proposed Order Limits. A draft of the **Outline WSI (Offshore)** has been forwarded to Historic England for review prior to submission.
Historic England	18th May 2022, Targeted Consultation Response Letter	Further to the acknowledgment of further geoarchaeological assessment as a component of any Outline WSI, we consider it relevant that any further discussion directed through the ETG allows for consideration of palaeo-channel features to be encountered. We are aware that utilising geophysical and geotechnical survey should be extended to include the additional temporary works area buffer zone and thereby build of the assessment provided in PEIR Appendix 16.1 (Archaeological Assessment of Geophysical Data), such an approach would give an indication of the potential for prehistoric landscape and channel features to be impacted in the extended area.	

14.3 Scope

14.3.1 Study Area

9. The study area for Offshore Archaeology and Cultural Heritage is defined as the SEP and DEP wind farm sites and the offshore cable corridors (interlink and export cables), including the intertidal zone at the landfall up to MHWS.

10. Following PEIR, an amendment has been made to the offshore order limits to include an Offshore Temporary Works Area (i.e. the adjacent areas of sea bed that may be subject to temporary works, such as anchoring or the use of jack-up vessels) comprising:

- 750m buffer either side of the export and interlink cable corridors; and
- 200m buffer to the SEP and DEP wind farm sites.

11. The study area for Offshore Archaeology and Cultural Heritage has been expanded to incorporate assessment of the Offshore Temporary Works Area as part of the ES.

14.3.2 Realistic Worst Case Scenario

14.3.2.1 General Approach

12. The final design of SEP and DEP will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust impact assessment at this stage of the development process, realistic worst-case scenarios have been defined in terms of the potential effects that may arise. This approach to EIA, referred to as the Rochdale Envelope, is common practice for developments of this nature, as set out in Planning Inspectorate Advice Note Nine: Rochdale Envelope (v3, 2018). The Rochdale Envelope for a project outlines the realistic worst-case scenario for each individual impact, so that it can be safely assumed that all lesser options will have less impact. Further details are provided in **Chapter 5 EIA Methodology**.

13. The realistic worst-case scenarios for the Offshore Archaeology and Cultural Heritage assessment are summarised in **Table 14-2**. These are based on the project parameters described in **Chapter 4 Project Description**, which provides further details regarding specific activities and their durations.

14. In addition to the design parameters set out in **Table 14-2**, consideration is also given to:

- How SEP and DEP will be built out as described in **Section 14.3.2.2** to **Section 14.3.2.4** below. This accounts for the fact that whilst SEP and DEP are the subject of one DCO application, it is possible that only one Project could be built out (i.e. build SEP or DEP in isolation) or that both of the Projects could be developed. If both are developed, construction may be undertaken either concurrently or sequentially.
- A number of further development options which either depend on pre-investment or anticipatory investment, or that relate to the final design of the wind farms.
- Whether one offshore substation platform (OSP) or two OSPs are required (relevant only to the offshore assessments).

- The design option of whether to use all of the DEP North and DEP South array areas, or whether to use the DEP North array area only (relevant only to the offshore assessments).

15. In order to ensure that a robust assessment has been undertaken, all development scenarios and options have been considered to ensure the realistic worst-case scenario for each topic has been assessed. Further details are provided in **Chapter 4 Project Description**.

16. The worst-case scenario for archaeology below MHWS is based upon the general assumption that the greatest potential footprint for the Projects represents the greatest potential for direct impacts (e.g. damage / destruction) to surviving archaeological material which could be present on the sea floor or buried within sea bed deposits.

17. The worst-case scenario for indirect impacts equates to those aspects of the development which result in the greatest potential for increased scour and sediment stripping across an area as a result of changes to physical processes. Conversely, those aspects of the development which result in the greatest increase in sediment deposition also represent the greatest potential effect in terms of the beneficial impact of increased protection for archaeology.

18. With regard to historic seascape character, the worst-case scenario (WCS) is considered in terms of the capacity for the seascape to accommodate change. Whilst **Table 14-2** makes reference to the maximum intrusive effect (e.g. number and type of new infrastructure elements, height of infrastructure etc.) for the longest duration (i.e. the maximum potential change), this is further qualified by the narrative description provided in **Section 14.5.4**. Similarly, for the setting of heritage assets the realistic worst-case provides a quantification of the maximum change, which is further qualified by the narrative description of that change, and how this would affect the significance of identified heritage assets, provided in **Section 14.6.2.4**.

19. In order to ensure that a robust assessment has been undertaken, all development scenarios and options have been considered to ensure the realistic worst-case scenario for each topic has been assessed. Further details are provided in **Chapter 4 Project Description**.

20. In relation to the different OSP scenarios where both SEP and DEP are built (i.e. where there are one or two OSPs), each scenario has been presented, however only the overall realistic worst-case for each impact has been assessed in **Section 14.6**. The worst-case parameter for each activity / footprint in the SEP and DEP one or two OSP scenario has been denoted with an asterisk and underlined in **Table 14-2**. In addition, cells have been shaded grey to indicate which scenario represents the worst-case in relation to each of the impacts assessed.

14.3.2.2 Construction Scenarios

21. In the event that both SEP and DEP are built, the following principles set out the framework for how SEP and DEP may be constructed:

- SEP and DEP may be constructed at the same time, or at different times;
- If built at the same time both SEP and DEP could be constructed in four years;
- If built at different times, either Project could be built first;

- If built at different times, each Project would require a four year period of construction. year period of construction;
- If built at different times, the offset between the start of construction of the first Project, and the start of construction of the second Project may vary from two to four years;
- Taking the above into account, the total maximum period during which construction could take place is eight years for both Projects; and
- The earliest construction start date is 2025.

22. The impact assessment for offshore archaeology can cultural heritage considers the following development scenarios in determining the worst-case scenario for each topic:

- Build SEP or build DEP in isolation – one OSP only; and
- Build SEP and DEP concurrently or sequentially – with either two OSPs, one for SEP and one for DEP, or with one OSP only to serve both SEP and DEP

23. For each of these scenarios it has been considered whether the build out of the DEP North and DEP South array areas, or the build out of DEP North array area only, represents the worst-case for that topic. Any differences between SEP and DEP, or differences that could result from the manner in which the first and the second projects are built (concurrent or sequential and the length of any gap) are identified and discussed where relevant in the impact assessment section of this chapter (**Section 14.6**). For each potential impact, where necessary, only the worst-case construction scenario for two Projects is presented, i.e. either concurrent or sequential. The justification for what constitutes the worst-case is provided, where necessary, in **Section 14.6**.

14.3.2.3 Operation Scenarios

24. Operation scenarios are described in detail in **Chapter 4 Project Description**. Where necessary, the assessment considers the following three scenarios:

- Only SEP in operation;
- Only DEP in operation; and
- The two Projects operating at the same time, with a gap of two to four years between each Project commencing operation.

25. The operational lifetime of each Project is expected to be 40 years.

14.3.2.4 Decommissioning Scenarios

26. Decommissioning scenarios are described in detail in **Chapter 4 Project Description**. Decommissioning arrangements will be agreed through the submission of a Decommissioning Programme prior to construction, however for the purpose of this assessment it is assumed that decommissioning of SEP and DEP could be conducted separately, or at the same time.

Table 14-2: Realistic Worst Case Scenarios

Impact	DEP in Isolation	SEP in Isolation	SEP and DEP		Notes and Rationale
			Two OSPs (one in SEP wind farm site and one in DEP North array area)	One OSP (located in SEP wind farm site)	
Construction					
Impact 1: Direct (physical) impact to known heritage assets **Impact 2**: Direct impact to potential heritage assets	**Wind farm site:** One wind farm site consisting of the DEP North and DEP South array areas totalling **114.8km²** **Wind turbine foundations:** Maximum footprint of 24 gravity base structure GBS foundations (18MW) including foundation scour protection: **0.61km²** **OSP foundations**: Maximum footprint of OSP foundations including scour protection (with suction cans): **4,761m²**	**Wind farm site:** One wind farm site totalling **97.0km²** **Wind turbine foundations:** Maximum footprint of 19 GBS foundations (18MW) including foundation scour protection: **0.48km²** **OSP foundations**: Maximum footprint of OSP foundations including scour protection (with suction cans): **4,761m²**	**Wind farm sites:** Two wind farm sites totalling **211.8km²** **Wind turbine foundations:** Maximum footprint of 43 18MW GBS foundations including foundation scour protection: **1.09km²** **OSP foundations**: Maximum footprint of OSP foundations including scour protection (with suction cans) (2 OSPs): **9,522m²***	**Wind farm sites:** Two wind farm sites totalling **211.8km²** **Wind turbine foundations:** Maximum footprint of 43 18MW GBS foundations including foundation scour protection: **1.09km²** **OSP foundations**: Maximum footprint of OSP foundations including scour protection (with suction cans (one OSP)): **4,761m²**	The worst-case scenario represents the maximum area of disturbed sea bed sediments with the potential for archaeological material to be present either on the seafloor or buried within sea bed deposits. Infrastructure that may not be removed during decommissioning. Individual GBS footprints including scour protection are 14,313.8m² and 25,446.9m² for a 15MW and 18MW wind turbine respectively and therefore the worst-case across the wind farm sites is associated with the 18MW wind turbines (based on maximum numbers of 15MW turbines of 30 and 23 at SEP and DEP respectively).
	Offshore cables: Up to **263km** One High Voltage Alternating Current (HVAC) export cable up to **62km** in length **135km** of infield cables (DEP North array area: 90km; DEP South array area: 45km) Up to 3 parallel interlink cables between DEP South array area and offshore substation platform (OSP) in DEP North array area: up to **66km** in length (combined) Burial depth: 0.5 to 1.5m (excluding burial in sand waves up to 20m); and up to 1.0m for the export cables. Cable installation maximum width of disturbance: 15m	**Offshore cables:** Up to **130km** One HVAC export cable up to **40km** in length **90km** of infield cables No interlink cables Burial depth: Same as DEP in isolation Cable installation maximum width of disturbance: Same as DEP in isolation Maximum area disturbed: **1.95km²** (Export cable 0.60km², Infield cables 1.35km²)	**Offshore cables:** Up to **393km** 2 HVAC export cables up to **102km** in length Up to **225km** of infield cables (DEP North array area: 90km; DEP South array area 45km; SEP 90km) Up to 3 interlink cables from DEP South array area to the OSP in DEP North array area **66km** total length Burial depth: Same as SEP and DEP in isolation Cable installation maximum width of disturbance: Same as SEP and DEP in isolation Maximum area disturbed: **5.90km²** (Export cable: 1.53km², infield 3.38km², interlink cables 0.99km²)	**Offshore cables:** Up to **448km** 2 HVAC export cables from SEP up to **80km** in length Up to **225km** of infield cables (DEP North array area: 90km; DEP South array area 45km[1]; SEP 90km) Up to 7 interlink cables from DEP North array area (up to 5) and DEP South array area (up to 3) to OSP in SEP, up to **143km*** total length[2] Burial depth: Same as SEP and DEP in isolation Cable installation maximum width of disturbance: Same as SEP and DEP in isolation Maximum area disturbed: **6.73km²*** (Export cable: 1.20km², infield 3.38km², interlink cables 2.15km²)	The worst-case scenario represents the maximum area of disturbed sea bed sediments with the potential for archaeological material to be present either on the seafloor or buried within sea bed deposits. The temporary disturbance relates to sea bed preparation and cable installation. As described in **Section 4.4.7.2** of **Chapter 4 Project Description**, the number of interlink cables includes an extra cable for contingency purposes with the maximum total number of interlink cables for any one scenario being seven. In addition, under a 1 OSP scenario where both the DEP North and South array areas are developed, there could be:

[1] Build out of the DEP North and South array areas is worst-case scenario for infield cable disturbance
[2] While a scenario where only the DEP North array area is built out would require a greater length of interlink cables (154km compared to 143km), overall, the worst-case area subject to temporary habitat loss / disturbance would be a scenario where both DEP North and South array areas are built out (see **Section 4.4.7.2** of **Chapter 4 Project Description** for details on interlink cables).

Impact	DEP in Isolation	SEP in Isolation	SEP and DEP		Notes and Rationale
			Two OSPs (one in SEP wind farm site and one in DEP North array area)	One OSP (located in SEP wind farm site)	
	Maximum area disturbed: 3.95km2 (Export cable 0.93km2, Infield cables 2.025km2, Interlink cables 0.99km2)				Up to 5 (22km in length each) cables between the DEP North array area and the SEP wind farm site; and Up to 3 cables (16.5km in length each) between the DEP South array area and the SEP wind farm site. If contingency is in the DEP North array area, the DEP South array area has only 2 cables (5 + 2 = 7) If contingency is in the DEP South array area, the DEP North array area has only 4 cables (4 + 3 = 7) The worst-case is for contingency in the DEP North array area so therefore the maximum length of all interlink cables for a 1 OSP scenario where both the DEP North and South array areas are developed is 5x22km + 2x16.5km = 143km.
	Subsea cable surface protection: Export cables up to 0.5km (including 100m in the MCZ) of cable protection 6m wide = 3,000m^2. Interlink cables up to 1.5km of cable protection 6m wide = 9,000m^2 Infield cables up to 1km of cable protection 4m wide = 4,000m^2 Total = **16,000m^2 (0.016km^2)** **Crossings** Up to **17 crossings** (over-trawlable), each crossing has a 2,100m^2 footprint (21m width x 100m length) **Export cable**: 4 crossings = 8,400m^2 **Infield cables**: 7 crossings = 14,700m^2 **Interlink cables**: 6 crossings = 12,600m^2 Total crossings protection = **35,700m^2**	**Subsea cable surface protection:** Export cables up to 0.5km (including 100m in the MCZ) of cable protection 6m wide = 3,000m^2. Infield cables up to 1km of cable protection 4m wide = 4,000m^2 Total = **7,000m^2 (0.007km^2)** **Crossings** **Export cable**: 4 crossings = 8,400m^2 **No interlink or infield cable crossing protection** material is required for a SEP in isolation scenario. Total maximum footprint of cable protection (export, interlink and infield) and cable crossing protection: **0.015km^2**	**Subsea cable surface protection:** Same as for a DEP in isolation scenario = **16,000m^2 (0.016km^2)** **Crossings** Up to **21 crossings*** (over-trawlable) **Export cables**: 8 crossings = 16,800m^2 **Infield cables**: 7 crossings = 14,700m^2 **Interlink cables**: 6 crossings = 12,600m^2 Total crossings protection = **44,100m^2 (0.0441km^2)*** Total maximum footprint of cable protection (export, interlink and infield) and cable crossing protection: **0.06km^2**	Same as for a two OSP scenario	Cable protection for crossings will be up to 21m wide and 100m long and consist of either concrete mattressing or rock dumping. **SEP and DEP worst-case crossing locations** Infield cables: up to seven crossings (three in the DEP North array area at Durango-Waveney pipeline, up to four in the DEP South array area) Interlink cables, up to six crossings (three cables from the DEP South array area crossing two Dudgeon export cables) Export cable, up to four crossings (two at Dudgeon export cables, two for Hornsea Three export cables). One disused subsea cable crosses the export cable, but no crossing required. Either SEP or DEP may use the total allowance of external cable protection when both Projects are built.

Impact	DEP in Isolation	SEP in Isolation	SEP and DEP		Notes and Rationale
			Two OSPs (one in SEP wind farm site and one in DEP North array area)	One OSP (located in SEP wind farm site)	
	Total maximum footprint of cable protection (export, interlink and infield) and cable crossing protection: **0.052km²**				
	Sea bed preparation Sand wave clearance: **0.93km²** (infield area: 0.42km²; interlink area: 0.17km²; export cable area: 0.34km²) Worst case is for GBS foundations: **0.073km²** (for up to 24 18MW wind turbines) Boulder clearance (up to 20 across wind farm site and offshore cable corridors): **786m²** **Total = 1km²**	**Sea bed preparation** Sand wave clearance: **0km²** Worst case is for GBS foundations: **0.057km²** (for up to 19 18MW wind turbines) Boulder clearance (up to 30 across wind farm site and offshore cable corridors): **1,178m²** **Total = 0.058km²**	**Sea bed preparation** Sand wave clearance: **0.93km²*** (as for DEP in isolation) Worst case is for GBS foundations: **0.13km²** (for up to 43 18MW wind turbines) Boulder clearance (up to 50 across wind farm sites and offshore cable corridors): **1,964m²** **Total = 1.06km²***	**Sea bed preparation** Sand wave clearance: **0.76km²** (infield area: 0.42km²; interlink area: 0.34km²) Worst case is for GBS foundations: **0.13km²** (for up to 43 18MW wind turbines) Boulder clearance (up to 50 across wind farm sites and offshore cable corridors): **1,964m²** **Total = 0.89km²**	The maximum area of sea bed preparation disturbance from a single 18MW GBS foundation = 3,019m². Sea bed preparation disturbance from a 15MW GBS foundation = 1,735m² and therefore despite there being a higher number of 15MW foundations (30 for DEP and 23 for SEP) the worst-case is associated with the 18MW GBS foundation of which there could be up to 24 for DEP and 19 for SEP. Sand wave clearance (pre-sweeping) is confined to the DEP wind farm site, the northern portion of the interlink cable corridor between the DEP North array area and SEP and the interlink cable corridor between the DEP North and DEP South array areas. Therefore, no sand wave clearance is required in the SEP wind farm site. The WCS is based on a two OSP scenario and is estimated based on analysis of existing geophysical data to determine where sand wave clearance is likely to be required (details provided in **Chapter 4 Project Description**). The width of sea bed disturbance along the pre-lay grapnel run (PLGR) is estimated to be up to 3m, which would be encompassed by the 15m cable installation disturbance width accounted for in the row above. Calculations assume boulders of 5m diameter and an equivalent disturbance footprint at the origin boulder location and at the location to which it is moved.
	Vessels *Jack up vessels*	**Vessels** *Jack up vessels* Up to two jack-up deployments at each turbine/OSP (**23 15MW turbines + one OSP: 57,600m²**)	**Vessels** *Jack up vessels* Up to two jack-up deployments at each turbine/OSP (**53 15MW turbines + two OSPs: 132,000m²***)	**Vessels** *Jack up vessels* Up to two jack-up deployments at each turbine/OSP. (**53 15MW turbines + one OSP: 129,600m²**)	Worst-case scenario is a jack-up barge with six legs per barge (200m² per leg) equating to a total footprint of 1,200m² per installation. Individual anchor footprint = 30m². Up to two anchor deployments required at each wind turbine location.

Impact	DEP in Isolation	SEP in Isolation	SEP and DEP		Notes and Rationale
			Two OSPs (one in SEP wind farm site and one in DEP North array area)	**One OSP (located in SEP wind farm site)**	
	Up to two jack-up deployments at each turbine/OSP (worst-case associated with 30 15MW turbines + one OSP = 74,400m^2) *Anchoring* **(Total = 76,080m^2)** Turbines (30) and OSP (1) installation vessel anchoring (up to 12 lines per location) = **22,320m^2** Export cable installation vessel anchoring (seven lines) (62km) = **26,040m^2** Interlink cable installation vessel anchoring (seven moorings) (66km) = **27,720m^2** **Total** sea bed disturbance footprint from vessels for DEP in isolation = **0.150km^2**	*Anchoring* (**Total = 34,080m^2**) Turbines (23) and OSP (1) installation vessel anchoring (up to 12 lines per location) = **17,280m^2** Export cable installation vessel anchoring (seven lines) (40km) = **16,800m^2** **Total** sea bed disturbance footprint from vessels for SEP in isolation = **0.092km^2)**	*Anchoring* **(Total = 110,160m^2)** Turbines (53) and OSP (2) installation vessel anchoring: (up to 12 lines per location) **39,600m^2**. Export cable installation vessel anchoring (seven lines) (62km + 40km) = **42,840m^2** Interlink cable installation vessel anchoring (seven moorings) (66km) = **27,720m^2** **Total** sea bed disturbance footprint from vessels = **0.242km^2**	*Anchoring* **(Total = <u>137,160m^2*</u>)** Turbines (53) and OSP (1) installation vessel anchoring: (up to 12 lines per location) **38,880m^2**. Export cable installation vessel anchoring (seven lines) (40km + 40km) = **33,600m^2** Interlink cable installation vessel anchoring (seven moorings) (154km)[3] = **64,680m^2** **Total** sea bed disturbance footprint from vessels = **<u>0.267km^2*</u>**	For offshore cables, vessels would have up to seven anchor / mooring lines, each with an anchor footprint of 30m^2 and requiring repositioning every 500m.
	HDD Exit Point Initial trench (600m^2) Transition zone (50m^2) Jack-up footprint (128m^2) Deposited material on sea bed (200m^2) **Total = 978m^2**	**HDD Exit Point** Initial trench (600m^2) Transition zone (50m^2) Jack-up footprint (128m^2) Deposited material on sea bed (200m^2) **Total = 978m^2**	**HDD Exit Point** Initial trench (600m^2) Transition zone (100m^2) Jack-up footprint (256m^2) Deposited material on sea bed (400m^2) **<u>Total = 1,356m^2*</u>**		HDD beneath the intertidal zone with offshore exit point approximately 1,000m offshore. For SEP and DEP, the initial trench assumes both export cables are within the same initial trench, meaning the area of disturbance is the same as SEP or DEP in isolation scenarios. However, for the transition zone it assumes two trenches and therefore the area of disturbance is double the SEP or DEP in isolation scenarios. Jack-up footprints for SEP and DEP include total jack-up leg footprints and jack-up movements required. Disturbance from the HDD exit point activities are within the CSCB MCZ, therefore footprint of temporary habitat loss / disturbance within the MCZ has been provided (below).
Impact 3: Indirect impact to heritage assets from changes to physical processes	The worst-case scenarios for marine physical processes are set out in **Chapter 6 Marine Geology, Oceanography and Physical Processes** (**Table 6-2**). The following impacts are relevant to the worst-case for offshore archaeology and cultural heritage: Construction Impact 8: Indentations on the sea bed due to installation vessels.				

[3] The greater overall length of interlink cables in a scenario where both the DEP North and South array areas are developed results in a greater area of disturbance from vessel anchoring compared to a DEP North array area only scenario and therefore this represents the worst-case for sea bed disturbance footprints from vessels

Impact	DEP in Isolation	SEP in Isolation	SEP and DEP		Notes and Rationale
			Two OSPs (one in SEP wind farm site and one in DEP North array area)	One OSP (located in SEP wind farm site)	
	Conversely, marine physical processes impacts which correspond to increased bed-level and consequent increased potential for the protection of heritage assets which are currently exposed through additional sediment cover (sediment deposited from plume) are: Construction Impact 2a: Changes in sea bed level due to sea bed preparation for foundation installation; Construction Impact 2b: Changes in sea bed level due to drill arisings for installation of piled foundations; Construction Impact 4: Change in sea bed level due to deposition from the suspended sediment plume during export cable installation within the offshore export cable corridor; and Construction Impact 6: Change in sea bed level due to offshore cable installation (infield and interlink cables).				
Impact 4: Impacts to the setting of heritage assets	**Maximum temporal footprint:** Duration of offshore construction: **2 years** **Construction vessels:** Maximum number of construction vessels on site at any one time: up to **16** vessels Construction vessel trips to port: **570** over 2 year construction period	**Maximum temporal footprint:** Duration of offshore construction: **2 years** **Construction vessels:** Maximum number of construction vessels on site at any one time: up to **16** vessels Construction vessel trips to port: **570** over 2 year construction period	**Maximum temporal footprint:** Duration of offshore construction activities: Up to **4 years** if built sequentially with a gap between offshore construction activities of up to three years **Construction vessels:** Maximum number of construction vessels on site at any one time: up to **25** (in total if both SEP and DEP constructed concurrently) Construction vessel trips to port: **1,130** during 4 year construction period if constructed sequentially	**Maximum temporal footprint:** Duration of offshore construction activities: Up to **2.5 years** for concurrent build **Construction vessels:** Maximum number of construction vessels on site at any one time: up to **25** (in total if both SEP and DEP constructed concurrently) Construction vessel trips to port: **1,130** during 2.5 year construction period if constructed concurrently	The worst-case scenario represents the maximum intrusive effect of construction activities for the longest duration. As noted in **Table 4-1** of **Chapter 4 Project Description**, if SEP and DEP are both built, a two OSP scenario could either be built out concurrently or sequentially. However, a one OSP scenario would require a concurrent build. Therefore the worst-case scenario for offshore construction duration is for a two OSP scenario since a sequential build would result in the longest duration.
Operation					
Impact 1 Direct (physical) impact to heritage assets **Impact 2**: Direct impact to potential heritage assets	**Wind farm sites and offshore cables:** Less than for construction (maintenance activities within the same footprint, impacts would already have occurred during construction) **Operational disturbance footprints** Up to 10 jack-up deployments per year. Legs footprint up to **12,000m²** per year Cable repair, replacement and reburial footprint: **1,743m²** per year **Total Disturbance** Worst-case scenario total temporary disturbance footprint for DEP in isolation per year = **13,743m²**	**Wind farm sites and offshore cables:** Less than for construction (maintenance activities within the same footprint, impacts would already have occurred during construction). **Operational disturbance footprints** Up to 10 jack-up deployments per year. Legs footprint up to **12,000m²** per year Cable repair, replacement and reburial footprint: **1,170m²** per year **Total Disturbance** Worst-case scenario total temporary disturbance footprint for SEP in isolation per year = **13,170m²**	**Wind farm sites and offshore cables:** Less than for construction (maintenance activities within the same footprint, impacts would already have occurred during construction) **Operational disturbance footprints** Up to 20 jack-up deployments per year. Legs footprint up to **24,000m²** per year Cable repair, replacement and reburial footprint: **4,473m²** per year. **Total Disturbance** Realistic worst-case scenario total temporary disturbance footprint SEP and DEP per year = **28,473m²**	**Wind farm sites and offshore cables:** Less than for construction (maintenance activities within the same footprint, impacts would already have occurred during construction) **Operational disturbance footprints** Up to 20 jack-up deployments per year. Legs footprint up to **24,000m²** per year Cable repair, replacement and reburial footprint: **4,704m²** per year. **Total Disturbance** Realistic worst-case scenario total temporary disturbance footprint SEP and DEP per year = **28,704m²***	The worst-case scenario represents the maximum area of disturbed sea bed sediments with the potential for archaeological material to be present either on the seafloor or buried within sea bed deposits. With the application of the mitigation (see **Section 14.3.3**), and the retention of AEZs throughout the project lifespan, it is anticipated that all direct impacts to known heritage assets will be avoided. Similarly, any currently unknown heritage assets which are identified during pre-construction surveys would be subject to avoidance, if required.

Impact	DEP in Isolation	SEP in Isolation	SEP and DEP		Notes and Rationale
			Two OSPs (one in SEP wind farm site and one in DEP North array area)	One OSP (located in SEP wind farm site)	
	Approximate total temporary disturbance footprint for operational lifetime (40 years) = **0.55km²**	Approximate total temporary disturbance footprint for operational lifetime (40 years) = **0.53km²**	Approximate total temporary disturbance footprint for operational lifetime (40 years) = **1.14km²**	Approximate total temporary disturbance footprint for operational lifetime (40 years) = **1.148km²**	
Impact 3: Indirect impact to heritage assets from changes to physical processes	The worst-case scenarios for marine physical processes are set out in **Chapter 6 Marine Geology, Oceanography and Physical Processes** (**Table 6-2**). The following impacts are relevant to the worst-case for offshore archaeology and cultural heritage: Operation Impact 1: Changes to the tidal regime due to the presence of structures on the sea bed (wind turbines and OSP foundations); Operation Impact 2: Changes to the wave regime due to the presence of structures on the sea bed (wind turbines and OSP foundations); Operation Impact 3: Changes to the sediment transport regime due to the presence of structures on the sea bed (wind turbines and OSP foundations); Operation Impact 5: Morphological and sediment transport effects due to cable protection measures within the SEP and DEP offshore sites and interlink cable corridor; Operation Impact 6: Morphological and sediment transport effects due to cable protection measures along the export cable; and Operation Impact 7: Cable repairs and reburial				The worst-case scenario represents the greatest potential for increased scour and sediment stripping across an area as a result of changes to physical processes which could result in the exposure and degradation of heritage assets which are currently buried and protected from marine processes.
Impact 4: Impacts to the setting of heritage assets	**Presence of wind farm infrastructure:** Up to **30** wind turbines **One** OSP in the DEP North array area **Maximum temporal footprint:** The operational lifetime is expected to be **40** years **O&M vessels:** Maximum number of vessels on site at any one time: **6** Operation and maintenance vessel trips to port per year: approximately **604** (although majority (600) will be (small O&M vessel (Crew Transfer Vessel (CTV))	**Presence of wind farm infrastructure:** Up to **23** wind turbines **One** OSP in SEP wind farm site **Maximum temporal footprint:** The operational lifetime is expected to be **40** years **O&M vessels:** Maximum number of vessels on site at any one time: **6** Operation and maintenance vessel trips to port per year: approximately **604** (although majority (600) will be (small O&M vessel (CTV))	**Presence of wind farm infrastructure:** Up to **53** wind turbines **Two** OSPs, one in the DEP North array area and one in the SEP wind farm site **Maximum temporal footprint:** The operational lifetime is expected to be **40** years **O&M vessels:** Maximum number of vessels on site at any one time: **7** (in total if both SEP and DEP constructed concurrently) Operation and maintenance vessel trips to port per year: approximately **1,206** (although majority (1,200) will be (small O&M vessel (CTV))	**Presence of wind farm infrastructure:** Up to **53** wind turbines **One** OSP in the SEP wind farm site **Maximum temporal footprint:** The operational lifetime is expected to be **40** years **O&M vessels:** Maximum number of vessels on site at any one time: **7** (in total if both SEP and DEP constructed concurrently) Operation and maintenance vessel trips to port per year: approximately **1,206** (although majority (1,200) will be (small O&M vessel (CTV))	The worst-case scenario represents the maximum intrusive effect of installed infrastructure and operation and maintenance activities for the longest duration.
Decommissioning					
Same as for construction	Decommissioning arrangements will be detailed in a Decommissioning Programme, which will be drawn up and agreed with the Department for Business, Energy and Industrial Strategy (BEIS) prior to construction. This plan will also ensure lighting and marking mitigations remain functioning throughout the life of SEP and DEP and include where an obstruction is left in place. Decommissioning areas will be assumed as those defined by the construction phase. Decommissioning impacts are assessed in **Section 14.6.3**.				

14.3.3 Summary of Mitigation Embedded in the Design and Additional Mitigation

27. For the purposes of this assessment, embedded mitigation is that which has been incorporated into the design of SEP and DEP to date. For example, for **Chapter 21 Onshore Archaeology and Cultural Heritage**, the route refinement process onshore has been undertaken to avoid all designated heritage assets and with consideration of areas of high archaeological potential. Offshore, there are no designated heritage assets within the project envelope, and equally, the parameters of the Projects are sufficiently wide to accommodate micro-siting as part of the cable route refinement and wind farm design which will be progressed post consent. To this end, whilst there is no embedded mitigation relevant to the Offshore Archaeology and Cultural Heritage assessment to date, additional mitigation measures are proposed in **Section 14.6** comprising:

- Geoarchaeological assessment;
- Archaeological assessment of further geophysical data to be acquired post-consent;
- Refinement of the design of offshore infrastructure post consent to avoid Archaeological Exclusion Zones (AEZs) and additional geophysical anomalies of potential archaeological interest (where possible);
- Further investigation where avoidance is not possible and additional mitigation to reduce or offset impacts should impacts be unavoidable; and
- Implementation of a protocol for archaeological discoveries to address unexpected discoveries which might be encountered during the course of planned activities.

28. A proposed approach to the delivery of this additional mitigation, post-consent, and how the outcomes of additional investigation will influence the final design of the Projects, is set out in the **Outline WSI (Offshore)** (document reference: 9.11) which has been prepared in accordance with industry good practice guidance on Archaeological WSIs (The Crown Estate, 2021) and accompanies the DCO application.

14.4 Impact Assessment Methodology

14.4.1 Policy, Legislation and Guidance

14.4.1.1 National Policy Statements

29. The assessment of potential impacts upon Offshore Archaeology and Cultural Heritage has been made with specific reference to the relevant National Policy Statements (NPS). These are the principal decision making documents for Nationally Significant Infrastructure Projects (NSIPs). Those relevant to SEP and DEP are:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC), 2011a);
- NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011b); and
- NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c).

30. The specific assessment requirements for Offshore Archaeology and Cultural Heritage, as detailed in the NPS, are summarised in **Table 14-3** together with an indication of the section of the ES chapter where each is addressed.

31. It is noted that the NPS for Energy (EN-1), the NPS for Renewable Energy Infrastructure (EN-3) and the NPS for Electricity Networks Infrastructure (EN-5) are in the process of being revised. Draft versions were published for consultation in September 2021 (Department for Business Energy and Industrial Strategy (BEIS), (2021a), BEIS, (2021b) and BEIS (2021c) respectively). A review of these draft versions has been undertaken in the context of this ES chapter.

32. **Table 14-3** includes a section for the draft version of NPS (EN-1, EN-3 and EN-5) in which relevant additional NPS requirements not presented within the current NPS (EN-1, EN-3 and EN-5) have been included. A reference to the particular requirement's location within the draft NPS and to where within this ES chapter or wider ES it has been addressed has also been provided.

33. Minor wording changes within the draft version which do not materially influence the NPS (EN-1, EN-3, EN-5) requirements have not been reflected in **Table 14-3.**

Table 14-3: NPS Assessment Requirements

NPS Requirement	NPS Reference	Section Reference
NPS for Energy (EN-1)		
"As part of the ES the applicant should provide a description of the significance of the heritage assets affected by the proposed development and the contribution of their setting to that significance.[4] The level of detail should be proportionate to the importance of the heritage assets and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset."	Paragraph 5.8.8	The significance of the archaeological receptors considered in this chapter, and the contribution of setting to that significance, have been detailed in **Sections 14.5.1.2, 14.5.2.2** and **14.5.3.2**. Issues relating to the setting of onshore heritage assets have been considered as part of **Chapter 21 Onshore Archaeological and Cultural Heritage**.
"Where a development site includes, or the available evidence suggests it has the potential to include, heritage assets with an archaeological interest, the applicant should carry out appropriate desk-based assessment and, where such desk-based research is insufficient to properly assess the interest, a field evaluation. Where proposed development will affect the setting of a heritage asset, representative visualisations may be necessary to explain the impact."	Paragraph 5.8.9	**Section 14.5** of this document provides a full assessment of the baseline environment
"The applicant should ensure that the extent of the impact of the proposed development on the significance of any heritage assets	Paragraph 5.8.10	This chapter provides an account of the potential impacts of DEP/SEP upon heritage assets and their significance (**Section 14.6**).

[4] Note minor change to this text in BEIS (2021a): …~~and the contribution of their setting to that significance~~ including any contribution made by their setting.

NPS Requirement	NPS Reference	Section Reference
affected can be adequately understood from the application and supporting documents."		
NPS for Renewable Energy Infrastructure (EN-3)		
"Consultation with the relevant statutory consultees (including English Heritage or Cadw) should be undertaken by the applicants at an early stage of the development."	Paragraph 2.6.140	Consultation has been undertaken with relevant statutory consultees, as outlined in **Section 14.2**. Consultation will be on going throughout the development process.
"Assessment should be undertaken as set out in section 5.8 of EN-1. Desk based studies should take into account geotechnical or geophysical surveys that have been undertaken to aid the windfarm design."	Paragraph 2.6.141	The assessment has been undertaken in accordance with section 5.8 of EN-1, as detailed above. Geophysical and geotechnical studies have underpinned the assessment (**Section 14.5** and **Appendix 14.1**, **Appendix 14.2** and **Appendix 14.3**).
"The assessment should also include the identification of any beneficial effects on the historic marine environment, for example through improved access or the contribution to new knowledge that arises from investigation."	Paragraph 2.6.142	Any beneficial effects to the offshore archaeology and cultural heritage resource resulting from SEP and DEP have been identified and incorporated as part of **Section 14.5**.
"Where elements of an application (whether offshore or onshore) interact with features of historic maritime significance that are located onshore, the effects should be assessed in accordance with the policy at section 5.8 of EN-1."	Paragraph 2.6.143	Potential impacts of SEP and DEP upon onshore heritage assets have been considered in **Chapter 21 Onshore Archaeology and Cultural Heritage**.
NPS for Electricity Networks Infrastructure (EN-5)		
…developers will be influenced by Schedule 9 to the Electricity Act 1989, which places a duty on all transmission and distribution licence holders, in formulating proposals for new electricity networks infrastructure, to "have regard to the desirability… of protecting sites, buildings and objects of architectural, historic or archaeological interest; and … do what [they] reasonably can to mitigate any effect which the proposals would have on the… sites, buildings or objects."	Paragraph 2.2.6	Potential impacts upon sites and objects of archaeological interest offshore are set out in **Section 14.6** along with a proposed approach to mitigation which is further detailed in the **Outline WSI (Offshore)** (document reference: 9.11).
Draft Overarching NPS for Energy (EN-1) (BEIS, 2021a)		
The applicant is encouraged, where opportunities exist, to prepare proposals which can make a positive contribution to the historic environment, and to consider how their scheme takes account of the significance of heritage assets affected. This can include, where possible:	Paragraph 5.9.14	Where potential opportunities arise for enhancement these are described within **Chapter 21 Onshore Archaeology and Cultural Heritage** and **Appendix 22.1**.

NPS Requirement	NPS Reference	Section Reference
enhancing, through a range of measures such as sensitive design, the significance of heritage assets or setting affected considering measures that address those heritage assets which are at risk or which may become at risk, as a result of the scheme considering how visual or noise impacts can affect heritage assets, and whether there may be opportunities to enhance access to, or interpretation, understanding and appreciation of, the heritage assets affected by the scheme		
Draft NPS for Renewable Energy Infrastructure (EN-3) (BEIS, 2021b)		
Consultation with the relevant statutory consultees on the potential impacts on the marine historic environment should be undertaken by applicants at an early stage of development, taking into account any applicable guidance (e.g., offshore renewables protocol for archaeological discoveries[5].	Paragraph 2.32.4	Consultation has been undertaken with relevant statutory consultees, as outlined in **Section 14.2**. Consultation will be on going throughout the development process. In demonstrating adherence to industry good practice, this chapter has been compiled in accordance with relevant standards and guidance as listed in **Paragraph 14.4.1.2.3**.
Assessment of potential impacts upon the historic environment should be considered as part of the Environmental Impact Assessment process undertaken to inform any application for consent. Desk based studies to characterise the features of the historic environment that may be affected by a proposed development and assess any likely significant effects should be undertaken by competent archaeological experts. These studies should take into account any geotechnical or geophysical surveys that have been undertaken to aid the wind farm design.	Paragraph 2.32.5	The assessment has been undertaken as part of the EIA process, as detailed above. Geophysical and geotechnical studies have underpinned the assessment (**Section 14.5** and **Appendix 14.1**, **Appendix 14.2** and **Appendix 14.3**). This chapter has been prepared by competent experts (and members of CIfA) in marine archaeology from Royal HaskoningDHV (with support from Wessex Archaeology – see **Appendix 14.1**, **Appendix 14.2** and **Appendix 14.3**) in consultation with Historic England (**Section 14.2**) and in accordance with legislation, policy and industry standards and guidance documents relevant to the marine archaeological and cultural heritage (historic) environment.

5 [redacted]

14.4.1.2 Other

34. In addition to the NPS, there are a number of pieces of legislation, policy and guidance applicable to the assessment of Offshore Archaeology and Cultural Heritage. Further detail where relevant is provided in **Chapter 2 Policy and Legislative Context**.

14.4.1.2.1 Legislation

35. SEP and DEP are located within the UK Exclusive Economic Zone (EEZ), and the export cable corridor extends through the English Territorial Sea (up to 12nm) from the coast into the UK EEZ. The following legislation applies to marine heritage within both the UK EEZ and English Territorial Sea:

- Protection of Wrecks Act 1973: Section One and Two;
- Ancient Monuments and Archaeological Areas Act 1979 (as amended);
- Protection of Military Remains Act 1986; and
- Merchant Shipping Act 1995.

36. The above legislation provides protection for wrecks of high historical, archaeological or artistic value, as well as allowing military wrecks and aircraft remains to be protected. There are currently no known protected wrecks within the study area, although, if encountered, all military aircraft crash sites are automatically protected under the Protection of Military Remains Act 1986. Ownership of any wreck remains is determined in accordance with the Merchant Shipping Act 1995.

37. In 2000, the UK government ratified The European Convention on the Protection of the Archaeological Heritage (Revised) 1992 (The Valletta Convention). The convention binds the UK to implement protective measures for the archaeological heritage within the jurisdiction of each party, including sea areas. The Articles of the Valletta Convention address:

- Article 1: Definition of archaeological heritage;
- Article 2: Identification and designation;
- Article 3: Control of archaeological work;
- Article 4: Physical protection of archaeological heritage;
- Article 5: Integration of archaeology in development planning;
- Article 6: Funding of archaeological work (public and private);
- Article 7: Collection and dissemination of information;
- Article 8: National and international exchange of information;
- Article 9: Promotion of public awareness;
- Article 10 and 11: Prevention of illicit circulation of elements of the archaeological heritage; and
- Article 11: Mutual technical and scientific assistance.

38. The UNESCO Convention on the Protection of Underwater Cultural Heritage, adopted in 2001, is intended to enable States to better protect their submerged cultural heritage. The UK was one of a number of States that abstained from the 2001 vote and has not ratified the Convention. The UK has, however, adopted the 'The Rules', an Annex to the Convention which sets out a standard for archaeological investigations, as government policy for underwater cultural heritage.

14.4.1.2.2 Policy

39. This assessment has been undertaken in a manner consistent with the NPPF, a revised version of which was published by the Ministry of Housing, Communities and Local Government (MHCLG) in July 2021, replacing the original policy from March 2012. Provision for the historic environment is principally given in section 16: Conserving and enhancing the historic environment of the NPPF, which directs local authorities to set out "a positive strategy for the conservation and enjoyment of the historic environment, including heritage assets most at risk through neglect, decay or other threats". Local planning authorities should recognise that heritage assets are "an irreplaceable resource and should be conserved in a manner appropriate to their significance, so that they can be enjoyed for their contribution to the quality of life of existing and future generations" (MHCLG, 2021).

40. The aim of NPPF section 16 is to ensure that local planning authorities, developers and owners of heritage assets adopt a consistent and holistic approach to their conservation and to reduce complexity in planning policy relating to proposals that affect them.

41. To summarise, UK government guidance provides a framework which:

- Recognises that heritage assets are an irreplaceable resource;
- Requires applicants to provide a level of detail that is proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance;
- Takes into account the desirability of sustaining and enhancing the significance of heritage assets, including any contribution made by their setting, and putting them to viable uses consistent with their conservation;
- Places weight on the conservation of designated heritage assets (which include world heritage sites, scheduled monuments, listed buildings, protected wreck sites, registered parks and gardens, registered battlefields or conservation areas), with any anticipated substantial harm weighed against the public benefits of the proposal;
- Requires applicants to include a consideration of the effect of an application on the significance of non-designated heritage assets, giving regard to the scale of any harm or loss and the significance of the heritage asset;
- Regards proposals that preserve those elements of the setting that make a positive contribution to the asset (or which better reveal its significance) favourably; and

- Requires developers to record and advance understanding of the significance of any heritage assets to be lost (wholly or in part) in a manner proportionate to their importance and impact, and to make this evidence (and any archive generated) publicly accessible.

42. The NPPF's associated Planning Practice Guidance (PPG) 'Conserving and enhancing the historic environment', published in 2014 and updated 2019, (MHCLG, 2019) includes further information and guidance on how national planning policy is to be interpreted and applied locally. Although the PPG is an important and relevant consideration in respect to SEP and DEP, EN-1 (the Overarching NPS for Energy) is the key decision-making document.

43. This assessment also takes account of the UK Marine Policy Statement (MPS) (DEFRA, 2011). The MPS sets out high level objectives for marine planning, which have directed development of the Plan at a local level. Marine Plans must be in accordance with other relevant national policy and are intended to contribute to the achievement of sustainable development in the UK marine area. area. Those relevant to SEP and DEP are the East Marine Plans; comprising the East Inshore and East Offshore Marine Plans (DEFRA, 2014), which outline the objective *"to conserve heritage assets, nationally protected landscapes and ensure the decisions consider the seascape of the local area".* This objective recognises the need to consider whether developments are appropriate to the area they will be located in and have an influence upon, and seeks to ensure that, as far as possible, the value of such assets and characteristics are not compromised. Policies specific to heritage assets are outlined in **Table 14-4**.

Table 14-4: Summary of East Inshore and East Offshore Marine Plans.

Plan Policies Specific to Heritage Assets	Section Reference
Policy SOC2: Proposals that may affect heritage assets should demonstrate, in order of preference: That they will not compromise or harm elements which contribute to the significance of the heritage asset How, if there is compromise or harm to a heritage asset, this will be minimised How, where compromise or harm to a heritage asset cannot be minimised it will be mitigated against or The public benefits for proceeding with the proposal if it is not possible to minimise or mitigate compromise or harm to the heritage asset	The primary method of mitigation when dealing with the archaeological resource as set out in this chapter is based on the prevention of damage to receptors by putting in place protective measures rather than attempting to repair damage. Avoidance by means of AEZs will serve to ensure that such assets will not be compromised. Potential archaeological receptors are safeguarded or the effects upon them minimised by means of mitigation measures outlined in **Section 14.3.3.**

14.4.1.2.3 Guidance

44. In demonstrating adherence to industry good practice, this chapter has been compiled in accordance with the following relevant standards and guidance:

- Principles of Cultural Heritage Impact Assessment in the UK (IEMA, IHBC and CIfA, 2021);

- The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3 (Second Edition) (Historic England, 2017);
- CIfA Standard and Guidance for Historic Environment Desk-Based Assessments (2014a) and Code of Conduct (2014b);
- Marine Geophysical Data Acquisition, Processing and Interpretation – guidance notes (Historic England, 2013);
- Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Gribble and Leather, 2011);
- Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy (Oxford Archaeology, 2008);
- Historic Environment Guidance for the Offshore Renewable Energy Sector Guidance (Wessex Archaeology, 2007); and
- Code for Practice for Sea bed Development (Joint Nautical Archaeology Policy Committee (JNAPC), 2006).

14.4.2 Data and Information Sources

14.4.2.1 Site Specific Surveys

45. In order to provide site specific and up to date information on which to base the impact assessment, a site characterisation survey was conducted comprising two campaigns of Geophysical Survey undertaken in 2019 and 2020. Data were acquired by Gardline over the Export Cable Route between September and December 2019 and consisted of sub-bottom profiler (SBP), SSS, magnetometer and multibeam bathymetry (MBES) datasets. Data were acquired with a line spacing of approximately 30 m on board the Titan Endeavour and the M.V. Ivero in the nearshore areas, and at a 75 m line spacing further offshore onboard the M.V. Kommandor.

46. Geophysical data were acquired over the remainder of the study area by Gardline between 31 March to 26 May 2020 consisting of SBP, SSS, Magnetometer. and MBES datasets. All areas were surveyed using a line spacing of 75 m, although this was reduced to 60 m in the south-west corner of SEP due to the water depths.

47. Full details of the technical specifications of the acquired geophysical data can be found in **Section 2.2** of **Appendix 14.1**. Once processed, Wessex Archaeology assessed each dataset for quality and their suitability for archaeological purposes based upon the criteria set out in **Table 14-5** below.

Table 14-5: Wessex Archaeology's Criteria for Assigning Data Quality Rating (Appendix 14.1, Table 6)

Data Quality	Description
Good	Data which are clear and unaffected or only slightly affected by weather conditions, sea state, background noise or data artefacts. Sea bed datasets are suitable for the interpretation of upstanding and partially buried wrecks, debris fields, and small individual anomalies. The structure of wrecks is clear, allowing assessments on wreck condition to be made. Subtle reflectors are clear within SBP data. These data

Data Quality	Description
	provide the highest probability that anomalies of archaeological potential will be identified.
Average	Data which are moderately affected by weather conditions, sea state and noise. Sea bed datasets are suitable for the identification of upstanding and partially buried wrecks, the larger elements of debris fields and dispersed sites, and larger individual anomalies. Dispersed and/or partially buried wrecks may be difficult to identify. Interpretation of continuous reflectors in SBP data is problematic. These data are not considered to be detrimentally affected to a significant degree.
Below Average	Data which are affected by weather conditions, sea state and noise to a significant degree. Sea bed datasets are suitable for the identification of relatively intact, upstanding wrecks and large individual anomalies. Dispersed and/or partially buried wrecks, or small isolated anomalies may not be clearly resolved. Small palaeogeographic features, or internal structure may not be resolved in SBP data.
Variable	This category contains datasets where the individual lines range in quality. Confidence of interpretation is subsequently likely to vary within the Study Area.

48. A summary of the acquired geophysical data and the quality ratings assigned by Wessex Archaeology are set out in **Table 14-6** below.

Table 14-6: Summary of Acquired Geophysical Data

Survey Campaign	Data Type	Data Quality	Notes
2019 (Titan Endeavour)	SBP (Boomer)	Good	Some noise and interference could be seen in places although it was still possible to trace the shallow horizons identified in the data.
	MBES	Good	Data resolution of 1.0 m in water depths greater than 15 m, and 0.5 m in water depths less than 15 m was found to be of a good standard and suitable for archaeological assessment of objects and debris over 0.5 m or 1.0 m in size.
	SSS	Variable	Heavily affected by weather noise, which made the identification of smaller objects difficult although larger objects such as wrecks and larger debris items were still identifiable in the data.
	Magnetometer	Good	Data affected by minor weather noise and cable snatching (largely removed in post-processing) although a small number of lines exhibited substantial weather noise.
2019 (M.V. *Kommandor*)	SBP (Pinger)	Good	Some noise was identified throughout the files, although this did not affect the data to a detrimental degree.
	MBES	Good	Data resolution of 1.0 m in water depths greater than 15 m, and 0.5 m in water depths less than 15 m was found to be of a good standard and suitable for archaeological assessment of objects and debris over 0.5 m or 1.0 m in size.

Survey Campaign	Data Type	Data Quality	Notes
	SSS	Variable	Occasional weather noise and cable snatching due to sea state and/or weather conditions, but overall, the data were not affected to a significant degree.
	Magnetometer	Good	Data affected by minor weather noise and cable snatching (largely removed in post-processing) although a small number of lines exhibited substantial weather noise.
2019 (M.V. *Ivero*)	SBP (Boomer)	Good	Some noise was identified throughout the files, although this did not affect the data to a detrimental degree.
	MBES	Good	Data resolution of 1.0 m in water depths greater than 15 m, and 0.5 m in water depths less than 15 m was found to be of a good standard and suitable for archaeological assessment of objects and debris over 0.5 m or 1.0 m in size.
	SSS	Variable	Occasional weather noise and cable snatching due to sea state and/or weather conditions, but overall, the data were not affected to a significant degree.
2020 (M.V. Ocean Endeavour)	SBP (Parametric Sonar)	Good	In the DEP array areas, some interference was observed although this did not affect the data to a significant degree.
	MBES	Good	Data resolution of 1.0 m in water depths greater than 15 m, and 0.5 m in water depths less than 15 m was found to be of a good standard and suitable for archaeological assessment of objects and debris over 0.5 m or 1.0 m in size.
	SSS	Good	Occasionally slightly affected by weather noise although this was minimal. The range of 100 m made the identification of small anomalies slightly more difficult. However, larger features of interest were still identifiable.
	Mag.	Average	Substantial background noise could be seen throughout the data due to shallow water depths although larger features such as wrecks and substantial ferrous debris were largely still identifiable in the data.

49. In conclusion, although some noise was observed in the data, all data were considered suitable for archaeological purposes.

50. Following the assessment of marine geophysical data (as set out in **Appendix 14.1**) additional interlink cable corridors were added to the scope and an addendum for these areas was prepared by Wessex Archaeology (**Appendix 14.2**).

51. It should be noted that some limited parts of the study areas assessed by Wessex Archaeology were not covered by the 2019/2020 surveys:

- A corridor approximately 400m wide, along the northern edge of the existing Sheringham OWF (SOW) (and southern edge of SEP) and where SSS and MBES originally acquired in 2015 for the Sheringham Post-Construction assessment (Wessex Archaeology, 2017) were used for the interpretation;
- A corridor up to 500m wide along the boundaries between Dudgeon Offshore Windfarm (DOW) and the DEP North and South array areas and where the previous phase of assessment for DOW (Wessex Archaeology 2009a and 2009b) was used for interpretation;
- The DEP South array area to DEP North array area interlink cable corridor was covered largely by previous interpretations of the 2007-2008 and 2013 geophysical datasets (Wessex Archaeology 2009a and 2014) although a small section to the west was covered by the 2019/2020 data; and
- The interlink / export cable corridor option which passes around SEP was covered by the assessment of the 2013 data for DOW (Wessex Archaeology, 2014) with the exception of the northern section (along the northern edge of SEP) which has no geophysical data coverage.

52. These gaps are illustrated on **Figures 5.01** to **5.30** of **Appendix 14.1** and **Figures 3.01** to **3.03** of **Appendix 14.2**.

53. Where the 2019/2020 datasets overlap with assessments previously undertaken for SOW and DOW, these have been fully integrated with the current dataset as set out in **Appendix 14.1** and **Appendix 14.2**. However, as the original SOW and DOW assessments were done as two separate projects with their own 7000 numbering schemes, there are six anomalies with duplicated IDs (i.e. six anomalies which share three IDs). These are 7046, 7047 and 7078. Given the small number of occurrences of duplication it was decided to retain the original IDs and not to assign new IDs to allow for continuity between all projects.

54. Within the Offshore Temporary Works Area no additional assessment has been carried out by Wessex Archaeology. These buffers, incorporated into the updated order limits, are addressed through desk-based assessment only. This does, however, include consideration of previously assessed anomalies identified during the Wessex Archaeology assessments for DOW (Wessex Archaeology 2009a, 2009b and 2014) (see **Section 14.5.2**).

55. With the addition of historic datasets, the geophysical data assessment carried out in support of this ES is considered to provide an accurate characterisation of the archaeological potential of the study area, appropriate to the purposes of EIA. It is noted that the risk of encountering previously undiscovered wrecks, aircraft crash sites and associated debris, or submerged prehistoric sites or features, is greater where there is no existing survey coverage. However, a commitment to ensuring full coverage of construction areas post-consent is set out in the **Outline WSI (Offshore)** (document reference 9.11) with specific consideration of the approach to the delivery of additional mitigation (see **Section 14.3.3**) and how the outcomes of additional investigation will influence the final design of SEP and DEP.

56. In addition to the geophysical surveys, a geotechnical survey comprising 51 vibrocores was undertaken in 2021 within the offshore export cable corridor. Cores were acquired offshore by GEO, split into 1m sections and transported to the laboratory of the Norwegian Geotechnical Institute (NGI) where they were split open lengthways, photographed, and described in detail. Geotechnical logs and core photographs were provided to Wessex Archaeology for review and the results of the initial assessment of the logs are presented in **Appendix 14.3**. Core sections and further samples have been acquired by Wessex Archaeology for further recording and geoarchaeological assessment as set out in the **Outline WSI (Offshore)** (document reference: 9.11).

14.4.2.2 Other Available Sources

57. Other sources that have been used to inform the assessment are listed in **Table 14-7**.

Table 14-7: Other Available Data and Information Sources

Data set	Spatial coverage	Notes
The United Kingdom Hydrographic Office (UKHO) data for charted wrecks and obstructions	UK	Data for all known charted wrecks and obstructions
The National Heritage List for England (NHLE) maintained by Historic England	England	Official, up to date, register of all nationally protected historic buildings and sites in England - listed buildings, scheduled monuments, protected wrecks, registered parks and gardens, and battlefields. (including sites protected under the Protection of Military Remains Act 1986 and the Protection of Wrecks Act 1973)
Records held by Historic England, formally part of the National Record of the Historic Environment (NRHE) dataset	England (to 12nm limit)	Records of heritage assets and documented losses of wrecks and aircraft.
Norfolk Historic Environment Record (NHER)	Norfolk County	HERs are information services that provide access to comprehensive and dynamic resources relating to the archaeology and historic built environment of a defined geographic area. HERs contain details on local archaeological sites and finds, historic buildings and historic landscapes and are regularly updated.
The Coastal and Intertidal Zone Archaeology Network (CITiZAN)	UK	CITiZAN, the Coastal and Intertidal Zone Archaeological Network, highlights the threat of coastal erosion to a wealth of foreshore and intertidal sites. These archaeological features encompass a huge time span, many are of considerable local or national significance
Relevant mapping including Admiralty Charts, historic maps and Ordnance Survey	UK	Information relation to previously charted wrecks, sea bed topography and topography
Relevant documentary sources and grey literature	UK	Various (see **Table 14-12**)

Data set	Spatial coverage	Notes
The Coastal and Intertidal Zone Archaeology Network (CITiZAN)	UK	CITiZAN, the Coastal and Intertidal Zone Archaeological Network, highlights the threat of coastal erosion to a wealth of foreshore and intertidal sites. These archaeological features encompass a huge time span, many are of considerable local or national significance

14.4.3 Impact Assessment Methodology

58. **Chapter 5 EIA Methodology** provides a summary of the general impact assessment methodology applied to SEP and DEP. The following sections confirm the methodology used to assess the potential impacts on Offshore Archaeology and Cultural Heritage.

59. The impact assessment methodology adopted for Offshore Archaeology and Cultural Heritage will define heritage assets, and their settings, likely to be impacted by the proposed scheme and assess the level of any resulting benefit, harm or loss to their significance. The assessment is not limited to direct (physical) impacts, but also assesses possible indirect (physical) impacts upon heritage assets which may arise as a result of changes to hydrodynamic and sedimentary processes and changes to the setting of heritage assets, whether visually, or in the form of noise, dust and vibration, spatial associations and a consideration of historic relationships between places which may impact their significance.

60. As set out in Principles of Cultural Heritage Impact Assessment in the UK (IEMA, IHBC and CIfA, 2021), Cultural Heritage Impact Assessment (CHIA) is concerned with “understanding the consequences of change to cultural significance”. The principles of assessment are:

- A. understanding cultural heritage assets; and
- B. evaluating the consequences of change.

61. Understanding cultural heritage assets distinguishes between:

- describing the asset (what it is and what is known about it);
- ascribing cultural significance (a description of what is valued about it); and
- attributing importance (a scaled measure of the degree to which the cultural significance of that asset should be protected).

62. Evaluating the consequences of change also distinguishes between three separate analytical stages:

- understanding change (a factual statement of how a proposal would change a cultural heritage asset or its setting, including how it is experienced);
- assessing impact (a scaled measure of the degree to which any change would impact on cultural significance);
- and weighting the effect (the measure that brings together the magnitude of the impact and the cultural heritage asset’s importance).

63. The relationship between these principles and the general approach to EIA **Chapter 5 EIA Methodology** is described below.

14.4.3.1 Understanding Cultural Heritage Assets

64. A description of the assets, and their cultural significance, relevant to the assessment of Offshore Archaeology and Cultural Heritage is provided in **Section 14.5**. At this initial stage of the Projects, many of these assets are not yet fully understood. However, as set out in the Principles, as well as in national planning guidance including the NPSs (see **Table 14-3**) and NPPF (see **Section 14.4.1.2** above), proportionality is key and applicants must provide a level of detail that is proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance. The level of detail provided in **Section 14.5**, therefore, sufficiently characterises these assets so that potential impacts upon their significance can be understood for the purposes of EIA.

65. As discussed in consultation with heritage stakeholders (see **Table 14-1**), further investigation and data gathering will be progressed post-consent, including high resolution surveys, alongside additional mitigation requirements as set out in the **Outline WSI (Offshore)** (document reference: 9.11). This is in line with the Principles which describe how, "an understanding of the cultural heritage asset is likely to be an iterative process which regularly reappraises the consequential impact on cultural significance as a proposal evolves or as more evidence emerges from research and investigations". **Section 14.5**, therefore, also highlights where there is a need to acquire additional information, and when this will be progressed, as part of an ongoing iterative design process.

66. As defined in the NPPF (MHCLG, 2021, Annex 2) cultural (or heritage) significance is the sum of the heritage values or interests that we, as a society, recognise in a heritage asset and seek to protect or enhance for future generations. A statement of significance should explain why we value a heritage asset. Understanding the significance of an asset should not be confused with a description of that asset which does not articulate 'what matters and why'. Historic England's 'Conservation Principles' (Historic England, 2017) defines the term significance as encompassed by four headings: archaeological interest, architectural interest, artistic interest and historic interest. These terms are used in articulating the cultural significance of heritage assets for the purposes of this impact assessment.

67. As defined in the Principles (IEMA, IHBC and CIfA, 2021), cultural significance does not have a scale associated with it and it is therefore not appropriate to refer to 'high' or 'low' significance. This scaling is addressed through the separate consideration of a heritage asset's importance. Cultural significance is not directly related to designation status nor is it defined in law. However, the reasons for designation may articulate aspects of heritage significance.

68. In describing the cultural significance of heritage assets, reference will also be made to the contribution of setting to that significance. The setting of a heritage asset is described as the surroundings in which a heritage asset is experienced (Historic England, 2017). Elements of an asset's setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral.

69. The importance of a heritage asset is a measure of the degree to which we seek to protect and preserve the cultural significance of that asset through, for example, legislation and planning policy. Determining the importance of an asset is a key decision in impact assessment as it will affect judgements regarding the relative weight to be given to protecting different assets during the design of a proposal.

70. Importance is scaled (unlike cultural significance) and requires the assessor to make a judgement regarding the merits of different heritage assets. It is therefore appropriate to refer to 'high' or 'low' importance for example. The statutory designation of heritage assets provides examples of how assets can be assigned a level of importance against explicit criteria. Some designated assets are judged to be of national importance, for example Scheduled Monuments, and World Heritage Sites are, again by definition, sites of international importance.

71. In determining the significance of effect for the purposes of EIA, this last analytical stage (attributing importance) broadly equates to 'sensitivity' as described in **Section 14.4.3.3** below.

14.4.3.2 Evaluating the Consequences of Change

72. The Principles describe change as, "both the act and the result of making something different from how it was before, whether directly or indirectly, temporarily or permanently, reversibly or irreversibly". It is also important to note that change may or may not lead to an impact on cultural significance. Before a scaled measure of this change can be determined it is necessary to describe the potential change to a heritage asset or its setting. To this end, a narrative approach describing the nature of potential changes is provided for each impact assessed in **Section 14.6**.

73. This is followed by the determination of a scaled measure of the degree to which any change would impact cultural significance, which broadly equates to the 'magnitude of impact' as described in **Section 14.4.3.3** below. This change could have a positive (beneficial) or negative (adverse) outcome. It is not a measure of the reach or extent of the proposal but rather the change to 'what matters' about a heritage asset.

74. The final stage is weighting the effect (the measure that brings together the magnitude of the impact and the cultural heritage asset's importance). For SEP and DEP this is articulated through the significance of effect matrix presented in **Table 14-10**. Following on from the previous stages of the assessment, which draw out the narrative regarding the importance of a cultural heritage asset, its cultural significance, and how the proposal will impact this significance, this measure is indicative of the weight that should be given to the matter in influencing the design of the proposal or, ultimately, in influencing whether the proposal will be acceptable and permitted.

75. Definitions for this weighted measure of significance of effect (in EIA terms) are provided in **Table 14-11**.

14.4.3.3 Definitions of Sensitivity and Magnitude

76. The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. However, while impacts to a heritage asset's setting or character can be temporary, impacts which result in damage or destruction of the assets themselves, or their relationship with their wider environment and context, are permanent. Once destroyed an asset cannot recover. On this basis, the assessment of the significance of effect of any identified impact is largely a product of the importance of an asset (rather than its sensitivity) and the degree to which any change would impact on cultural significance.

77. For the purposes of this EIA, the criteria for determining the heritage importance of any relevant heritage assets are described in **Table 14-8**.

78. The categories and definitions of heritage importance do not necessarily reflect a definitive level of importance of an asset. They are intended to provide a provisional guide to the assessment of perceived heritage importance, which is to be based upon professional judgement incorporating the evidential, archaeological, historical, aesthetic, architectural and communal heritage values of the asset or assets. It is important to note that the importance and cultural significance of an asset can be amended or revised as more information comes to light (i.e. as part of further investigations planned post-consent).

79. **Table 14-8** includes heritage assets of uncertain heritage importance i.e. where the importance, existence and / or level of survival of an asset has not been ascertained (or fully understood) from available evidence. Although **Table 14-8** provides a definition for assets of an uncertain heritage importance, where uncertainty occurs, the precautionary approach is to assign the highest likely level of importance. This precautionary approach represents good practice in cultural heritage impact assessment and reduces the potential for impacts to be under-estimated.

Table 14-8: Criteria for Determining Heritage Importance

Importance	Definition
High (perceived International / National Importance)	World Heritage Sites Scheduled Monuments Grade I and II* Listed Buildings or structures Protected wrecks Designated historic landscapes of outstanding interest Conservation Areas containing buildings or structures with high heritage importance, or high concentrations of listed buildings Assets of acknowledged international / national importance Assets that can contribute significantly to acknowledged international / national research objectives
Medium (perceived Regional Importance)	Grade II Listed Buildings or structures Designated special historic landscapes Other types and character of Conservation Areas Assets that contribute to regional research objectives Assets with regional value, educational interest or cultural appreciation

Importance	Definition
Low (perceived Local importance)	'Locally Listed' buildings or structures Assets that contribute to local research objectives Assets with local value, educational interest or cultural appreciation Assets compromised by poor preservation and / or poor contextual associations
Negligible	Assets with no significant value or archaeological / historical interest
Uncertain/Unknown	The importance / existence / level of survival of the asset has not been ascertained (or fully ascertained / understood) from available evidence

80. Magnitude broadly equates as the degree to which cultural significance is positively or negatively changed by the proposal.

81. Direct physical impacts, indirect physical impacts and impacts from a change in setting on the significance of heritage assets are considered relevant. Impacts may be adverse or beneficial. Depending on the nature of the impact and the duration of development, impacts can also be temporary and / or reversible or permanent and / or irreversible.

82. The finite nature of archaeological remains means that physical impacts are almost always permanent and irreversible as the 'fabric' of the asset and, hence, its potential to inform our historical understanding, will be removed. By contrast, impacts resulting from the change in the setting of heritage assets will depend upon the longevity of construction and operation of SEP and DEP and the sensitivity with which the landscape/seascape is re-instated subsequent to decommissioning / demolition, if applicable.

83. The magnitude of adverse impact with respect to Offshore Archaeology and Cultural Heritage directly relates to the extent of harm to, or loss of, key elements of the assets cultural significance, which may include its setting.

84. The magnitude of beneficial impact with respect to Offshore Archaeology and Cultural Heritage directly relates to the level of public benefit associated with an individual impact. Benefits may correspond directly to the project itself where a project will enhance the historic environment (e.g. through measures which will improve the setting of a heritage asset or public access to it).

85. Alternatively, benefits may occur on the basis of data gathering exercises undertaken for the purpose of a project which will enhance public understanding by adding to the archaeological record (e.g. through the accumulation of publicly available information and data). The measure of beneficial impact (high / medium / low) is, therefore, necessarily situational and specific to a given site, area or subject. One such example of a positive magnitude of impact could be relevant to, for example, new survey data being acquired, which will ultimately be made publicly accessible.

86. The criteria used for assessing the magnitude of impact with regard to archaeology and cultural heritage are presented in **Table 14-9**.

Table 14-9: Definition of Magnitude of Impact to Heritage Assets

Magnitude	Definition
High Adverse	Key elements of the asset's fabric and/or setting are lost or fundamentally altered, such that the asset's cultural significance is lost or severely compromised.
Medium Adverse	Elements of the asset's fabric and/or setting which contribute to its significance are affected, but to a more limited extent, resulting in an appreciable but partial loss of the asset's cultural significance.
Low Adverse	Elements of the asset's fabric and/or setting which contribute to its cultural significance are affected, resulting in a slight loss of cultural significance.
Negligible	The asset's fabric and/or setting is changed in ways which do not materially affect its cultural significance.
Low Beneficial	Elements of the asset's physical fabric which would otherwise be lost, leading to a slight loss of cultural significance, are preserved *in situ*; or Elements of the asset's setting are improved, slightly enhancing its cultural significance; or Research and recording leads to a slight enhancement to the archaeological or historical interest of the asset. This only applies in situations where the asset would not be otherwise harmed i.e. it is not recording in advance of loss.
Medium Beneficial	Elements of the asset's physical fabric which would otherwise be lost, leading to an appreciable but partial loss of cultural significance, are preserved *in situ*; or Elements of the asset's setting are considerably improved, appreciably enhancing its cultural significance; or Research and recording leads to a considerable enhancement to the archaeological or historical interest of the asset. This only applies in situations where the asset would not be otherwise harmed i.e. it is not recording in advance of loss.
High Beneficial	Elements of the asset's physical fabric which would otherwise be lost, severely compromising its cultural significance, are preserved *in situ*; or Elements of the asset's setting, which were previously lost or unintelligible, are restored, greatly enhancing its cultural significance.
No impact	No change to the assets fabric or setting which affects its cultural significance.

14.4.3.4 Significance of Effect

87. In accordance with the Principles for cultural heritage landscape (IEMA, IHBC and CIfA, 2021), for the purposes of this chapter the assessment refers to magnitude of impact and significance of effect. This is a departure from the language used in other chapters which refers to magnitude of effect and impact significance.

88. In basic terms, the potential significance of effect is a function of the sensitivity of the receptor and the magnitude of the impact (see **Chapter 5 EIA Methodology** for further details). As described above, for Offshore Archaeology and Cultural Heritage this equates to the importance of a heritage asset weighed against the magnitude of change to its cultural significance. The determination of significance is guided by the use of a significance of effect matrix, as shown in **Table 14-10**. Definitions of each level of significance are provided in **Table 14-11**.

89. Potential impacts identified within the assessment as major or moderate are regarded as significant in terms of the EIA regulations. Potential impacts should be described using significance of effect, followed by a statement of whether this is significant in terms of the EIA regulations, e.g. "*minor adverse effect, not significant in EIA terms / moderate adverse effect, significant in EIA terms"*. Appropriate mitigation has been identified, where possible, in consultation with the regulatory authorities and relevant stakeholders. The aim of mitigation measures is to avoid or reduce the overall impact in order to determine a residual impact upon a given receptor.

Table 14-10: Significance of Effect Matrix

		Adverse Magnitude				Beneficial Magnitude			
		High	**Medium**	**Low**	**Negligible**	**Negligible**	**Low**	**Medium**	**High**
Importance	**High**	*Major*	*Major*	*Moderate*	*Minor*	*Minor*	*Moderate*	*Major*	*Major*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Major*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*	*Negligible*	*Minor*	*Minor*	*Moderate*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Minor*

Table 14-11: Definition of Significance of Effect

Significance	Definition
Major	Change in cultural significance, both adverse or beneficial, which are likely to be important considerations at a national or regional level because they contribute to achieving national or regional objectives. Effective/acceptable mitigation options may still be possible, to offset and / or reduce residual impacts to satisfactory levels.
Moderate	Change in cultural significance, both adverse or beneficial, which are likely to be important considerations at a local level. Effective / acceptable mitigation options may still be possible, to offset and / or reduce residual impacts to satisfactory levels.
Minor	Change in cultural significance, both adverse or beneficial, which may be raised as local issues but are unlikely to be material considerations in the decision-making process. Industry standard mitigation measures may still apply.
Negligible	No material change to cultural significance.
No change	No impact, therefore, no change to cultural significance.

14.4.4 Historic Seascape Character

90. The approach to the assessment of historic seascape character differs to that outlined above for heritage assets.

91. The historic character of the seascape is described in terms of ability to accommodate change. A key aspect of this ability is how that character is perceived by the public. For this reason, an approach is required which recognises the dynamic nature of seascape and how all aspects of the seascape, no matter how modern or fragmentary, can form part of the character of that seascape.

92. It is not meaningful, therefore, to assign a level of importance to these perceptions of character, which are by nature subjective, nor to assign a measure of magnitude in order to understand the nature of the potential changes. Rather, this change is expressed as a narrative description of the seascape character, how it is perceived by the public and how these perceptions could be affected by SEP and DEP, which may or may not be perceived as important from a historic perspective. In this respect, while damage to, or destruction of, a heritage asset is considered permanent and irreversible, impacts to historic seascape character are dynamic, and may be temporary and reversible.

93. Changes to the historic seascape character and the extent to which these changes can be accommodated are discussed in **Section 14.5.4**.

14.4.5 Cumulative Impact Assessment Methodology

94. The cumulative impact assessment (CIA) considers other plans, projects and activities that may impact cumulatively with SEP and DEP. As part of this process, the assessment considers which of the residual impacts assessed for SEP and/or DEP on their own have the potential to contribute to a cumulative impact, the data and information available to inform the cumulative assessment and the resulting confidence in any assessment that is undertaken. **Chapter 5 EIA Methodology** provides further details of the general framework and approach to the CIA.

95. For Offshore Archaeology and Cultural Heritage, cumulative impacts may occur where archaeological receptors also have the potential to be impacted by other existing, consented and/or proposed developments or activities. This includes consideration of the extent of influence of changes to marine physical processes (see **Chapter 6 Marine Geology, Oceanography and Physical Processes**) arising from the Projects alone and those arising from the Projects cumulatively or in combination with other OWF developments.

96. Cumulative impacts are considered in **Section 14.7**.

14.4.6 Transboundary Impact Assessment Methodology

97. The transboundary assessment considers the potential for transboundary effects to occur on Offshore Archaeology and Cultural Heritage receptors as a result of the projects; either those that might arise within the EEZ of European Economic Area (EEA) states or arising on the interests of EEA states e.g. a non UK fishing vessel. **Chapter 5 EIA Methodology** provides further details of the general framework and approach to the assessment of transboundary effects.

98. For Offshore Archaeology and Cultural Heritage, transboundary impacts may be relevant heritage where wrecks of non-British, European nationality are subject to impact from development and may therefore fall within the jurisdiction of another country. Transboundary impacts may also occur if the cumulative effects of changes to physical processes have the potential to impact archaeology across extended sea areas. In addition, there is potential for developments, individually and cumulatively, to affect larger-scale archaeological features such as palaeolandscapes and to affect the setting of heritage assets and historic landscapes/seascapes which may also extend across these boundaries. This may also include sensitivities in conjunction with local community groups and interests.

99. Transboundary impacts are considered in **Section 14.8**.

14.4.7 Assumptions and Limitations

100. The records held by the UKHO, Historic England (NHLE and formerly the NRHE), NHER and the other sources used in this assessment are not a record of all surviving cultural heritage assets, rather a record of the discovery of a wide range of archaeological and historical components of the marine historic environment. The information held within these datasets is not complete and does not preclude the subsequent discovery of further elements of the historic environment that are, at present, unknown. In particular, this relates to buried archaeological features.

14.5 Existing Environment

14.5.1 Sea bed Prehistory

14.5.1.1 Description of Identified Assets

101. There are no known sea bed prehistory sites within the study area.

102. The potential for prehistoric sites to be present within study area, either exposed on or buried within the sea bed, is primarily associated with surviving terrestrial features and deposits corresponding to times when sea levels were lower and hence prehistoric hominin populations may have inhabited what is now the sea bed. Archaeological material may also be present within secondary contexts, as isolated finds within deposits comprising material from terrestrial phases that may have been reworked by marine or glacial processes, for example.

103. The shallow geology of the study area has been established from SBP and geotechnical data interpreted by Wessex Archaeology and comprises a series of Pleistocene and Holocene sediments deposited in a range of environments, from terrestrial to marine. Terrestrial sediments, deposited during periods of low relative sea level, are of the highest archaeological potential. This potential is discussed in detail in **Appendix 14.1**, **Appendix 14.2** and **Appendix 14.3** and is summarised below. Account has also been taken of previous geoarchaeological assessments undertaken for SOW and DOW as summarised in **Table 14-12** below.

Table 14-12: Summary of Previous Geoarchaeological Assessments for SOW and DOW

Date	Summary	References
2006	Archaeological assessment of vibrocores taken along the SOW cable route undertaken by Wessex Archaeology identified a sequence of sediment	Wessex Archaeology (2006a) Sheringham Shoal Offshore Wind Farm Desk

Date	Summary	References
	which would support the preservation of prehistoric archaeological and paleoenvironment material. The DBA concluded there was potential for the presence of drowned land surfaces (and associated sites) from the Lower Paleolithic to the Iron Age (500,000 BP – 43 AD) these deposits.	Based Assessment. Report ref. 61033. Wessex Archaeology (2006b) Sheringham Shoal OWF Stage 2 Archaeological Recording and Sampling of Vibrocores. Report ref. 61032.02
2009	Assessment of marine geophysical data from DOW by Wessex Archaeology revealed a possible peat layer and several cut and fill features identified from the SBP data with channel 7026 being the largest (maximum extent of c. 3 km by 800 m).	Wessex Archaeology (2009a) Dudgeon Offshore Wind Farm: Archaeological Desk Based and Geophysical Assessment. Report ref. 69680.08
2009	Assessment of marine geophysical data from a proposed extension to DOW by Wessex Archaeology revealed a possible peat layer and several cut and fill features identified from the SBP data 7311 and 7312 being the largest, thought to be part of the same event and with a combined maximum extent of c. 4.9 km long by 600 m wide.	Wessex Archaeology (2009b) Dudgeon Offshore Wind Farm Extension Area: Archaeological Assessment of Marine Geophysical Data. Report ref. 69680.04
2014	Paleoenvironmental assessment of samples from BH06 and BH21 (both located within feature 7026) suggests that in the early Holocene a freshwater lake, then a tidal environment of brackish creeks. A 7.5 m thick deposit of gravel and sand immediately above early Mesolithic peat in borehole BH06 may be evidence for the 'Storegga slide' tsunami event c.8100 BP. Above this a brief return to more sedate brackish estuarine depositional conditions was recorded, dated to c. 8105-7931cal.BP.	Wessex Archaeology (2014) Dudgeon Offshore Wind Farm: Stages 1 to 3 Geoarchaeological and Palaeoenvironmental Assessment. Report ref. 69681.03
2016	Paleoenvironmental analysis revealed a complex sequence of late quaternary sediments infilling a linear feature (7026) similar to scaphiform glacial valleys recorded in other areas of the southern North Sea basin. The sediments analysed cover a period of c. 4800 years over the transition between the last (Weichselian) Ice Age and current (Holocene) warm period culminating in the final marine inundation of this landscape by ca. 7900 cal BP, including a deposit which may represent the 'Storegga Slide'.	Wessex Archaeology (2016) Dudgeon Offshore Wind Farm Stage 4 Palaeoenvironmental Analysis, Borehole BH06. Report ref. 69685.01
2019	A key conclusion of the peer-reviewed publication was that rather than representing the Storegga Slide, overlying gravely, shelly sand equates to the development of a higher-energy fluvial environment within channel 7026, whilst a radiocarbon date of 8411–8331 cal BP from a thin layer of overlying peat is close in timing to a 200-year period of abrupt climate cooling argued to have been caused by the collapse of the Laurentide Ice Sheet and the draining of the	Brown, A., Russell, J., Scaife, R., Tizzard, L., Wittaker, J. and Wyles S. F. (2018) Late glacial/ early, Holocene paleoenvironments in the southern North Sea Basin: new data from the Dudgeon offshore wind farm, *Journal of Quaternary Science* 33(6): 597-610

Date	Summary	References
	proglacial Lakes Agassiz and Ojibway. This resulted in a meltwater pulse and associated increase in sea- level which precipitated major palaeogeographical and climate changes within and beyond the North Sea Basin.	

104. The geology within the study area has been divided by Wessex Archaeology into eight phases as summarised in **Table 14-13.**

Table 14-13: Shallow Stratigraphy of the Study Area Identified by Wessex Archaeology (Appendix 14.3 Table 4)

WA Unit	Unit Name (Age)	Geophysical Characteristics	Sediment Type	Archaeological Potential
Unit 8	Holocene sea bed sediments (post-transgression, marine isotope stage (MIS) 1)	Generally observed as a veneer or thickening into large sand waves and bank features. Boundary between superficial sediments and underlying units not always discernible.	Gravelly sand with frequent shell fragments, sand waves and ripples (marine)	Considered of low potential in itself, but possibly contains reworked artefacts and can cover wreck sites and other cultural heritage.
Unit 7	Holocene sediments (pre-transgression, MIS 2-1)	Small shallow infilled channels with either seismically transparent fill, or fill characterised by subparallel internal reflectors. May also comprise a basal, high amplitude reflector, possibly representing a peat layer	Sand with organics (fluvial), laminated sand, silt and clay (estuarine) and peat (semi-terrestrial)	Potential to contain *in situ* and derived archaeological material, and palaeoenvironmental material. Peat is considered to have high potential as it may be radiocarbon dated and record vegetation change.
Unit 6b	Botney Cut (Weichselian to possibly Early Holocene, MIS 2-1)	Channel features with distinct basal reflectors and fill characterised by sub-parallel internal reflectors. Acoustic blanking occasionally seen at base and within.	Clays and sands (estuarine and terrestrial peats relating to the Holocene)	
Unit 6a	Botney Cut (Weichselian to possibly Early Holocene, MIS 2-1)	Acoustically chaotic unit with faint basal reflector, possibly infilling broad, faint channel features. Some sub-horizontal internal reflectors.	Stiff red brown gravelly, sandy clays (Glacial till) and laminated sands and clays (glaciolacustrine and glaciomarine)	Considered low but has potential to bury deposits of interest or to contain reworked material
Unit 5	Bolders Bank (Late Weichselian, MIS 2)	Acoustically chaotic blanket deposit often with internal reflectors and some occasional internal channelling	Stiff red brown gravelly, sandy clays containing erratics including chalk (glacial till)	

WA Unit	Unit Name (Age)	Geophysical Characteristics	Sediment Type	Archaeological Potential
Unit 4	Egmond Ground (Holsteinian/Saalian, MIS 11-8)	Fill characterised by numerous faint reflectors and a distinct basal reflector	Shelly sands and gravel with interbedded silt and clay (marine)	
Unit 3	Swarte Bank (Elsterian/Early Holsteinian, MIS 12/11)	Acoustically chaotic unit with faint basal reflector, possibly infilling broad, faint channel features. Some sub-horizontal internal reflectors.	Stiff grey gravelly sandy clays with lenses of coarse glaciofluvial sand (glacial till)	
Unit 2	pre-Devensian Weybourne Channel	Broad, distinct channel feature with an undulating basal reflector. Fill characterised by an upper unit characterised by numerous, faint subhorizontal reflectors, overlaying a more acoustically chaotic unit	Alluvial sequence found to comprise sand, clay and organic silt.	Exact age, and therefore archaeological potential, is uncertain however has the potential to contain *in situ* and derived archaeological material, and palaeoenvironmental material.
Unit 1	Upper Cretaceous Chalk	Fairly acoustically quiet with some, faint dipping reflectors	White and greyish white chalk with some nodular flint	Considered of low potential
(1) Based on geophysical data (Wessex Archaeology 2020; 2021) (2) Based on vibrocore and borehole data (Wessex Archaeology 2009c; 2014a; 2016) and Cameron *et al.*, (1992)				

105. The stratigraphy set out in **Table 14-13** is a combination of all the interpreted shallow geological units from across the entire study area. The entire stratigraphy was not identified in any one single area of the study area, and the exact number of units present will differ depending on location.

106. Wessex Archaeology has also interpreted a number of palaeogeographic features from the SBP data which have been correlated with the stratigraphy set out in **Table 14-13** to provide a detailed description of the potential for submerged prehistoric archaeology to be present within the study area. **Table 14-14** below provides as summary of the number of these features and their archaeological discrimination. The distribution of these features is illustrated on **Figures 3.01** to **3.06** in **Appendix 14.1**.

Table 14-14: Wessex Archaeology's Criteria Discriminating Relevance of Palaeogeographic Features to Proposed Scheme and Number of Features

Archaeological Discrimination	Description	Number of Features
P1	Feature of probable archaeological interest, either because of its palaeogeography or likelihood for producing palaeoenvironmental material	43
P2	Feature of possible archaeological interest	69

107. A summary of the potential for submerged prehistoric archaeology to be present within the study areas is presented below.

108. Unit 1 (Upper Cretaceous chalk) is the oldest deposit noted across the offshore sites and is only identified within the offshore export cable corridor. Unit 1 is of no archaeological interest as this was deposited during the Upper Cretaceous period and thus predates the earliest occupation of the UK by early hominins.

109. Within the nearshore area of the export cable corridor, Unit 1 is cut by a distinct complex channel (**79000**) which is possibly the continuation of feature **7034**, identified during the 2009 assessment undertaken for DOW (Wessex Archaeology, 2009). This was interpreted as the Weybourne Channel (Unit 2) thought to be pre-Devensian in date. A second, smaller channel (**79002**) was noted to the north of (**79000**). The exact age and archaeological potential of these channels is uncertain, although the channel is thought to have the potential to contain *in situ* and derived archaeological and palaeoenvironmental material. Furthermore, these channels sit just to the north of one of the most important stretches of coastline for Palaeolithic archaeology in the British Isles (EMU 2009). Additionally, the channels are close to the NHER feature **MNF6256**, a series of Holocene organic deposits, faunal remains and Mesolithic/Neolithic worked and burned flints. It is possible that either of the features **79000** or **79002** may be associated with these later sediments. Therefore, although the exact date is uncertain, their archaeological potential is still considered high.

110. Further offshore within the export cable corridor, Unit 3 (Swarte Bank Formation) overlays Unit 1 and within the interlink cable corridors is expected to be present below a veneer of Unit 8. The Swarte Bank consists of infilled sub-glacial valleys, originally cut during MIS 12 (480-423 ka) and infilled during the early part of MIS 10-9 (ca. 350-280 ka) (Brown *et al*. 2018). The presence of Unit 3 is also indicated within the SEP wind farm site, but due to acoustic similarities with Unit 5 (discussed below) has not been definitively identified.

111. During the previous assessments of vibrocore and borehole data, these sediments were found to comprise gravelly sandy clay (Wessex Archaeology 2009c). The vibrocores recovered from SEP and DEP show a comparatively different structure, with grey glacial diamict preserved at shallow depths (from 0.7 mbsf in VC36) and overlying brown sandy diamict interpreted as a sand unit forming part of the Swarte Bank Formation. This variability in the composition of Swarte Bank may reflect reworking and remobilisation through glacitectonism. Although these sediments are within the timeframe of lower Palaeolithic occupation of the British Isles, they are thought to be glacial in origin and considered of low archaeological potential.

112. Unit 4 (Egmond Ground (Holsteinian/Saalian, MIS 11-8) consists of sands and gravels laid down in the Holsteinian and Saalian stages. This Unit is not considered to be of archaeological potential but may overlay earlier *in situ* deposits. This unit has only been identified within the DEP North array area as a probable blanket deposit across the entire area and was not identified in the vibrocore logs.

113. Unit 5 (Bolders Bank (Late Weichselian, MIS 2) comprises subglacial terrestrial tills laid down in the Late Weichselian period. These glacial deposits are not considered to be of archaeological potential in themselves, whilst glacial activity is likely to have removed any immediately underlying archaeological material. This Unit has been identified throughout the offshore sites and is present as a blanket deposit either incised by later Pleistocene or Holocene Channels (Units 6b and 7), below Unit 8 or otherwise directly below the sea bed. In the majority of vibrocores recovered from SEP and DEP, the lowermost sediments are described as high strength reddish brown silty sandy clay with frequent chalk gravel correlating to the Bolders Bank Formation.

114. Unit 6 comprises lower glacial tills (Unit 6a), which are considered to be of low archaeological potential, and possible upper alluvial and terrestrial sediments (Unit 6b). Unit 6b appears as channel fills with alluvial (estuarine) and terrestrial (peat) sediments probably relating to the Holocene, and with the potential to contain derived or *in situ* artefacts and preserved palaeoenvironmental material. One of the channel features (**79075**) corresponds with the location of an NRHE record (**225765**) of peat recovered during a benthic trawl within SOW.

115. However, the possibility of this upper Botney Cut unit having a more complex depositional history should be noted. Wessex Archaeology identify that several of the channel features seen in the SBP, and attributed to Unit 6b, may alternatively be associated with Unit 7. This complexity has also been encountered in previous assessments for SOW and DOW, and for OWF projects off the east coast. For example, during the palaeoenvironmental assessment of the nearby Triton Knoll OWF, the Botney Cut Formation was grouped together as one unit along with terrestrial marshland and fluvial channels thought to relate to the Elbow Formation (Wessex Archaeology 2019c).

116. In summary, the main channel features identified are:

- Three complex channel features (**79013**, **79015** and **79019**) within the central and offshore section of the export cable corridor, possible alluvial Botney Cut features (Unit 6b), cutting into possible glacial tills (Unit 3, or 5), or possibly the underlying chalk bedrock (Unit 1);
- **79025-32** and **79038** in the interlink / export cable corridor between the SEP wind farm site and the DEP North array area and the SEP wind farm site and the DEP South array area, either late Weichselian or possibly Holocene in age (Units 6b and 7);
- Two Botney Cut channels are identified in the eastern section of the DEP South array area (**79056-7**);

- A broad Botney Cut channel (**79044**) interpreted as cutting across the north of the DEP North array area, cutting through the Bolders Bank formation (Unit 5) and into The Egmond Ground Formation (Unit 4). Channel features **79048-50** are all thought to represent the southern edge of the channel feature. Channel **79043**, identified just to the north, may be part of the larger possible Botney Cut feature (**79044**);
- Botney Cut feature (**7026**) identified during the 2009 assessment, reported as cutting into the underlying Bolders Bank Formation located in the south-western tip of the DEP North array area, adjacent to DOW, and not covered by the SBP data acquired for this phase of assessment;
- A number of channel features within the SEP wind farm site (**79061**, **79063**, **79073-5**, **79082**, **79085**, **79087-8**, **79103-4** and **79106**), interpreted as Botney Cut features although there is the possibility of them being later Holocene features (Unit 7). It is possible that some of these Botney Cut channels represent a continuation of features identified during the original 2009 Sheringham Shoal Assessment (Wessex Archaeology 2009c). For example, **70987** may be a continuation of **7011** which was sampled (Borehole BH9) as part of 2006 geotechnical investigations and found to contain evidence of alluvial and terrestrial sediments, including thin layers of peat (Wessex Archaeology, 2009c); and
- A series of features identified within the interlink corridors which are thought to be channels of a similar age as those described above. However, as they could not be traced any distance as coherent palaeochannels, they are interpreted as cut and fill features. It is possible that they are the remnants of eroded palaeochannel systems but, as their nature is less certain, they are considered of lower archaeological potential.

117. These channel features are thought to have formed during periods of low sea level when the area would have been exposed as a terrestrial landscape. As such, the sediments associated with these features are deemed to be of high archaeological potential. This is due to the fact they could contain *in situ* or derived anthropogenic artefacts and preserved palaeoenvironmental material. Within channel feature **79088**, a series of poorly developed mounded features have been identified, possibly terrestrial in origin and possibly aeolian dunes (although these may also be subaqueous in formation or possible internal fluid or gas escape). If these were to be demonstrated to be terrestrial origin, it suggests that they formed during a significant period of aerial exposure and may be of high archaeological potential.

118. During the assessment of BH06 from channel **7026** (Wessex Archaeology, 2016), units of highly laminated organic gyttja and peat with intervening sandy peat were identified, which are thought to represent the gradual infilling of a freshwater lake followed by the development of a small channel infilled with shelly sandy gravel and sealed by a thin layer of gyttja and peat. Radiocarbon dating showed that these sediments accumulated over a period between ca. 12 700 and 9260 cal BP during a period of significant climate change with the abrupt cooling of the Younger Dryas (from 12,900 to 12,700 cal a BP) followed by rapid warming during the onset of the Holocene (from 11, 700 cal a BP) (Brown *et al*., 2018). It is possible that the other Botney Cut channels identified across the Study Areas are of a similar age to those sediments and, as such, the sediments associated with these features are deemed to be of high archaeological potential.

119. Two features (**7025** and **7032**) were identified during the 2009 assessment (Wessex Archaeology 2009b) as high amplitude reflectors and interpreted as being possible peat. If peat, these features are likely to represent former terrestrial landscapes and, as such, the sediments associated with these features are deemed to be of high archaeological potential.

120. The review of vibrocore logs acquired for SEP and DEP confirm the presence of a series of deposits comprising clayey sand and sand and gravel, representing deposition within a floodplain or active fluvial channel. In most instances, deposits interpreted as fluvial in nature are overlain by laminated sand, silt and clay with shell, representing deposition in an environment influenced by tidal processes. These minerogenic sediments are frequently mapped within former channel systems and document the progressive inundation of the North Sea during the early Holocene. In one vibrocore log (VC62), tidally-influenced sediments are intersected by fluvial deposits, possibly showing a fluctuating landscape, with a temporary fall in relative sea level and the reactivation of channel activity. A sub-aerially exposed North Sea intersected by channels would have formed an attractive landscape for Mesolithic communities, with floodplain deposits possibly containing *in situ* archaeological material.

121. Several vibrocores recovered from the SEP and DEP offshore sites record alluvium interbedded with peat and organic clay (gyttja). Equivalent deposits were previously recorded from DOW (Brown et al. 2018) and following a palaeoenvironmental assessment, were suggested as showing the gradual infilling of a proglacial freshwater lake system between 12,700 and 9260 cal. BP. Peat deposits have also been recovered with wood fragments frequently observed within the organic sediments and likely representing deposition within a semi-terrestrial environment which developed during the Holocene and prior to final marine transgression. In VC59, a transition is observed with the deposition of peat, followed by organic clay and the reformation of peat demonstrating peat development ceasing and the reactivation of a channel, possibly as a result of rising sea levels.

122. Throughout the offshore sites, further complex and simple cut and fill features were identified which are thought to be of a similar age as the channels described above. However, these could not be coherently traced as palaeochannels and are considered of lower archaeological potential.

123. Several of the features were described as associated with acoustic blanking, or with distinct, high amplitude and possible gaseous basal reflectors, thought to be indicative of gas caused by the microbial breakdown of organic matter within the feature. This suggests that these features are more likely to contain preserved material of palaeoenvironmental interest.

124. Unit 8 Holocene Sea bed Sediments (post-transgression) (MIS) 1) comprises post-transgression marine sediments laid down during the Holocene and not considered to be of archaeological potential in themselves. However, such deposits could periodically bury and expose archaeological sites such as shipwrecks in areas of mobile sediment. This Unit has been identified across the whole study area and has been shown to be mobile by the presence of sand waves and ripples. This Unit has been identified across all of the offshore sites as either a thin veneer or thickening out into sand waves. In several areas across the offshore sites, an erosion surface has been identified which possibly represents a former terrestrial landscape which may contain peat.

125. A number of infilled depressions were also identified (**79004-5**, **79007-11** and **70106-7**) in the surface of the chalk bedrock (Unit 1), present in patches in the southern/central section of the export cable corridor. It is possible that these features are infilled by modern marine sediments (Unit 8), however they may be infilled by pre-transgression Holocene sediments or re-worked sediments which may have some archaeological and paleoenvironmental potential.

126. A fine-grained deposit (**79023**) is interpreted in the central section of the interlink corridor between the SEP wind farm site and DEP South array area which, in the MBES data, appears to correspond with a bathymetric high, indicating a banked feature. A small, acoustically quiet channel (**79024**), orientated north-west to south-east is seen to be cutting through the fine-grained deposit, indicating that feature **79023** may have once formed part of a terrestrial landscape, possibly protected by the overlying marine sediments which may have helped to preserve lower units of archaeological and palaeoenvironmental interest.

127. In several places across the study area, including in the northern section of the DEP South to DEP North array area interlink cable corridor, and the south-eastern corner of the SEP wind farm site / offshore export cable corridor, a distinct, horizontal reflector is identified below Unit 8 which has been interpreted as a possible erosion surface and possibly a former terrestrial landscape which may contain peat similar to **7025** and **7032**. However, it is also possible that this may represent the base of the mobile sands. Due to the uncertainty in its origins, the feature has been mapped (**Figures 2.01-2.03** of **Appendix 14.2**) however it has not been given its own anomaly number. Within the DEP South array area, an anomaly (**7015**) was identified during the 2009 assessment (Wessex Archaeology, 2009a) as being possible peat, which corresponds to a distinct horizontal horizon identified in the parametric sonar data.

128. The relationship between the potential for submerged prehistoric archaeology within the SEP and DEP offshore sites and wider evidence for East Coast palaeolandscapes is discussed further with respect to both historic seascape character (**Section 14.5.4**) and CIA (**Section 14.7**) below.

14.5.1.2 Cultural Significance of Identified Assets

129. There are no known sea bed prehistory sites within the study area for which significance can be described.

130. The interpretation of shallow stratigraphy and associated palaeogeographic features provides context for an understanding of the potential for past inhabitation of these formerly terrestrial landscapes. As such, their significance lies primarily in their archaeological interest or research value, particularly when considered alongside survey data and interpretations produced for other sea bed development projects in the North Sea. This is discussed further in terms of CIA and transboundary impacts in **Sections 14.7** and **14.8** below.

131. The setting of a heritage asset is described as the surroundings in which a heritage asset is experienced (Historic England 2017). Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral. Historic England's guidance on setting notes how the setting of buried heritage assets may not be readily appreciated by a casual observer but retain a presence in the landscape.

132. For offshore assets, for the most part, submerged archaeological sites are not 'readily appreciated by a casual observer'. With respect to former prehistoric landscapes in the North Sea, these are largely experienced conceptually in terms of interpreted data and research and the setting of these assets (in terms of the surroundings in which they are experienced) does not, therefore, form a key part of their significance. However, changes within the physical setting will occur (i.e. the introduction of SEP or DEP into the seascape) and the capacity of these palaeolandscapes to accommodate this change is discussed alongside historic seascape character in **Section 14.5.4**.

14.5.1.3 Importance of Identified Assets

133. The rarity of *in situ* prehistoric sites in offshore contexts means that, should such sites be encountered within the offshore sites, these will be of national, or possibly international interest, with significant potential to contribute to acknowledged international and national research objectives. Given the particularly high importance of these *in situ* sites, the features and deposits which have the potential to contain *in situ* prehistoric archaeological material (i.e. interpreted palaeolandsurfaces and palaeolandscape features) should also be considered of high importance. Similarly, should palaeoenvironmental evidence be discovered in the context of an *in situ* prehistoric site this would also be of high importance.

134. Although palaeoenvironmental material encountered beyond the context of an *in situ* prehistoric site still has evidential value for understanding changes in the climate and environment with offshore contexts, isolated discovers should be considered of low importance for the purposes of assessment.

135. Isolated finds of prehistoric archaeological material within secondary contexts, comprising material from terrestrial phases that may have been reworked by marine or glacial processes, also have evidential value for understanding patterns of population and exploitation of landscapes, for example. However, as these finds are derived, and out of context, they are regarded as being of medium rather than high importance.

136. The heritage importance of the potential heritage assets outlined above are presented in **Table 14-15**.

Table 14-15: Heritage Importance (Sea bed Prehistory)

Asset Type	Definition	Importance
Potential *in situ* prehistoric sites	Primary context features and associated artefacts and their physical setting (if/where present)	High
	Known submerged prehistoric sites and landscape features with the demonstrable potential to include artefactual material	High
Potential submerged landscape features	Other known submerged palaeolandscape features and deposits likely to date to periods of prehistoric archaeological interest with the potential to contain in situ material	High
Potential derived Prehistoric finds	Isolated discoveries of prehistoric archaeological material discovered within secondary contexts	Medium
Potential palaeoenvironmental evidence	Isolated examples of palaeoenvironmental material	Low
	Palaeoenvironmental material associated with specific palaeolandscape features or archaeological material	High

14.5.2 Maritime and Aviation Archaeology

14.5.2.1 Description of Identified Assets

137. There are no known sites within the study area that are subject to statutory protection from the Protection of Wrecks Act 1973, the Protection of Military Remains Act 1986 or the Ancient Monuments and Archaeological Areas Act 1979. There are, however, a number of wrecks (described below) charted by the UKHO.

138. SSS, MBES and magnetometer data interpreted by Wessex Archaeology has demonstrated the presence of a number of sea bed features which have been identified as being of archaeological interest (A1) or potential archaeological interest (A2 and A3). Sea bed features are discriminated by Wessex Archaeology in accordance with the definitions set out in **Table 14-16**.

Table 14-16: Wessex Archaeology Criteria for Discriminating Relevance of Identified Sea bed Features to Proposed Scheme

Discrimination	Criteria	Number of Anomalies
A1	Anthropogenic origin of archaeological interest	30
A2	Uncertain origin of possible archaeological interest	518
A3	Historic record of possible archaeological interest with no corresponding geophysical anomaly	1
D	Anomaly/feature subsequently confirmed as unexploded ordnance (UXO) and detonated in situ	1

139. A full list of sea bed features interpreted from the data by Wessex Archaeology for the SEP and DEP offshore sites are included in the gazetteer in **Appendix 14.1**, with features identified within the additional interlink cable corridor options included in **Appendix 14.2**. The locations of these features are illustrated in **Figures 5.01** to **5.30** of **Appendix 14.1** and **Figures 3.01** to **3.03** of **Appendix 14.2**. These features are discussed in detail in **Appendix 14.1** and **Appendix 14.2** and are summarised below.

140. In total 550 features of archaeological interest or potential archaeological interest have been identified by Wessex Archaeology. These are distributed across the study area as shown in **Table 14-17**. Where the interlink cable corridors overlap other areas, there are nine anomalies which are located in more than one Project area. In **Table 14-17** these are only counted once in the totals. These are:

- **7035** and **72513** which are located within the DEP North array area and also within the interlink cable corridor from the DEP North to DEP South array area;
- **72683** which is located within the interlink cable corridor between SEP wind farm site and DEP the South array area and the interlink / export cable corridor which passes around SEP; and
- **7124**, **72546**, **72593**, **72596**, **72632** and **72640** which are located within the SEP wind farm site and the interlink / export cable corridor which passes through SEP.

Table 14-17: Distribution of Sea bed Features Within the Study Area Identified by Wessex Archaeology

Archaeological Discrimination	Number of Sea bed Features					Total
	DEP South array area	DEP North array area	SEP	Export Cable Corridor	Interlink Cable Corridors	
A1	4	3	19	3	3 (2 coincidental with other areas)	30
A2	49	44	88	194	149 (7 coincidental with other areas)	518
A3	0	0	1	0	0	1
D	0	1	0	0	0	1
Total	53	48	108	197	152 (9 coincidental with other areas)	550

141. These anomalies have also been classified by probable type as shown in **Table 14-18**.

Table 14-18: Types of Anomaly Within the Study Area Identified by Wessex Archaeology.

Anomaly Classification	Definition	Number of Anomalies
Wreck (A1)	Areas of coherent structure including wrecks of ships, submarines and some aircraft (where coherent structure survives)	16
Debris Field (A1)	A discrete area containing numerous individual debris items that are potentially anthropogenic and can include dispersed wreck sites for which no coherent structure remains.	7
Debris (A1)	Distinct objects on the sea bed, generally exhibiting height or with evidence of structure, that are potentially anthropogenic in origin	6
Rope/Chain (A1)	Curvilinear dark reflectors, often with a small amount of height, indicating rope or chain (if ferrous)	1
Debris Field (A2)	A discrete area containing numerous individual debris items that are potentially anthropogenic and can include dispersed wreck sites for which no coherent structure remains.	24
Debris (A2)	Distinct objects on the sea bed, generally exhibiting height or with evidence of structure, that are potentially anthropogenic in origin.	121
Sea bed disturbance (A2)	An area of disturbance without individual, distinct objects. Potentially indicates wreck debris or other anthropogenic features buried just below the sea bed.	8
Rope/chain (A2)	Curvilinear dark reflectors, often with a small amount of height, indicating rope or chain (if ferrous)	32
Bright reflector (A2)	Individual objects or areas of low reflectivity, characteristic of materials that absorb acoustic energy, such as waterlogged wood or synthetic materials. Precise nature is uncertain	10
Dark reflector (A2)	Individual objects or areas of high reflectivity, displaying some anthropogenic characteristics. Precise nature is uncertain	142
Depression (A2)	An area of disturbed sea bed with depth. Potentially indicates scour around a buried feature or where a feature has been cleared.	1
Magnetic (A2)	No associated sea bed surface expression, and have the potential to represent possible buried ferrous debris or buried wreck sites	170
Magnetic (D)	Magnetic anomaly previously confirmed as UXO and detonated in situ	1
Mound (A2)	A mounded feature with height not considered to be natural. Mounds may form over wreck sites or other debris.	10
Recorded Wreck (A3)	Position of a recorded wreck at which previous surveys have identified definite sea bed anomalies, but for which no associated feature has been identified within the current data set.	1
Total		550

142. Of the A1 features identified within the study area, 17 have previously been charted by the UKHO and are summarised within **Table 14-19** below.

Table 14-19: A1 Anomalies Previously Charted by the UKHO

Wessex ID	UKHO ID	Wreck Name	Description	Offshore Site Area
7043 (Appendix 14.1, Wreck Sheet 3)	9517	N/A	A very large wreck that may be in two parts. The wreck has significant height and appears upright on the sea bed in a north-east to south-west orientation.	SEP wind farm site

Wessex ID	UKHO ID	Wreck Name	Description	Offshore Site Area
72544 (Appendix 14.1, Wreck Sheet 7)	9513	N/A	Southern section of a broken wreck in two, the wreck is highly dispersed and appears to have significant height. Fishing gear is visible in the vicinity, with a very large magnetic anomaly associated with it.	SEP wind farm site
72541 (Appendix 14.1, Wreck Sheet 7)	9513	N/A	Northern section of the above wreck. Orientated on the sea bed in a North North-East to South South-West position. Hull appears to be intact and upright with a possible bow and stern visible. Two mounds are visible which may be boilers.	SEP wind farm site
72557 (Appendix 14.1, Wreck Sheet 9)	9462	N/A	A large spread of small round objects and linear objects on an area of featureless seafloor. Associated with a large magnetic anomaly.	SEP wind farm site
72565 (Appendix 14.1, Wreck Sheet 11)	9293	Chelsea	A large area of dispersed wreck with some linear objects, curvilinear objects and rounded objects scattered on a featureless area of sea bed. A series of dispersed mounds were also identified. The wreck is associated with the collier *Chelsea* which sank in 1903 after a collision with the steamer *Kirkcaldy*.	SEP wind farm site
72615 (Appendix 14.1, Wreck Sheet 15)	9275	Czestochowa	A large spread of irregularly shaped mounds on a north to south orientation. There is a very large magnetic anomaly associated with it. The position is associated with the wreck the *Czestochowa* which sank in 1941 after being torpedoed by a German E-boat with one casualty.	SEP wind farm site
72561 (Appendix 14.1, Wreck Sheet 10)	9274	Robert W Pomeroy	A very large upright wreck which is partially broken up with a large amount of hull structure intact. The deck is partially, and superstructure is visible, along with multiple rounded and angular objects within the hull. The position is associated with the wreck the *Robert W Pomeroy* a steamship which sank in 1942 after striking a German mine.	SEP wind farm site
72574 (Appendix 14.1, Wreck Sheet 12)	9259	Sitona	A large wreck that appears relatively intact and upright on the sea bed. The wreck is orientated north-east to south-west on a featureless area of sea bed. There are some sub-rounded mounds around the wreck indicating associated debris and fishing gear. The position is associated with the wreck of the steam ship the *Sitona* which sank in 1941 after being torpedoed.	SEP wind farm site
72582 (Appendix 14.1, Wreck Sheet 13)	9255	HMS Kylemore	A broken-up wreck which is poorly preserved and buried in places. The position is associated with the location of the *HMS Kylemore* which sank in 1940 with nine casualties after being bombed by a German Heinkel	SEP wind farm site
72552	9242	HMS Arley	A large collapsed wreck in a featureless area of sea bed with some of the hull still intact with the	SEP wind farm site

Wessex ID	UKHO ID	Wreck Name	Description	Offshore Site Area
(Appendix 14.1, Wreck Sheet 8)			bow and stern discernible but broken in places. The wreck has significant height and a possible boiler is visible. The position is associated with the location of the *HMS Arley* a British minesweeper which sank after being damaged by a German mine in 1945 with one casualty	
72534 (Appendix 14.1, Wreck Sheet 6)	9512	N/A	A wreck located outside of the study area, but the associated AEZ will impact the scheme. The wreck is identified as a large elongated feature with complex linear and angular features. The hull maybe visible but the wreck looks largely broken up.	DEP North array area
7035	9509	Aquarius	This wreck was identified during 2009 assessment as a wreck with a hull and superstructure visible. The wreck corresponds with the position of the *Aquarius* a British steam trawler that was mined by German mine in 1945 when proceeding to Grimsby fishing grounds with the loss of 10 lives.	DEP North array area
72714 (Appendix 14.1, Wreck Sheet 18)	9511	N/A	A compact area of linear and smaller rounded objects. The area is identified as a Debris Field and may represent an area of wreck debris.	DEP South array area
72697 (Appendix 14.1, Wreck Sheet 17)	9267	Pacific SS	A very large wreck that appears to be upright on the sea bed. The wreck is orientated north-west to south-east on a sandy and featureless areas of sea bed. The wreck is visible as a series of irregularly shaped mounds with some possibly representing boilers. The position is associated with the possible location of the *Pacific SS* a steamship which sank in 1943. The wreck maybe in two parts. Possible loss of 38 lives	DEP South array area
7040 (Appendix 14.1, Wreck Sheet 1)	9226	N/A	Wreck with very distinct edges appearing mostly intact, although slightly broken up in places. Some internal structures visible.	Export Cable Corridor
72647 (Appendix 14.1, Wreck Sheet 16)	9276	Ottar Jarl	Wreck appears as a large feature with some smaller associated features. Largely broken up. The wreck is associated with the location of the known wreck *Ottar Jarl*, which sank in 1924 after a collision	Interlink cable Corridor
7041 (Appendix 14.1, Wreck Sheet 2)	9222	N/A	Identified as a distinct group of indistinct features, situated within a linear area of sand ripples so difficult to distinguish the full extent.	Export Cable Corridor

143. Additionally, three of the wrecks listed in **Table 14-19** have also been recorded by the NRHE. These are the *HMS Kylemore* (**NRHE 24638**), the *Sitona* (**NRHE 24642**) and wreck **7043** (**NRHE 108425**).

144. Of the remaining 13 A1 anomalies, one has been interpreted as a Wreck (**72596**) (not previously charted by the UKHO), six as items of Debris (**72612**, **72613**, **72614**, **7044**, **7045** and **7047**), five Debris Fields (**70402**, **72535**, **72542**, **72700** and **7083**) and one as a Rope/Chain (**7046**).

145. Wreck **72596**, located within the SEP wind farm site, was identified within the SSS data as a distinct oval outline measuring 36.4 x 14.6 x 0.5m, which is pointed at one end and slightly flattened at the other, interpreted as being a possible wreck (**Wreck Sheet 14** of **Appendix 14.1**). The feature appears hull-like in shape with a more distinct southern edge, possibly indicating the feature is either more degraded along its northern edge, or possibly that it's listing toward the north and slightly more buried. There is very little internal detail within the interpreted hull.

146. Anomaly **72542** is located within the SEP wind farm site and is thought to be associated with **72541** and **72544**, themselves part of the same wreck. It is located to the west and the north-west of the main sections of wreckage and is identified in the SSS data as a large spread of debris, measuring 121.8 x 59.6 m, containing objects with heights of up to 0.8 m. A large magnetic anomaly is identified close to this location. However, due to the line spacing at its proximity to the sections of wreckage, it is not possible to discern whether the magnetic anomaly is associated with one or all of these features.

147. Similarly, anomaly **72535** has been interpreted as debris associated with wreck **72534** located 7.0m to the south, within the DEP North array area. In the SSS data, the feature is visible as three angular dark reflectors with irregular shadows measuring 11.2 x 3.1 x 0.4 m. The feature is located outside of the Study Area, but its associated AEZ, when combined with the AEZ associated with **72534**, will overlap with the scheme.

148. Anomaly **7083,** located within the DEP South array area, is seen in the SSS data as a spread of small dark reflectors with bright shadows, covering an area measuring 23.0 x 9.4 x 0.5 m (**Wreck Sheet 4**). It was originally identified in the 2009 geophysical assessment as a possible wreck measuring 25.9 x 7.5 x 0.4 m with an associated magnetic anomaly of 28 nT (Wessex Archaeology 2009b). During this phase of assessment, it was been reclassified as a debris field. However, its A1 archaeological discrimination has been retained as a precaution.

149. The areas of Debris **72612-14** are all located within the SEP wind farm site and are all interpreted as items of debris associated with the debris field **72615** (**Wreck Sheet 15**, **Appendix 14.1**) which may itself be the remains of the steamship *Czestochowa*.

150. A single A1 anomaly, located within the SEP wind farm site, **7046** has been classified as Rope/Chain. This was identified as a section of rope or chain and along with **7044**, **7045** and **7047** are all thought to be item of debris associated with wreck **7043.**

151. In addition to the A1 anomalies, 518 sea bed features have been discriminated as A2 anomalies (uncertain origin of possible archaeological interest). These are detailed in **Appendix 1** of **Appendix 14.1** and **Appendix 1** of **Appendix 14.2**.

152. Sea bed features interpreted as A2 have been identified as being of possible anthropogenic origin and have the potential to represent archaeological material on the sea bed of maritime or aviation origin. Magnetic only anomalies (without visible surface expression) have the possibility to be buried objects with ferrous content that are of archaeological potential.

153. A single feature (**72636**) has been discriminated as A3. This consists of a UKHO record (**9292**) of Foul Ground. This record describes the *Herport,* a broken-up wreck built in 1919 and sunk in 1941. A small condenser was found during a dive in 1990, however, nothing was recorded in this area in a 1993 survey. Additionally, nothing was identified in the current geophysical data. The record has been retained due to its association with a historic record.

154. Additional geophysical assessment has not been undertaken within the 750m buffer (either side of the export and interlink cable corridors) and the 200m buffer (around the SEP and DEP wind farm sites) proposed to accommodate possible temporary works. A commitment to acquiring survey data from these areas, should they be required to accommodate activities such as anchoring or the use of jack-up vessels, is included in the **Outline WSI (Offshore)** (document reference: 9.11).

155. For the purposes of the ES, however, a review of existing desk-based data, and previous archaeological assessments undertaken for DOW and shows that there are 21 additional wrecks and obstructions (**Table 14-20**) listed by the UKHO within the Offshore Temporary Works Area (**Figure 14.5**).

Table 14-20: Wrecks and Obstruction Charted by the UKHO within the Offshore Temporary Works Area

UKHO ID	Wreck Name	Description
9190	Pontfield (Forepart)	Forepart of the oil tanker *Pontfield*, mined when on passage from New York for Shell Haven 15/09/1941.The stern section was recovered and towed to Yarmouth (Salt End) and later to the Tyne where a new forepart was fitted. The wreck is described as a poorly defined area of well broken debris with very little height. Wreck dimensions recorded as 65 x 22 x 3m.
9237	Westland	Wreck of a steam ship built in 1906 and torpedoed and sunk 25/05/1917 whilst on passage from Methil for Rouen with a cargo of coal. In 1972 the wreck was described by divers as silted at both ends with the centre section rising to a hump of confused mass of steel. In 2018 it was described as broken and partially buried. Wreck dimensions recorded as 68 x 14.4 x 4.5. The wreck was outside DOW but was recorded in assessments in 2009 by Wessex Archaeology as wreck 7039.
9270	Hull Trader	Wreck of a steam ship, built in 1917 and thought to have been mined 23/06/1941 (but could have been sunk by German aircraft) whilst on passage from London for Hull with a general cargo. In 2018 it was described as broken and partially buried. Wreck dimensions recorded as 61.3 x 16.1 x 1.7m.
9272	Trajan	Wreck of a steam ship built in 1915 and lost whilst on passage from Blyth for London with a cargo of 1744 tons coal after being bombed and sunk by German aircraft on 03/05/1941. In 2018 it was described as broken and partially buried. Wreck dimensions recorded as 79.5 x 23.5 x 2.3m.

UKHO ID	Wreck Name	Description
9273	HMS Solomon	Wreck of a trawler built in 1928, hired as minesweeper in 1939 and sunk by a mine 01/04/1942. Described in 1993 as debris lying in two separate sections and 2018 as broken in two and mainly buried. Wreck dimensions recorded as 42 x 38m in 1993 and 5 x 4.4 x 2.2m in 2018.
9277	Beechwood	A dead wreck, reported 1916 in the 'Grimsby Loss List' as lost 40 miles south east by east of the Spurn Light Vessel following capture by a German submarine and sunk by gunfire. The record is marked "for filing only". A wreck at this location has not been found during subsequent surveys as is considered to present a reported loss only (and not actual wreck remains).
9278	Weelsby	A dead wreck, reported 1916 in the 'Grimsby Loss List' as lost 40 miles south east by east of the Spurn Light Vessel. Whilst on passage from Grimsby for fishing grounds, the vessel was captured by a German submarine and scuttled using explosives. The record is marked "for filing only". A wreck at this location has not been found during subsequent surveys as is considered to present a reported loss only (and not actual wreck remains).
9279	Cockatrice	A dead wreck, reported 1916 in the 'Grimsby Loss List' as lost 40 miles south east by east of the Spurn Light Vessel. Whilst on passage from Grimsby for fishing grounds, the vessel was captured by a German submarine and sunk by gunfire. The record is marked "for filing only". A wreck at this location has not been found during subsequent surveys as is considered to present a reported loss only (and not actual wreck remains).
9280	Restless	A dead wreck, reported 1916 in the 'Grimsby Loss List' as lost 40 miles south east by east of the Spurn Light Vessel. Whilst on passage from Grimsby for fishing grounds, the vessel was captured by a German submarine and sunk by gunfire. The record is marked "for filing only". A wreck at this location has not been found during subsequent surveys as is considered to present a reported loss only (and not actual wreck remains).
9281	Britannia III	A dead wreck, reported 1916 in the 'Grimsby Loss List' as lost 40 miles south east by east of the Spurn Light Vessel following capture by a German submarine and sunk by gunfire. The record is marked "for filing only". A wreck at this location has not been found during subsequent surveys as is considered to present a reported loss only (and not actual wreck remains).
9317	N/A	A dead wreck, recorded 1919 following a reported sighting of three masts of a steam vessel 4 miles north by east of the Cromer Knoll Light Vessel. Recorded as the fishing drifter Blue Haze of Lowestoft). IN 1921 the wreck is recorded as completely broken up and in 1963 a sonar contact was located '3 cables' south south east of the recorded position. In 1992 the record was marked 'delete'.
9504	N/A	Unknown wreck recorded in 1992, well broken with dimensions 80 x 20m. Also recorded in 1994 as a partially broken wreck, and dived in 1996 when a brass plate was recovered with the wording 'Palmers Shipbuilding & Iron Company Ltd, Engineers, Jarrow on Tyne, 1884, no.459'. In 2018 the wreck was recorded with dimensions 72.6 x 16.8 x 5.7.

UKHO ID	Wreck Name	Description
9506	N/A	Unknown wreck recorded in 1992 with dimensions 55 x 10m. In 2018 the wreck was recorded with dimensions 52.6 x 9.5 x 4.2m, intact and upright.
9507	N/A	Unknown wreck recorded in 1992 with a height of 1m and length 10m. In 2018 the wreck was recorded as partially broken and buried with dimensions 18.7 x 4.3 x 1.3m.
9508	N/A	Unknown wreck recorded in 1992 as an area of large broken debris with dimensions 60 x 15 x 3.8m. In 2018 the wreck was recorded as intact and partially buried with dimensions 60.9 x 13.7 x 3.7m.
9512	N/A	Unknown wreck recorded in 1992 with dimensions 65 x 18 x 5m. It was also recorded that the magnetometer reading indicates ferrous content of c. 550 Tons. In 1993 the wreck was recorded as partially broken with dimensions 75 x 25 x 5.5m.
10616	Rosalie (Possibly)	Wreck of a collier built in 1914 and lost 1917 whilst on passage from the Tyne for San Francisco. The steam ship was torpedoed by UB-11, anchored and was later beached at Weybourne. Reported in 1967 as possibly the wreck of the collier sunk off the beach at Weybourne comprising a mass of plate and engine room remains and a battery of 4 boilers. In 1978 bollards and a propeller were found with superstructure and steel plates recorded as spread over large area with 4 boilers in the centre. In 2015 the wreck was recorded with dimensions 85 x 16 x 4.5m and in 2017with a length 112mtrs. The wreck was outside DOW but was recorded in assessments in 2009 by Wessex Archaeology as wreck 7044.
77976	N/A	Reported in 2011 following multibeam and magnetometer survey as a wreck and debris covering an area of c. 17 x 17m and described as ‘apparently’ a four engine aircraft.
93919	N/A	A live wreck recorded in 2020 (no further details)
93922	N/A	A live wreck recorded in 2020 (no further details)
94147	N/A	A new ‘feature’ recorded in 2020 (no further details)

156. There are also 221 A2 anomalies previously recorded by Wessex Archaeology (2009a, 2009b, 2014) where the temporary works areas correspond to the surveyed footprint of DOW (**Figure 14.5**). Fifteen of these A2 anomalies were investigated using a remote operated vehicle (ROV) as part of the unexploded ordnance (UXO) investigation and clearance campaigns undertaken for DOW. These are listed in full in the gazetteer provided in the **Outline WSI (Offshore)** (document reference: 9.11) and summarised by type in **Table 14-21**.

Table 14-21: Types of Anomaly Within the Study Area Identified by Wessex Archaeology.

Anomaly Classification	Definition	Number of Anomalies
Anchor (70693)	Magnetic anomaly (343nT) interpreted as a possible piece of ferrous material and identified as an anchor during ROV investigation (M30101) for DOW and of medium archaeological importance.	1

Anomaly Classification	Definition	Number of Anomalies
Cable/Wire (70680)	Magnetic anomaly (193nT) interpreted as a possible piece of ferrous material. Identified as cable/wire during ROV investigation (M809) for DOW and non-archaeological.	1
Engine (70819)	Magnetic anomaly (1054nT) also seen as a feature on the sea bed and described as partially buried/broken up on a gravelly sea bed. One of two aircraft engines (X40705/X40706) identified during ROV investigation for DOW. A 50m AEZ was established around both engines. Both engines were identified as Rolls Royce Merlin engines, fitted with a Rotol propeller hub, and that, given the short distance between the two engines (which lie 23.6m apart), it is possible that they come from the same aircraft which broke up on impact.	1
Engine and debris (70842)	Magnetic anomaly (459nT) also seen as a feature on the sea bed and described as debris situated on a sandy and even part of the sea bed and in a slight depression. One of two aircraft engines (X40705/X40706) identified during ROV investigation for DOW. A 50m AEZ was established around both engines. Both engines were identified as Rolls Royce Merlin engines, fitted with a Rotol propeller hub, and that, given the short distance between the two engines (which lie 23.6m apart), it is possible that they come from the same aircraft which broke up on impact.	1
Metal Bars (70542 and 70543)	Magnetic anomalies (112 and 104nT) interpreted as a possible pieces of ferrous material and identified as metal bars during ROV investigation (M43600 and M43681) for DOW and of low archaeological importance.	2
Modern Debris (70677, 70679, 70684, 70686 and 70817)	Anomalies interpreted as possible pieces of ferrous debris and identified as non-archaeological or of low archaeological importance during the ROV investigation for DOW.	5
Nothing found (70581)	Nothing was found at the location of a magnetic anomaly (126nT) during the ROV investigation for DOW.	1
Propeller with mount and debris (70832)	Recorded in the geophysical data as a medium sized area of possible seafloor disturbance containing ferrous material, comprising approximately 5 hard edged dark reflectors with shadows and some bright reflectors. Looks anomalous to surrounding sea bed. Largest anomaly 1.8m. Distinct associated magnetic anomaly. Propellers and debris were identified during ROV investigation for DOW. Four of the non-UXO anomalies were found relating to a single target (M41062) described by MMT as debris associated with a plane wreck. Debris A and C were interpreted to be propellers attached to a mounting, debris B and D were interpreted to be metal debris associated with the same plane wreck. A 30m archaeological exclusion zone was placed around the extents of the debris as seen in the ROV footage and geophysical data.	1
UXO Sea Mine (70586)	Magnetic anomaly (183nT) interpreted as a possible piece of ferrous material and identified as a sea mine during the ROV investigation for DOW.	1

Anomaly Classification	Definition	Number of Anomalies
Wire (7156)	Recorded in the geophysical data as a small mound on flat sea bed and a 637nT magnetic anomaly, Identified as wire during ROV investigation (M36549) for DOW and non-archaeological.	1
Bright reflector (A2)	Individual objects or areas of low reflectivity, characteristic of materials that absorb acoustic energy, such as waterlogged wood or synthetic materials. Precise nature is uncertain	3
Dark reflector (A2)	Individual objects or areas of high reflectivity, displaying some anthropogenic characteristics. Precise nature is uncertain	11
Debris (A2)	Distinct objects on the sea bed, generally exhibiting height or with evidence of structure, that are potentially anthropogenic in origin.	48
Debris Field (A2)	A discrete area containing numerous individual debris items that are potentially anthropogenic and can include dispersed wreck sites for which no coherent structure remains.	1
Linear (A2)	no description (2009 only)	1
Magnetic (A2)	No associated sea bed surface expression, and have the potential to represent possible buried ferrous debris or buried wreck sites	132
Mound (A2)	A mounded feature with height not considered to be natural. Mounds may form over wreck sites or other debris.	4
Rope/chain (A2)	Curvilinear dark reflectors, often with a small amount of height, indicating rope or chain (if ferrous)	6
Total		550

157. In addition to the known wrecks and anomalies described above, there is also potential for the presence of further maritime archaeological material to be present, dating from the Mesolithic period up to the present day, which has not previously been identified. There are many factors which affect the visibility and subsequent identification of wreck remains on the seafloor during hydrographic surveys (e.g. wooden-hulled vessels buried within sea bed sediments are less likely to be visible on geophysical survey data). As such, the potential for remains to exist depends on an understanding of the variable survivability and visibility of wrecks on the sea bed, with factors of consideration including the age of the vessel, the construction material, the sea bed sediment type, the prevailing hydrodynamic and sedimentary regimes of the area and the occurrence of any sea bed activities in that location.

158. The NRHE groups recorded losses at arbitrary points on the sea bed called Named Locations, these represent general loss locations and do not (unless by chance) relate to actual sea bed remains. Adjacent to the export cable corridor at the landfall there are five recorded losses of vessels recorded at the Named Location ‘WEYBOURNE NORFOLK’. These are summarised below in **Table 14-22**.

Table 14-22: Summary of Recorded Losses (NRHE).

NRHE ID	Name	Period	Description
1351091	Ann	Post-Medieval	The ANN, from St. Petersburg to London, was totally wrecked at Salthouse in 1823.
1351034	Expedition	Post-Medieval	English cargo vessel, driven onto the shore in a gale and totally wrecked near Weybourne beach in 1823.

NRHE ID	Name	Period	Description
1320832	Unknown	Post-Medieval	1770 wreck of a wooden sailing vessel, thought to have been built in New England, which foundered off Salthouse Beach with oranges and lemons, and passengers thought to have been bound for Scotland.
1339622	James	Post-Medieval	1804 wreck of English sloop which stranded near Holt en route from Newcastle-upon-Tyne to Rochester with coal.
1344109	Neptune	Post-Medieval	English Craft, driven on shore on the coast of Norfolk, during a violent gale in 1814.

159. Five of the UKHO wrecks within the Offshore Temporary Works Area also represent reported losses only (**Table 14-20**). It is possible that any of the unnamed wrecks identified within the cable corridor may be correlated to one of these records of losses. Similarly, A2 anomalies of potential archaeological interest may also represent remains associated with any one of these losses.

160. The potential for previously unidentified wreck remains is further highlighted by the number of wrecks and wrecks related material identified during the various phases of site investigation and analysis for SOW and DOW. For example, the archaeological assessment of marine geophysical data for both Projects similarly revealed the presence of both known and previously charted wrecks, new wrecks which had not previously been identified and a large number of A2 anomalies indicating the further presence of material of potential archaeological interest. Some of these fall within the boundary of the Offshore Temporary Works Area as discussed above (**Table 14-21**). During UXO investigation and clearance undertaken for DOW, some of which are discussed above (**Table 14-21**), several of these sites and anomalies were further investigated and positively identified as maritime related material including:

- Four isolated discoveries of anchors (i.e. not associated with any wider wreck site), once of which was seen with a length of chain attached;
- A further length of chain, which could have previously been attached to an anchor, or other maritime object or wreck site;
- 26 separate finds of metal debris including both unidentified items and objects positively identified as:
    - a bollard or winch with some deck frame attached and additional metal plating;
    - possible ship siding;
    - a winch drum or capstan;
    - a possible latch door; and
    - a possible trawl door.
- Six separate pieces of timber/wooden debris possibly representing ships timbers and a possible wooden windlass;
- 23 historic UXO comprising projectile shells, a range of air dropped bombs from 250lb up to 2000lb and sea mines/sinkers; and

- Six finds specified as wreck material:
  - Five corresponding to a single wreck site (**7034**), described as a large area of metal structure, frames and metal sheeting partially buried and covered in marine growth representing the wreckage of a late 19th or 20th century wreck;
  - Three pieces of wooden debris (MMT ID F14335 (**Figure 3.01** of **Appendix 14.2**)), the longest measuring approximately 80 cm in length, and about 10 cm in width. The smaller two pieces measure roughly 60 cm and 30 cm in length interpreted as possibly being indicative of a lightly built wooden shipwreck of unknown date; and
  - A potential small wreck (**70402**) represented by an area of debris including a possible mast.

161. These discoveries from DOW, adjacent to the DEP offshore area indicate the likely potential for similar discoveries within both SEP and DEP, possibly represented by the position of the geophysical anomalies identified by Wessex Archaeology (**Appendix 14.1** and **Appendix 14.2**). All of the above finds were reported through the Offshore Renewables Protocol for Archaeological Discoveries (ORPAD) (The Crown Estate, 2014) and the information disseminated to stakeholders.

162. In addition to the recorded losses at the Weybourne Named Location there are three records of de Havilland Queen Bee radio-controlled target aircraft, all from a batch of 174 delivered between December 1940 and March 1941 to Contract No. B55389/39:

- QUEEN BEE V4755 (NRHE ID: 1352754), hit by anti-aircraft off Weybourne and control lost, 2.7.1941;
- QUEEN BEE V4797 (NRHE ID: 1352765), shot down by rockets off Weybourne, 18.6.1941; and
- QUEEN BEE V4757 (NRHE ID: 1352748), engine lost power on launching and flew into sea, Weybourne, 5.5.1941.

163. The Queen Bee was used for anti-aircraft gunnery training as a low-cost radio-controlled target aircraft. Based on the design of a Tiger Moth they were made of fabric over a wooden frame, which was both low cost and was buoyant to assist recovery in the event of ditching. The Weybourne Anti-Aircraft Artillery Range was one of several locations around the UK from which the Queen Bees were launched for target practice during World War II (WWII), and the bases for the launch catapults still survive at Weybourne. The potential for the remains of these aircraft to be encountered during construction may, however, be limited by the low potential for survival of the slight wooden fuselage and fabric, although elements such as the engines and radio control system may still survive.

164. There is only one further recorded loss in the vicinity of SEP and DEP comprising a record of a German Heinkel He111 which was shot down and crashed 1.5 miles off Ingoldmells Point in Lincolnshire. The recorded grid reference for this loss within the interlink cable corridor between the DEP South array area and SEP wind farm site, however, is c. 67km from Ingoldmells (c. 42 miles) suggesting that the location may be reported inaccurately in the NRHE record.

165. Nonetheless, these records, alongside the known presence of aircraft remains recorded during assessment undertaken for DOW, indicate the high potential for aircraft remains to be present within the SEP and DEP offshore sites. A large number of aircraft are known two have been lost in the east coast region, particularly during WWII, and the identification of such remains during the creation of DOW, highlights the potential for the presence of similar remains within the wind farm sites and cable corridors. For example, 19 aircraft finds were reported to ORPAD following UXO investigation and clearance for DOW including 13 finds relating to a single aircraft crash site (**7309**), identified from the presence of an aircraft engine and numerous other pieces of debris that appeared to represent a lightly built aluminium structure. Two further aircraft engines were identified in proximity to one another adjacent to the export cable route, and 500m away from two propellers and two further items of associated debris also seen in the ROV footage (**Table 14-21**).

166. It should be noted that military aircraft crash sites are of particular importance as all aircraft lost in military service are automatically protected under the Protection of Military Remains Act 1986.

14.5.2.2 Cultural Significance of Identified Assets

167. The cultural significance of unidentified wrecks and debris, A1 and A2 anomalies and potential wrecks, aircraft and isolated finds (which are yet to be discovered) is currently unknown. The archaeological interest (or otherwise) of these features will be further examined post-consent (e.g. investigation of individual anomalies (ground truthing) through ROV and/or diver survey). Once the character, nature and extent of selected features are more fully understood, their cultural significance can be described to inform any requirements for further work on a case by case basis.

168. The cultural significance of shipwrecks lies largely in their historic and archaeological interest, in terms of their historical associations with people or events and with their research value.

169. The nine named wrecks with the SEP and DEP surveyed areas all represent vessels built in the late 19th / early 20th century, seven of which have historical value in terms of their loss during WWII. These are, the *Aquarius* (**7035**), the *Pacific SS* (**72697**), the *Czestochowa* (**72615**), the *HMS Arley* (**72552**), the *HMS Kylemore* (**72582**), the *Robert W Pomeroy* (**72561**), the *Sitona* (**72579**). Of these wrecks, the *HMS Arley* and the *Aquarius* appear largely intact, while the *Robert W Pomeroy* and the *Sitona* are partially broken up, but with a large amount of hull structure, with the *Pacific SS, Czestochowa* and *HMS Kylemore* largely broken up, with the latter recorded as poorly preserved.

170. The forepart of the *Pontfield* (UKHO 9190) within the Offshore Temporary Works Area was similarly lost during WWII and, although the wreck is poorly defined and well broken up, its relationship to the stern part of the vessel which was towed to the Tyne to have a new fore part fitted is of interest as part of historical narratives surrounding salvage and repair. The *Hull Trader* (UKHO 9270) and HMS Solomon (UKHO 9273) were also lost during WWII, whilst the *Westland* (UKHO 9237), *Trajan* (UKHO 9272) and *Rosalie* (10616) were all lost during World War I (WWI). The *Rosalie* is also a popular dive site, located close to shore with some metalwork visible at low tide. As such it is well photographed, filmed and researched wreck site with a high level of cultural significance to Weybourne.

171. The two other named wrecks the *Chelsea* (**72565**) and the *Ottar Jarl* (**72647**) represent the remains of vessels which were wrecked either side of WWI, 1909 and 1924 respectively, after collisions with other vessels. Both vessels are recorded as largely broken up.

172. These wrecks are each considered to represent average examples of wrecks from this period, exhibiting characteristics which are relatively well represented in the known wreck resource around the UK. Furthermore, the research value of the vessels described as broken up or poorly preserved may be limited. The archaeological interest of the wrecks will be defined further post-consent following the acquisition of additional data, including ground truthing through ROV and/or diver survey where appropriate.

173. With regard to setting, as for sea bed prehistory above, for the most part, submerged archaeological sites are not 'readily appreciated by a casual observer'. Although some wreck sites have a setting which can be experienced and appreciated within their seascape (by divers or visitors on boats trips for example) none of the wrecks identified within SEP and DEP fall into this category, due to distance from shore, for example. Setting (in terms of the surroundings in which they are experienced), does not, therefore, form a key part of their significance.

174. These wrecks are, however, located physically within a 'setting' of relevance to their historical and archaeological interest. The study East Coast War Channels in WWI and WWII (Firth 2014) examines the spatial extent of navigation channels and minefields between the Thames and the Scottish border during both wars and the heritage assets that are associated with these channels. Together with the presence of military instillations within the intertidal zone discussed in **Section 14.5.3** the context of the East Coast war channels represents the wider setting of 20th century military activity within which the study area is located. The remains of vessels which operated within the East Coast war channels may thus have a setting that contributes towards their significance when considered against the wider backdrop of hostile military action.

175. Similarly, the physical 'setting' of *Ottar Jarl* may be considered to contribute to its significance in terms of its loss and subsequent survival within an area in which it operated as a Norwegian Cargo steamer. The setting of the *Chelsea* may be considered to contribute to its significance in terms of its loss and subsequent survival within an area in which it operated as a British steam cargo ship.

14.5.2.3 Importance of Identified Assets

176. The importance of unidentified wrecks and debris, A1 and A2 anomalies and potential wrecks, aircraft and isolated finds (which are yet to be discovered) is currently unknown and these are, therefore, assessed as being of high importance as a precautionary measure. However, for 'potential' sites each individual discovery will be considered independently and any requirements for further data gathering or analysis will be considered on a case-by-case basis proportionate to the importance of the discovery.

177. The named wrecks are not considered to represent examples which could be considered of national importance warranting protection at a national level. On the basis that they may be considered as assets of regional interest, due to their association with 20th century military and mercantile activities within the East Coast region, they are assessed as heritage assets of medium importance.

178. Isolated finds of maritime or aviation origin within secondary contexts will have evidential value for patterns of activities offshore, and are assessed as being of medium importance.

Table 14-23: Heritage Importance (Maritime and Aviation Archaeology)

Asset Type	Definition	Importance
Known maritime heritage assets	Named wrecks and associated debris (A1)	Medium
	Debris identified as possible wreck sites or associated debris (A1)	High
	Un-named wrecks and associated debris fields / debris (A1)	
	Sea bed disturbance associated with large magnetic anomaly (A1)	
	Previously recorded wrecks not seen in geophysical data (A3)	
Additional anomalies	Anomalies identified by geophysical assessment that could be of anthropogenic origin (A2)	High
Potential wrecks	Wrecks within the study area that are yet to be discovered	High
Potential derived maritime finds	Isolated artefacts lost from a boat or ship or moved from a wreck site	Medium
Potential aircraft	Aircraft within the study area that are yet to be discovered	High
Potential derived aviation finds	Isolated artefacts lost from an aircraft or moved from a crash site	Medium

14.5.3 Intertidal Archaeology

14.5.3.1 Description of Identified Assets

179. The landfall at Weybourne is characterised by a shelving pebble beach. There are no existing coastal defences at the landfall.

180. A total of 45 HER (Norfolk) records have been identified within the intertidal zone which related to known heritage assets (**Figure 14.1**).

181. Four of these records relate to findspots which date between the Lower Palaeolithic and Late Neolithic periods and comprises of a two Prehistoric flint flakes (**MNF46139** and **MNF46138**), a Palaeolithic flint handaxe (**MNF12755**) and Holocene organic deposits, faunal remains and Mesolithic/Neolithic worked and burnt flint (**MNF6256**). While the former of these records relate to stray findspots, the later of these actually refers to an assemblage of finds which may itself could be evidence of a multiphase Prehistoric settlement. The site consists of a sequence of organic sands, peats and muds that outcrop on the Weybourne foreshore and are periodically exposed. The deposits are thought to have formed within a valley by a freshwater stream. Human bones, Mesolithic flint flakes, Neolithic flints, cut wooded stakes and animal remains have all been recovered from these organic deposits, perhaps suggesting a multiphase Prehistoric settlement.

182. The potential for similar remains within the intertidal zone should be considered high, as the evidence above suggests a Prehistoric settlement could be present. However, with the use of Horizontal Directional Drilling (HDD) for the cable instillation beneath the intertidal zone, the potential for encountering such remains is limited as any surviving deposits associated with prehistoric activity will likely be avoided, with entry on the landward side of the cliffs and exit below Mean Low Water Springs (MLWS) in the marine zone.

183. Similarly, a large number of Iron Age findspots have been identified within the intertidal zone, largely comprising of coins hoards. The Iron Age find spots can be summarised as follows:

- **MNF6269** – Two gold Iron Age coins found on the beach between Sheringham and Weybourne in about 1940;
- **MNF6268** – An uninscribed gold Iron Age coin found on the beach in about 1966;
- **MNF41330** – A hoard of 206 Iron Age coins found in two soil-filled features exposed by a storm in 1954;
- **MNF6272** – Two fragments of Iron Age copper alloy sheet metal found on the beach in 1960;
- **MNF6270** – an unknown number of gold Iron Age coins;
- **MNF6264** – A hoard of at least twelve Iron Age gold coins found on the beach near the coastguard station in 1940; and
- **MNF6271** – Iron Age or Roman sheet metal fragments.

184. Four of the records that have been identified within the intertidal zone relate to Roman findspots. The largest of these (**MNF6274**) consisted of the base of a Roman pottery and coins found along the beach in 1885. The base of a Roman jar/bowl was found in a similar area in 1980. The remaining Roman findspots comprise: A Roman coin of Nero (**MNF6276**) found on the beach in 1968; an enamelled copper alloy brooch (**MNF29806**) found via metal detecting in 1993; and five Roman coins (**MNF42532**).

185. A single Medieval findspot was identified on Weybourne Beach in 1990 and consisted of the rim of a Medieval bowl (**MNF25908**).

186. The presence of Iron Age, Roman and Medieval archaeological material previously reported from the intertidal area indicates that similar remains could still survive within beach deposits. Several undated features have also been identified along the cliffs of Weybourne and comprises several possible v-shaped ditches (**MNF46580, MNF46579** and **MNF46581**).and a pit (**MNF6301**). However, as for prehistoric material described above, such remains are unlikely to be encountered during construction with the use of HDD with entry on the landward side of the cliffs and exit below MLWS in the marine zone.

187. The majority of the HER records relate to former Post-Medieval, World War I (WWI) and WWII defences and military infrastructure, summarised as follows:

- **MNF11335** – A line of three possible WWI slit trenches along the coast at Weybourne, which are visible on aerial photographs;
- **MNF43687** – An area of WWII coastal defences at Weybourne to the immediate east of Weybourne Camp (**NRHE 11335**). visible on 1940 and 1941 aerial photographs. The site consists of a barbed wire enclosure, a possible pillbox and gun emplacement, plus several sections of slit trench;
- **MNF43689** – A line of three possible WWI slit trenches along the coast at Weybourne, which are visible on aerial photographs. Possibly associated with Weybourne Camp training activities (**NRHE 11335**);
- **MNF46186** – A scaffolding clamp from WWII beach defence found on the beach in 2004;
- **MNF19438** – The remains of a quite rare type 20 pillbox, constructed between 1940 and 1941 and Post Medieval: underground bunker. Rectangular brick with entrance sunken at southeast. Concrete slit in cliff face over valley to west. Designed to control land attacks on Weybourne Hope;
- **MNF19439** – The remains of a WWII pillbox recorded on cliff edge and eroded onto the beach. Much carried away by sea;
- **MNF19437** – The remains of a 1940/41 type 20V pillbox, now completely ruined in the sea off Weybourne Hope;
- **MNF19441** – The remains of a concrete and brick type 22 pillbox on the beach, occasionally exposed by the tide;
- **MNF32503** – A pillbox on aerial photographs from 1969, located on the beach at Weybourne;
- **MNF32506** – A WWII type 22 pillbox built in 1940. Only the roof is now showing above the shingle;
- **MNF32504** – The ruins of very rare CDL searchlight emplacement, now destroyed by cliff falls, used to defend the beach at Weybourne;
- **MNF32515** – A small rough concrete anti-tank mortar base, lying on its side on the beach;
- **MNF32507** – Remains of spigot mortar gun emplacement built in 1940;

- **MNF32519** – A concrete anti-tank mortar base, lying on its side on the beach;
- **MNF32516** – The remains of a rare WWII type 28 pillbox;
- **MNF46185** – Fragments of concrete and small sections of brick wall noted on the beach in 2004 are probably the remains of a WWII pillbox. Further pieces of concrete observed in the same area are likely to be from some other kind of WWII structure;
- **MNF43697** – A group of WWII defensive structures set into the cliff at Weybourne, near to the Anti-Aircraft Training Camp (**NRHE 11335**), is visible on aerial photographs. The exact function of these structures is not known although it seems likely that they are gun emplacements or a similar coastal defence site;
- **MNF43690** – A barbed wire obstruction constructed along the coast at Weybourne, visible on aerial photographs;
- **MNF43704** – A large WWII complex of defensive structures, including pillboxes, barbed wire obstructions, scaffolding and slit trenches, is visible along the coast at Weybourne on aerial photographs;
- **MNF43974** – An area of WWII coastal defences protecting a gap in the cliffs at Weybourne, is visible on aerial photographs. The site consisted of beach scaffolding, a pillbox, slit trenches and barbed wire and a minefield. None of these defences remain;
- **MNF43978** – The earthworks of a WWII rifle range and associated structures and trenches are visible on aerial photographs;
- **MNF46184** – A fragment of reinforced concrete observed on the beach in 2004 is probably part of a WWII building; and
- **MNF46137** – A reinforced concrete wall about 6m long and possibly WWII in date was recorded in 2004.

188. Based on the amount of WWI and WWII archaeological remains that have been identified within, the potential for related archaeological remains to be present should be considered high. However, based upon the HER descriptions this will likely consist of eroded fragmentary remains of WWI and WWII defensive structures.

189. A site walkover survey was undertaken the week commencing 5/10/2020, to determine whether any of the assets discussed above or any remnants of them still survive within the intertidal zone. This concluded, however, that none of the assets survive as extant structures and no archaeological material was identified. Remains related to these may survive beneath the surface, however, with the use of HDD for the cable instillation beneath the intertidal zone, such remains are unlikely to be encountered during construction.

14.5.3.2 Cultural Significance of Identified Assets

190. The majority of the NHER records relate to previously recorded assets and findspots which are no longer present, although there is potential for the presence of an *in situ* prehistoric site associated with **MNF6256** and for the fragmentary remains of WWI and WWII defensive structures. Their cultural significance, therefore, is currently unknown although the archaeological interest (or otherwise) of any remains which come to light during the course of the Projects will be described to inform any requirements for further work on a case by case basis.

191. Previously recorded assets and findspots are no longer present within their 'setting' and setting does not, therefore, contribute to their significance. It is also not possible to articulate the contribution that setting would make to the significance of a potential *in situ* prehistoric site associated with **MNF6256**. However, whilst buried archaeological sites may not be 'readily appreciated by a casual observer' the presence of any WWI and WWII defensive structures which may be present will be encountered within their original, intended coastal setting, a contextual setting which was fundamental to their use in the defence of Britain during the two world wars. In this respect, should such remains be present, their setting would contribute to their significance. However, this contribution is limited through their survival as fragmentary, buried remains as opposed to *in situ* extant structures.

14.5.3.3 Importance of Identified Assets

192. Should *in situ* prehistoric sites be encountered within the intertidal zone, particularly in context with nearshore evidence of prehistoric occupation, these will be of national, or possibly international interest, with significant potential to contribute to acknowledged international and national research objectives. Given the particularly high importance of these *in situ* sites, any palaeoenvironmental evidence discovered in the context of an *in situ* prehistoric site would also be of high importance.

193. Although palaeoenvironmental material encountered beyond the context of an *in situ* prehistoric site still has evidential value for understanding changes in the climate and environment within offshore contexts, isolated discoveries should be considered of low importance for the purposes of assessment.

194. Isolated finds of prehistoric archaeological material within secondary contexts, also have evidential value for understanding patterns of population and exploitation of former landscapes, for example. However, as these finds are derived, and out of context, they are regarded as being of medium rather than high importance.

195. The fragmentary and buried remains of WW2 coastal defences and isolated finds relating to WW2 activities are also assessed as being of medium importance.

196. The heritage importance of the potential heritage assets outlined above are presented in **Table 14-24**.

Table 14-24: Heritage Importance (Intertidal Archaeology)

Asset Type	Definition	Importance
Potential *in situ* prehistoric sites	Primary context features and associated artefacts and their physical setting (if/where present)	High
Potential	Isolated examples of palaeoenvironmental material	Low

Asset Type	Definition	Importance
palaeoenvironmental evidence	Palaeoenvironmental material associated with prehistoric settlements or archaeological evidence for prehistoric activities	High
Intertidal heritage assets	WW2 coastal defences (fragmentary and buried remains on beach)	Medium
Potential derived intertidal finds	Isolated artefacts and findspots dating to all periods which are located within the intertidal zone	Medium

14.5.4 Historic Seascape Character

197. The HSC of coastal and marine areas around England has been mapped through a series of eight separate projects funded by Historic England and undertaken between 2008 to 2014. This has since been followed by an initiative to consolidate the existing projects into a single national database (LUC, 2017a, 2017b, 2017c). The programme uses Geographical Information System (GIS) to map data that can be queried to identify the key cultural processes that have shaped the historic seascape within a given area.

198. The consolidated national GIS dataset was mapped against the study area to identify the primary cultural processes which have shaped the historic seascape of the study area. This includes both the current character types (**Figure 14.2**) and the previous (prehistoric and historic) (**Figure 14.3**) character types for which information is available. The accompanying character texts were used to identify the primary values and perceptions for each character type summarised in **Table 14-25**.

Table 14-25: Summary of Historic Seascape Character Types.

Broad Character Types	Character Sub-Types	Perceptions
Communications	Submarine Telecommunication cable	Submarine telecommunications cables are mostly undetected in the marine environment. However, they are a highly reliable form of transferring information and are critical to our present-day life. They can be perceived as obstacles to certain sea users such as fishermen and dredgers.
Cultural Topography	Coarse sediment plains Fine sediment	These marine cultural topographies overall are highly valued due to their biodiversity and habitat range and have high archaeological potential and can contribute to our understanding of past landscape use. These two types of sea bed sediments each provide distinct preservation conditions for wrecks and implications for the potential form and survival of underlying palaeolandscapes.
	Exposed bedrock Rocky foreshore (North Norfolk Coast)	This character of subtype is dominated by areas of the seafloor whose surface predominantly comprises bedrock exposures along with associated rocks and boulders but little finer sediment deposition. Where bedrock extends onto the foreshore it may become part of a ‘Rocky foreshore’. Bedrock exposures are

Broad Character Types	Character Sub-Types	Perceptions
		liable to snag fishing gear and may figure as 'rough' or 'catchy' areas in fishing ground perceptions. Their potential hazard to shipping may increase the shipwreck debris to be found in this Sub-character Type.
Fishing	Bottom trawling Drift netting Fishing ground Potting	Commercial fishing has long been important to this region and the industry remains a distinctive element of the East Anglian coastal character. Generally fishing fleets today have distinct fishing grounds, predominantly within 10 km of their home port. As such the local fishermen from each area know their particular area intimately. From a recreational point of view the traditional fishing industry has now taken on an almost 'quaint' character, a memory of better days. To the east of landfall, Sheringham and Cromer have a long history of crab fishing.
Industry	Energy industry: Hydrocarbon installation Hydrocarbon pipeline Hydrocarbon field (gas) Renewable energy installation (wind)	The North Sea as a whole has always been important to the energy industry, most notably for its natural oil and gas resources which have been heavily exploited since the 1960s. More recently nuclear power and renewable energy sources have become viewed as more important as a result of increasing concerns about CO_2 emissions from energy generation using fossil fuels. The North Sea and in particular the East Anglian coast has remained crucial to these newer energy industries. With the presence of the operations at SOW and DOW, the study area is adjacent to an area which has strong associations with offshore renewables, and this is anticipated to develop further with The Crown Estate Round 4 bidding areas expanding the potential for further offshore wind development to the north and east of DOW and SEP and DEP. However, hydrocarbon remains a strong character type in the study area with, for example, the development of the Blythe Hub and the installation of the Blythe Hub pipeline directly adjacent to the boundaries of DEP.
Navigation	Maritime Safety: Buoyage	Overall maritime safety features are considered both invaluable and locally characteristic of this area, although those located wholly offshore will only be known to small sectors of the community. The coastal landscape is dotted with daymarks and lighthouses which are now seen as particularly iconic. The HSC within the study area describes a combination of Buoys, Beacons, and Lights (Buoyage)

Broad Character Types	Character Sub-Types	Perceptions
	Navigation activity: Navigation route	Navigation activity has always been important to the East Anglian region economy and coastal character. For centuries communities have made their living from their proximity to the North Sea and its connecting routes, linking East Anglia to other parts of Britain and to the continent. Navigation activities are deeply ingrained in the psyche of the local communities.
	Navigation hazard: Wreck hazard Shoals and flats	Historically, the sea has been perceived as a dangerous place which often behaves in unexpected and unpredictable ways. Based on the UKHO definition, wrecks become dangerous in shallow water when they are either exposed and/or found less than 10m below the sea-level. Wrecks have most relevance from their roles as hazards to navigational activity or as indicators of areas and routes of past navigational, naval or trading activity. For example, the study *East Coast War Channels in the First and Second World War* (Firth 2014), examines the spatial extent of navigation channels and minefields between the Thames and the Scottish border during both wars and the heritage assets that are associated with these channels. Hazardous water includes wrecks and other hazards such as submerged rocks, shoal or flats. Navigational hazards have always been a preoccupation for sailors, but they became prominent in people's consciousness, including in tales and myths, evoking rhymes and songs, due to the danger associated within them. Wrecks, although fatal for many, added to the local heritage of stories about dangers on the high seas. There are also now perceived as recreational opportunities, with many wrecks dived by both amateur dive groups and professional organisations. Many wrecks are also valued for their strong contribution to habitat diversity and by the fishing community as they attract certain prey specifies. See **Section 14.5.2** for detail on wrecks within the study area.
Previous character types	Palaeolandscape component	Within the study area, the HSC describes the known existence of a general palaeolandscape, 'A part of the 10,000-year-old land mass that bridged England with what is now mainland Europe'. In England, value is becoming more positive on these remains and resource due to growing interest in submerged landscapes fueled by the media and popular culture. In particular there is a developing interest within certain sectors of society who come into contact with the resource (e.g. fishermen and aggregate dredgers). Submerged landscapes are becoming ever more recognised and valued within the

Broad Character Types	Character Sub-Types	Perceptions
		archaeological community. See **Section 14.5.1** for detail on submerged prehistoric landscapes within the study area. The palaeolandscape component sub-type mapped for the HSC is illustrated on **Figure 14.3** (Sub Type 1) and alongside further features interpreted from data acquired for SEP, DEP, SOW and DOW in **Figure 14.4**.
	Fishing Ground (Modern (AD1900 – Present)) Drift Netting (Early Modern (AD1750 – 1900) Bottom Trawling Modern (AD1900 – Present)	Fishing has been an integral part of human activity since at least the Upper Palaeolithic and became a major industry in the medieval period in East Anglia where the herring fishery was key and already established by the 11th century. The widespread introduction of bottom trawling in the Early Modern period had a revolutionary impact on the fishing industry as a whole, with trawling in the North Sea proving the most dynamic section of English fisheries by the end of the 19th century. By the 1930s, rowed and sailed boats had virtually disappeared following the appearance of steam powered boats at the start of the 1900s and along with the development of diesel-powered boats fishing grounds were expanded into areas which had previously not been accessible. The previous character types for fishing, as mapped for the HSC, are illustrated on **Figure 14.3** (Sub Types 2 and 3).
	Navigation Route (Medieval (AD1066 – 1540)	Coastal navigation routes are known to have existed through the study area from at least the medieval period, mapped as part of the ALSF funded England's Shipping project in 2007 which used GIS to map historic shipping movements recorded in historical archives. During the medieval period trading networks expanded across Europe and these coastal trade routes were fundamental to the connection of north east England with this European trade. Although the routes themselves are not necessarily represented by tangible remains, and are not easily appreciated by people observing the sea from land, these historic routes are often associated with increased potential for wrecks and local accounts of historic wrecking events, with coastal vessels driven on to shore and lost in storms, for example. The previous character types for navigation, as mapped for the HSC, are illustrated on **Figure 14.3** (Sub Types 2 and 3).

199. In order to examine further how this HSC baseline has changed since its compilation, the mapped HSC was compared against publicly available GIS data for offshore development including open data from the Crown Estate portal and ArcGIS online. The previous character types were also mapped against GIS data produced from SOW and DOW together with those for SEP and DEP.

200. The primary change to the HSC has been the construction SOW and DOW and the Elgood Wellhead and Blythe Platform, introducing additional elements associated with the energy industry character sub-type. These are shown on **Figure 14.2**. The planned export cable for Hornsea THREE is also mapped on **Figure 14.2**, introducing a further element associated with renewable energy. This demonstrates continuity with the HSC character sub-types, but has also introduced new marine development structures into the historic seascape character with subsequent implications for the capacity of that character to accommodate change, as summarised in **Table 14-26**.

201. The worst-case scenario for historic seascape character is referred to in (**Table 14-2**) as the maximum intrusive effect (e.g. number and type of new infrastructure elements, height of infrastructure etc.) for the longest duration (i.e. the maximum potential change). However, this must be further qualified in reference to the capacity to accommodate change which would also include consideration of layouts, which are not yet defined. For example, as noted by Historic England during consultation (**Table 14-1**), fewer, but larger wind turbines may have more optimal location restrictions which could jeopardise more known or presently unknown heritage assets and places. In this respect, the worst-case scenario would equate to the maximum potential change to currently unknown heritage assets (sea bed prehistory, maritime or aviation) which form part of the historic seascape character. Conversely, in terms of numbers, the use of larger wind turbines and fewer foundations could present fewer discrete locations with the potential to be co-located with heritage assets and prehistoric landscape features.

202. However, detail regarding layouts and the placement of turbines is currently unknown and will be developed further through detailed design post-consent. This will include detailed consideration of layouts, in consultation with Historic England, to avoid heritage assets wherever possible and will be based upon the results of further investigation (post-application/post-consent), including geoarchaeological assessment, the archaeological assessment of high resolution geophysical data post-consent, and ground-truthing where necessary to determine the nature and extent of remains on the sea bed. It is, therefore, not possible, currently, to understand if there are any locational restrictions for the installation of larger wind turbines which could be co-located with heritage assets and elements of the prehistoric landscape. This would require further consideration in accordance with the approach set out in the **Outline WSI (Offshore)** (document reference 9.11).

203. A further consideration raised in the consultation response was the potential for fewer, although physically larger, and more dispersed wind turbines to represent characteristics which correspond with the legacy of other energy-related industrial infrastructure located in the southern North Sea. DOW comprises 67 Siemens 6MW wind turbines installed on monopile foundations, each turbine with a rotor diameter of 154m and 75m long rotor blades. SOW comprises 88 Siemens 3.6MW wind turbines, also installed on monopile foundations, each turbine with a rotor diameter of 107m and 52m long rotor blades. The turbine layouts within SOW and DOW are shown on **Figure 14.2**. The oil and gas platforms within the study area have a larger footprint than individual wind turbines but are of comparably reduced height.

204. For SEP and DEP the minimum rotor diameter is 235m whilst the maximum is 300m which would correspond to 53 wind turbines and 30 wind turbines respectively. Although the layouts are not yet known, the turbines will be regularly spaced to allow for safe navigation. In terms of cumulative change to historic seascape character, in conjunction with SOW and DOW, and the existing platforms, therefore, the installed wind turbines will be different in character to the existing installed elements of the 'energy industry' component of seascape. The wind turbines for SEP and DEP will be significantly larger than those for SOW and DOW, although wider spaced turbines also has potentially beneficial implications.

205. For example, in reference to the character sub-type "Palaeolandscape component" Historic England also requested consideration of the implications of loss of access which could be permanent (**Table 14-1**). As shown on **Figure 14.4**, the HSC maps the palaeolandscape component across a wide area, incorporating the existing footprint of SOW and DOW as well as SEP and DEP. In order to provide additional context, the extent of interpreted palaeolandscape features for SEP, DEP, SOW and DOW are also shown on **Figure 14.4**. This illustrates how the provision of additional data acquired for offshore wind developments is expanding current understanding of these former landscapes, considered to be a potential beneficial change to this character sub-type.

206. As stated above, while the locations of the foundations have not yet been determined, during the operational phase, there will be restrictions on entry into the wind farm sites via safety zones around major maintenance work although, given the separation distance of turbines (1.04km), access to the operational area outside of safety zones can accommodated. Therefore, access would only be restricted by the foundations and the safety zones, providing access to palaeolandscape components of the historic seascape character beyond these limits and not representing a permanent limitation to access for further research. This will also be provided during further consideration of the final design and layouts (in terms of potential co-location of installed infrastructure with features of interest) in consultation with Historic England post consent.

207. Cumulative direct (physical) impact to palaeolandscapes are discussed in **Section 14.7** below.

208. With consideration of the above, the capacity of perceptions of character types to accommodate change are summarised in **Table 1524**.

Table 14-26: Capacity of Perceptions of Character to Accommodate Change During Construction

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
Submarine telecommunication cable	As submarine telecommunications cables are mostly undetected in the marine environment it is unlikely that perceptions of this character type will be altered by construction activities or by the presence of installed infrastructure.	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
Cultural Topography: Rocky foreshore (North Norfolk Coast)	The presence of landfall infrastructure will remain largely undetectable and therefore not perceived by the public. No change to perceptions of the foreshore are anticipated.	No change
Cultural Topography: Coarse sediment plains Fine sediment Exposed bedrock Rocky foreshore	The primary perceptions which associate marine cultural topography with high archaeological potential could be enhanced through the accumulation of publicly available data in the event of unexpected discoveries reported through the protocol for archaeological discoveries during construction activities. Conversely, the physical presence of cables and foundations, for example, will restrict access for future research within their footprints and within operational safety zones, thereby reducing the perceived archaeological potential. However, access to operational areas beyond these safety zones will be maintained and, as the final design of layouts will take the locations of heritage assets and palaeolandscape features into account, this change can be offset by the accumulation of publicly available data acquired by the project prior to construction which is considered to be of public value.	Character has capacity to accommodate change. Publication of data and completion of archaeological works to acceptable professional standards will help offset potential adverse effects. Potential beneficial change
Fishing: Bottom trawling Drift netting Fishing ground Potting	Although there will be areas where fishing activities are temporarily displaced as a result of construction works, fishing activities will still be permitted in areas of the offshore development not undergoing construction activities. Similarly, fishing activities will not be prohibited during the operation phase of SEP and DEP, although temporary restrictions may apply during construction and around major maintenance activities. Furthermore, the distance of the SEP and DEP wind farm sites from the coast, and the minimal above ground infrastructure at the coast, means that the project will be largely undetectable by the public and historic perceptions of the traditional fishing industry, which the HSC described as having taken on a ‘quaint’ character, a memory of better days, will remain largely unchanged.	No change
Energy industry: Hydrocarbon installation Hydrocarbon pipeline Hydrocarbon field (gas) Renewable energy installation (wind)	Overall, perceptions of the North Sea energy industry place greater emphasis upon nuclear power and renewable energy. The HSC states that Britain has the best offshore wind resource in Europe and the marine zone of East Anglia is well placed to take advantage of this. Changing perceptions associated with the construction of SEP and DEP are therefore likely to be seen as part of this natural progression for energy generation and as a positive change from fossil	Potential beneficial change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
	fuels to renewable energy. This is further qualified by UK climate change policies as set out in the **Planning Statement** (document reference 9.1). The larger and more dispersed wind turbines planned for SEP and DEP will be different in character to the existing SOW and DOW wind turbine sizes and layouts but represent fewer discrete locations for avoidance in determining the final layouts. This change will be further understood following the acquisition of additional information to inform detailed design post-consent.	
Maritime Safety: Buoyage	As stated by the HSC, overall the area has a long history of maritime safety features which is at risk of being forgotten if not fully recorded. Short term construction activities at the landfall, and the presence of landfall infrastructure and offshore export cables, which will remain largely undetectable and therefore not perceived by the public, are considered unlikely to result in a meaningful change to the perceived character of maritime safety.	No change
Navigation hazard: Wreck hazard Shoals and flats	The primary perceptions which associate hazardous water and wrecks with local heritage and stores relating to dangers of the high seas, to recreational diving and to wrecks as habitats could be enhanced through the provision of publicly available data on sea bed features identified during geophysical survey, and in the event of unexpected discoveries reported through the protocol for archaeological discoveries during construction activities. During operation, the project may result in a change to the perception of navigational hazards on the basis that the introduction of wind turbines represents additional navigation hazards. They are, however, equipped with navigational features such as warning lights. In addition, information on the location of the various types of offshore renewable energy installations can be found on navigational charts and updated as necessary by Admiralty Notices to Mariners. Any urgent information regarding offshore renewable energy installations will be promulgated by navigational warnings. On this basis, this character sub-types are considered to have the capacity to accommodate this level of change.	Potential beneficial change
Navigation activity: Navigation route	Construction and maintenance activities and additional vessel traffic would occur in the context of one of the busiest shipping channels between south east England and mainland Europe and it	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
	is anticipated that no change to the perception of this character type would occur as a result of construction activities.	
Palaeolandscape component	There is the potential for positive enhancement of primary perceptions associated with a growing interest in submerged landscapes through the provision of publicly available data on palaeolandscapes following the further archaeological and geoarchaeological assessment of survey data. As for the 'cultural; topography' sub-type described above, although the physical presence of cables and foundations, for example, will restrict access for future research within their footprints and within operational safety zones, access to operational areas beyond these safety zones will be maintained. Furthermore, as the final design of layouts will take palaeolandscapes into account, this change can be offset by the accumulation of publicly available data acquired by the project prior to construction which is considered to be of public value.	Potential beneficial change

14.5.5 Climate Change and Natural Trends

209. The existing environment for offshore archaeology and cultural heritage as set out above has been shaped by a combination of factors, with the most prevalent being changes in global sea levels and associated climatic and environmental conditions which have affected the burial and preservation of prehistoric archaeology, and latterly that of maritime and aviation archaeology.

210. Historic England (2018) recognise, 'that the marine and inter-tidal zones are dynamic and have always undergone natural environmental change and changing patterns of use and exploitation which are nothing new'.

211. The Norfolk Coast Area of Outstanding Natural Beauty (AONB) Climate Change Adaptation Strategy (Norfolk Coast Partnership, 2017) recognises that climate change is not a new driver for change for the Norfolk Coast, with profound climate changes, culminating in the end of the last Ice Age and the subsequent climatic warming, combined with the actions of humans having shaped the area as it is known today. The strategy also recognises that the global climate is changing more rapidly now that at any time since the Ice Age and that this is expected to have significant impacts on the Norfolk Coast.

212. To the west of the landfall, the North Norfolk Heritage Coast (from Old Hunstanton to Weybourne) is described as a very dynamic coastline subject to continuous change, both erosion and accretion varying over time and in rate along the coast. However, the soft cliffs which characterise the landfall study area, are being affected by sea level rise causing increased erosion and increasing difficulty in maintaining sea defences. In particular, increased frequency and severity of storms, coupled with sea level rise, will likely impact on the beaches and in the medium to long term, sea level rise is likely to drive a very significant change.

213. Historic and archaeological heritage are identified as a specific area of vulnerability and impact within the strategy with damage to, or loss of heritage assets, recognised as a direct result of continued erosion. Conversely, it is also recognised that erosion may facilitate the discovery of previously hidden archaeological sites and finds.

214. Cycles of burial and exposure resulting from marine physical processes, including storm events which can result in the stripping of shallow sediment from the sea bed and beach, have an ongoing effect upon the preservation of archaeological material. As described in **Section 14.5.3** there are a large number of records of military infrastructure known from this coastal stretch, many of which appear to have eroded from the cliff top and represented as fragmentary remains along the beach within the study area. Historical and current trends indicate that erosive conditions are likely to be ongoing, resulting in the erosion and exposure of heritage assets currently present within and along this stretch of the coastline.

215. By contrast, increased burial arising as a result of changes in marine physical processes due to climate change may cause heritage assets to be subject to increase levels of burial. Exposed heritage assets are at greater risk from erosion and degradation as a result of the effects of physical processes than those which remain buried and are consequently provided with greater protection from continued sediment cover. These cycles of burial and exposure are anticipated to continue although the effect upon individual heritage assets is difficult to predict as this will depend upon site specific conditions and will vary depending upon the nature of any exposed archaeology.

14.6 Potential Impacts

14.6.1 Potential Impacts During Construction

14.6.1.1 Impact 1: Direct (physical) impact to known heritage assets

216. Direct (physical) impacts, as stated in the NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b: 49, BEIS 2021b: 59), encompass direct effects from the physical siting of the Projects. Direct impacts to heritage assets, either present on the seafloor or buried within sea bed deposits, may result in damage to, or total destruction of, archaeological material or the relationships between that material and the wider environment (stratigraphic context or setting). These relationships are crucial to developing a full understanding of an asset. Such impacts may occur if heritage assets are present within the footprint of elements of SEP and DEP (i.e. foundations or cables) or within the footprint of activities such as sea bed clearance, anchoring or the placement of jack up barges.

217. As described in **Section 14.5.2** above, there are 550 sea bed features of archaeological interest or possible archaeological interest within the offshore study area. There is potential for direct impact to these features during the following activities:

- Sea bed preparation (including UXO and boulder clearance, where required);
- Installation of wind turbine foundations and foundations for other offshore infrastructure;
- Installation of ancillary infrastructure;
- Installation of offshore cabling; and
- Sea bed contact by legs of jack-up vessels and / or anchors (including within the Offshore Temporary Works Area).

218. Within the intertidal zone (see **Section 14.5.3**), there are 45 HER (Norfolk) records of previously recorded findspots, former Post-Medieval, WWI and WWII defences and military infrastructure and a single record of a possible prehistoric multiphase settlement (**MNF6256**). During a site walkover survey, however, none of the assets were seen to survive as extant structures and no archaeological material was identified. It is possible that remains related to these records may survive beneath the surface. Until the final design and layouts are confirmed, there will remain uncertainty in the precise nature and extent of any direct impacts, however, it is anticipated that all such remains can be avoided through the use of HDD to install the cable ducts, passing below the beach deposits, and there will be no direct pathway for impact to intertidal assets. The depth of sedimentary sequences of archaeological interest at the landfall will be further clarified through the geoarchaeological assessment of geotechnical data post-consent, and will inform the design of HDD and nearshore cable installation.

219. There are no known sea bed prehistory or aviation sites within the study area.

14.6.1.1.1 Magnitude of impact – SEP or DEP in Isolation

220. Due, to the use of HDD, there will be no impact to known heritage assets within the intertidal zone.

221. With regard to sea bed features identified in the geophysical data, all direct impacts that result in damage to, or disturbance of, a feature will be adverse, permanent and irreversible. The ‘fabric’ of the asset and, hence, its potential to inform our historical understanding, will be removed.

222. With respect to sea bed features there are 108 within the SEP wind farm site and 101 identified within DEP wind farm site (with 197 in the export cable corridor and 80 in the interlink cable corridors (**Appendix 14.1**). This marginal difference between SEP and DEP does not, however, equate to a greater potential magnitude of impact associated with SEP in isolation from DEP in isolation, for example.

223. Until the final design and layout is confirmed, there will remain uncertainty in the precise nature and extent of any direct impacts, should they occur within either SEP or DEP, or within the offshore temporary works area (should this be required). It is not currently possible to determine how many, or which of the sea bed features will be impacted, nor how such impacts would occur or the extent of such impacts.

224. Therefore, with the application of a precautionary approach, it is necessary to assess the worst-case scenario which assumes that, if any of the sea bed features are directly impacted, key elements of the asset's fabric and/or setting could be lost or fundamentally altered, such that the asset's heritage significance is lost or severely compromised. Therefore, in accordance with the definitions set out in **Table 14-9**, without mitigation, there is potential for direct impacts of high adverse magnitude for any of the identified features.

14.6.1.1.2 Magnitude of impact – SEP and DEP

225. As above, until the final design and layouts are confirmed, there will remain uncertainty in the precise nature and extent of any direct impacts, should they occur within both SEP and DEP. Therefore, without mitigation, there is potential for direct impacts of high adverse magnitude for any of the 550 identified features (or additional wrecks and features within the Offshore Temporary Works Area).

14.6.1.1.3 Significance of Effect – SEP or DEP in Isolation

226. As set out in **Table 14-23**, known maritime heritage assets are of medium (named A1 wrecks) or high (as a precautionary measure) heritage importance. In accordance with the Significance of Effect matrix (**Table 14-10**) without mitigation, should impacts occur within either SEP or DEP in isolation, these have the potential to be of **major adverse** significance.

14.6.1.1.4 Significance of Effect – SEP and DEP

227. The potential Significance of Effect for direct (physical) impacts to known heritage assets, without mitigation, is the same for SEP and DEP as for SEP or DEP in isolation (i.e. any direct impacts have the potential to be of **major adverse** significance).

14.6.1.1.5 Mitigation

228. With the application of mitigation, as set out in the **Outline WSI (Offshore)** (document reference: 9.11) submitted alongside the DCO application, it is anticipated that all direct impacts to known heritage assets as a result of SEP and DEP will be avoided.

229. Subject to approval by Historic England, it is recommended that AEZs are implemented around all 30 A1 anomalies and the 16 'live' UKHO wrecks within the Offshore Temporary Works Area. The locations of these features are illustrated on **Figures 5.01** to **5.30** in **Appendix 14.1** and **Figure 14.5**.

230. Ten anomalies have existing AEZs in place associated with SOW and DOW (7035, **7040-1**, **7043-7**, **7083** and **70402**). These have been retained where the feature was not seen in the most recent geophysical datasets (**7035**) or amended where the feature extents are seen to go beyond those previously seen.

231. The only significant recommended changes to a previous AEZ is for wreck **7043** and its associated debris items (**7044-7**). Due to the wide spread of possible debris items in the vicinity of wreck **7043**, the recommended AEZ has been extended from the previous recommendation of 50m to 100m. However, as point contacts, the recommended AEZs for the possible associated items of wreck debris (**7044-7**) have been reduced down from 50m to 25m.

232. As features of high archaeological potential, it is recommended that AEZs are implemented around the 20 newly identified A1 anomalies.

233. Where possible wrecks were identified as being highly dispersed, a precautionary 100m AEZ has been recommended. For the wrecks which appear to be slightly more intact, AEZs of 50m around the wrecks' extents is recommended.

234. For the four newly identified debris fields which have been classified as A1 (**72535**, **72542**, **72700** and **72714**), an AEZ of 25m is recommended. Although **72714** has an associated UKHO record for a possible wreck, based on its form in the geophysical data, its origins are considered uncertain and, as such, a 25m AEZ is recommended at present.

235. A total of three newly identified items of debris (**72612-4**) were recommended an AEZ of 25m based on their form and proximity to known wreck sites. However, in all cases, the areas were already covered by the wreck's recommended AEZ.

236. For the one A3 wreck (**72636**) a precautionary AEZ of 100m has been recommended. Although the wreck was not identified in any of the geophysical datasets at this time, the UKHO record states that wreckage has been identified by divers at the location in the past.

237. For the 16 UKHO records within the Offshore Temporary Works Area, AEZs of 100m around the recorded point locations are recommended in order to ensure that the full extent of wreckage and associated debris are encapsulated. There are two further AEZs within the Offshore Temporary Works Area which correspond to the aircraft remains identified during the ROV investigation for DOW.

238. The proposed AEZs are summarised in **Table 14-27** below:

Table 14-27: Recommended AEZs Within the Study Area.

ID	Classification	Position (WGS84 UTM31N)		Status	Exclusion	Areas
		Easting	Northing			
7040	Wreck	383380	5883156	Amended	50m buffer around current feature extent	Export Cable Corridor
7041	Debris field	384180	5881858	Amended	50m buffer around current feature extent	Export Cable Corridor
70402	Debris field	383830	5883309	Retained	50m buffer around previous feature extent	Export Cable Corridor
7035	Wreck	387699	5905833	Retained	70m buffer around previous feature extent	DEP North array area

ID	Classification	Position (WGS84 UTM31N)		Status	Exclusion	Areas
		Easting	Northing			
72534	Wreck	394815	5907658	New	100 m buffer around current feature extent	DEP North array area
72535	Debris field	394813	5907642	New	25 m buffer around current feature extent	DEP North array area
7043	Wreck	380848	5885352	Amended	100 m buffer around current feature extent	SEP wind farm site
7044	Debris	380893	5885230	Amended	25 m buffer around central location	SEP wind farm site
7045	Debris	380897	5885241	Amended	25 m buffer around central location	SEP wind farm site
7046	Rope/chain	380936	5885337	Amended	25 m buffer around central location	SEP wind farm site
7047	Debris	380921	5885375	Amended	25 m buffer around central location	SEP wind farm site
72541	Wreck	375273	5895493	New	50 m buffer around current feature extent	SEP wind farm site
72542	Debris field	375218	5895477	New	25 m buffer around current feature extent	SEP wind farm site
72544	Wreck	375285	5895410	New	50 m buffer around current feature extent	SEP wind farm site
72552	Wreck	383496	5885033	New	50 m buffer around current feature extent	SEP wind farm site
72557	Wreck	374157	5898238	New	100 m buffer around current feature extent	SEP wind farm site
72561	Wreck	376692	5894587	New	50 m buffer around current feature extent	SEP wind farm site
72565	Wreck	372499	5899449	New	100 m buffer around current feature extent	SEP wind farm site
72574	Wreck	382503	5889837	New	50 m buffer around current feature extent	SEP wind farm site
72582	Wreck	382503	5889083	New	100 m buffer around current feature extent	SEP wind farm site

ID	Classification	Position (WGS84 UTM31N)		Status	Exclusion	Areas
		Easting	Northing			
72596	Wreck	382091	5886033	New	50 m buffer around current feature extent	SEP wind farm site
72612	Debris	372079	5894948	New	25 m buffer around central location	SEP wind farm site
72613	Debris	372078	5894955	New	25 m buffer around central location	SEP wind farm site
72614	Debris	372110	5894951	New	25 m buffer around central location	SEP wind farm site
72615	Wreck	372108	5895017	New	100 m buffer around current feature extent	SEP wind farm site
72647	Wreck	381703	5895453	New	50 m buffer around current feature extent	Inter-connector corridor
72697	Wreck	397195	5892259	New	50 m buffer around current feature extent	DEP South array area
72700	Debris field	397251	5892193	New	25 m buffer around current feature extent	DEP South array area
72714	Debris field	399396	5893456	New	25 m buffer around current feature extent	DEP South array area
7083	Debris field	395482	5897504	Amended	65 m buffer around current feature extent	DEP South array area
72636	Recorded Wreck	372209	5899142	New	100 m buffer around central location	SEP wind farm site
9190	Recorded Wreck	382614	5875454	New	100 m buffer around central location	Offshore Temporary Works Area
9237	Recorded Wreck	385726	5884754	New	100 m buffer around central location	Offshore Temporary Works Area
9270	Recorded Wreck	379503	5893877	New	100 m buffer around central location	Offshore Temporary Works Area
9272	Recorded Wreck	379240	5894205	New	100 m buffer around central location	Offshore Temporary Works Area

ID	Classification	Position (WGS84 UTM31N)		Status	Exclusion	Areas
		Easting	Northing			
9273	Recorded Wreck	379127	5894297	New	100 m buffer around central location	Offshore Temporary Works Area
9317	Recorded Wreck	385544	5909841	New	100 m buffer around central location	Offshore Temporary Works Area
9504	Recorded Wreck	380952	5897119	New	100 m buffer around central location	Offshore Temporary Works Area
9506	Recorded Wreck	391919	5895868	New	100 m buffer around central location	Offshore Temporary Works Area
9507	Recorded Wreck	392678	5896309	New	100 m buffer around central location	Offshore Temporary Works Area
9508	Recorded Wreck	382957	5897355	New	100 m buffer around central location	Offshore Temporary Works Area
9512	Recorded Wreck	394851	5907633	New	100 m buffer around central location	Offshore Temporary Works Area
10616	Recorded Wreck	374593	5868519	New	100 m buffer around central location	Offshore Temporary Works Area
77976	Recorded Wreck	381166	5884047	New	100 m buffer around central location	Offshore Temporary Works Area
93919	Recorded Wreck	385775	5883784	New	100 m buffer around central location	Offshore Temporary Works Area
93922	Recorded Wreck	385108	5882968	New	100 m buffer around central location	Offshore Temporary Works Area
94147	Recorded Obstruction	383332	5875813	New	100 m buffer around central location	Offshore Temporary Works Area
70819 and 70842	Aircraft engines	377540	5872079	Retained	30m around recorded location	Offshore Temporary Works Area
70832	Aircraft propeller	377943	5872312	Retained	30m around recorded location	Offshore Temporary Works Area

239. AEZs may be reduced, enlarged or removed in agreement with Historic England if further relevant information becomes available. However, unless modified by agreement, it is important that AEZs are retained throughout the lifetime of SEP and DEP and monitoring of AEZs may be required by the regulator and Historic England to ensure adherence both during construction and in the future operation of the wind farm.

240. AEZs are not recommended at this time for features assigned an A2 archaeological discrimination. The positions of these features will be avoided by means of micro-siting during detailed project design, where possible. The archaeological assessment of pre-construction survey data, including high resolution geophysical data undertaken for the purposes of UXO identification, will further clarify the nature and extent of these anomalies and the scheme design will be modified to avoid heritage assets where possible.

241. If features cannot be avoided, then additional work may be required (to be undertaken post-consent) to establish the archaeological interest of the feature (e.g. investigation of individual anomalies (ground truthing) through ROV and/or diver survey). Once the character, nature and extent of selected features are more fully understood, appropriate mitigation measures (proportionate to the significance of the asset) to reduce or off-set impacts can be determined on a case by case basis.

242. The approach to the implementation of these mitigation measures is set out in the **Outline WSI (Offshore)** (document reference: 9.11) submitted alongside the DCO application. The WSI has been prepared in accordance with industry standards and guidance including *Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects* (The Crown Estate, 2021).

14.6.1.1.6 Residual Impacts – SEP or DEP in Isolation

243. With the application of AEZs and micro-siting to avoid A2 anomalies, direct impacts to known heritage assets will be avoided, and there will be no impact during construction.

244. Where micro-siting is not possible, and therefore where additional mitigation will be required, it is anticipated that the residual magnitude and significance can be reduced or offset so that impacts may be considered non-significant in EIA terms (i.e. anticipated to be no worse than a **minor adverse** significance).

14.6.1.1.7 Residual Impacts – SEP and DEP

245. The application of mitigation (as detailed above) will be the same for the construction of both SEP and DEP, as for either Project built in isolation. Therefore, with the application of mitigation it is anticipated that impacts can be reduced or offset to levels considered non-significant in EIA terms (i.e. anticipated to be no worse than a **minor adverse** significance).

14.6.1.2 Impact 2: Direct impact to potential heritage assets

246. It is not possible to avoid heritage assets that have not yet been discovered (potential heritage assets). Therefore, unavoidable direct impacts may occur if archaeological material is present within the footprint of the Projects associated with the following activities:

- Sea bed preparation (including UXO and boulder clearance, where required);
- Installation of wind turbine foundations and foundations for other offshore infrastructure;
- Installation of ancillary infrastructure;
- Installation of offshore cabling;
- Sea bed contact by legs of jack-up vessels and / or anchors; and
- Cable installation at the landfall.

247. For the purpose of this assessment, potential heritage assets are regarded as comprising the following asset types:

- Potential *in situ* prehistoric sites, submerged landscape features, derived/isolated Prehistoric finds and palaeoenvironmental evidence;
- Potential wrecks and derived/isolated maritime finds;
- Potential aircraft and derived/isolated aviation finds; and
- Potential intertidal finds.

14.6.1.2.1 Magnitude of impact – SEP or DEP in Isolation

248. Until the final design and layouts are confirmed, there will remain uncertainty in the precise nature and extent of any direct impacts, however, it is anticipated that, within the intertidal zone, the use of HDD, with entry on the landward side of the cliffs, and exit below MLWS in the marine zone, will mean that impacts to potential intertidal archaeological material can be avoided. The depth of sedimentary sequences of archaeological interest at the landfall will be further clarified through the geoarchaeological assessment of geotechnical data (**Appendix 14.3** and to be acquired post-application/post-consent), and will inform the design of HDD and nearshore cable installation so that HDD will pass beneath Quaternary deposits of potential archaeological interest and therefore, no impact will occur.

249. All direct impacts that result in damage to, or disturbance of, *in situ* prehistoric, maritime and aviation sites and potential submerged landscape features and potential palaeoenvironmental evidence (where associated with palaeolandscape features or archaeological material) will be adverse, permanent and irreversible. The 'fabric' of the asset and, hence, its potential to inform our historical understanding, will be removed.

250. In practice, the magnitude of the impact will not be fully understood until after the potential heritage asset has been encountered and the impact has occurred. The extent of any impact will depend on the presence, nature and depth of any such remains, in association with the depth, location and nature of construction-related groundworks and contact with the sea bed. However, as a precautionary approach, it should be assumed that key elements of the asset's fabric could be lost or fundamentally altered, such that the asset's heritage significance is lost or severely compromised. Therefore, in accordance with the definitions set out in **Table 14-9**, without mitigation, there is potential for direct impacts of high adverse magnitude upon potential *in situ* heritage assets.

251. Isolated/derived artefacts, either of prehistoric, maritime or aviation origin within reworked deposits may be considered less sensitive to change than *in-situ* material, as their relationship with their context or physical setting is less relevant to understanding their significance. Therefore, in accordance with the definitions set out in **Table 14-9**, without mitigation, there is potential for direct impacts of low adverse magnitude upon potential isolated finds. Should such finds be encountered during construction activities, although removal from the marine context will still result in the destruction of that contextual relationship, albeit a secondary context (i.e. not *in situ*), isolated artefacts have capacity to accommodate physical changes, therefore resulting in only a slight loss of heritage significance.

14.6.1.2.2 Magnitude of impact – SEP and DEP

252. As above, as the magnitude of the impact will not be fully understood until after the potential heritage asset has been encountered and the impact has occurred there is no difference between the potential magnitude of impact for SEP and DEP, compared with SEP or DEP in isolation. Therefore, without mitigation, and as a precautionary approach, there is potential for direct impacts of high adverse magnitude upon potential *in situ* heritage assets. Potential impacts upon isolated finds will be of low adverse magnitude.

14.6.1.2.3 Significance of Effect – SEP or DEP in Isolation

253. As set out in **Table 14-15, Table 14-23** and **Table 14-24**, *in situ* prehistoric, maritime and aviation sites are assessed as being of potentially high heritage significance (importance), as are potential submerged landscape features and potential palaeoenvironmental evidence (where associated with palaeolandscape features or archaeological material). In accordance with the significance matrix in **Table 14-10**, direct (physical) impacts to these heritage asset types thereby have the potential to be of **major adverse** significance, as a worst-case scenario.

254. Isolated/derived finds in secondary contexts are assessed as being of medium heritage significance (importance). Should they be encountered during construction activities, direct (physical) impacts to isolated finds are considered to be of potential **minor adverse** significance.

14.6.1.2.4 Significance of Effect – SEP and DEP

255. The potential Significance of Effect for direct (physical) impacts to potential heritage assets, without mitigation, is the same for SEP and DEP as for SEP or DEP in isolation (i.e. any direct impacts upon *in situ* heritage assets have the potential to be of **major adverse** significance while direct impacts upon isolated finds will be of potential **minor adverse** significance).

14.6.1.2.5 Mitigation

256. Further archaeological assessment of high-resolution geophysical data and geoarchaeological assessment of geotechnical data will be undertaken post-application/post-consent in order to reduce, as far as possible, the potential for unintended impacts during construction.

257. The examination of potential prehistoric deposits through the assessment of preconstruction geotechnical and geophysical data will further contribute to the body of scientific data available for the study of sea bed prehistory within the East Coast region. There will be archaeological input into any future sampling programmes and all available geotechnical data (e.g. samples / geotechnical logs acquired as part of engineering-led ground investigation works) will be subject to geoarchaeological assessment during the post-application/post-consent stages of the Projects. If *in situ* prehistoric sites are identified as a result of such work then mitigation measures to record and/or protect such sites will be agreed in consultation with Historic England.

258. Similarly, the archaeological assessment of high-resolution geophysical data to be acquired post-application/post-consent, together with ground-truthing of identified anomalies of potential archaeological significance, where required, will help to confirm and clarify further the potential for maritime and aviation heritage assets. Planned pre-construction surveys will result in full coverage of the areas within which construction will take place (corresponding to the final wind farm layout and cable route) with SSS, MBES and magnetometer data.

259. If features of archaeological interest are identified during these further investigations, they will be subject to the same mitigation as described for known heritage assets described in **Section 14.6.1.1.5** above.

260. Although measures will be taken to reduce, as far as possible, the potential for impact to previously undiscovered heritage assets it is still possible that unexpected discoveries may be encountered during construction. However, possible measures to further reduce the significance of potential impacts include ensuring that prompt archaeological advice is received in the event of a discovery and through recording and conserving any objects that have been disturbed.

261. In the event of an unexpected discovery, of an isolated find or where discoveries of multiple chance finds from a specific location might be indicative of a wider debris field representing previously unknown *in situ* archaeological material, this will be reported through a formal protocol for archaeological discoveries, based upon the established *Protocol for* Archaeological *Discoveries: Offshore Renewables Projects* (The Crown Estate, 2014) (ORPAD). This will establish whether the recovered objects are of archaeological interest and allow for the application of appropriate mitigation measures where necessary. For any new discoveries, any further mitigation which may be required will be considered on a case by case basis, proportionate to the significance of the discovery.

262. The approach to the implementation of these mitigation measures is set out in the **Outline WSI (Offshore)** (document reference: 9.11) submitted alongside the DCO application. The WSI has been prepared in accordance with industry standards and guidance including *Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects* (The Crown Estate, 2021).

14.6.1.2.6 Residual Impacts – SEP or DEP in Isolation

263. If further sea bed features are identified during the course of post-application/post-consent investigations, including the archaeological assessment of pre-construction survey data, these will be subject to the same mitigation measures (avoid, reduce or offset) as set out in **Section 14.6.1.1.5** above. Therefore, residual impacts will be the same as for known heritage assets (i.e. anticipated to be no worse than a **minor adverse** significance).

264. Similarly, with regard to potential prehistoric sites, with the additional investigation of potential prehistoric deposits post-application/post-consent, and the application of additional mitigation in the event of the discovery of any prehistoric archaeological material, residual impacts will be reduced or offset to levels considered non-significant in EIA terms (i.e. anticipated to be no worse than **minor adverse** significance).

265. In the event of unforeseen impact to potential sites, the implementation of a formal protocol will ensure that any finds are promptly reported, archaeological advice is obtained, and any recovered material is stabilised, recorded and conserved. Although the precise nature of the impact, and the heritage significance of any material impacted, cannot be fully understood until the impact has occurred, it is anticipated that the appropriate application of these additional mitigation measures, specifically tailored to the significance of a discovery, means that the residual impacts will be no higher than **minor adverse** significance.

14.6.1.2.7 Residual Impacts – SEP and DEP

266. As impacts to potential heritage assets cannot be avoided, the worst-case for direct impact is based upon the general assumption that the greatest potential footprint for the SEP and DEP represents the greatest potential for direct impacts (e.g. damage / destruction) to surviving archaeological material. The combined footprint of both Projects, therefore, represents a greater potential for direct impacts than if, for example, only SEP or DEP was to be built in isolation.

267. However, the application of mitigation, comprising further assessment and investigation post-application/post-consent, and the application of the protocol for archaeological discoveries to ensure that prompt advice is received in the event of an unexpected discovery, will be the same for the construction of both SEP and DEP, as for either Project being built in isolation. Therefore, with the application of mitigation it is anticipated that impacts can be reduced or offset to levels considered non-significant in EIA terms (i.e. anticipated to be no worse than **minor adverse** significance).

14.6.1.3 Impact 3: Indirect impact to heritage assets from changes to physical processes

268. SEP and DEP also have the potential to interact with both local and regional hydrodynamic and sedimentary processes which in turn may result in impacts of an in-direct (physical) nature occurring upon heritage assets. Changes in coastal processes can lead to re-distribution of erosion and accretion patterns while changes in tidal currents, for example, may affect the stability of nearby morphological and archaeological features. Indirect impacts to heritage assets may occur if buried heritage assets become exposed to marine processes, due to increased wave / tidal action for example, as these will deteriorate faster than those protected by sediment cover. Conversely, if increased sedimentation results in an exposed site becoming buried this may be considered a beneficial impact.

269. The potential indirect impact to heritage assets from changes to physical processes is assessed with reference to **Section 6.6.4** (Potential Impact during Construction) of **Chapter 6 Marine Geology, Oceanography and Physical Processes**.

270. With respect to the marine physical processes Impact 8 (indentations on the sea bed due to installation vessels), as the leg is inserted, the sea bed sediments would primarily be compressed vertically downwards and displaced laterally. As the leg is retracted, some of the sediment would return to the hole via mass slumping under gravity until a stable slope angle is achieved. Over the longer term, the hole would become shallower and less distinct due to infilling with mobile sea bed sediments.

271. As it is only sediments within the immediate vicinity of the leg that will be impacted, it is also only heritage assets within the footprint of the legs that will be impacted (with no change in the near- and far-field). As this corresponds to the same footprint as the direct impacts discussed above, this indirect impact is considered to equate to the same conclusions and mitigation as presented above and is not considered further.

272. Marine physical processes impacts which correspond to increased bed-level, and, therefore, increased potential for the protection of heritage assets which are currently exposed through additional sediment cover (sediment deposited from plume) are:

- Impact 2a: Changes in sea bed level due to sea bed preparation for foundation installation;
- Impact 2b: Changes in sea bed level due to drill arisings for installation of piled foundations for wind turbines and OSPs;
- Impact 4: Change in sea bed level due to deposition from the suspended sediment plume during export cable installation within the offshore cable corridor; and
- Impact 6: Change in sea bed level due to offshore cable installation (infield and interlink cables).

14.6.1.3.1 Magnitude of impact – SEP or DEP in Isolation

273. The magnitude of impacts for the marine physical processes impacts from **Chapter 6 Marine Geology, Oceanography and Physical Processes** which correspond to increased bed-level, and, therefore, increased potential for the protection of heritage assets which are currently exposed through additional sediment cover (sediment deposited from plume) are set out in **Table 14-28**.

Table 14-28: Magnitude of Impacts on Sea Bed Level Changes Due to Deposition Under the Worst-Case Scenario for Sediment Dispersal Following GBS Foundation Installation.

Location	Scale	Duration	Frequency	Reversibility	Magnitude of impact
Impact 2a: Changes in sea bed level due to sea bed preparation for foundation installation					
Near-field	Medium	Negligible	Negligible	Negligible	Low
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Impact 2b: Changes in sea bed level due to drill arisings for installation of piled foundations for wind turbines and OSPs					
Near-field	Low	Low-Medium	Low-Medium	Negligible	Low
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Impact 4: Change in sea bed level due to deposition from the suspended sediment plume during export cable installation within the offshore cable corridor					
Near-field	Low	Negligible	Negligible	Negligible	Low
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Impact 6: Change in sea bed level due to offshore cable installation (infield and interlink cables)					
Near-field	Low	Negligible	Negligible	Negligible	Low
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

274. Based upon the assessment of marine physical process, therefore, the indirect far-field effect upon the burial of heritage assets will be negligible and will not result in a measurable change to the preservation of heritage assets. Similarly, although short term changes will occur near-field, the low magnitude (as a worst-case) combined with the temporary nature of such changes, which will be largely confined to the vicinity of the offshore infrastructure, are not anticipated to result in a measurable change to the burial of heritage assets should they be present.

275. The indirect effect of changes to marine physical process upon offshore heritage assets, therefore, is concluded to result in no impact.

14.6.1.3.2 Magnitude of impact – SEP and DEP

276. **Section 6.6.4** (Potential Impacts during Construction) of **Chapter 6 Marine Geology, Oceanography and Physical Processes** concludes that for all elements, the change in sea bed levels for SEP and DEP will be similar or the same to that outlined for SEP or DEP in isolation. Therefore, the indirect effect of changes to marine physical process upon offshore heritage assets is also concluded to result in no impact.

14.6.1.3.3 Significance of Effect – SEP or DEP in Isolation

277. As the magnitude of impact is concluded to be no impact the significance will also be **no impact**.

14.6.1.3.4 Significance of Effect – SEP and DEP

278. As the magnitude of impact is concluded to be no impact the significance will also be **no impact**.

14.6.1.4 Impact 4: Changes to the setting of heritage assets

279. As part of the settings assessment undertaken in relation to onshore heritage assets, **Chapter 21 Archaeology and Cultural Heritage** has concluded that any changes in setting due to construction activities will be temporary and of sufficiently short duration that they would not give rise to material harm. The same conclusions are considered as applicable to marine and intertidal heritage assets and as such, indirect (non-physical) impacts upon the setting of such assets during the construction phase have therefore also been excluded from further consideration (no impact).

14.6.2 Potential Impacts During Operation

14.6.2.1 Impact 1: Direct (physical) impact to known heritage assets

280. As all known heritage assets will be avoided through the retention of AEZs throughout the lifetime of SEP and DEP, there is no pathway for impact during routine or unscheduled maintenance activities.

14.6.2.2 Impact 2: Direct (physical) impact to potential heritage assets

14.6.2.2.1 Magnitude of impact – SEP or DEP in Isolation

281. Direct impacts to potential heritage assets are unlikely to occur as a result of intrusive maintenance as any impacts would already have occurred during installation of the wind farm infrastructure during the construction phase and would already have been subject to appropriate and proportionate additional mitigation measures, as and where necessary. There will be no impact at the landfall during the operation phase as there will be no groundworks within or disturbance of intertidal deposits.

282. There is, however, potential for impacts to occur if archaeological material is present within the footprint of jack-ups or vessel anchors deployed during planned or unscheduled maintenance activities, if these are located in areas which were not previously subject to disturbance. In practice, the nature and extent of individual impacts cannot be fully understood until after the impact has occurred. Therefore, as for construction activities, and as a worst-case, there is potential for direct impacts of **major adverse** magnitude upon potential *in situ* heritage assets and low adverse magnitude upon potential isolated finds.

14.6.2.2.2 Magnitude of impact – SEP and DEP

283. As above, as the magnitude of the impact will not be fully understood until after the potential heritage asset has been encountered and the impact has occurred there is no difference between the potential magnitude of impact for SEP and DEP, compared with SEP or DEP in isolation. Therefore, without mitigation, and as a precautionary approach, there is potential for direct impacts of high adverse magnitude upon potential *in situ* heritage assets and low adverse magnitude upon potential isolated finds.

14.6.2.2.3 Significance of Effect – SEP or DEP in Isolation

284. As set out in **Table 14-15, Table 14-23 and Table 14-24** , *in situ* prehistoric, maritime and aviation sites are assessed as being of potentially high heritage significance (importance), as are potential submerged landscape features and potential palaeoenvironmental evidence (where associated with palaeolandscape features or archaeological material). In accordance with the significance matrix in **Table 14-10**, direct (physical) impacts to these heritage asset types thereby have the potential to be of **major adverse** significance, as a worst-case scenario.

285. Isolated/derived finds in secondary contexts are assessed as being of medium heritage significance (importance). Should they be encountered during operational activities, direct (physical) impacts to isolated finds are considered to be of potential **minor adverse** significance.

14.6.2.2.4 Significance of Effect – SEP and DEP

286. The potential Significance of Effect for direct (physical) impacts to potential heritage assets, without mitigation, is the same for SEP and DEP as for SEP or DEP in isolation (i.e. any direct impacts upon *in situ* heritage assets have the potential to be of **major adverse** significance while direct impacts upon isolated finds will be of potential **minor adverse** significance).

14.6.2.2.5 Mitigation

287. The archaeological assessment of post-construction monitoring data will further reduce, as far as possible, the potential for unintended impacts during operation. If further features of archaeological interest are identified these will be subject to the same mitigation as described for known heritage assets described in **Section 14.6.1.1.5** above with the primary approach being avoidance.

288. In the event of an unexpected discovery, the ongoing implementation of a formal protocol for archaeological discoveries, throughout the operation phase, will allow for such discoveries to be efficiently reported, for advice to be provided and for any further mitigation to be considered on a case by case basis, proportionate to the significance of the discovery.

289. The approach to the implementation of these mitigation measures is set out in the **Outline WSI (Offshore)** (document reference: 9.11) submitted alongside the DCO application. The WSI has been prepared in accordance with industry standards and guidance including *Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects* (The Crown Estate, 2021).

14.6.2.2.6 Residual Impacts – SEP or DEP in Isolation

290. Although the precise nature of the impact, and the heritage significance of any material impacted, cannot be fully understood until the impact has occurred, it is anticipated that the implementation of a formal protocol for archaeological discoveries, and the appropriate application of additional mitigation measures if required, specifically tailored to the significance of a discovery, means that the residual impacts will be no higher than **minor adverse** significance.

14.6.2.2.7 Residual Impacts – SEP and DEP

291. The combined footprint of potential jack-up and anchor locations during operation for both Projects represents a greater potential for direct impacts than if, for example, only SEP or DEP was to be built in isolation. However, the application of a formal protocol for archaeological discoveries to ensure that prompt advice is received in the event of an unexpected discovery, will be the same for the construction of both SEP and DEP, as for either Project being built in isolation. Therefore, with the application of mitigation it is anticipated that impacts will be reduced or offset to levels considered non-significant in EIA terms (i.e. anticipated to be no worse than a **minor adverse** significance).

14.6.2.3 Impact 3: Indirect impact to heritage assets from changes to physical processes

292. SEP and DEP also have the potential to interact with both local and regional hydrodynamic and sedimentary processes which in turn may result in impacts of an in-direct (physical) nature occurring upon heritage assets. Changes in coastal processes can lead to re-distribution of erosion and accretion patterns while changes in tidal currents, for example, may affect the stability of nearby morphological and archaeological features. Indirect impacts to heritage assets may occur if buried heritage assets become exposed to marine processes, due to increased wave / tidal action for example, as these will deteriorate faster than those protected by sediment cover. Conversely, if increased sedimentation results in an exposed site becoming buried this may be considered a beneficial impact.

293. Potential indirect impact to heritage assets from changes to physical processes is assessed with reference to **Section 6.6.5** (Potential Impact during Operation) of **Chapter 6 Marine Geology, Oceanography and Physical Processes.**

294. For Impact 7 (cable repairs/reburial), because only sediments within the immediate vicinity of the cables will be impacted, only heritage assets within the footprint will be impacted (with no change in the near- and far-field). As this corresponds to the same footprint as the direct impacts discussed above, this indirect impact is considered to equate to the same conclusions and mitigation as presented above and is not considered further.

295. Marine physical processes impacts which correspond to changes which could result in scour and sediment stripping across the study area, and the exposure and increased degradation of heritage assets which are currently buried and protected from marine processes, are as follows:

- Impact 1: Changes to the tidal regime due to the presence of structures on the sea bed (wind turbine and OSP foundations);
- Impact 2: Changes to the wave regime due to the presence of structures on the sea bed (wind turbine and OSP foundations);
- Impact 3: Changes to the sediment transport regime due to the presence of structures on the sea bed (wind turbine and OSP foundations);
- Impact 5: Morphological and sediment transport effects due to cable protection measures within the SEP and DEP wind farm sites and interlink cable corridor; and
- Impact 6: Morphological and sediment transport effects due to cable protection measures along the export cable.

14.6.2.3.1 Magnitude of impact – SEP or DEP in Isolation

296. For Impacts 1, 2 and 3, the magnitude of impact for marine physical processes is concluded to be low for near-field effects and negligible for far-field effects. This is considered insufficient to result in a measurable increase in the exposure and degradation of heritage assets and there will be no impact.

297. For Impact 5 (morphological and sediment transport effects due to cable protection measures within the SEP and DEP offshore sites and interlink cable corridor) the gross patterns of bedload transport across the SEP and DEP wind farm sites would not be affected significantly. Therefore, this will not result in the exposure and degradation of heritage assets and there will be no impact. Localised changes, if they should occur, will only affect heritage assets that have already been addressed as direct impacts due to their co-location with, or location within the immediate vicinity of, installed cable protection measures.

298. For Impact 6 (morphological and sediment transport effects due to cable protection measures along the export cable) it is concluded that there will be a negligible magnitude of impact at the landfall, no change in water depths lower than 9m, and a low magnitude of impact in water depth greater than 9m. This is considered to be insufficient to result in the exposure and degradation of heritage assets and there will be no impact. As above, localised changes will only affect heritage assets that have already been addressed as direct impacts due to their co-location with, or location within the immediate vicinity of, installed cable protection measures.

14.6.2.3.2 Magnitude of impact – SEP and DEP

299. **Section 6.6.5** (Potential Impact during Operation) of **Chapter 6 Marine Geology, Oceanography and Physical Processes** concludes that for all Impacts 1, 2, 3 and 6, the magnitude of impact for marine physical processes for SEP and DEP will be the same to that outlined for SEP or DEP in isolation. Therefore, the indirect effect of changes to marine physical process upon offshore heritage assets is also concluded to result in no impact.

300. For Impact 5 (morphological and sediment transport effects due to cable protection measures within the SEP and DEP wind farm sites and interlink cable corridors) the footprint of sea bed impacted by cable protection measures will be greater in a scenario where both SEP and DEP are built (including the interlink cables which are only considered in this scenario). However, gross patterns of bedload transport would not be affected significantly and the impacts associated with SEP and DEP will be the same as those outlined for SEP or DEP in isolation. Therefore, this will not result in the exposure and degradation of heritage assets and there will be no impact.

14.6.2.3.3 Significance of Effect – SEP or DEP in Isolation

301. As the magnitude of impact is concluded to be no impact the significance will also be **no impact**.

14.6.2.3.4 Significance of Effect – SEP and DEP

302. As the magnitude of impact is concluded to be no impact the significance will also be **no impact**.

14.6.2.4 Impact 4: Changes to the setting of heritage assets

303. During the operational life of SEP and DEP the presence of the wind turbines and offshore platforms will introduce a clear change to the setting of offshore assets. However, as assessed in **Sections 14.5.1.2** and **14.5.2.2**, the setting of marine heritage assets is not considered to form a key part of their significance, which lies primarily in their historical and research value. Furthermore, the baseline setting is already influenced by passing vessels in this area associated with industry, fishing and recreation, thereby reducing the potential magnitude of impact from the presence of vessels, personnel and infrastructure associated with maintenance activities, for example. The significance of effect would, therefore, be **negligible adverse** as the setting will change in a way which does not materially affect its cultural significance.

304. With regard to the setting of WWI and WWII defensive structures (**Section 14.5.3.2**) the context of the potential change to setting of coastal heritage assets is discussed further in **Chapter 21 Onshore Archaeology and Cultural Heritage**. A settings assessment following Historic England guidance has been completed which concludes that, whilst the offshore wind turbines would be visible from some of the assets along the coastline, they will not detract from their appreciation or setting.

14.6.3 Potential Impacts During Decommissioning

305. No decision has been made regarding the final decommissioning policy for SEP and DEP as it is recognised that industry best practice, rules and legislation change over time. Decommissioning works would most likely involve the accessible installed components. Offshore, this is likely to include removal of all of the wind turbine and OSP components, including the foundations above sea bed level but excluding scour protection. Offshore cables may be left *in situ* or removed depending on available information and technology at the time of decommissioning. The infield cables will be cut at each end towards the foundation structures. Scour and cable protection would likely be left *in situ*, other than in the MCZ where external cable protection may be removed.

14.6.3.1 Impact 1: Direct (physical) impact to known heritage assets

306. As all known heritage assets will be avoided through the retention of AEZs throughout the lifetime of SEP and DEP, there is no pathway for impact during decommissioning activities.

14.6.3.2 Impact 2: Direct (physical) impact to potential heritage assets

14.6.3.2.1 Magnitude of impact – SEP or DEP in Isolation

307. Direct impacts to potential heritage assets are unlikely to occur as a result of decommissioning as any impacts would already have occurred during installation of the wind farm infrastructure during the construction phase and would already have been subject to appropriate and proportionate additional mitigation measures, as and where necessary.

308. There is, however, potential for impacts to occur if archaeological material is present within the footprint of jack-ups or vessel anchors deployed during decommissioning activities, if these are located in areas which were not previously subject to disturbance. In practice, the nature and extent of individual impacts cannot be fully understood until after the impact has occurred. Therefore, as for construction activities, and as a worst-case, there is potential for direct impacts of **major adverse** magnitude upon potential *in situ* heritage assets and low adverse magnitude upon potential isolated finds.

14.6.3.2.2 Magnitude of impact – SEP and DEP

309. As above, as the magnitude of the impact will not be fully understood until after the potential heritage asset has been encountered and the impact has occurred there is no difference between the potential magnitude of impact for SEP and DEP, compared with SEP or DEP in isolation. Therefore, without mitigation, and as a precautionary approach, there is potential for direct impacts of high adverse magnitude upon potential *in situ* heritage assets and low adverse magnitude upon potential isolated finds.

14.6.3.2.3 Significance of Effect – SEP or DEP in Isolation

310. As set out in **Table 14-15, Table 14-23 and Table 14-24**, *in situ* prehistoric, maritime and aviation sites are assessed as being of potentially high heritage significance (importance), as are potential submerged landscape features and potential palaeoenvironmental evidence (where associated with palaeolandscape features or archaeological material). In accordance with the significance matrix in **Table 14-10**, direct (physical) impacts to these heritage asset types thereby have the potential to be of **major adverse** significance, as a worst-case scenario.

311. Isolated/derived finds in secondary contexts are assessed as being of medium heritage significance (importance). Should they be encountered during decommissioning activities, direct (physical) impacts to isolated finds are considered to be of potential **minor adverse** significance.

14.6.3.2.4 Significance of Effect – SEP and DEP

312. The potential Significance of Effect for direct (physical) impacts to potential heritage assets, without mitigation, is the same for SEP and DEP as for SEP or DEP in isolation (i.e. any direct impacts upon in situ heritage assets have the potential to be of **major adverse** significance while direct impacts upon isolated finds will be of potential **minor adverse** significance).

14.6.3.2.5 Mitigation

313. The archaeological assessment of any further geophysical data will further reduce, as far as possible, the potential for unintended impacts during operation. If further features of archaeological interest are identified these will be subject to the same mitigation as described for known heritage assets described in **Section 14.6.1.1.5** above with the primary approach being avoidance.

314. In the event of an unexpected discovery, the ongoing implementation of a formal protocol for archaeological discoveries, throughout the decommissioning phase, will allow for such discoveries to be efficiently reported, for advice to be provided and for any further mitigation to be considered on a case by case basis, proportionate to the significance of the discovery.

315. The approach to the implementation of these mitigation measures will be agreed in consultation with Historic England in accordance with industry standards and guidance at the time of decommissioning.

14.6.3.2.6 Residual Impacts – SEP or DEP in Isolation

316. Although the precise nature of the impact, and the heritage significance of any material impacted, cannot be fully understood until the impact has occurred, it is anticipated that the implementation of a formal protocol for archaeological discoveries, and the appropriate application of additional mitigation measures if required, specifically tailored to the significance of a discovery, means that the residual impacts will be no higher than **minor adverse** significance.

14.6.3.2.7 Residual Impacts – SEP and DEP

317. The combined footprint of potential jack-up and anchor locations during operation for both Projects represents a greater potential for direct impacts than if, for example, only SEP or DEP was to be built in isolation. However, the application of a formal protocol for archaeological discoveries to ensure that prompt advice is received in the event of an unexpected discovery, will be the same for the construction of both SEP and DEP, as for either Project being built in isolation. Therefore, with the application of mitigation it is anticipated that impacts will be reduced or offset to levels considered non-significant in EIA terms (i.e. anticipated to be no worse than a **minor adverse** significance).

14.6.3.3 Impact 3: Indirect impact to heritage assets from changes to physical processes

318. Potential indirect impact to heritage assets from changes to physical processes is assessed with reference to **Section 6.6.6** (Potential Impact during Decommissioning) of **Chapter 6 Marine Geology, Oceanography and Physical Processes**.

319. During the decommissioning phase, there is potential for wind turbine foundation and cable removal activities to cause changes in suspended sediment concentrations and/or sea bed or shoreline levels because of sediment disturbance effects. The types of effect will be comparable to those identified for the construction phase and there will be **no impact** to heritage assets.

14.6.3.4 Impact 4: Changes to the setting of heritage assets

320. Decommissioning may result in a further change to the setting of heritage assets with the removal of the wind turbines and associated infrastructure. The presence of vessels, personnel and infrastructure associated with decommissioning activities will also temporarily affect the setting. However, as for construction these impacts are temporary and reversible and the significance of this effect would, therefore, be **negligible adverse** as the setting will change in a way which does not materially affect its cultural significance.

14.7 Cumulative Impacts

14.7.1 Identification of Potential Cumulative Impacts

321. The first step in the cumulative assessment is the identification of which residual impacts assessed for SEP and/or DEP on their own have the potential for a cumulative impact with other plans, projects and activities (described as ‘impact screening’). This information is set out in **Table 14-29** below. Only potential impacts assessed in **Section 209** as negligible or above are included in the CIA (i.e. those assessed as ‘no impact’ are not taken forward as there is no potential for them to contribute to a cumulative impact).

322. **Table 14-29** concludes that in relation to Offshore Archaeology and Cultural Heritage, cumulative direct (physical) impacts to known heritage assets can be avoided (no impact). There are a number of constructed/consented and planned offshore wind farms, aggregate dredging licence areas, coastal defence/maintenance licences and an oil and gas development within 100km (for example) of SEP and DEP. Of these, only the export cables for DOW and Hornsea Project Three OWF overlap with the export/interlink cables for SEP and DEP, and the Offshore Temporary Works Area, although all projects are subject to the same primary mitigation for known heritage assets (i.e. avoidance and preservation *in situ*) and there is no pathway for cumulative direct (physical) impacts. Similarly, all projects are subject to the same mitigation where known heritage assets cannot be avoided (i.e. investigation and recording, preservation by record) which will reduce anticipated impacts to acceptable levels in EIA terms (i.e. no greater than minor adverse significance).

323. As it is not possible to avoid heritage assets that have not yet been discovered (potential heritage assets), significant cumulative (unavoidable) direct (physical) impacts may occur if archaeology is present across multiple plans, projects and activities. The potential cumulative impact upon the significance of these heritage assets is described below.

324. The change to historic seascape character, including consideration of cumulative change in conjunction with the constructed SOW and DOW and the Elgood Wellhead and Blythe Platform is described in **Section 14.5.4** above.

Table 14-29: Potential Cumulative Impacts (Impact Screening)

Impact	Potential for Cumulative Impact	Rationale
Construction Impact 1: Direct (physical) impact to known heritage assets	No	Direct cumulative impacts to known heritage assets are unlikely to occur due to the application of AEZs identified through EIA for constructed and planned projects as part of the consenting process.
Construction Impact 2: Direct (physical) impact to potential heritage assets	Yes	Although the effect of unavoidable impacts will be mitigated by agreed measures as part of the consenting process for each of the constructed and planned projects, the impacts will still have occurred and permanent damage or destruction will have taken place. The assessment of cumulative impacts, therefore, needs to consider the effect of multiple unavoidable impacts from multiple projects upon the archaeological resource.
Construction Impact 3: Indirect impact to heritage assets from changes to physical processes	No	In relation to marine geology, oceanography and physical processes, as no cumulative impacts are anticipated during the construction phase (see **Chapter 6 Marine Geology, Oceanography and Physical Processes**), there is no pathway for cumulative impacts to heritage assets.

Impact	Potential for Cumulative Impact	Rationale
Construction Impact 4: Impacts to the setting of heritage assets	No	As assessed in **Sections 14.5.1.2** and **14.5.2.2**, the setting of marine heritage assets is not considered to form a key part of their significance, which lies primarily in their historical and research value.
Operational Impact 1: Direct (physical) impact to known heritage assets	No	Direct cumulative impacts to known heritage assets are unlikely to occur due to the continued avoidance and retention of AEZs throughout the life of constructed and planned projects.
Operational Impact 2: Direct (physical) impact to potential heritage assets	Yes	There is potential for multiple unavoidable impacts associated with operations and maintenance activities (e.g. cable repairs and vessel anchors/jack up legs) during the operation phases of multiple projects
Operational Impact 3: Indirect impact to heritage assets from changes to physical processes	No	In relation to marine geology, oceanography and physical processes, as no cumulative impacts are anticipated during the construction phase (see **Chapter 6 Marine Geology, Oceanography and Physical Processes**), there is no pathway for cumulative impacts to heritage assets.
Operational Impact 4: Impacts to the setting of heritage assets	No	As assessed in **Sections 14.5.1.2** and **14.5.2.2**, the setting of marine heritage assets is not considered to form a key part of their significance, which lies primarily in their historical and research value.
Decommissioning Impact 1: Direct (physical) impact to known heritage assets	No	Direct cumulative impacts to known heritage assets are unlikely to occur due to the continued avoidance and retention of AEZs throughout the life of constructed and planned projects.
Decommissioning Impact 2: Direct (physical) impact to potential heritage assets	Yes	There is potential for multiple unavoidable impacts associated with decommissioning considered cumulatively with activities associated with other projects.
Decommissioning Impact 3: Indirect impact to heritage assets from changes to physical processes	No	In relation to marine geology, oceanography and physical processes, as no cumulative impacts are anticipated during the construction phase (see **Chapter 6 Marine Geology, Oceanography and Physical Processes**), there is no pathway for cumulative impacts to heritage assets.
Decommissioning Impact 4: Impacts to the setting of heritage assets	No	As assessed in **Sections 14.5.1.2** and **14.5.2.2**, the setting of marine heritage assets is not considered to form a key part of their

Impact	Potential for Cumulative Impact	Rationale
		significance, which lies primarily in their historical and research value.

14.7.2 Other Plans, Projects and Activities

325. The second step in the cumulative assessment is the identification of the other plans, projects and activities that may result in cumulative impacts for inclusion in the CIA (described as 'project screening'). This information is set out in **Table 14-30** below, together with a consideration of the relevant details of each, including current status (e.g. under construction), planned construction period, closest distance to SEP and DEP, status of available data and rationale for including or excluding from the assessment.

326. The project screening has been informed by the development of a CIA Project List which forms an exhaustive list of plans, projects and activities in a very large study area relevant to SEP and DEP. The list has been appraised, based on the confidence in being able to undertake an assessment from the information and data available, enabling individual plans, projects and activities to be screened in or out.

Table 14-30: Summary of Projects Considered for the CIA in Relation to Offshore Archaeology and Cultural Heritage (Project Screening)

Project	Status	Construction Period	Closest Distance from the Project (km)	Confidence in Data	Included in the CIA (Y/N)	Rationale
DOW	Operational	N/A	0.0 (DEP North and South array areas)	High	Y	All three projects have footprints which overlap with those of SEP and/or DEP resulting in potential cumulative direct (physical) impact to potential heritage assets. Whilst geo-spatial data for SOW and DOW is available for the purposes of assessment, mapped data for interpreted Palaeolandscape features or Hornsea Three is not currently publicly available.
SOW	Operational	N/A	0 (cable corridor) 0 (array area)	High	Y	
Hornsea Project Three OWF	Consented	2023-2031 (offshore export cable construction 2026-2027, possibly also 2030-2031)	0 (cable corridor) 83 (array area)	Low	N	

14.7.3 Assessment of Cumulative Impacts

327. Assessments undertaken for EIA as part of the consents process for offshore plans, projects and activities have revealed a large body of data indicating the likely potential for previously undiscovered prehistoric, maritime and aviation archaeology within the Southern North Sea. This includes palaeolandscape features mapped through interpretations of sub-bottom profiler and multibeam bathymetry data and geoarchaeological assessment of geotechnical data to better understand the potential for terrestrial landscapes and inhabitable environments where prehistoric populations may have settled when sea levels were lower. Similarly, studies have also shown that historic maritime and aviation networks can be mapped, such as the East Coast War Channels (Firth 2014), whilst the group value of individual wrecks, or crash sites, for example, also collectively form part of the variously perceived historic seascape characters (e.g. wartime conflict, fishing areas, transport, leisure industry etc) of the North Sea.

328. As stated for the assessment of impacts from SEP and DEP in **Section 14.6** Above, it is not possible to avoid heritage assets that have not yet been discovered (potential heritage assets). Therefore, unavoidable direct impacts may occur if archaeological material is present within the footprint of any plans, projects and activities and these impacts have the potential to be of high adverse magnitude. Through the application of appropriate mitigation to reduce or offset direct (physical) impacts, these will be reduced to no greater than a **minor adverse** significance at a project level. However, if multiple unavoidable impacts occur during the construction, operation or decommissioning of multiple projects, then cumulative impacts may be considered of greater significance. For example, it is possible that unique aspects of former landscapes, or of the *in situ* maritime and aviation archaeological resource, may be lost as a result. In addition, if a site is damaged or destroyed, comparable sites elsewhere may increase in importance as a result of greater rarity and any future direct impacts will be of greater significance.

329. Despite the significant data that is being produced through the consenting process, the extent of these networks and seascapes/landscapes from various periods remain largely unmapped, and may either be confined within a project area, or may extend beyond the bounds of a project (or beyond UK waters see **Section 14.8** below). **Figure 14.4** maps the extents of interpreted palaeogeographic features within SEP and DEP alongside features identified for SOW and DOW. This shows some mapped features extending from one project area into to another which shows how cumulative impacts could occur through multiple unavoidable impacts upon the same features, for example. The extents of features mapped as part of the North Sea Palaeolandscapes Project (Gaffney *et al*., 2007) are also illustrated on **Figure 14.4** to the north of SEP and DEP.

330. However, the potential magnitude of such changes and impacts remains poorly understood. It is acknowledged that strategic analysis in relation to the cumulative impact of multiple constructed and planned projects would facilitate greater understanding of the cumulative effect of offshore wind development within the North Sea. Whilst this is considered beyond the scope of an individual project, the contribution of publicly available data from SEP and DEP has the potential to contribute to the ongoing industry wide build-up of data which would form the basis for such a study.

331. Research agendas and academic research focussing on the marine historic environment of the North Sea have gained considerable momentum in recent decades, with data acquired from development-led investigations increasingly considered to represent a significant opportunity to enhance our understanding of the archaeology and cultural heritage resource in offshore contexts. Examples include (but are not limited to):

- North Sea Prehistory Research and Management Framework (Peeters *et al*., 2009);
- People and the Sea: A Maritime Research Agenda for England (Ransley *et al*., 2013);
- Europe's Lost Frontiers (Research led by Professor Vince Gaffney, University of Bradford); and
- Submerged Palaeolithic Archaeology of the North Sea (Research led by Dr Rachel Bynoe, University of Southampton); and
- Ice sheet and palaeoclimate controls on drainage network evolution: an example from Dogger Bank, North Sea (University of Leeds, Emery *et al*. 2020).

332. This research falls in line with various policy frameworks which have been developed to ensure the sustainable development of the North Sea, taking into account the non-renewable nature of the marine historic environment. Through the delivery of further investigation and mitigation post-application/post-consent, with account of current research agendas, policy frameworks and academic or industry led research initiatives, SEP and DEP have the potential to contribute to this overall cumulative beneficial impact.

333. In addition to scientific research objectives, SEP and DEP also have the potential to contribute significantly to wider public interest. Marine heritage assets, and in particular shipwreck sites, are often connected to significant past events and, in themselves, retain and reflect stories of the crew, vessel construction, trade, immigration, emigration and conflict, for example. As such, discoveries within the offshore sites have the potential to be of significant interest to the public, creating opportunities for outreach and education, particularly with local audiences.

334. Should the SEP and DEP be granted consent, the approach to realising this public benefit, and to the creation of joined-up objectives for post-consent investigation and mitigation, including links with academic and industry wide research initiatives, will be established post-consent in consultation with key stakeholders, including Historic England. A commitment to the delivery of this beneficial effect, including the completion of studies to professional archaeological standards and to making the results of such work publicly available, is set out in the Outline WSI prepared and submitted as part of the DCO application.

14.8 Transboundary Impacts

335. Transboundary impacts to heritage assets will not occur due to the localised nature of disturbance which do not cross territorial borders. Similarly, as concluded in **Section 6.8** of **Chapter 6 Marine Geology, Oceanography and Physical Processes**, given that there will be no impact to the hydrodynamic and sedimentary regime as a result of SEP and DEP (in isolation and if both Projects are built), transboundary impacts to heritage assets are unlikely to occur as a result of changes to marine physical processes.

336. However, the North Sea is not the property of any nation, although distinctions are made between territorial waters (the administrative and political division which form part of a particular nation's territory up to 12 nautical miles) and EEZs, which represent sea zones prescribed by the United Nations (UN) Convention on the Law of the Sea over which a state has special rights regarding the exploration and use of marine sources. Although SEP and DEP are within the UK's EEZ, any data acquired and archaeologically assessed as part of the Projects also has the potential to feed into wider research objectives initiated by neighbouring EEZs in the North Sea (most notably, the Dutch and Belgian EEZs).

337. In terms of palaeolandscapes, Doggerland was a landscape of central importance in northern Europe, larger than many current European countries, and boasting a wealth of unexplored archaeology and environmental data vital to our understanding of how past populations met challenges of climate change and sea-level rise. With regard to maritime and aviation archaeology, the North Sea has played host to numerous conflicts, migration and trade routes and wrecks and aircraft from multiple nations are known to be present on the seafloor. Therefore, the cumulative impacts discussed above, are not restricted to the UK's EEZ and transboundary effects must also be considered.

338. As in the UK, there are a number of research agendas and initiatives focusing on the archaeology of the North Sea from various European states and partnerships. For example, palaeolandscape research in the southern North Sea and the English Channel has been undertaken by the Flanders Marine Institute (platform for marine research), in partnership with the Ghent University, the Royal Institute for Natural Sciences (RBINS), the Natural History Museum of Rotterdam (The Netherlands) and the University of Bradford (UK) ([redacted]). In the Netherlands, the Cultural Heritage Agency, in conjunction with Rijkswaterstaat (the Dutch maritime and marine management organisation), has commissioned the production of a policy advice map for the North Sea's submerged archaeological landscapes. Much of this European wide research and policy has been brought together in in the Coastal Research Library publication Under the Sea: Archaeology and Palaeolandscapes of the Continental Shelf (Bailey *et al*., 2017).

339. The potential for integrated research and management represents a positive cumulative, transboundary impact of development-led initiatives across all sectors of the North Sea. Alongside data produced through UK offshore wind farm development, and that of other European nations bordering the North Sea, data sharing across national boundaries has the potential to result in a significant beneficial impact. As for cumulative impacts above, should SEP and DEP be granted consent, the approach to delivering these transboundary objectives will be established in consultation with key stakeholders post-consent, so that the potentially beneficial effects can be realised by those engaged in marine archaeological research (and the offshore wind farm industry) for both commercial and non-commercial purposes.

14.9 Inter-relationships

340. There are potential inter-relationships between the offshore archaeology and cultural heritage topic and several other topics that have been considered within this ES. **Table 14-31** provides a summary of the principal inter-relationships and sign-posts to where those issues have been addressed.

Table 14-31: Offshore Archaeology and Cultural Heritage Inter-relationships

Topic and Description	Related Chapter	Where Addressed in this Chapter	Rationale
Construction			
Indirect impact to heritage assets from changes to physical processes	**Chapter 6 Marine Geology, Oceanography and Physical Processes**	**Section 14.6.1.3**	Significant changes to physical processes may impact the preservation/survival of buried/exposed heritage assets.
Indirect (non-physical) impacts upon the setting of heritage assets (designated and non-designated)	**Chapter 21 Onshore Archaeology and Cultural Heritage**	Addressed in **Chapter 21 Onshore Archaeology and Cultural Heritage**	Impacts to the setting of heritage assets onshore may occur associated with activities associated with the installation of offshore infrastructure.

Topic and Description	Related Chapter	Where Addressed in this Chapter	Rationale
Operation			
Indirect impact to heritage assets from changes to physical processes	**Chapter 6 Marine Geology, Oceanography and Physical Processes**	**Section 14.6.2.3**	Significant changes to physical processes may impact the preservation/survival of buried/exposed heritage assets.
Indirect (non-physical) impacts upon the setting of heritage assets (designated and non-designated)	**Chapter 21 Onshore Archaeology and Cultural Heritage**	Addressed in **Chapter 21 Onshore Archaeology and Cultural Heritage**	Impacts to the setting of heritage assets onshore may occur associated with the presence of offshore infrastructure.
Decommissioning			
As for construction			

341. Inter-relationships between offshore archaeology and marine physical processes (**Chapter 6 Marine Geology, Oceanography and Physical Processes**) have been discussed as part of the impact assessment above. This has demonstrated that no significant impacts are expected for any single archaeological receptor as a result of the construction, operation or decommissioning of SEP and DEP. As such, there is no potential for the accumulation of residual impacts on a single archaeological receptor. Potential impacts upon the setting of onshore heritage assets from offshore infrastructure are addressed in **Chapter 21 Onshore Archaeology and Cultural Heritage**.

14.10 Interactions

342. The impacts identified and assessed in this chapter have the potential to interact with each other. The areas of potential interaction between impacts are presented in **Table 14-32.** This provides a screening tool for which impacts have the potential to interact. **Table 14-33** provides an assessment for each receptor (or receptor group) as related to these impacts.

343. Within **Table 14-32** the impacts are assessed relative to each development phase (Phase assessment, i.e. construction, operation or decommissioning) to see if (for example) multiple construction impacts affecting the same receptor could increase the level of impact upon that receptor. Following this, a lifetime assessment is undertaken which considers the potential for impacts to affect receptors across all development phases.

344. The significance of each individual impact is determined by the sensitivity of the receptor and the magnitude of impact; the sensitivity is constant whereas the magnitude may differ. Therefore, when considering the potential for impacts to be additive it is the magnitude of impact which is important – the magnitudes of the different effects are combined upon the same sensitivity receptor.

Table 14-32: Interaction Between Impacts – Screening.

Potential Interaction between Impacts				
Construction				
	Impact 1: Direct impact to known heritage assets	Impact 2: Direct impact to potential heritage assets	Impact 3: Indirect impact to heritage assets from changes to physical processes	Impact 4: Impacts to the setting of heritage assets and historic seascape character
Impact 1: Direct impact to known heritage assets	-	No	No	No
Impact 2: Direct impact to potential heritage assets	No	-	Yes	Yes
Impact 3: Indirect impact to heritage assets from changes to physical processes	No	Yes	-	Yes
Impact 4: Impacts to the setting of heritage assets and historic seascape character	No	Yes	Yes	-
Operation				
	Impact 1: Direct impact to known heritage assets	Impact 2: Direct impact to potential heritage assets	Impact 3: Indirect impact to heritage assets from changes to physical processes	Impact 4: Impacts to the setting of heritage assets and historic seascape character
Impact 1: Direct impact to known heritage assets	-	No	No	No
Impact 2: Direct impact to potential heritage assets	No	-	Yes	Yes

Potential Interaction between Impacts				
Impact 3: Indirect impact to heritage assets from changes to physical processes	No	Yes	-	Yes
Impact 4: Impacts to the setting of heritage assets and historic seascape character	NoEN1	Yes	Yes	-
Decommissioning				
It is anticipated that the decommissioning impacts will be similar in nature to those of construction.				

Table 14-33: Interaction Between Impacts – Phase and Lifetime Assessment

Receptor	Highest significance level			Phase assessment	Lifetime assessment
	Construction	Operation	Decommissioning		
Potential heritage assets	Minor adverse	Minor adverse	Minor adverse	No greater than individually assessed impact. While impacts to known heritage assets can be avoided, potential heritage assets may be subject to direct physical impact, indirect impacts from changes to physical processes and from changes to their setting (i.e. an artefact removed from the sea bed). Once an impact has occurred (i.e. a new heritage asset has been	No greater than individually assessed impact As for the phase assessment, once a new heritage asset is discovered or encountered, the application of additional mitigation means that that the magnitude of each, spatially discrete impact (should an impact occur), will be no greater across the Projects' lifetime.

	Highest significance level				
				discovered/encountered) the application of additional mitigation (such as additional recording, AEZs, micro-siting or relocation) means that the magnitude of each, spatially discrete impact (should an impact occur), will be no greater across all phases than each phase in isolation.	

14.11 Potential Monitoring Requirements

345. Anticipated monitoring requirements are described in the **Outline WSI (Offshore)** (document reference 9.11) and **Offshore IPMP** (document reference 9.5), submitted alongside the DCO application. It is anticipated that monitoring requirements will consist of archaeological analysis of any pre- and post-construction geophysical and geotechnical survey data to identify known and potentially unknown heritage assets, sea bed/paleolandscape features and to monitor construction and post-construction effects. These will be further developed and agreed with stakeholders prior to construction, taking account of the final detailed design of SEP and DEP.

346. It is recognised that monitoring will form an important element in the management and verification of the impacts of SEP and DEP. In particular, AEZs will be retained throughout the Project lifetimes and monitoring of AEZs may be required by the regulator to ensure adherence both during construction and in the future operation of SEP and DEP. Post-construction monitoring may also be required to assess any changes to sediment cover across the study area which may result in the exposure or burial of heritage assets, which may affect their long term preservation.

14.12 Assessment Summary

347. This chapter has provided a characterisation of the existing environment for Offshore Archaeology and Cultural Heritage based on both existing and site specific survey data, which has established that there will be at worst **minor adverse** residual impacts on heritage assets during the construction, operation and decommissioning phases of SEP and DEP.

348. There are no known sea bed prehistory sites within the study area, although a number of paleogeographic features have been interpreted by Wessex Archaeology (**Appendix 14.1**) from the geophysical survey data (SBP and MBES) associated with an interpreted geological sequence comprising eight phases with varying degrees of archaeological potential. The highest archaeological and palaeoenvironmental potential is associated with channel features attributable to either the Botney Cut unit (Unit 6b) or later Holocene features (Unit 7). A geoarchaeological review of the geotechnical logs has been undertaken (**Appendix 14.3**) alongside consideration of previous geoarchaeological assessments undertaken for SOW and DOW. Core sections and further samples have been recommended for geoarchaeological recording, and further assessment and analysis, and additional project specific geoarchaeological assessment is planned post-application/post-consent, as set out in the **Outline WSI (Offshore)** (document reference: 9.11).

349. Wessex Archaeology has identified 550 sea bed features of archaeological interest (A1) or potential archaeological interest (A2 and A3). Of the 30 A1 anomalies, 16 have been identified as wrecks, seven as debris fields, six as items of debris and one as a rope or chain which, along with three of the items of debris, are all thought to be associated with wreck **7043.** Sea bed features interpreted as A2 have been identified as being of possible anthropogenic origin and have the potential to represent archaeological material on the sea bed of maritime or aviation origin. Magnetic only anomalies (without visible surface expression) have the possibility to be buried objects with ferrous content that are of archaeological potential. There is a single A3 historic record (**72636**), described as a Foul Ground by the UKHO, which has not been seen in the geophysical data.

350. In addition to the known wrecks and identified anomalies described above, there is also potential for the presence of further maritime and aviation archaeological material to be present, which has not been seen in the geophysical data. This may comprise isolated finds of material, or wrecks or aircraft crash sites, potentially buried and concealed within or beneath marine sea bed sediments.

351. A total of forty-five HER (Norfolk) records have been identified within the intertidal zone which relate to previously recorded Post-Medieval, WWI and WWII defences and military infrastructure, Prehistoric, Iron Age, Roman and Medieval findspots and a sequence of organic sands, peats and muds that outcrop on the Weybourne foreshore which are periodically exposed. Although the potential for similar remains within the intertidal zone should be considered high, no visible archaeological remains were observed during the site visit.

352. Until the final design and layouts are confirmed, there will remain uncertainty in the precise nature and extent of any direct impacts, however, it is anticipated that, within the intertidal zone, the use of HDD, with entry on the landward side of the cliffs, and exit below MLWS in the subtidal, will mean that impacts to potential intertidal archaeological material will be avoided. The depth of sedimentary sequences of archaeological interest at the landfall will be further clarified through the geoarchaeological assessment of geotechnical data to be acquired post-consent, and will inform the design of HDD and nearshore cable installation so that HDD will pass beneath deposits of potential archaeological interest.

353. With the application of mitigation, it is anticipated that all direct impacts to known heritage assets as a result of SEP and DEP will be avoided. The approach to the implementation of these mitigation measures is set out in the **Outline WSI (Offshore)** (document reference 9.11) submitted alongside the DCO application which has been prepared in accordance with industry standards and guidance including *Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects* (The Crown Estate, 2021).

354. Subject to approval by Historic England, it is recommended that AEZs are implemented around all 30 A1 anomalies and the A3 historic record **(Table 14-24**), to be retained for the Projects' lifetime. AEZs are not recommended at this time for features assigned an A2 archaeological discrimination. The positions of these features will be avoided by means of micro-siting during detailed project design, where possible. The archaeological assessment of pre-construction survey data, including high resolution geophysical data undertaken for the purposes of UXO identification, will further clarify the nature and extent of these anomalies and the scheme design will be modified to avoid heritage assets where possible. If features cannot be avoided, then additional work may be required to establish the archaeological interest of the feature (e.g. investigation of individual anomalies (ground truthing) through ROV and/or diver survey) and to record features prior to removal, as appropriate.

355. It is not possible to avoid heritage assets that have not yet been discovered (potential heritage assets). In order to minimise this potential impact, further archaeological assessment of high-resolution geophysical data and geoarchaeological assessment of geotechnical data will be undertaken post-application/post-consent in order to reduce, as far as possible, the potential for unintended impacts during construction. In the event of an unexpected discovery, this will be reported using a formal protocol for archaeological discoveries which will establish whether the recovered objects are of archaeological interest and recommend appropriate mitigation measures where necessary. Through the protocol, any possible *in situ* heritage assets encountered on the sea bed will be immediately provided with a temporary exclusion zone to prevent further impacts from taking place until advice had been received. Following confirmation of the presence of archaeological material, additional mitigation measures to record or conserve the site will be agreed in consultation with Historic England.

356. Potentially beneficial effects have also been identified in relation to both cumulative and transboundary impacts, through the contribution of data to academic and scientific objectives, and public outreach and engagement, both within the UK and wider European networks. The approach to delivering these objectives will be established post-consent in consultation with key stakeholders, including Historic England, and set out in the **Outline WSI (Offshore)** (document reference 9.11).

Table 14-34 Summary of Potential Impacts on Offshore Archaeology and Cultural Heritage

Potential impact	Receptor	Importance	Magnitude	Pre-Mitigation Impact	Mitigation Measures Proposed	Residual Impact	Cumulative Residual Impact
Construction							
Impact 1: Direct impact to known heritage assets	Wrecks and anomalies of archaeological interest (A1)	Medium/High	High	Major adverse	AEZs	**No impact**	**No impact**
	A3 historic record	High	High	Major adverse	AEZs	**No impact**	
	Additional anomalies of possible archaeological interest (A2)	High	High	Major adverse	Avoid location	**No impact**	
					Additional mitigation to reduce or offset impacts	**Minor adverse**	
Impact 2: Direct impact to potential heritage assets	*In situ* prehistoric, maritime or aviation sites	High	High	Major adverse	Further assessment and investigation and additional mitigation to avoid, reduce or offset impacts.	**Minor adverse**	**Potential beneficial effect** (described but currently not quantifiable, to be realised post-consent through provision of publicly accessible data)
	Intertidal assets	Negligible	No impact	No impact	None	**No impact**	
	Isolated finds	Medium	Low	Minor adverse	Protocol for archaeological discoveries.	**Minor adverse**	
Impact 3: Indirect impact to heritage assets from changes to physical processes	Known and potential heritage assets	Medium to High	No Impact	No Impact	N/A	**No Impact**	**No Impact**

Potential impact	Receptor	Importance	Magnitude	Pre-Mitigation Impact	Mitigation Measures Proposed	Residual Impact	Cumulative Residual Impact
Impact 4: Impacts to the setting of heritage assets	Known and potential heritage assets	Medium to High	No Impact	No Impact	N/A	**No Impact**	**No Impact**
Operation							
Impact 1: Direct impact to known heritage assets	Known heritage assets	Medium to High	High	Major adverse	AEZs	**No impact**	**No Impact**
Impact 2: Direct impact to potential heritage assets	*In situ* prehistoric, maritime or aviation sites	High	High	Major adverse	Further assessment of geophysical and geotechnical data.	**Minor adverse**	**Potential beneficial effect** (described but currently not quantifiable, to be realised post-consent through provision of publicly accessible data)
	Isolated finds	Medium	Low	Minor adverse	Protocol for archaeological discoveries.	**Minor adverse**	
Impact 3: Indirect impact to heritage assets from changes to physical processes	Known and potential heritage assets	Medium to High	No Impact	No Impact	N/A	**No Impact**	**No Impact**
Impact 4: Impacts to the setting of heritage assets	Known and potential heritage assets	Medium to High	No Impact	No Impact	N/A	**No Impact**	**No Impact**
Decommissioning							
Impact 1: Direct impact to known heritage assets	Known heritage assets	Medium to High	High	Major adverse	AEZs	**No impact**	**No Impact**
	In situ prehistoric,	High	High	Major adverse	Further assessment of	**Minor adverse**	**Potential beneficial effect** (described but

Potential impact	Receptor	Importance	Magnitude	Pre-Mitigation Impact	Mitigation Measures Proposed	Residual Impact	Cumulative Residual Impact
Impact 2: Direct impact to potential heritage assets	maritime or aviation sites				geophysical and geotechnical data.		currently not quantifiable, to be realised post-consent through provision of publicly accessible data)
	Isolated finds	Medium	Low	Minor adverse	Protocol for archaeological discoveries.	**Minor adverse**	
Impact 3: Indirect impact to heritage assets from changes to physical processes	Known and potential heritage assets	Medium to High	No Impact	No Impact	N/A	**No Impact**	**No Impact**
Impact 4: Impacts to the setting of heritage assets	Known and potential heritage assets	Medium to High	No Impact	No Impact	N/A	**No Impact**	**No Impact**

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