Dudgeon and Sheringham Shoal Offshore Wind Farm Extensions

Preliminary Environmental Information Report

Volume 1

Chapter 16 - Offshore Archaeology & Cultural Heritage

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China Resources
Better Life Together

Masdar
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equinor

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Glossary of Acronyms

AEZ	Archaeological Exclusion Zones
CIA	Cumulative Impact Assessment
CITiZAN	Coastal and Intertidal Zone Archaeology Network
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DEFRA	Department for the Environment and Rural Affairs
DEP	Dudgeon Extension Project
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
GIS	Geographical Information System
HDD	Horizontal Directional Drilling
HSC	Historic Seascape Characterisation
HVAC	High-Voltage Alternating Current
IPMP	In-Principle Monitoring Plan
KA	Kilo annum (thousand years ago)
km	Kilometre
LVIA	Landscape and Visual Impact Assessment
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
MW	Megawatts
NHER	Norfolk Historic Environment Record
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project

nT	nanoTesla
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
PPG	Planning Practice Guidance
ROV	Remote Operated Vehicle
SBP	Sub-bottom Profiler
SEP	Sheringham Shoal Extension Project
SSS	Sidescan Sonar
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UN	United Nations
UXO	Unexploded Ordnance
WSI	Written Scheme of Investigation
WWI	World War I

Glossary of Terms

The Applicant	Equinor New Energy Limited
Aviation archaeology	The remains of crashed aircraft and archaeological material associated with historic aviation activities.
Dudgeon Offshore Wind Farm Extension site	The Dudgeon Offshore Wind Farm Extension offshore wind farm boundary.
The Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.
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.
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 Anglian, the Wolstonian and the Devensian which ended about 12,000 years ago. The Holocene period corresponds to the current interglacial.
Grid option	Mechanism by which DEP and SEP will connect to the existing electricity network. This may either be an integrated grid option providing transmission infrastructure which serves both of the wind farms, or a separated grid option, which allows DEP and SEP to transmit electricity entirely separately.
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.

Interlink cables	Cables linking two separate project areas. This can be cables linking 1. DEP South and DEP North 2. DEP South and SEP 3. DEP North and SEP 1 is relevant if DEP is constructed in isolation or first with a separated grid option. 2 and 3 are relevant with an integrated grid option.
Landfall	The point at the coastline at which the offshore export cables are brought onshore, connecting to the onshore cables at the transition joint bay above mean high water
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 export cables	The cables which would bring electricity from the landfall to the onshore substation. 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.
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.
Seabed 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.
Seabed prehistory	Archaeological remains on the seabed corresponding to the activities of prehistoric populations that may have inhabited what is now the seabed when sea levels were lower.
Study area	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
Sheringham Shoal Offshore Wind Farm Extension site	Sheringham Shoal Offshore Wind Farm Extension offshore wind farm boundary.
The Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.

16 OFFSHORE ARCHAEOLOGY & CULTURAL HERITAGE

16.1 Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) considers the potential impacts of the proposed Dudgeon Extension Project (DEP) and Sheringham Shoal Extension Project (SEP) 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 DEP and SEP.

2. This chapter has been written by Royal HaskoningDHV, with the approach to assessment undertaken with specific reference to the National Planning Policy Framework (NPPF), the Marine Policy Statement and to the relevant 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 **Section 16.4**.

3. Baseline conditions as set out in this PEIR chapter provide an account of the known archaeological and cultural heritage resource (including designated and non-designated heritage assets), a summary of the potential for currently unrecorded heritage assets and finds to exist within the offshore development area and a review of the Historic Seascape Character (HSC). The known and potential offshore and intertidal archaeological resource is identified with respect to:

   - Seabed prehistory (i.e. archaeological remains on the seabed corresponding to the activities of prehistoric populations that may have inhabited what is now the seabed 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).

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

   - **Chapter 8 Marine Geology, Oceanography and Physical Processes**; and
   - **Chapter 23 Onshore Archaeology and Cultural Heritage**.

5. This chapter has been prepared in consultation with Historic England (**Section 16.2**) and in accordance with legislation, policy and industry standards and guidance documents relevant to the marine archaeological and cultural heritage (historic) environment (**Section 16.4**), with specific reference to the relevant NPSs, the NPPF and the Marine Policy Statement.

16.2 Consultation

6. Consultation with regard to Offshore Archaeology and Cultural Heritage has been undertaken in line with the general process described in **Chapter 6 EIA Methodology**. The key elements to date have included scoping and the ongoing Evidence Plan Process (EPP) via the Archaeology (onshore and offshore) Expert Topic Group (ETG). The feedback received has been considered in preparing the PEIR. **Table 16-1** provides a summary of how the consultation responses received to date have influenced the approach that has been taken.

7. This chapter will be updated following the consultation on the PEIR in order to produce the final assessment that will be submitted with the Development Consent Order (DCO) application. Full details of the consultation process will also be presented in the Consultation Report alongside the DCO application.

Table 16-1: 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 seabed. 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 16.6.2**.
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 16.6**.

Consultee	Date/ Document	Comment	Project Response
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 16.5.1**.
The Planning Inspectorate	November 2019/ Scoping Opinion	Figure 2.9.1 identifies four different seabed 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.
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 16.6** and are illustrated on **Figures 3-5** of **Appendix 16.1**
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 16.4**.

Consultee	Date/ Document	Comment	Project Response
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 DEP and SEP (see **Appendix 16.1** and **Section 16.5.2**.
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 is will be agreed through Method Statements will be set out in the Outline Written Scheme of Investigation (WSI) which will be submitted alongside the DCO application.

Consultee	Date/ Document	Comment	Project Response
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.	No geotechnical investigations have been carried out pre-consent. A commitment to including archaeological objectives in planned surveys post consent forms part of the proposed mitigation summarised in **Section 16.6**. The approach to geoarchaeological assessment will be set out in the Outline WSI.
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 16.1** and **Section 16.5**. An Outline WSI will be submitted alongside the DCO application.

Consultee	Date/ Document	Comment	Project Response
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 16.4.4**.
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 **Section16.7**.
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 16.5.3**.

16.3 Scope

16.3.1 Study Area

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

16.3.2 Realistic Worst-Case Scenario

16.3.2.1 General Approach

9. Offshore infrastructure for DEP and SEP includes wind turbines, offshore substation platforms (OSPs), infield cables, interlink cables and export cables.

10. The final design of DEP and SEP 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 (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 6 EIA Methodology**.

11. The realistic worst-case scenarios for the Offshore Archaeology and Cultural Heritage assessment are summarised in **Table 16-2**. These are based on the project parameters described in **Chapter 5 Project Description**, which provides further details regarding specific activities and their durations.

12. In addition to the design parameters set out in **Table 16-22**, consideration is also given to how DEP and SEP will be built out as described in **Section 16.3.2.2** to **Section 16.3.2.4** below. This accounts for the fact that whilst DEP and SEP are the subject of one DCO application, it is possible that either one or both DEP and SEP will be developed, and if both are developed, that construction may be undertaken either concurrently or sequentially.

13. The worst-case scenario for archaeology below MHWS is based upon the general assumption that the greatest potential footprint for the project 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 seabed deposits.

14. 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.

15. 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.

Table 16-2: Realistic Worst-Case Scenarios.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
Construction				
Direct (physical) impact to heritage assets	**Wind farm site:** Two wind farm sites (DEP North and South) totalling **103.50km²** **Wind turbine foundations:** Maximum footprint of 32 GBS foundations (14MW) including foundation scour protection: **0.46km²** **Substation foundations:** Maximum footprint of substation foundations including scour protection (with suction cans): **1,662m²**	**Wind farm site** One wind farm site totaling **92.6km²** **Wind turbine foundations:** Maximum footprint of 24 GBS foundations (14MW) including foundation scour protection: **0.34km²** **Substation foundations:** Maximum footprint of substation foundations including scour protection (with suction cans): **1,662m²**	**Wind farm sites** Three farm sites totalling **196.1km²** (DEP North, DEP South and SEP) **Wind turbine foundations:** Maximum footprint of 56 GBS foundations (14MW) including foundation scour protection: **0.86km²** **Substation foundations:** Maximum footprint of substation foundations including scour protection (with suction cans): **3,324m²**	The worst case scenario represents the maximum area/depth of disturbed seabed sediments with the potential for archaeological material to be present either on the seafloor or buried within seabed deposits.
	Offshore cables: Up to **267km** of cables comprising:	**Offshore cables:** Up to **130km** of cables comprising:	**Offshore cables:**	**DEP and SEP together worst case scenario per cable**

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	• One HVAC export cable up to **62km** in length • **135km** of infield cables (DEP North: 90km; DEP South: 45km) • Up to 3 parallel interlink cables between DEP South and OSP in DEP North: up to **66km** in length (combined) • Burial depth: 0.5 to 1.5m (excluding burial in sand waves up to 20m; export cable surface lay possible in Cromer Shoal Chalk Beds MCZ) and up to 1.0m for the export cables.	• One HVAC export cable up to **40km** in length • **90km** of infield cables • No interlink cables • Burial depth: Same as DEP in isolation • Cable trench maximum width of disturbance: Same as DEP in isolation • Maximum area disturbed: **0.390km²** (Export cable 0.12km², Infield cables 0.27km²)	Up to **481km**[1] of cables comprising: • 2 HVAC export cables up to **102km** in length • Up to **225km** of infield cables • Up to 7 interlink cables from DEP North to OSP in SEP, up to **154km** total length • Burial depth: Same as DEP and SEP in isolation • Cable trench maximum width of disturbance: Same as DEP and SEP in isolation **Realistic worst case scenario for all cables** Up to **448km** of cables based on realistic scenario: **1.35km²**	**Export:** DEP and SEP are developed with a separated grid option (each having their own substation and export cable). **Infield:** Assumes SEP, DEP North and DEP South are all built. **Interlink:** Assumes DEP and SEP are developed with an integrated grid option but only DEP North is developed. **Realistic worst case scenario for all cables** The realistic worst case scenario for cables is DEP and SEP are developed with an integrated grid option and both DEP North

[1] The individual worst case scenarios presented for export, interlink and infield cables would not represent a developable scenario if taken as a total, therefore a 'realistic' worst case scenario for all cables is presented for this and for all other activities that vary depending on the development scenario in question. This includes sandwave clearance, number of OSP and anchoring.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	• Cable trench maximum width of disturbance: 3.0m • Maximum area disturbed: **0.789km²** (Export cable **0.186km²**, Infield cables **0.405km²**, Interlink cables **0.198km²**)		(Export cable 0.24km², Infield cables 0.68km², Interlink cables 0.43km²	and DEP South are developed.
	External cable protection (unburied cables): Up to **3.0km of surface protection: 16,000m²** (0.5km export cables, 1.5km interlink cables, 1.0km infield cables) **Subsea cable and pipeline crossings:** Up to **17 crossings** (overtrawlable) each with 2,100m² footprint (**35,700m²**) • Infield cables, up to 7 crossings (3 in DEP North at Durango-	**External cable protection (unburied cables):** Up to **1.5km of surface protection: 7,000m²** (0.5km export cables, 1.0km infield cables) **Subsea cable and pipeline crossings:** Up to **4 crossings** (overtrawlable) each with 2,100m² footprint (**8,400m²**) • Infield cables, no crossings • Export cable, up to 4 crossings (2 for	**External cable protection (unburied cables):** Up to **3.0km of surface protection: 16,000m²** (0.5km export cables, 1km interlink cables, 1.5km infield cables) **Subsea cable and pipeline crossings:** Up to **21 crossings** (overtrawlable) each with 2,100m² footprint (**44,100m²**) • Infield cables, up to 7 crossings (3 in DEP North at Durango-	Cable protection would be required at crossing locations in the offshore cable corridor. A total of four crossings are required for each cable (up to two cables for a DEP and SEP together scenario). The height of cable crossings would be 0.5m. The DEP and SEP worst case scenario is the same for all DEP and SEP together scenarios.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	Waveney pipeline, up to 4 in DEP South) • Interlink cables, up to 6 crossings (3 cables from DEP South crossing 2 Dudgeon export cables) • Export cable, up to 4 crossings (2 at Dudgeon export cables, 2 for Hornsea Three export cables). One disused subsea cable crosses the export cable but no crossing required.	Dudgeon export cables, 2 for Hornsea Three export cables). One disused subsea cable crosses the export cable but no crossing required.	Waveney pipeline, up to 4 in DEP South) • Interlink cables, up to 6 crossings (3 cables from DEP South crossing 2 Dudgeon export cables) • Export cables, up to 8 crossings (4 at Dudgeon export cables, 4 for Hornsea Three export cables). One disused subsea cable crosses the export cable but no crossing required.	
	Seabed preparation (0.986km^2): • Sandwave clearance at north end of corridor between SEP and DEP North and corridor between DEP South and DEP North, in DEP North and DEP South: **0.93km^2**	**Seabed preparation (0.043km^2)** • Levelling (dredging) for GBS foundations, max5m depth: **0.042km^2** (for 18+MW) • Route clearance: PLGR: included in cable trench areas / boulder clearance: **1,178m^2**	**Seabed preparation** • Sandwave clearance at north end of corridor between SEP and DEP North and corridor between DEP South and DEP North, in DEP North and DEP South: **0.93km^2** • Levelling (dredging) for GBS foundations, max	The width of seabed disturbance along the PLGR is estimated to be up to 3m, which would be encompassed by the maximum footprint of cable installation works which has already been accounted for above. Boulders that present an obstacle to installation of infrastructure will be

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	• Levelling (dredging) for GBS foundations, max 5m depth: **0.056km²** (for 18+MW) • Route clearance: Pre-lay grapnel run (PLGR): included in cable trench area / boulder clearance: **785m²**		5m depth: **0.097km²** (for 18+MW) • Route clearance: PLGR: included in cable trench areas / boulder clearance: **1,963m²** **Realistic worst case scenario** Realistic worst case scenario for sandwave clearance: **0.76km²** Maximum realistic worst case scenario for seabed preparation for DEP and SEP together: **0.85km²**	confirmed by the pre-construction surveys. Large boulders (in the order of 5m diameter and 1m height) will be relocated by subsea grab to an adjacent area of seabed within the DEP and SEP boundaries. The footprint of the boulder placement in the new location has been counted in the 'boulder clearance' disturbance footprint. **DEP and SEP together worst case scenario** The worst case scenario for sandwave levelling when considered on its own is DEP and SEP developed with a separated grid option. **DEP and SEP Together realistic worst case scenario**

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
				The realistic worst case scenario for sandwave clearance is DEP and SEP developed with an integrated grid option and both DEP North and DEP South are developed.
	Vessels (0.134km^2) **Jack up vessels** • Up to two jack-up deployments at each turbine/OSP (**32 turbines + one OSP: 79,200m^2**) **Anchoring** • Turbine/OSP installation vessel anchoring (up to 12 lines per location): **23,760m^2** • Export cable installation vessel anchoring (seven lines) (62km): **26,040m^2**	**Vessels (0.078km^2)** **Jack up vessels** • Up to two jack-up deployments at each turbine/OSP. (**24 turbines + 1 OSP: 60,000m^2**) **Anchoring** • Turbine/OSP installation vessel anchoring (up to 12 lines per location) = **18,000m^2** • Export cable installation vessel anchoring (seven lines) (40km) = **16,800m^2**	**Vessels** **Jack up vessels** • Up to two jack-up deployments at each turbine/OSP. (**56 turbines + 2 OSPs: 139,200m^2**) **Anchoring** • Turbine/OSP installation vessel anchoring (up to 12 lines per location): **41,760m^2.** • Export cable installation vessel anchoring (seven lines) (62km + 40km): **42,840m^2**	Worst-case scenario is a jack-up barge with six legs per barge (200m^2 per leg) equating to a total footprint of 1,200m^2 per installation. **The worst case scenario for DEP and SEP together for anchoring** Turbine/OSP: DEP and SEP developed in an separated grid option. Export: DEP and SEP is developed with a separated grid option. Interlink: DEP and SEP are developed with an integrated grid option but only DEP North

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	Interlink cable installation vessel anchoring (7 lines): **27,720m²**		• Interlink cable installation vessel anchoring (7 lines): **64,680m²** **Realistic worst case scenario** • Anchoring: **0.135km²** • Jack up (1 OSP only): **0.137km²** Maximum realistic worst case scenario for vessels for DEP and SEP together: **0.27km²**	
	HDD Exit Point (978m²) • Initial trench: **600m²** • Transition zone: **50m²** • Jack up footprint: **128m²** • Deposited material on seabed: **200m²** **HDD exit cable protection**	**HDD Exit Point (978m²)** • Initial trench: **600m²** • Transition zone: **50m²** • Jack up footprint: **128m²** • Deposited material on seabed: **200m²** **HDD exit cable protection**	**HDD Exit Point (1356m²)** • Initial trench: **600m²** • Transition zone: **100m²** • Jack up footprint: **256m²** • Deposited material on seabed: **400m²** **HDD exit cable protection**	Horizontal Directional Drilling (HDD) beneath intertidal zone with offshore exit point approximately 1,000m offshore. For the DEP and SEP together scenario, the initial trench assumes both export cables are within the same initial trench, meaning the area of disturbance is the same as DEP and SEP in isolation scenarios.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	• 100m of HDD exit point cable protection: **300m²**	• 100m of HDD exit point cable protection: **300m²**	• 200m of HDD exit point cable protection: **600m²**	However, for the transition zone it assumes two trenches therefore the area of disturbance is double DEP and SEP in isolation scenarios. Jack up footprint for DEP and SEP together is includes total jack up legs footprint and jack up movements required.
Indirect (physical) impact to heritage assets from changes to physical processes	The worst case scenarios for marine physical processes are set out in **Chapter 8** (**Table 8.3**). The following impacts are relevant to the worst case for offshore archaeology and cultural heritage: • Impact 7: Indentations on the seabed due to installation vessels. 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: • Impact 2a: Changes in seabed level due to sea bed preparation for foundation installation; • Impact 2b: Changes in seabed level due to drill arisings for installation of piled foundations;			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	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	• Impact 4: Change in seabed level due to deposition from the suspended sediment plume during export cable installation within the offshore cable corridor; and • Impact 6: Change in seabed level due to offshore cable installation (array and interlink cables).			
Non-physical impacts to the setting of heritage assets and historic seascape character	**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: **603** 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: **603** over 2 year construction period	**Maximum temporal footprint:** • Duration of offshore construction activities: **4 years** if built sequentially with a maximum gap between offshore construction activities of one year **Construction vessels:** • Maximum number of construction vessels on site at any one time: up to **25** (in total if both DEP and SEP constructed concurrently) • Construction vessel trips to port: **1,196**	The worst case scenario represents the maximum intrusive effect of construction activities for the longest duration. Construction port/s will not be confirmed until nearer the start of construction.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
			during 4 year construction period if constructed sequentially	
Operation				
Direct (physical) impact to 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).	**Wind farm sites and offshore cables:** Less than for construction (maintenance activities within the same footprint, impacts would already have occurred during construction)	**Wind farm sites and offshore cables:** Less than for construction (maintenance activities within the same footprint, impacts would already have occurred during construction)	The worst case scenario represents the maximum area/depth of disturbed seabed sediments with the potential for archaeological material to be present either on the seafloor or buried within seabed deposits
Indirect (physical) impact to heritage assets from changes to physical processes	The worst case scenarios for marine physical processes are set out in **Chapter 8** (**Table 8.3**). The following impacts are relevant to the worst case for offshore archaeology and cultural heritage: • Impact 1: Changes to the tidal regime due to the presence of structures on the seabed (wind turbines and OSP foundations); • Impact 2: Changes to the wave regime due to the presence of structures on the seabed (wind turbines and OSP foundations); • Impact 3: Changes to the sediment transport regime due to the presence of structures on the seabed (wind turbines and OSP foundations);			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

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	• Impact 5: Morphological and sediment transport effects due to cable protection measures within the DEP and SEP sites and interlink cable corridor; • Impact 6: Morphological and sediment transport effects due to cable protection measures along the export cable; and • Impact 7: Cable repairs/reburial and maintenance vessel footprints.			protected from marine processes.
Non-physical impacts to the setting of heritage assets and historic seascape character	**Presence of wind farm infrastructure:** • Up to **32** wind turbines • **One** OSP in DEP North **Maximum temporal footprint:** The operational lifetime is expected to be 35 years **O&M vessels:** • Maximum number of vessels on site at any one time: **7**	**Presence of wind farm infrastructure:** • Up to **24** wind turbines • **One** OSP in SEP **Maximum temporal footprint:** The operational lifetime is expected to be 35 years **O&M vessels:** • Maximum number of vessels on site at any one time: **7**	**Presence of wind farm infrastructure:** • Up to **56** wind turbines • **Two** OSPs, one in DEP North and one in SEP (if projects are built with a separated grid option) **Maximum temporal footprint:** The operational lifetime is expected to be 35 years **O&M vessels:** • Maximum number of vessels on site at any one time: **9** (in total if	The worst case scenario represents the maximum intrusive effect of installed infrastructure and operation and maintenance activities for the longest duration.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	• Operation and maintenance vessel trips to port per year: approximately **690** (although majority (624) will be (small O&M vessel (CTV))	• Operation and maintenance vessel trips to port per year: approximately **690** (although majority (624) will be (small O&M vessel (CTV))	both DEP and SEP constructed concurrently) • Operation and maintenance vessel trips to port per year: approximately **694** (although majority (624) will be (small O&M vessel (CTV))	
Decommissioning				
	Decommissioning arrangements will be detailed in a Decommissioning Plan, which will be drawn up and agreed prior to construction. This plan will also ensure lighting and marking mitigations remain functioning throughout the life of the project and include where an obstruction is left in place. Decommissioning areas will be assumed as those defined by the construction phase.			

16.3.2.2 Construction Scenarios

16. The following principles set out the framework for how DEP and SEP may be constructed:

- DEP and SEP may be constructed at the same time, or at different times;
- If built at the same time both projects could be constructed in four years, with offshore construction being undertaken over two years (likely years three and four) of the overall construction period;
- If built at different times, either project could be built first;
- If built at different times the first project would require a four-year period of construction including a two-year offshore construction period, the second project a three-year period of construction including a two year offshore construction period;
- If built at different times, the duration of the gap between the start of overall construction of the first project, and the start of overall construction of the second project may vary from two to four years;
    - If the gap between the projects is less than two years, the first project would wait for the second project in order to be constructed together.
- Assuming maximum construction periods, and taking the above into account, the maximum period over which the overall construction of both projects could take place is seven years; and
- The earliest overall construction start date is 2024 and the latest is 2028.

17. To determine which construction scenario presents the realistic worst case for each receptor and impact, the assessment considers both maximum duration effects and maximum peak effects, in addition to each project being developed in isolation, drawing out any differences between each of the two projects.

18. The three construction scenarios considered by the Offshore Archaeology and Cultural Heritage assessment are therefore:

- Build DEP or build SEP in isolation;
- Build DEP and SEP concurrently – reflecting the maximum peak effects; and
- Build one project followed by the other with a gap of up to four years between the start of construction on each project (sequential) – reflecting the maximum duration of effects. Under this scenario there would be a maximum gap between offshore construction activities of one year.

19. Any differences between DEP and SEP, 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 16.6**). For each potential impact 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 16.6**.

16.3.2.3 Operation Scenarios

20. Operation scenarios are described in detail in **Chapter 5 Project Description**. The assessment considers the following three scenarios:

    - Only DEP in operation;
    - Only SEP in operation; and
    - The two projects operating at the same time, with a gap of up to three years between each project commencing operation.

21. The operational lifetime of each project is expected to be 35 years.

16.3.2.4 Decommissioning Scenarios

22. Decommissioning scenarios are described in detail in **Chapter 5 Project Description**. Decommissioning arrangements will be agreed through the submission of a Decommissioning Plan prior to construction, however for the purpose of this assessment it is assumed that decommissioning of DEP and SEP could be conducted separately, or at the same time.

16.3.3 Summary of Mitigation Embedded in the Design

23. There is no embedded mitigation relevant to the Offshore Archaeology and Cultural Heritage assessment, which has been incorporated into the design of the projects to date. Other mitigation measures are proposed, as detailed in the impact assessment (**Section 16.3.3**).

24. An Outline WSI setting out the methodology for all proposed mitigation will be prepared as part of the DCO application. The WSI will take account of the standards and guidance presented in *Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects* (The Crown Estate, 2010).

16.4 Impact Assessment Methodology

25. The following sections set out the assessment methodology used to establish baseline conditions for offshore archaeology and cultural heritage within the study area and the approach to identifying and evaluating potential impacts upon the historic environment (within offshore and intertidal contexts, up to MHWS) arising as a result of the project.

16.4.1 Policy, Legislation and Guidance

16.4.1.1 National Policy Statements

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

27. The specific assessment requirements for Offshore Archaeology and Cultural Heritage as detailed in the NPS, are summarised in **Table 16-3** together with an indication of the section of the PEIR chapter where each is addressed.

Table 16-3: NPS Assessment Requirements.

NPS Requirement	NPS Reference	Section Reference
EN-1 Overarching 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. 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 and value of the archaeological receptors considered in this chapter have been detailed in **Section 16.5.5**. The contribution of setting to significance is addressed in **Section 16.5.4**. Issues relating to the setting of onshore heritage assets have been considered as part of **Chapter 23 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 16.5** 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 affected can be adequately understood from the application and supporting documents."	Paragraph 5.8.10	This chapter provides an account of the potential impacts of DEP/SEP upon heritage assets and their significance (**Section 16.6**).
EN-3 NPS for Renewable Energy Infrastructure		
"Consultation with the relevant statutory consultees (including English Heritage or Cadw) should be undertaken by the	Paragraph 2.6.140	Consultation has been undertaken with relevant

NPS Requirement	NPS Reference	Section Reference
applicants at an early stage of the development."		statutory consultees, as outlined in **Section 16.2**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 studies have underpinned the assessment (**Section 16.5** and **Appendix 16.1**). Geotechnical surveys have not been progressed pre-consent.
"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 the proposed DEP/SEP project have been identified and incorporated as part of **Section 16.5**.
"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 the proposed project upon onshore heritage assets have been considered in **Chapter 23 Onshore Archaeology and Cultural Heritage**.

16.4.1.2 Other

28. In addition to the above, there are a number of pieces of legislation, policy and guidance applicable to the assessment of Offshore Archaeology and Cultural Heritage.

29. DEP and SEP 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.

30. 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.

31. 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;
- Article 11: Mutual technical and scientific assistance.

32. 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.

33. 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 June 2019, 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 2019).

34. The aim of NPPF section 16 is to ensure that Regional Planning Bodies and local 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.

35. 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;
- Regard 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.

36. The NPPF's associated Planning Practice Guidance (PPG) 'Conserving and enhancing the historic environment' (DCLG 2014) 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 this project, EN-1 (the Overarching NPS for Energy) is the key decision-making document.

37. This assessment also takes account of the UK Marine Policy Statement (MPS) (HM Government 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 this project 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 16-4**.

Table 16-4: Summary of East Inshore and East Offshore Marine Plans.

Plan policies specific to heritage assets	PEIR 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 16.3.3.**

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

- The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3 (Second Edition) (Historic England, 2017);
- Chartered Institute for Archaeologists' 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 Seabed Development (Joint Nautical Archaeology Policy Committee (JNAPC), 2006).

39. In the absence of an industry standard methodology for heritage impact assessment within the framework of EIA, the assessment methodology adopted takes account of overarching principles presented in policy and guidance:

- NPPF (Department for Communities and Local Government, 2012 Revised June 2019);
- Marine Policy Statement (HM Government, 2011);
- Overarching NPS for Energy (EN-1) and NPS for Renewable Energy Infrastructure (EN-3) (DEFRA, 2011); and
- Conservation Principles: For the Sustainable Management of the Historic Environment (Consultation Draft 10th November 2017, Historic England 2017a).

40. Further detail is provided in **Chapter 3 Policy and Legislative Context**.

16.4.2 Data and Information Sources

16.4.2.1 Site specific surveys

41. Two campaigns of Geophysical Survey were undertaken in 2019 and 2020 In order to provide site specific and up to date information on which to base the impact assessment. Data were acquired by Gardline over the Export Cable Route between September and December 2019 and consisted of sub-bottom profiler (SBP), sidescan sonar (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*.

42. Geophysical data were acquired over the remainder of the study area by Gardline between 31 March to 26 May 2020 consisting of SBP, SSS, Mag. 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.

43. Full details of the technical specifications of the acquired geophysical data can be found in **Section 2.2** of **Appendix 16.1**.Once processed, Wessex Archaeology assessed each dataset for quality and their suitability for archaeological purposes based upon the criteria set out in **Table 16-5** below.

Table 16-5: Wessex Archaeology's criteria for assigning data quality rating (Appendix 16.1, 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.

Data Quality	Description
	Seabed 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 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. Seabed 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. Seabed 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.

44. A summary of the acquired geophysical data and the quality ratings assigned by Wessex Archaeology are set out in **Table 16-6** below.

Table 16-6: 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

Survey Campaign	Data Type	Data Quality	Notes
			although larger objects such as wrecks and larger debris items were still identifiable in the data.
	Mag	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.
	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.
	Mag	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.

Survey Campaign	Data Type	Data Quality	Notes
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.

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

46. Following the assessment of marine geophysical data (as set out in **Appendix 16.1**) additional interlink cable corridors were added to the scope and an addendum for these areas was prepared by Wessex Archaeology (**Appendix 16.2**).

47. It should be noted that some, limited parts of the study area were not covered by the 2019/2020 surveys:

- A corridor approximately 400m wide, along the northern edge of the existing Sheringham OWF (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 the Dudgeon OWF and DEP North and DEP South and where the previous phase of assessment for Dudgeon OWF (Wessex Archaeology 2009a and 2009b) was used for interpretation;
- The DEP South to DEP North interlink cable 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 cable corridor option which passes around SEP was covered by the assessment of the 2013 data for the Dudgeon OWF (Wessex Archaeology, 2014) with the exception of the northern section (along the northern edge of SEP) which has no geophysical data coverage.

48. , Where the 2019/2020 datasets overlap with assessments previously undertaken for the Sheringham OWF and Dudgeon OWF, these have been fully integrated with the current dataset as set out in **Appendix 16.1** and **Appendix 16.2**. However, as the original Dudgeon assessment and Sheringham assessment 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.

49. With the addition of historic datasets, the geophysical data assessment carried out in support of this PEIR is considered to provide an accurate characterisation of the archaeological potential of the study area, appropriate to the purposes of EIA.

16.4.2.2 Other available sources

50. Other sources that have been used to inform the assessment are listed in **Table 16-7**.

Table 16-7: 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

Data set	Spatial coverage	Notes
		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, seabed topography and topography
Relevant documentary sources and grey literature	UK	Various (see **Table 16-12**)

16.4.3 Impact Assessment Methodology

51. **Chapter 6 EIA Methodology** provides a summary of the general impact assessment methodology applied to DEP and SEP. The following sections confirm the methodology used to assess the potential impacts on Offshore Archaeology and Cultural Heritage.

52. The specific approach to the assessment of impacts for Offshore Archaeology and Cultural Heritage are detailed below. In the absence of an industry standard methodology for heritage impact assessment within the framework of EIA, the impact assessment methodology adopted will take account of overarching principles presented in policy and guidance:

- NPPF (MHCLG 2019);
- Marine Policy Statement (HM Government 2011);
- The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3 (Historic England 2017); and
- Conservation Principles: For the Sustainable Management of the Historic Environment (Consultation Draft 10th November 2017, Historic England 2017a).

16.4.3.1 Definitions

53. The impact assessment methodology adopted for offshore and intertidal archaeology 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 indirect (non-physical) impacts upon 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 and the historic seascape character.

54. More specifically, the impact assessment will present:

- The perceived heritage importance of identified assets;
- A consideration of heritage significance, and where relevant the contribution that setting makes to the heritage significance of the assets identified as being affected, both designated and non-designated;
- The anticipated magnitude of impact (change to heritage significance) upon those assets identified; and
- The significance of effect (in EIA terms) of any identified impacts upon those assets identified.

55. The impact assessment methodology adopted differs from some of the more standard approaches and terminology used and applied more generally within the PEIR for other technical disciplines. The standardised and tailored EIA matrices provide a useful guidance framework for the expert judgement by suitably experienced and qualified heritage practitioners based on the heritage specific legislation, policy and guidance documents available, and using the fundamental concepts from the NPSs and NPPF of benefit, harm and loss.

16.4.3.2 Heritage Significance and Heritage Importance

56. 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 (NPPF 2019, Annex 2). A statement of heritage significance should explain why we value a heritage asset. Understanding the heritage significance of an asset should not be confused with a description of that asset which does not articulate ‘what matters and why’.

57. Heritage significance does not have a scale associated with it and it is therefore not appropriate to refer to ‘high’ or ‘low’ heritage significance. This scaling is addressed through the separate consideration of a heritage asset’s importance. Heritage 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.

58. The importance of a heritage asset is a measure of the degree to which we seek to protect and preserve the heritage 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, as well as conclusions regarding the significance of effect (in EIA terms) once combined with assessed magnitude of impacts on heritage significance.

59. Importance is scaled (unlike heritage 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.

16.4.3.3 Sensitivity (Heritage Importance)

60. 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 any identified impact is largely a product of the heritage importance of an asset (rather than its sensitivity) and the perceived magnitude of the effect on it, assessed and qualified by professional judgement.

61. The initial indicative criteria for determining the heritage importance of any relevant heritage assets are described in **Table 16-8**.

62. 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.

63. Establishing heritage importance (or likely heritage importance) of an asset or group of assets, and the related significance of effect by considering the perceived magnitude of impact on the asset or assets, assists in the development of appropriate evaluation and mitigation approaches. It is important to note that the heritage importance and heritage significance of an asset can be amended or revised as more information comes to light.

64. **Table 16-8** 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 16-8** 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 archaeological impact assessment and reduces the potential for impacts to be under-estimated.

Table 16-8: Indicative Criteria for Determining Heritage Importance

Sensitivity	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

Sensitivity	Definition
	• 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
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

16.4.3.4 Magnitude

65. Magnitude can be broadly defined as the degree to which heritage significance positively or negatively changed.

66. 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.

67. The finite nature of archaeological remains means that physical impacts are almost always adverse, permanent and irreversible; 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 the DEP and SEP and the sensitivity with which the landscape is re-instated subsequent to decommissioning / demolition, if applicable.

68. The magnitude of beneficial impact with respect to Offshore Archaeology and Cultural Heritage directly relates to the level of public value 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).

69. 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.

70. The indicative criteria used for assessing the magnitude of impact with regard to archaeology and cultural heritage are presented in **Table 16-9**.

Table 16-9: Indicative Criteria for Assessing Magnitude of Impact

Magnitude	Definition
High Adverse	Key elements of the asset's fabric and/or setting are lost or fundamentally altered, such that the asset's heritage 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 heritage significance.
Low Adverse	Elements of the asset's fabric and/or setting which contribute to its heritage significance are affected, resulting in a slight loss of heritage significance.
Negligible	The asset's fabric and/or setting is changed in ways which do not materially affect its heritage 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.

Magnitude	Definition
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 heritage significance.

71. It is important that there is a narrative behind the assessment for example as a modifier (qualifier) for the heritage importance assigned to an asset, or the perceived magnitude of impact on the asset, as well as the subsequent anticipated significance of effect (**Section 16.4.3.5**).

16.4.3.5 Impact Significance

72. Following the identification of the heritage importance of the asset, and the magnitude of the potential effect upon heritage significance, it is possible to determine the significance of the effect in EIA terms using the matrix presented in **Table 16-10**.

73. The significance of effect is qualitative and reliant on professional experience, interpretation and judgement. The matrix should therefore be viewed as a framework to aid understanding of how a judgement has been reached, rather than as a prescriptive, formulaic tool.

Table 16-10: Impact significance matrix.

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Heritage 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

74. As with the definitions of magnitude and heritage importance, the matrix used is clearly defined by the expert assessor within the context of that assessment. The impact significance categories are divided as shown in **Table 16-11**.

75. Following initial assessment, if the impact does not require additional mitigation (or none is possible) the residual impact will remain the same. If, however, additional mitigation is proposed there will be an assessment of the post mitigation residual impact.

Table 16-11: Definition of impact significance.

Significance	Definition
Major	Change in heritage 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.

Significance	Definition
	Effective/acceptable mitigation options may still be possible, to offset and / or reduce residual impacts to satisfactory levels.
Moderate	Change in heritage 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 heritage 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 heritage significance.
No change	No impact, therefore, no change to heritage significance.

76. For the purposes of this chapter of the EIA, 'major' and 'moderate' impacts are generally deemed to be significant (in EIA terms). In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively or through interactions between heritage assets or elements of the historic environment (historic landscape/seascape).

77. Where uncertainty occurs, a precautionary approach will be taken to ensure that impacts are not under assessed. Where the extent of harm is uncertain, either because an asset is not fully understood (i.e. if further investigation is required to establish the significance of an asset) or the magnitude of the impact is unclear (i.e. because the design is not yet finalised) the precautionary approach is to assume the potential for major (substantial) harm.

78. Proposed mitigation (for example where potential impacts to known heritage assets are avoided through AEZs and micro-siting through design) is referred to and included prior to initial assessment of impacts. If the impact does not require mitigation (or no mitigation is possible) the residual impact will remain the same. If, however, specific mitigation is required then there an assessment of the post-mitigation residual impact is provided.

16.4.4 Historic Seascape Character

79. The approach to the assessment of HSC differs to that outlined above for heritage assets.

80. 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.

81. It is not meaningful, therefore, to assign a level of heritage 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 DEP and SEP, 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 HSC are dynamic, and may be temporary and reversible.

16.4.5 Cumulative Impact Assessment Methodology

82. The CIA considers other plans, projects and activities that may impact cumulatively with DEP and SEP. As part of this process, the assessment considers which of the residual impacts assessed for DEP and/or SEP 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 6 EIA Methodology** provides further details of the general framework and approach to the CIA.

83. 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 8**) arising from the proposed project alone and those arising from the proposed project cumulatively or in combination with other OWF developments.

84. Cumulative impacts are considered in **Section 16.7**.

16.4.6 Transboundary Impact Assessment Methodology

85. 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 6 EIA Methodology** provides further details of the general framework and approach to the assessment of transboundary effects.

86. 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.

87. Transboundary impacts are considered in **Section 16.8**.

16.4.7 Assumptions and Limitations

88. The records held by the UKHO, 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

16.5 Existing Environment

16.5.1 Seabed Prehistory

89. There are no known seabed prehistory sites within the study area.

90. The potential for prehistoric sites to be present within study area, either exposed on or buried within the seabed, 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 seabed. 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.

91. The shallow geology of the study area has been established from SBP 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 16.1** and **Appendix 16.2** and is summarised below. Geotechnical investigations have not been carried out for the purposes of EIA although account has been taken of previous geoarchaeological assessments undertaken for the Sheringham Shoal and Dudgeon OWFs as summarised in **Table 16-12** below.

Table 16-12: Summary of previous geoarchaeological assessments for Dudgeon and Sheringham Shoal OWFs

Date	Summary	References
2006	Archaeological assessment of vibrocores taken along the Sheringham Shoal Offshore Wind Farm cable route undertaken by Wessex Archaeology identified a sequence of sediment 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.	Wessex Archaeology (2006a) Sheringham Shoal Offshore Wind Farm Desk 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 the Dudgeon OWF by Wessex	Wessex Archaeology (2009a) Dudgeon Offshore Wind Farm:

Date	Summary	References
	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).	Archaeological Desk Based and Geophysical Assessment. Report ref. 69680.08
2009	Assessment of marine geophysical data from a proposed extension to the Dudgeon OWF 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 (Devensian) 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	Brown A, Russel J, Scaife R, Tizzard L, Wittaker J, Wyles S F. (2018). Late glacial/ early, Holocene paleoenvironments in the southern North Sea Basin: new data from the Dudgeon offshore wind farm, Journal

Date	Summary	References
	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 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.	of Quaternary Science 33(6), 597-610
2020	Assessment of marine geophysical data and the identification of 110 features of palaeogeographic interest.	Wessex Archaeology. (2020). Dudgeon and Sheringham Offshore Wind Farm Extensions Archaeological Assessment of Geophysical Data. Document reference 233450.01
2021	Assessment of marine geophysical data from cable corridors linking DEP North and DEP South, running along the southern extent of the current Dudgeon OWF (DEP South to DEP North along Dudgeon'); a corridor running along the north and eastern edge of SEP ('Around SEP'); a corridor running south through the proposed SEP and along the north-eastern edge of the current Sheringham Shoal OWF ('Through SEP along Sheringham Shoal') and a final corridor 'straight through SEP'. Two anomalies (7025 and 7032) were identified during the 2009 assessment were identified in the study area as a high amplitude reflector and interpreted as being possible peat.	Wessex Archaeology. (2021). Dudgeon and Sheringham Offshore Wind Farm Extensions Archaeological Assessment of Geophysical Data – Addendum. Document reference 233450.02

92. The geology within the study area has been divided by Wessex Archaeology into eight phases as summarised in **Table 16-13.**

Table 16-13: Shallow Stratigraphy of the Study Area Identified by Wessex Archaeology (Appendix 16.1 Table 8)

Unit	Unit Name	Geophysical Characteristics (1)	Sediment Type (2)	Archaeological Potential
8	Holocene Seabed	Generally observed as a veneer across	Gravelly sand with shell	Considered of low potential in itself, but

Unit	Unit Name	Geophysical Characteristics (1)	Sediment Type (2)	Archaeological Potential
	Sediments (post-transgression) (Marine Isotope Stage (MIS) 1)	the site, but occasionally thickening into large sand wave and bank features. Boundary between surficial sediments and underlying units not always discernible, but an occasionally, distinct horizontal reflector may mark the base of sand in some locations.	fragments, sand waves and ripples indicate sediment is mobile.	possibly contains reworked artefacts and can cover wreck sites and other cultural heritage.
7	Holocene Sediments (Pre-transgression) (MIS 2 to 1)	Small shallow infilled channels with either seismically transparent fill, or fill characterised by sub-parallel internal reflectors. May also comprise a basal, high amplitude reflector, possibly representing a peat layer.	Fluvial, estuarine and terrestrial (including peat) deposits.	Potential to contain *in situ* and derived archaeological material, and palaeoenvironmental material.
6b	Botney Cut Devensian to possibly Early Holocene (MIS 2 to 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. Alluvial (estuarine) and terrestrial (peat) sediments probably relating to the Holocene	Upper deposit of glaciolacustrine mud infilling sub-glacial valleys. Upper deposits could possibly contain derived or *in situ* artefacts and preserved palaeoenvironmental material.
6a	Botney Cut Devensian to possibly Early Holocene age (MIS 2)	Acoustically chaotic unit with faint basal reflector, possibly infilling broad, faint channel features.	Glacial tills	Sequence of glacial till. Likely to have removed earlier archaeological material, the lower

Unit	Unit Name	Geophysical Characteristics (1)	Sediment Type (2)	Archaeological Potential
		Some sub-horizontal internal reflectors.		till is unlikely to contain artefacts.
5	Bolders Bank (Late Devensian) (MIS 2)	Acoustically chaotic blanket deposit often with internal reflectors and some occasional internal channeling	Subglacial terrestrial till	Glacial till deposits. Likely to have removed earlier archaeological material and unlikely to contain artefacts.
4	Egmond Ground (Hoxnian/ Wolstonian) (MIS 8)	Fill characterised by numerous faint reflectors and a distinct basal reflector	Sands and gravels of probably marine origin.	Shallow marine sediments. Earlier *in situ* deposits may be buried by the formation.
3	Swarte Bank Formation (Anglian/Early Hoxnian) (MIS 12/11)	Acoustically chaotic unit with faint basal reflector, possibly infilling broad, faint channel features. Some sub-horizontal internal reflectors.	Sub-glacial channel fill, comprising a basal reworked till with upper glaciolacustrine / glaciomarine sediment.	Sequence of glacial till, glaciolacustrine muds and glaciomarine sands infilling large sub-glacial valleys. Likely to have removed earlier archaeological material and the fill is unlikely to contain artefacts.
2	Pre-Devensian Weybourne Channel	Broad, distinct channel feature with an undulating basal reflector. Fill characterised by an upper unit characterised by numerous, faint sub horizontal 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 thought to have the potential to contain *in situ* and derived archaeological material, and palaeoenvironmental material.
1	Upper cretaceous chalk	Fairly acoustically quiet with some, faint dipping reflectors	White and greyish white chalk with	Pre-Earliest occupation of the UK

Unit	Unit Name	Geophysical Characteristics (1)	Sediment Type (2)	Archaeological Potential
			some nodular flint and some softer "putty" chalk, resulting in periglacial activity.	
(1) Based on geophysical data (2) Based on vibrocore and borehole data (Wessex Archaeology 2009c; 2014a; 2016) and Cameron et al., (1992)				

93. The stratigraphy set out in **Table 16-13** 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.

94. 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 16-13** to provide a detailed description of the potential for submerged prehistoric archaeology to be present within the study area. **Table 16-14** 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 16.1**.

Table 16-14: 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

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

96. Unit 1 (Upper Cretaceous chalk) is the oldest deposit noted across any of the project areas and is only identified within the 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.

97. 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 the Dudgeon OWF (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.

98. 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 area, but due to acoustic similarities with Unit 5 (discussed below) has not been definitively identified. During the previous assessments of vibrocore and borehole data, these sediments were found to comprise gravelly sandy clay (Wessex Archaeology 2009c). 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.

99. Unit 4 (Egmond Ground (Hoxnian/Wolstonian) (MIS 8)) consists of sands and gravels laid down in the Hoxnian and Wolstonian 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 DEP North as a probable blanket deposit across the entire area.

100. Unit 5 (Bolders Bank (Late Devensian) (MIS 2)) comprises subglacial terrestrial tills laid down in the Late Devensian 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 within all of the project areas 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 seabed.

101. 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 the Sheringham Shoal OWF.

102. 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 the Dudgeon and Sheringham Shoal OWFs, 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).

103. 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 cable corridors between DEP North and SEP and DEP South and SEP , either late Devensian or possibly Holocene in age (Units 6b and 7);
- Two Botney Cut channels are identified in the eastern section of DEP South (**79056-7**);
- A broad Botney Cut channel (**79044**) interpreted as cutting across the north of DEP North, 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 DEP North, adjacent to the Dudgeon OWF, and not covered by the SBP data acquired for this phase of assessment;
- A number of channel features within the SEP area (**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 complex cut and fill feature (70721) and three simple cut and fills (79045-7) identified within the DEP South to DEP North along Dudgeon interlink cable corridor, two simple cut and fills identified within the Straight Through SEP interlink cable corridor and the simple cut and fill (79062) identified within the Through SEP Along Sheringham Shoal interlink cable corridor. These features 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.

104. 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.

105. 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.

106. 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.

107. Throughout all of the project areas 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.

108. 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.

109. Unit 8 Holocene Seabed 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 project areas as either a thin veneer or thickening out into sand waves. In several areas across the project areas, an erosion surface has been identified which possibly represents a former terrestrial landscape which may contain peat.

110. 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.

111. A fine-grained deposit (**79023**) is interpreted in the central section of the interlink corridor between DEP South and SEP 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.

112. In several places across the study area, including in the northern section of the DEP South to DEP North interlink cable corridor, and the south-eastern corner of the 'Through SEP Along Sheringham Shoal' interlink 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 16.2**) however it has not been given its own anomaly number. Within DEP South, 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.

113. The relationship between the potential for submerged prehistoric archaeology within the DEP and SEP project areas and wider evidence for East Coast palaeolandscapes is discussed further with respect to both HSC (**Section 16.5.4**) and CIA (**Section 16.7**) below.

16.5.2 Maritime and Aviation Archaeology

114. 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.

115. SSS, MBES and magnetometer data interpreted by Wessex Archaeology has demonstrated the presence of a number of seabed features which have been identified as being of archaeological interest (A1) or potential archaeological interest (A2 and A3). Seabed features are discriminated by Wessex Archaeology in accordance with the definitions set out in **Table 16-15**.

Table 16-15: Wessex Archaeology criteria for discriminating relevance of identified seabed 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

116. A full list of seabed features interpreted from the data by Wessex Archaeology for the DEP and SEP sites are included in the gazetteer in **Appendix 16.1**, with features identified within the additional interlink cable corridor options included in **Appendix 16.2**. The locations of these features are illustrated in **Figures 5.01** to **5.30** of **Appendix 16.1** and **Figures 3.01** to **3.03** of **Appendix 16.2**. These features are discussed in detail in **Appendix 16.1** and **Appendix 16.2** and are summarised below.

117. 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 16-16**. Where the interlink cable corridors overlap other areas, there are nine anomalies which are located in more than one project area. In **Table 16-16** these are only counted once in the totals. These are:

- **7035** and **72513** which are located within DEP North and also within the interlink cable corridor from DEP North to DEP South;
- **72683** which is located within the interlink cable corridor between DEP South and SEP and the interlink cable corridor which passes around SEP; and
- **7124**, **72546**, **72593**, **72596**, **72632** and **72640** which are located within SEP and the interlink cable corridors which pass through SEP.

Table 16-16: Distribution of seabed features within the study area identified by Wessex Archaeology.

Archaeological Discrimination	Number of Seabed Features					Total
	DEP South	DEP North	SEP	Export Cable Corridor	Interlink 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

118. These anomalies have also been classified by probable type as shown in **Table 16-17**.

Table 16-17: 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 seabed, 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

Anomaly Classification	Definition	Number of Anomalies
Debris (A2)	Distinct objects on the seabed, generally exhibiting height or with evidence of structure, that are potentially anthropogenic in origin.	121
Seabed disturbance (A2)	An area of disturbance without individual, distinct objects. Potentially indicates wreck debris or other anthropogenic features buried just below the seabed.	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 seabed with depth. Potentially indicates scour around a buried feature or where a feature has been cleared.	1
Magnetic (A2)	No associated seabed 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 seabed anomalies, but for which no associated feature has been identified within the current data set.	1
Total		550

119. Of the A1 features identified within the study area, 17 have previously been charted by the UKHO and are summarised within **Table 16-18** below.

Table 16-18: A1 anomalies previously charted by the UKHO

Wessex ID	UKHO ID	Wreck Name	Description	Project Area
7043 (**Appendix 15.1**, **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 seabed in a north-east to south-west orientation.	SEP wind farm site

Wessex ID	UKHO ID	Wreck Name	Description	Project Area
72544 (Appendix 15.1, 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 15.1, Wreck Sheet 7)	9513	N/A	Northern section of the above wreck. Orientated on the seabed in a NNE to SSW 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 15.1, 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 15.1, 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 seabed. 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 15.1, 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 15.1, 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

Wessex ID	UKHO ID	Wreck Name	Description	Project Area
72574 (**Appendix 15.1**, **Wreck Sheet 12**)	9259	*Sitona*	A large wreck that appears relatively intact and upright on the seabed. The wreck is orientated north-east to south-west on a featureless area of seabed. 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 15.1**, **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 (**Appendix 15.1**, **Wreck Sheet 8**)	9242	*HMS Arley*	A large collapsed wreck in a featureless area of seabed with some of the hull still intact with the 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	SEP wind farm site
72534 (**Appendix 15.1**, **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
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

Wessex ID	UKHO ID	Wreck Name	Description	Project Area
72714 (**Appendix 15.1**, **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
72697 (**Appendix 15.1**, **Wreck Sheet 17**)	9267	*Pacific SS*	A very large wreck that appears to be upright on the seabed. The wreck is orientated north-west to south-east on a sandy and featureless areas of seabed. 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
7040 (**Appendix 15.1**, **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 15.1**, **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 Corridor
7041 (**Appendix 15.1**, **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

120. Additionally, three of the wrecks listed in **Table 16-18** have also been recorded by the NRHE. These are the *HMS Kylemore* (**NRHE 24638**), the *Sitona* (**NRHE 24642**) and wreck **7043** (**NRHE 108425**).

121. 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**).

122. Wreck **72596**, located within the SEP wind farm site, was identified within the SSS data as a distinct oval outline measuring 36.4 x 15.6 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 16.1**). 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.

123. 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.

124. Similarly, anomaly **72535** has been interpreted as debris associated with wreck **72534** located 7.0m to the south, within the DEP North wind farm site. 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.

125. Anomaly **7083,** located within the DEP South, 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.

126. 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 16.1**) which may itself be the remains of the steamship *Czestochowa*.

127. 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.**

128. In addition to the A1 anomalies, 518 seabed features have been discriminated as A2 anomalies (uncertain origin of possible archaeological interest). These are detailed in **Appendix 1** of **Appendix 16.1** and **Appendix 1** of **Appendix 16.2**.

129. Seabed features interpreted as A2 have been identified as being of possible anthropogenic origin and have the potential to represent archaeological material on the seabed 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.

130. 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.

131. 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 seabed 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 seabed, with factors of consideration including the age of the vessel, the construction material, the seabed sediment type, the prevailing hydrodynamic and sedimentary regimes of the area and the occurrence of any seabed activities in that location.

132. The NRHE groups recorded losses at arbitrary points on the seabed called Named Locations, these represent general loss locations and do not (unless by chance) relate to actual seabed 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 16-19.**

Table 16-19: 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.
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 1815.

133. 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.

134. 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 the Sheringham Shoal and Dudgeon OWFs. 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. During UXO investigation and clearance undertaken for Dudgeon OWF, 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 16.2**)), 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.

135. These discoveries from the Dudgeon OWF, adjacent to the DEP offshore area indicate the likely potential for similar discoveries within both DEP and SEP, possibly represented by the position of the geophysical anomalies identified by Wessex Archaeology (**Appendix 16.1**). 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.

136. 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.

137. 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.

138. There is only one further recorded loss in the vicinity of DEP and SEP 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 DEP South and SEP, however, is c. 67km from Ingoldmells (c. 42 miles) suggesting that the location may be reported inaccurately in the NRHE record.

139. Nonetheless, these records, alongside the known presence of aircraft remains recorded during assessment undertaken for the Dudgeon OWF, indicate the high potential for aircraft remains to be present within the DEP and SEP project areas. 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 the Dudgeon OWF, 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 Dudgeon OWF 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 tow further items of associated debris also seen in the Remote Operated Vehicle (ROV) footage.

140. 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.

16.5.3 Intertidal Archaeology

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

142. A total of 45 HER (Norfolk) records have been identified within the intertidal zone which related to known heritage assets (**Figure 16.1**).

143. 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.

144. 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 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.

145. 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.

146. 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**).

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

148. 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.

149. 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.

150. Based on the amount of WWI and WWII 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.

151. 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.

16.5.4 Historic Seascape Character and Setting

152. 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 2015. 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 GIS to map data that can be queried to identify the key cultural processes that have shaped the historic seascape within a given area.

153. 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 and the previous (prehistoric and historic) 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 16-20.**

Table 16-20: 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 its biodiversity and habitat range and has high archaeological potential and can contribute to our understanding of past landscape use. These two types of seabed 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. here bedrock extends onto the foreshore it may become part for a ‘Rocky foreshore’ Bedrock exposures are 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

Broad Character Types	Character Sub-Types	Perceptions
		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 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 CO2 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 Dudgeon and Sheringham Shoal OWFs 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 Dudgeon OWF and the DEP and SEP projects. However, hydrocarbon remains a strong character type in the study area with, for

Broad Character Types	Character Sub-Types	Perceptions
		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)
	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.

Broad Character Types	Character Sub-Types	Perceptions
		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 16.5.2** 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 archaeological community. See **Section 16.5.1** for detail on submerged prehistoric landscapes within the study area.
	Fishing Ground (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

Broad Character Types	Character Sub-Types	Perceptions
	Drift Netting (Early Modern (AD1750 – 1900) Bottom Trawling Modern (AD1900 – Present)	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 has previously not been accessible.
	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.

154. 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.

155. Historic England's guidance on setting (2017) notes how the setting of buried heritage assets may not be readily appreciated by a casual observer but retain a presence in the landscape. To this end, the assessment of the setting for offshore heritage assets focuses on the physical setting (i.e. historic associations and character) of an asset. 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), for the most part submerged archaeological sites are not 'readily appreciated by a casual observer'.

156. As discussed in **Section 16.5.2**, 17 previously known wrecks have been identified, of these nine have been named while the other nine are unidentified.

157. Within the interlink cable corridor between DEP North and SEP one named wreck is currently identified, the *Ottar Jarl* (**72647**).

158. Six named wrecks have been identified within the SEP area, these being, the *Chelsea* (**72565**), the *Czestochowa* (**72615**), the *HMS Arley* (**72552**), the *HMS Kylemore* (**72582**), the *Robert W Pomeroy* (**72561**) and the *Sitona* (**72579**).

159. Two wrecks have been identified within the DEP area, these are the named wrecks the *Pacific SS* (**72697**) and the *Aquarius* (**7035**).

160. Of the 9 named wrecks listed, six were lost during the hostilities of WWII, these being the *Pacific SS,* the *Aquarius,* the *Czestochowa, HMS Arley, HMS Kylemore,* the *Robert W Pomeroy* and the *Sitona.* 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 16.5.3** 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 loss 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.

161. The 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.

162. 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.

163. For the eight unidentified wrecks (**7040**, **7041**, **7043**, **72534**, **72714**, **7043**, **72544**, **72541**, and **72557**) there is no further information which can be used to ascertain the contribution the setting makes to its significance.

164. The settings assessment undertaken for Onshore Archaeology and Cultural Heritage Assets (**Chapter 23**) will include the assessment of onshore heritage assets from infrastructure below MHWS. The onshore heritage setting assessment, however, is currently ongoing and will be informed by Landscape and Visual Impact Assessment (LVIA) toolkits and further site visits. The full findings of the heritage setting assessment will be presented in the ES, accompanying the final DCO application.

16.5.5 Heritage Significance (importance)

165. The offshore and intertidal archaeological and cultural heritage baseline within the study area (based on available information) comprises:

- Palaeogeographic features of probable/possible archaeological interest (P1and P2);
- Recorded wrecks/debris (A1 and A3);
- Geophysical anomalies of possible archaeological interest (A2);
- WWII coastal and beach defences, and the potential for associated archaeological material buried within the beach;
- Potential for the discovery of prehistoric sites and artefacts from the lower Palaeolithic to the Mesolithic;
- Potential for the discovery of maritime related archaeological material from the late Mesolithic to the present; and
- Potential for the discovery of aviation related archaeological material from the 20th century.

166. The heritage importance of the heritage assets outlined above are presented in **Table 16-21**. For the purposes of assessment, the importance of potential discoveries has been defined as high importance for *in situ* sites and finds and medium importance for isolated finds within secondary contexts. However, each individual discovery would be considered independently and any requirements for further data gathering or analysis would be considered on a case-by-case basis according to the importance of the discovery. Known un-named wrecks (and associated debris) are also assigned as high importance. Should further information be acquired which serves to identify these wrecks and informs upon their nature and character, their heritage importance may be revised in light of new data.

Table 16-21: Summary of Heritage Significance (Importance)

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

Asset Type	Definition	Importance
Potential derived Prehistoric finds	Isolated discoveries of prehistoric archaeological material discovered within secondary contexts	Medium
Potential palaeoenvironmental evidence	Isolated examples of palaeoenvironmental material	High
	Palaeoenvironmental material associated with specific palaeolandscape features or archaeological material	
Known maritime heritage assets	Named wrecks and associated debris (A1)	High
	Debris identified as possible wreck sites or associated debris (A1)	
	Un-named wrecks and associated debris fields / debris (A1)	
	Seabed 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
Intertidal assets	Isolated artefacts and findspots dating from Prehistoric, Roman, Medieval, Post-Medieval and Modern periods which are located within the intertidal zone	Negligible

Asset Type	Definition	Importance
	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

167. The nine named wrecks all represent vessels built in the late 19th / early 20th century, six of which were lost as result of 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.

168. 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.

169. 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. On the basis that they may be considered to as assets of regional importance due to their association with WWI and WWII and the East Coast channels, they are regarded as heritage assets of medium importance.

16.5.6 Climate Change and Natural Trends

170. 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.

171. 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’.

172. The Norfolk Coast 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.

173. 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.

174. 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.

175. Cycles of burial and exposure resulting from marine physical processes, including storm events which can result in the stripping of shallow sediment from the seabed and beach, have an ongoing effect upon the preservation of archaeological material. As described in **Section 16.5.3** 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.

176. 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.

16.6 Potential Impacts

16.6.1 Potential Impacts during Construction

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

177. Direct (physical) impacts, as stated in the NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b: 49), encompass direct effects from the physical siting of the projects. Direct impacts to heritage assets, either present on the seafloor or buried within seabed 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 DEP and SEP (i.e. foundations or cables) or within the footprint of activities such as seabed clearance, anchoring or the placement of jack up barges.

178. As described in **Section 16.5.2** above, there are 550 seabed 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:

- Seabed 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
- Seabed contact by legs of jack-up vessels and / or anchors.

179. Within the intertidal zone (see **Section 16.5.3**), 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, however, all such remains will be avoided through the use of HDD to install the cable ducts, passing below the beach deposits, and there is no direct pathway for impact to intertidal assets.

180. There are no known seabed prehistory sites within the study area.

16.6.1.1.1 Magnitude of effect – DEP or SEP in Isolation

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

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

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

184. 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 DEP or SEP. It is not currently possible to determine how many, or which of the seabed features will be impacted, nor how such impacts would occur or the extent of such impacts.

185. Therefore, with the application of a precautionary approach, it is necessary to assess the worst case scenario which assumes that, if any of the seabed 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 16-9**, without mitigation, there is potential for direct impacts of high adverse magnitude for any of the identified features.

16.6.1.1.2 Magnitude of effect – DEP and SEP Together

186. 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 DEP and SEP. Therefore, without mitigation, there is potential for direct impacts of high adverse magnitude for any of the 550 identified features.

16.6.1.1.3 Impact Significance – DEP or SEP in Isolation

187. As set out in **Section 16.5.5**, all known heritage assets are of medium (named A1 wrecks) or high heritage significance (importance). In accordance with the impact significance matrix (**Table 16-10**) without mitigation, should impacts occur within either DEP or SEP in isolation, these have the potential to be of major adverse significance.

16.6.1.1.4 Impact Significance – DEP and SEP Together

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

16.6.1.1.5 Mitigation

189. With the application of the mitigation, to be set out in the Outline WSI which will be submitted alongside the DCO application, it is anticipated that all direct impacts to known heritage assets as a result of the project would be avoided.

190. Subject to approval by Historic England, it is recommended that AEZs are implemented around all 30 A1 anomalies. The locations of these features are illustrated on **Figures 5.01** to **5.30** in **Appendix 16.1**.

191. Ten anomalies have existing AEZs in place associated with the current Dudgeon and Sheringham OWFs (**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.

192. 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.

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

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

195. 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.

196. 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.

197. 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.

198. The proposed AEZs are summarised in **Table 16-22** below:

Table 16-22: Recommended AEZs within the study area.

ID Number	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
72534	Wreck	394815	5907658	New	100 m buffer around current feature extent	DEP North
72535	Debris field	394813	5907642	New	25 m buffer around current feature extent	DEP North

ID Number	Classification	Position (WGS84 UTM31N)		Status	Exclusion	Areas
		Easting	Northing			
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	SEP wind farm site

ID Number	Classification	Position (WGS84 UTM31N)		Status	Exclusion	Areas
		Easting	Northing			
					current feature extent	
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
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

ID Number	Classification	Position (WGS84 UTM31N)		Status	Exclusion	Areas
		Easting	Northing			
72700	Debris field	397251	5892193	New	25 m buffer around current feature extent	DEP South
72714	Debris field	399396	5893456	New	25 m buffer around current feature extent	DEP South
7083	Debris field	395482	5897504	Amended	65 m buffer around current feature extent	DEP South
72636	Recorded Wreck	372209	5899142	New	100 m buffer around central location	SEP wind farm site

199. 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 project lifetime 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.

200. 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 the 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 would be modified to avoid heritage assets where possible.

201. 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.

202. The approach to the implementation of these mitigation measures will be agreed in consultation with Historic England in accordance with industry standards and guidance including *Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects*. (The Crown Estate 2010). An Outline WSI setting out the methodology for all proposed mitigation will be prepared and submitted as part of the DCO application.

16.6.1.1.6 Residual Impacts – DEP or SEP in Isolation

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

204. Where micro-siting is not possible, with the application of mitigation it is anticipated that the residual magnitude and significance 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).

16.6.1.1.7 Residual Impacts – DEP and SEP Together

205. The application of mitigation (as detailed above) will be the same for the construction of both DEP and SEP, as for either project 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).

16.6.1.2 Impact 2: Direct impact to potential heritage assets

206. 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 project associated with the following activities:

- Seabed 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;
- Seabed contact by legs of jack-up vessels and / or anchors; and
- Cable installation at the landfall.

207. For the purpose of this assessment, potential heritage assets are regarded as comprising the following asset types (the importance of which is presented in **Section 16.5.5**):

- 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.

16.6.1.2.1 Magnitude of effect – DEP or SEP in Isolation

208. 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, means that impacts to potential intertidal archaeological material will be avoided. It is anticipated that HDD will pass beneath Quaternary deposits of potential archaeological interest and therefore, no impact will occur.

209. 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) would be adverse, permanent and irreversible. The 'fabric' of the asset and, hence, its potential to inform our historical understanding, will be removed.

210. In practice, the magnitude of the effect 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 seabed. 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 16-9**, without mitigation, there is potential for direct impacts of high adverse magnitude upon potential *in situ* heritage assets.

211. 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 16-9**, 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.

16.6.1.2.2 Magnitude of effect – DEP and SEP Together

212. As above, as the magnitude of the effect 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 effect for DEP and SEP together, compared with DEP or SEP 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.

16.6.1.2.3 Impact Significance – DEP or SEP in Isolation

213. As set out in **Section 16.5.5**, *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 16-10**, direct (physical) impacts to these heritage asset types thereby have the potential to be of major adverse significance, as a worst-case scenario.

214. 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.

16.6.1.2.4 Impact Significance – DEP and SEP Together

215. The potential impact significance for direct (physical) impacts to potential heritage assets, without mitigation, is the same for DEP and SEP together as for DEP or SEP 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).

16.6.1.2.5 Mitigation

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

217. 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 seabed prehistory within the East Coast region. There will be archaeological input into any future sampling programmes and all available pre-construction 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-consent stages of the project. If *in situ* prehistoric sites are identified as a result of such work then mitigation measures to record and/or protect such sites would be agreed in consultation with Historic England.

218. Similarly, the archaeological assessment of high-resolution geophysical data to be acquired 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.

219. If features of archaeological interest are identified during these further investigations post-consent, they will be subject to the same mitigation as described for known heritage assets described in **Section 16.6.1.1.5** above.

220. 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, measures are possible to further reduce the significance of potential impacts by ensuring that prompt archaeological advice is received in the event of a discovery and by recording and conserving any objects that have been disturbed.

221. 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 would be considered on a case by case basis, proportionate to the significance of the discovery.

222. The approach to the implementation of these mitigation measures will be agreed in consultation with Historic England in accordance with industry standards and guidance including *Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects*. (The Crown Estate 2010). An Outline WSI setting out the methodology for all proposed mitigation will be prepared and submitted as part of the DCO application.

16.6.1.2.6 Residual Impacts – DEP or SEP in Isolation

223. If further seabed features are identified during the course of 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 16.6.1.1.5** 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).

224. Similarly, with regard to potential prehistoric sites, with the additional investigation of potential prehistoric deposits 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 a **minor** adverse significance).

225. 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.

16.6.1.2.7 Residual Impacts – DEP and SEP Together

226. 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 project 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 DEP or SEP was to be built in isolation.

227. However, the application of mitigation, comprising further assessment and investigation 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 DEP and SEP, 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).

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

228. DEP and SEP 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.

229. The potential indirect impact to heritage assets from changes to physical processes is assessed with reference to **Section 8.6.4** (Potential Impact during Construction) of **Chapter 8 Marine Geology, Oceanography and Physical Processes**.

230. With respect to the marine physical processes Impact 7 (indentations on the seabed due to installation vessels), as the leg is inserted, the seabed 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 seabed sediments.

231. As it is only sediments within the immediate vicinity of the leg that would be impacted, it is also only heritage assets within the footprint of the legs that would 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.

232. 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 seabed level due to seabed preparation for foundation installation;
- Impact 2b: Changes in seabed level due to drill arisings for installation of piled foundations;
- Impact 4: Change in seabed level due to deposition from the suspended sediment plume during export cable installation within the offshore cable corridor; and

- Impact 6: Change in seabed level due to offshore cable installation (array and interlink cables).

16.6.1.3.1 Magnitude of effect – DEP or SEP in Isolation

233. The magnitude of effects for the marine physical processes impacts from Chapter 8 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 16-23**.

Table 16-23: Magnitude of effects on seabed level changes due to deposition under the worst-case scenario for sediment dispersal following GBS foundation installation.

Location	Scale	Duration	Frequency	Reversibility	Magnitude of Effect
Impact 2a: Changes in seabed level due to seabed preparation for foundation installation					
Near-field	Medium	Negligible	Negligible	Negligible	Low
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Impact 2b: Changes in seabed level due to drill arisings for installation of piled foundations					
Near-field	Low	Low-Medium	Low-Medium	Negligible	Low
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible
Impact 4: Change in seabed 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 seabed level due to offshore cable installation (array and interlink cables)					
Near-field	Low	Negligible	Negligible	Negligible	Low
Far-field	Negligible	Negligible	Negligible	Negligible	Negligible

234. 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 results 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.

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

16.6.1.3.2 Magnitude of effect – DEP and SEP Together

236. **Section 8.6.4** (Potential Impact during Construction) of **Chapter 8 Marine Geology, Oceanography and Physical Processes** concludes that for all elements, the change in seabed levels for DEP and SEP together will be similar or the same to that outlined for DEP and SEP in isolation. Therefore, the indirect effect of changes to marine physical process upon offshore heritage assets is also concluded to result in no impact.

16.6.1.3.3 Impact Significance – DEP or SEP in Isolation

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

16.6.1.3.4 Impact Significance – DEP and SEP Together

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

16.6.1.4 Impact 4: Impacts to the setting of heritage assets and historic seascape character

239. Indirect impacts on the historic environment of a non-physical nature, as stated in NPS EN-3 (DECC 2011b: 67), include effects on the setting of heritage assets. Indirect impacts upon the setting of heritage assets have the potential to occur throughout the lifetime of the project, thus encompassing all phases, from construction, into operation and subsequent decommissioning.

240. The setting of a heritage asset is 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. Indirect impacts to setting may occur if a development affects the surroundings in which a heritage asset is experienced.

241. Similarly, impacts to the character of the historic seascape may occur with the introduction of new elements causing a change in that character which may affect present perceptions of that seascape across an area. Indirect impacts upon the setting of heritage assets may arise as a result of above seabed infrastructure for the project during the operational phase, the effects of which may be long-term or permanent in nature. Indirect impacts upon the setting of heritage assets may also arise as a result of construction and decommissioning works, although effects will be, by comparison, shorter in duration and of a temporary nature.

242. As stated in **Section 16.4.4** above, it is not meaningful to assign a level of heritage importance to perceptions of character, which are by nature subjective, nor to assign a measure of magnitude in order to understand the nature of potential changes. Changes to the setting of offshore heritage assets, and to the historic seascape character, are therefore assessed in the form of a narrative.

243. The HSC of the study area and the setting of marine heritage assets will be temporarily affected during the construction phase by the presence of vessels, personnel and infrastructure associated with construction activities. The worst-case scenario anticipates that construction activities offshore could have a maximum duration of 4 years.

244. Construction activities may change perceptions of character with respect to the primary cultural processes which have been established and spatially defined through the HSC. The assessed capacity of each of the character sub-types to accommodate change during construction is set out in **Table 16-24**.

Table 16-24: 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 would be altered by construction activities.	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.	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.	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate 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 DEP and SEP are therefore likely to be seen as part of this natural progression for energy generation and as a positive change from fossil fuels to renewable energy.	Potential beneficial change
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, however, are considered unlikely to result in a meaningful change to the perceived character	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	Potential beneficial change
Navigation activity: Navigation route	Construction 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 is anticipated that no change to the perception of this	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
	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.	Potential beneficial change

245. The table above demonstrates that for most character sub-types, perceptions of historic character will remain unchanged or will result in a potential beneficial change.

246. In terms of setting, as part of the initial settings assessment undertaken in relation to onshore heritage assets, **Chapter 23 Archaeology and Cultural Heritage** has concluded that any changes in setting due to construction activities would 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 asserts during the construction phase have therefore also been excluded from further consideration (**no impact**).

16.6.2 Potential Impacts during Operation

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

247. As all known heritage assets will be avoided through the retention of AEZs throughout the project lifespan, there is no pathway for impact during routine or unscheduled maintenance activities.

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

16.6.2.2.1 Magnitude of effect – DEP or SEP in Isolation

248. 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.

249. 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.

16.6.2.2.2 Magnitude of effect – DEP and SEP Together

250. As above, as the magnitude of the effect 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 effect for DEP and SEP together, compared with DEP or SEP 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.

16.6.2.2.3 Impact Significance – DEP or SEP in Isolation

251. As set out in **Section 16.5.5**, *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 16-10**, direct (physical) impacts to these heritage asset types thereby have the potential to be of major adverse significance, as a worst-case scenario.

252. 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.

16.6.2.2.4 Impact Significance – DEP and SEP Together

253. The potential impact significance for direct (physical) impacts to potential heritage assets, without mitigation, is the same for DEP and SEP together as for DEP or SEP 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).

16.6.2.2.5 Mitigation

254. 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 would be subject to the same mitigation as described for known heritage assets described in **Section 16.6.1.1.5** above with the primary approach being avoidance.

255. 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.

256. The approach to the implementation of these mitigation measures will be agreed in consultation with Historic England in accordance with industry standards and guidance including *Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects*. (The Crown Estate 2010). An Outline WSI setting out the methodology for all proposed mitigation will be prepared and submitted as part of the DCO application.

16.6.2.2.6 Residual Impacts – DEP or SEP in Isolation

257. 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.

16.6.2.2.7 Residual Impacts – DEP and SEP Together

258. 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 DEP or SEP 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 DEP and SEP, 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).

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

259. DEP and SEP 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.

260. Potential indirect impact to heritage assets from changes to physical processes is assessed with reference to **Section 8.6.5** (Potential Impact during Operation) of **Chapter 8 Marine Geology, Oceanography and Physical Processes.**

261. For Impact 7 (cable repairs/reburial and maintenance vessel footprints) as only sediments within the immediate vicinity of the leg will be impacted, only heritage assets within the footprint of the legs would 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.

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

16.6.2.3.1 Magnitude of effect – DEP or SEP in Isolation

263. For Impacts 1, 2 and 3, the magnitude of effect 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.

264. For Impact 5 (morphological and sediment transport effects due to cable protection measures within the DEP and SEP sites and interlink cable corridor) the gross patterns of bedload transport across the DEP and SEP array 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.

265. 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 effect at the landfall, no change in water depths lower than 9m, and a low magnitude of effect 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.

16.6.2.3.2 Magnitude of effect – DEP and SEP Together

266. **Section 8.6.5** (Potential Impact during Operation) of **Chapter 8 Marine Geology, Oceanography and Physical Processes** concludes that for all Impacts 1, 2, 3 and 6, the magnitude of effect for marine physical processes for DEP and SEP together will be the same to that outlined for DEP and SEP in isolation. Therefore, the indirect effect of changes to marine physical process upon offshore heritage assets is also concluded to result in no impact.

267. For Impact 5 (morphological and sediment transport effects due to cable protection measures within the DEP and SEP sites and interlink cable corridor) the footprint of sea bed impacted by cable protection measures would be greater in a DEP and SEP together scenario (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 DEP and SEP together would be the same as those outlined for DEP or SEP in isolation. Therefore, this will not result in the exposure and degradation of heritage assets and there will be no impact.

16.6.2.3.3 Impact Significance – DEP or SEP in Isolation

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

16.6.2.3.4 Impact Significance – DEP and SEP Together

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

16.6.2.4 Impact 4: Impacts to the setting of heritage assets and historic seascape character

270. During the operational life of DEP and SEP the presence of the wind turbines, offshore platforms and vessels during this operational phase will introduce a clear change to both the visual setting and the character of the seascape.

271. The setting of marine heritage assets will be affected during the operational phase by the presence of vessels, personnel and infrastructure associated with maintenance activities and by the presence of wind turbines and associated infrastructure. Those wrecks considered to have a setting which may be considered as contributing towards their significance are the named wrecks recorded to have been lost during the hostilities of WWII, 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**) and the wrecks *Chelsea* (**72565**) *Ottar Jarl* (**72647**). Despite this, the baseline setting is already influenced by passing vessels in this area associated with industry, fishing and recreation, thereby reducing the sensitivity and potential magnitude of change. The potential impact to the setting of marine heritage assets is considered to be of negligible magnitude and of **minor adverse** significance.

272. For **Chapter 23 Onshore Archaeology and Cultural Heritage**, a settings assessment following Historic England guidance has commenced and is ongoing and will be reported in full in support of the DCO application.

273. As for construction above, maintenance activities and the presence of the wind farm infrastructure may change perceptions of character with respect to the primary cultural processes which have been established and spatially defined through the HSC. The assessed capacity of each of the character sub-types to accommodate change during operation is set out in **Table 16-25.**

Table 16-25: Capacity of Perceptions of Character to Accommodate Change During Operation

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 there will be no change to perceptions of historic character	No 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 Palaeolandscape component	The presence of the installed infrastructure may result in a change to the perception of these marine areas as being of high archaeological potential. The physical presence of cables and foundations, for example, will limit ease of access for future research within the project areas thereby reducing the perceived archaeological potential. This change will however 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 impacts
Fishing: Bottom trawling Drift netting Fishing ground Potting	The distance of the DEP and SEP 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. Fishing activities will not be prohibited during the operation phase of the wind farm, although temporary restrictions may apply around major maintenance activities.	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate 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 DEP and SEP are, therefore, likely to be seen as part of this natural progression for energy generation and as a positive change from fossil fuels to renewable energy.	Potential beneficial change
Maritime Safety: Buoyage	The presence of landfall infrastructure and offshore export cables will remain largely undetectable and therefore not perceived by the public. No change to perceptions of maritime safety are anticipated.	No change
Navigation hazard: Wreck hazard Shoals and flats	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:	Maintenance activities and additional vessel traffic would occur in the context of	No change

Character Sub-types	Perception of Character and Capacity for Change	Assessed Capacity to Accommodate Change
Navigation route	one of the busiest shipping channels between south east England and mainland Europe and it is anticipated that no change to the perception of this character type would occur.	

274. **Table 16-25** above demonstrates that for most character sub-types, perceptions of historic character will remain unchanged or will result in a potential beneficial change. This is with the exception of navigational hazards and leisure sailing, the perceptions of which are likely to be altered to a small degree due to the presence of the wind turbines and OSPs within the DEP and SEP wind farm sites. By introducing features in the seascape that are considered to represent navigational hazards (e.g. the wind turbines and offshore platforms), the presence of the offshore components necessarily alters the perception of navigational hazards in the area. Nonetheless, with the introduction of measures which serve to reduce any risk to surrounding shipping (e.g. by means of charting or associated navigational marks / lights), this character sub-type has the capacity to accommodate this level of change.

16.6.3 Potential Impacts during Decommissioning

275. No decision has been made regarding the final decommissioning policy for DEP and SEP 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 seabed 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.

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

276. As all known heritage assets will be avoided through the retention of AEZs throughout the project lifespan, there is no pathway for impact during routine or unscheduled maintenance activities.

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

16.6.3.2.1 Magnitude of effect – DEP or SEP in Isolation

277. 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.

278. 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.

16.6.3.2.2 Magnitude of effect – DEP and SEP Together

279. As above, as the magnitude of the effect 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 effect for DEP and SEP together, compared with DEP or SEP 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.

16.6.3.2.3 Impact Significance – DEP or SEP in Isolation

280. As set out in **Section 16.5.5**, *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 16-10**, direct (physical) impacts to these heritage asset types thereby have the potential to be of major adverse significance, as a worst-case scenario.

281. 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.

16.6.3.2.4 Impact Significance – DEP and SEP Together

282. The potential impact significance for direct (physical) impacts to potential heritage assets, without mitigation, is the same for DEP and SEP together as for DEP or SEP 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).

16.6.3.2.5 Mitigation

283. 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 would be subject to the same mitigation as described for known heritage assets described in **Section 16.6.1.1.5** above with the primary approach being avoidance.

284. 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.

285. 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.

16.6.3.2.6 Residual Impacts – DEP or SEP in Isolation

286. 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.

16.6.3.2.7 Residual Impacts – DEP and SEP Together

287. 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 DEP or SEP 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 DEP and SEP, 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).

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

288. Potential indirect impact to heritage assets from changes to physical processes is assessed with reference to **Section 8.6.6** (Potential Impact during Decommissioning) of **Chapter 8 Marine Geology, Oceanography and Physical Processes**.

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

16.6.3.4 Impact 4: Impacts to the setting of heritage assets and historic seascape character

290. Decommissioning activities may result in a further change to the setting of heritage assets and historic seascape character with the removal of the wind turbines and associated infrastructure. Perceptions of historic character will remain unchanged or will result in a potential beneficial change with the conceptual return of the area to its pre-project state. The presence of vessels, personnel and infrastructure associated with decommissioning activities will also temporarily affect the setting and character of the project area. However, as for construction these impacts are temporary and reversible and the change to setting and character during decommissioning is therefore considered to be of negligible magnitude (a minor alteration of an asset which does not affect its significance in any notable way) and of **minor adverse** significance.

16.7 Cumulative Impacts

16.7.1 Identification of Potential Cumulative Impacts

291. The first step in the cumulative assessment is the identification of which residual impacts assessed for DEP and/or SEP 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 16-26** below, together with a consideration of the confidence in the data that is available to inform a detailed assessment and the associated rationale. Only potential impacts assessed in **Section 16.6** 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).

292. **Table 16-26** 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 DEP and SEP. Of these, only the export cables for the Dudgeon OWF and Hornsea Project Three OWF overlap with the export/interlink cables for DEP and SEP, 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).

293. 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. Similarly, whilst changes to the setting or historic character of an area may be acceptable on a project level, with wider consideration of these plans, projects and activities across the North Sea, for example, there is potential for cumulative changes which may be significant. 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. Therefore, a definitive list of projects assessed as part of this chapter is not provided as part of this CIA. Rather the potential for cumulative impact to both potential heritage assets, and to the setting and character of the North Sea, is discussed as a broad narrative in **Section 16.7.2** below.

Table 16-26: Potential Cumulative Impacts (impact screening)

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction			
Construction Impact 1: Direct (physical) impact to known heritage assets	No	High	Direct cumulative impacts to known heritage assets are unlikely to occur due

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
			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	Low	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	High	In relation to marine geology, oceanography and physical processes, as no cumulative impacts are anticipated during the construction phase (see **Chapter 8**), there is no pathway for cumulative impacts to heritage assets.
Construction Impact 4: Impacts to the setting of heritage assets and historic seascape character	Yes	High	Across the region, cumulative impacts to the setting of heritage assets and historic seascape character may occur as a result of the construction of multiple projects.
Operation			
Operational Impact 1: Direct (physical) impact to known heritage assets	No	High	Direct cumulative impacts to known heritage assets are unlikely to occur due to the continued

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
			avoidance and retention of AEZs throughout the life of constructed and planned projects.
Operational Impact 2: Direct (physical) impact to potential heritage assets	Yes	Low	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	High	In relation to marine geology, oceanography and physical processes, as no cumulative impacts are anticipated during the construction phase (see **Chapter 8**), there is no pathway for cumulative impacts to heritage assets.
Operational Impact 4: Impacts to the setting of heritage assets and historic seascape character	Yes	High	Across the region, cumulative impacts to the setting of heritage assets and historic seascape character may occur as a result of the presence of multiple constructed projects.
Decommissioning			
Decommissioning Impact 1: Direct (physical) impact to known heritage assets	No	High	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	Low	There is potential for multiple unavoidable impacts associated with decommissioning considered cumulatively

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
			with activities associated with other projects.
Decommissioning Impact 3: Indirect impact to heritage assets from changes to physical processes	No	High	In relation to marine geology, oceanography and physical processes, as no cumulative impacts are anticipated during the construction phase (see **Chapter 8**), there is no pathway for cumulative impacts to heritage assets.
Decommissioning Impact 4: Impacts to the setting of heritage assets and historic seascape character	Yes	High	Changes to the setting of heritage assets and historic seascape character will occur although the nature of this change will depend upon the decommissioning plans for multiple projects

16.7.2 Assessment of Cumulative Impacts

294. 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.

295. As stated for the assessment of impacts from DEP and SEP in **Section 16.6** 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 would 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.

296. Similarly, in **Sections 16.6.1.4**, **16.6.2.4** and **16.6.3.2.4**, the assessment of impacts upon the setting of offshore heritage assets are concluded to be no greater than minor adverse significance for DEP and SEP, whilst perceptions of historic character will remain unchanged or will result in a potential beneficial change, or, in the case of navigation and leisure, only altered to a small degree. However, when considered against other plans, projects and activities, and particularly the current and future development of offshore wind projects in the North Sea, there is potential for a significant cumulative change from a historically perceived, open North Sea seascape to a seascape characterised by industrial infrastructure and activities and, in particular, offshore renewables.

297. 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 16.8** below). The potential magnitude of such changes and impacts, therefore, 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 DEP and SEP has the potential to contribute to the ongoing industry wide build-up of data which would form the basis for such a study.

298. 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).

299. 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-consent, with account of current research agendas, policy frameworks and academic or industry led research initiatives, DEP and SEP have the potential to contribute to this overall cumulative beneficial impact.

300. In addition to scientific research objectives, the project also has 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 project areas have the potential to be of significant interest to the public, creating opportunities for outreach and education, particularly with local audiences.

301. Should the proposed projects 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, will be set out in the Outline WSI prepared and submitted as part of the DCO application.

16.8 Transboundary Impacts

302. 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 8.8** of **Chapter 8 Marine Geology, Oceanography and Physical Processes**, given that there will be no impact to the hydrodynamic and sedimentary regime as a result of DEP and SEP (in isolation and together), transboundary impacts to heritage assets are unlikely to occur as a result of changes to marine physical processes.

303. 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 nations 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 DEP and SEP are within the UK's EEZ, any data acquired and archaeologically assessed as part of the project 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).

304. 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.

305. 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) (http://www.vliz.be/en/palaeolandscape-research). 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).

306. 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 the proposed projects 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.

16.9 Inter-relationships

307. Potential inter-relationships for Offshore Archaeology and Cultural Heritage are listed in **Table 16-27**.

Table 16-27: Offshore Archaeology & 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 8 Marine Geology, Oceanography and Physical Processes	**Section 16.6.1.3**	Significant changes to physical processes may impact the preservation/survival of

Topic and description	Related chapter	Where addressed in this chapter	Rationale
			buried/exposed heritage assets.
Indirect (non-physical) impacts upon the setting of heritage assets (designated and non-designated)	Chapter 23 Onshore Archaeology and Cultural Heritage	Addressed in **Chapter 23 Onshore Archaeology & Cultural Heritage**	Impacts to the setting of heritage assets onshore may occur associated with activities associated with the installation of offshore infrastructure.
Operation			
Indirect impact to heritage assets from changes to physical processes	Chapter 8 Marine Geology, Oceanography and Physical Processes	**Section 16.6.2.3**	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 23 Onshore Archaeology and Cultural Heritage	Addressed in **Chapter 23 Onshore Archaeology & Cultural Heritage**	Impacts to the setting of heritage assets onshore may occur associated with the presence of offshore infrastructure.
Decommissioning			
As for construction			

308. Inter-relationships between offshore archaeology and marine physical processes (Chapter 8) 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 DEP and SEP. 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 23 Onshore Archaeology and Cultural Heritage**.

16.10 Interactions

309. 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 16-28.** This provides a screening tool for which impacts have the potential to interact. **Table 16-29** provides an assessment for each receptor (or receptor group) as related to these impacts.

310. Within **Table 16-28** 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.

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

Table 16-28: 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	No	Yes	Yes	-
Decommissioning				
It is anticipated that the decommissioning impacts will be similar in nature to those of construction.				

Table 16-29: Interaction between impacts – phase and lifetime assessment

Receptor	Highest significance level				
	Construction	Operation	Decommissioning	Phase assessment	Lifetime assessment
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	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

	Highest significance level				
				artefact removed from the seabed). Once an impact has occurred (i.e. a new heritage asset has been 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.	greater across the project lifetime.

16.11 Potential Monitoring Requirements

312. Monitoring requirements for offshore and intertidal archaeology will be described in the Outline WSI and in-principle monitoring plan (IPMP) submitted alongside the DCO application and further developed and agreed with stakeholders prior to construction based on the Outline WSI and IPMP and taking account of the final detailed design of the DEP and SEP.

313. It is recognised that monitoring will form an important element in the management and verification of the impacts of DEP and SEP. In particular, AEZs will be retained throughout the project lifetime and monitoring of AEZs may be required by the regulator to ensure adherence both during construction and in the future operation of the wind farm. 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.

16.12 Assessment Summary

314. 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 only **minor adverse** residual impacts on heritage assets during construction, operation and decommissioning phases of DEP and SEP.

315. There are no known seabed prehistory sites within the study area, although a number of paleogeographic features have been interpreted by Wessex Archaeology 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). Geotechnical investigations have not been carried out for the purposes of EIA although account has been taken of previous geoarchaeological assessments undertaken for the Sheringham Shoal and Dudgeon OWFs and additional project specific geoarchaeological assessment is planned post-consent.

316. Wessex Archaeology have identified 470 seabed 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.** Seabed features interpreted as A2 have been identified as being of possible anthropogenic origin and have the potential to represent archaeological material on the seabed 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.

317. 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 seabed sediments.

318. 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. Furthermore, with the use of HDD for the cable installation 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 MLWS in the subtidal.

319. With the application of the embedded mitigation (see **Section 16.3.3**), to be set out in the Outline WSI which will be submitted alongside the DCO application, it is anticipated that all direct impacts to known heritage assets as a result of the project would be avoided. The approach to the implementation of the embedded and additional mitigation measures will be agreed in consultation with Historic England in accordance with industry standards and guidance including *Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects.* (The Crown Estate 2010).

320. Subject to approval by Historic England, it is recommended that AEZs are implemented around all 30 A1 anomalies and the A3 historic record (**Table 16-22**), to be retained for the project's 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 the 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 would 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.

321. 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-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 seabed would 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 would be agreed in consultation with Historic England.

322. 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 Offshore WSI.

Table 16-30: Summary of potential impacts on Offshore Archaeology and Cultural Heritage

Potential impact	Receptor	Value (Sensitivity)	Magnitude	Pre-mitigation impact	Mitigation measures proposed	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**
	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**
	Intertidal assets	Negligible	No impact	No impact	None	**No impact**

Potential impact	Receptor	Value (Sensitivity)	Magnitude	Pre-mitigation impact	Mitigation measures proposed	Residual 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**
Impact 4: Impacts to the setting of heritage assets and historic seascape character	Perceptions of historic character will remain unchanged or will result in a potential beneficial change. In terms of setting, it has been concluded that any changes to setting due to construction activities would be temporary and of sufficiently short duration that they would not give rise to material harm (see Chapter 23 Archaeology and Cultural Heritage for further information regarding onshore and inter-tidal heritage assets).					
Operation						
Impact 1: Direct impact to known heritage assets	Known heritage assets will be avoided during operation activities through the retention of AEZs throughout the project lifespan.					**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 post-consent.	**Minor adverse**

Potential impact	Receptor	Value (Sensitivity)	Magnitude	Pre-mitigation impact	Mitigation measures proposed	Residual 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**
Impact 4: Impacts to the setting of heritage assets and historic seascape character	Perceptions of historic character will remain unchanged or will result in a potential beneficial change. The planned infrastructure at the landfall, comprising buried cables installed using HDD, is not considered to give rise to material harm to the setting of intertidal assets. The baseline setting of known wrecks within the offshore cable corridor are already influenced by passing vessels in this area associated with industry, fishing and recreation, thereby reducing the sensitivity and potential magnitude of change. The potential impact to the setting of marine heritage assets is considered to be of negligible magnitude and of minor adverse significance.					
Decommissioning						
Impact 1: Direct impact to known heritage assets	Known heritage assets will be avoided during operation activities through the retention of AEZs throughout the project lifespan.					**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 post-consent.	**Minor adverse**

Potential impact	Receptor	Value (Sensitivity)	Magnitude	Pre-mitigation impact	Mitigation measures proposed	Residual 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	TBC	TBC	TBC	**TBC**
Impact 4: Impacts to the setting of heritage assets and historic seascape character	Perceptions of historic character will remain unchanged or will result in a potential beneficial change. In terms of setting, it has been concluded that any changes to setting due to decommissioning activities would be temporary and of sufficiently short duration that they would not give rise to material harm (see **Chapter 23 Archaeology and Cultural Heritage** for further information regarding onshore and inter-tidal heritage assets).					

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