LLŶR FLOATING OFFSHORE WIND PROJECT

Llŷr 1 Floating Offshore Wind Farm

Environmental Statement

Volume 3: Chapter 24 - Marine Archaeology and Cultural Heritage

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FLOVENTIS ENERGY

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Acronyms and abbreviations

Acronym or abbreviation	Definition	Acronym or abbreviation	Definition
ADS	Archaeology Data Service	MPS	Marine Policy Statement
AEZ	Archaeological exclusion zone	MSL	Mean sea-level
AMAA	Ancient Monuments and Archaeological Areas Act	MW	Mega watt
BGS	British Geological Survey	NLS	National Library of Scotland
BIIS	British-Irish ice sheet	NMRW	National Monuments Record of Wales
BP	Before present	NME	National Museum of Wales
CA	Coracle Archaeology	NPS	National Policy Statement
CIfA	Chartered Institute for Archaeologists	NPRN	National primary reference number
COARS	Coastal and Offshore Archaeological Research Services	NRW	Natural Resources Wales
DAT	Dyfed Archaeological Trust	nT	nanoTesla
DBA	Desk-based assessment	OSL	Optically stimulated luminescence
EM	Electro-magnetic	PAD	Protocol for archaeological discoveries
EMODnet	European Marine Observation and Data Network	PaMELA	Palaeolithic and Mesolithic Artefact Database
ES	Environmental statement	PMRA	Protection of Military Remains Act
GIA	Global isostatic adjustment	PLGR	Pre-lay grapnel run
GIS	Geographic Information System	PWA	Protection of Wrecks Act
GPS	Global Positioning System	RCAHMW	Royal Commission on the Ancient and Historical Monuments of Wales
grt	Gross registered tonnage	RoV	Remotely-operated vehicle
HDD	Horizontal directional drilling	RoW	Receiver of Wreck
HER	Historic Environment Record	RSL	Relative sea-level
IAM	Impact assessment matrix	SBP	Sub-bottom profiler
ICOMOS	International Council of Monuments and Sites	SEA	Strategic environmental assessment
JNAPC	Joint Nautical Archaeology Policy Committee	SLIP	Sea-level index point
ka	kilo annum	SSS	Sidescan sonar
kHz	kiloHertz	TAN	Technical Advice Note
IAC	Inter array cable	UKHO	United Kingdom Hydrographic Office
LAT	Lowest astronomical tide	UNCLOS	United Nations Convention on the Law of the Sea
LGM	Last glacial maximum	WNMP	Welsh National Marine Plan
MBES	Multibeam echosounder	WSA	Wider study area
MCA	Marine and Coastal Access Act	WSI	Written scheme of investigation
MEDIN	Marine Environment Data Information Network	WTG	Wind turbine generators
MHWS	Mean high water springs	ZoI	Zone of influence
MIS	Marine isotope stage		
MLW	Mean low water		

Glossary of project terms

Term	Definition
AEZ	Archaeological exclusion zone imposed for the in-situ protection of known archaeological sites or geophysical anomalies of high or medium archaeological potential.
The Applicant	The developer of the Project, Llŷr Floating Wind Limited.
Array	All wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the Array Area, as defined, when considered collectively, excluding the offshore export cable(s).
Array Area	The area within which the wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure will be located.
Calibrated BP	The number of years before present (1950). The prefix 'calibrated' indicates that the dates are the result of calibration using tree-ring data.
Dead wreck	A wreck that has not been detected, by repeated surveys, and is therefore not considered to exist in its recorded location is recorded by the United Kingdom Hydrographic Office (UKHO) as 'dead'.
Designated wreck	A restricted area placed around a wreck to prevent uncontrolled interference in accordance with the Protection of Wrecks Act 1973. These protected areas are likely to contain the remains of a vessel or its contents, which are of historical, artistic or archaeological importance.
Floventis Energy	A joint venture company between Cierco Ltd and SBM Offshore Ltd of which Llŷr Floating Wind Limited is a wholly owned subsidiary.
Geotechnical investigations	Surveys performed by geotechnical engineers or engineering geologists to obtain information on the physical properties of soil earthworks and foundations for proposed structures.
Heritage assets	Elements of the historic environment that have local, regional or national significance, such as protected wrecks or submerged palaeo-landscapes.
Kilo annum	A unit of geological time equivalent to 1000 years.
Landfall	The location where the offshore export cable(s) from the Array Area, as defined, are brought onshore and connected to the onshore export cables (as defined) via the transition joint bays (TJB).
Llŷr 1	The proposed Project, for which the Applicant is applying for Section 36 and Marine Licence consents. Including all offshore and onshore infrastructure and activities, and all project phases.
Local curatorial body	Dyfed Archaeological Trust is the local planning authority with responsibility for the historic environment.
Marine Licence	A licence required under the Marine and Coastal Access Act 2009 for marine works which is administered by Natural Resources Wales (NRW) Marine Licensing Team (MLT) on behalf of the Welsh Ministers.

Term	Definition
Offshore Development Area	The footprint of the offshore infrastructure and associated temporary works, comprised of the Array Area and the Offshore Export Cable Corridor, as defined, that forms the offshore boundary for the S36 Consent and Marine Licence application.
Offshore Export Cable	The cable(s) that transmit electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OfECC)	The area within which the offshore export cable circuit(s) will be located, from the Array Area to the Landfall.
Onshore Development Area	The footprint of the onshore infrastructure and associated temporary works, comprised of the Onshore Export Cable Corridor and the Onshore Substation, as defined, and including new access routes and visibility splays, that forms the onshore boundary for the planning application.
Onshore Export Cable(s)	The cable(s) that transmit electricity from the landfall to the onshore substation.
Onshore Export Cable Corridor (OnECC)	The area within which the onshore export cable circuit(s) will be located.
PAD	The protocol for archaeological discoveries sets out the procedures that must be followed in the event of unexpected archaeological discoveries either on the seabed or on the deck of working vessels and identifies the personnel with responsibility for ensuring that the PAD is followed.
Palaeo-environment	An environment at a period in the geological past.
Peat	An organic material formed by decayed vegetation matter that can preserve important environmental and archaeological evidence.
Project	All aspects of the Llŷr 1 development (i.e. the onshore and offshore components).
Receiver of Wreck	The Receiver of Wreck, the wreck administration within the Maritime and Coastguard Agency (MCA), deals with all reports of wreckage from around the UK including Northern Ireland. It is based at the MCA headquarters in Southampton, with assistance from coastguard personnel around the coast.
Royal Commission on the Ancient and Historical Monuments of Wales	The national curatorial body that provides guidance and advice to the regulator pre- and post-consent.
Onshore Substation	Located within the Onshore Development Area, converts high voltage generated electricity into low voltage electricity that can be used for the grid and domestic consumption.
Section 36 consent	Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works.
WSI	The written scheme of investigation sets out the roles and respective responsibilities of the project team, contractors, the retained archaeologist and archaeological contractors and sets out formal lines of communication between the parties and with archaeological curators. It outlines the known and potential receptors that could be impacted by

Term	Definition
	the scheme, outlines the agreed mitigation and archaeological actions that are to take place in various circumstances, and provides detailed methodologies for these archaeological actions.

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24. MARINE ARCHAEOLOGY AND CULTURAL HERITAGE

24.1 Introduction

1. Llŷr Floating Wind Limited (hereafter the Applicant) is proposing to develop the Llŷr 1 Floating Offshore Wind Farm (hereafter referred to as the proposed Project), located approximately 35 km off the coast of Pembrokeshire in the Celtic Sea.
2. The proposed Project is a test and demonstration wind farm development, comprising up to 10 wind turbine generators (WTGs). The proposed Project will make landfall at Freshwater West before connecting into Pembroke Dock power station and the national grid network.
3. The Applicant is seeking a Section 36 consent and Marine Licence for Llŷr 1. This chapter forms part of the Environmental Statement (ES) which is submitted in support of those consent applications. This chapter describes the potential impacts and effects of the proposed Project on marine archaeology and cultural heritage during the construction, operation and maintenance (O&M) and decommissioning phases, and includes mitigation and good practice measures to reduce the impacts of the proposed Project on identified and potential marine archaeology and cultural heritage assets.
4. **Section 24.8** of this ES chapter provides a summary of the impact assessment undertaken and any residual significant effects on marine archaeology and cultural heritage following consideration of any mitigation measures.
5. The assessment presented in this chapter should be read in conjunction with the following linked and supporting chapters:

    - **Chapter 04: Description of the Proposed Project** - provides further details of the project design parameters.
    - **Chapter 05: EIA Approach and Methodology** - provides further details of the general framework and approach to the Environmental Impact Assessment (EIA).
    - **Chapter 17: Physical environment –** provides an assessment of the proposed Project on coastal and marine processes; and
    - **Chapter 31: Inter-related effects assessment** – provides an assessment of the inter-related effects of the proposed Project, both throughout the project lifetime and receptor led effects.

6. Additional information to support the assessment includes:

    - **Appendix 24A**: Marine archaeology desk based assessment (DBA). The DBA identified known marine cultural heritage assets located in proximity to the proposed Project (Coracle Archaeology 2024a);
    - **Appendix 24B**: Archaeological review of marine geophysical and landfall survey data (Coracle Archaeology 2024b); and
    - **Appendix 24C**: Marine archaeology and cultural heritage technical report (Coracle Archaeology 2024c). The technical report collates the results of the proposed Project-specific archaeological assessments completed to date and presents the current understanding of the marine archaeology and cultural heritage in proximity to the proposed Project.

7. A Project-specific marine archaeological written scheme of investigation (WSI) and protocol for archaeological discoveries (PAD) will also be prepared. This document will provide further detail on mitigation measures outlined in this chapter, and outline protocols for the reporting

of unexpected archaeological discoveries during works associated with the proposed Project. This will be submitted to the curator and regulator for review and approval prior to the onset of works.

8. This assessment focuses on the potential impact of the offshore components of the proposed Project on known and potential cultural heritage assets encapsulated within the Offshore Development Area, from below mean high water springs (MHWS) at Freshwater West. This includes the Array Area and the OfECC (**Volume 5: Figure 24-1**). It should be noted that the DBA assessed a wider Study Area extending c. 1 km around the Array Area and 500 m around the OfECC; no buffer is required for the purposes of the Environmental Statement as any identified impacts to marine archaeology and cultural heritage will be restricted to those assets located within the Offshore Development Area itself. This is considered industry standard for marine archaeology. The potential impacts of the proposed Project on cultural heritage assets above MHWS are described and addressed in **Chapter 09: Onshore Historic Environment and Cultural Heritage**.

9. This assessment has been undertaken by Coracle Archaeology. Further details of the Project Team's competency are provided in **Appendix 1A: Statement of Competence**.

24.2 Legislation, Policy and Guidance

10. The following sections identify specific legislation, policy and guidance that is applicable to the assessment of marine archaeology and cultural heritage. All assessments summarised in this chapter have been undertaken in accordance with the legislation and following the standards and guidance outlined below. Further detail on the wider legislation, policy and guidance relevant to this ES is provided in **Chapter 02: Regulatory and Planning Policy Context**.

24.2.1. Legislation

11. Several Acts serve to protect and define the marine archaeology and cultural heritage resource in UK and Welsh waters. These include:

- *Protection of Wrecks Act (PWA 1973)*. This legislation secures the protection of wrecks within designated areas in territorial waters (i.e. within the 12 nautical mile (nm) limit), and protects those sites from interference by unauthorised persons. Under the Act, it is an offence to carry out certain activities on or in proximity to the wreck, unless a licence has been obtained from the appointed Government body;
- *Marine and Coastal Access Act (MCAA 2009)*. This Act sets out a framework for the management of marine functions and activities in waters in or adjacent to the UK and its coastal areas, up to the seaward limits of the territorial sea. It legislates for the preparation and adoption of marine plans and for the regulation of licensable activities in the marine environment through the grant and enforcement of conditions on marine licences. Marine licences in Wales are administered by Natural Resources Wales (NRW);
- *Historic Environment (Wales) Act (2016)*. This Act forms part of a wider suite of legislation, policy and guidance notes that ensures the protection and sustainable management of the Welsh Historic Environment. It should be read in conjunction with Cadw's *Technical Advice Note (TAN): 24 Historic Environment*, which provides guidance on development plans, designated assets and archaeological remains;
- *Protection of Military Remains Act (PMRA 1986)*. This Act provides protection for the wreckage of military aircraft and certain military wrecks. Designations, as Controlled Sites or Protected Places, restrict access whilst any operations that might disturb the site must be licensed by the Ministry of Defence (MoD). Under the Act, diving is permissible at a Protected Place, though it is an offence to tamper, move or remove any remains deemed sensitive. Diving, salvage and excavation are prohibited on Controlled Sites

except under licence. All military aircraft are automatically protected under this legislation, though vessels are designated individually;

- *Ancient Monuments and Archaeological Areas Act (AMAA 1979).* This Act provides protection for sites and monuments considered to be of national importance, including those found in UK territorial waters and in the intertidal zone (defined as the area between MHWS and mean low water springs (MLWS). Nationally important sites are protected through designation within the schedule of monuments defined under this Act. It is an offence to damage or carry out a range of specified activities on a scheduled monument unless authorised to do so;
- *Merchant Shipping Act (1995).* The ownership of finds recovered from the sea is determined in the UK by the Receiver of Wreck (RoW), under the auspices of the Merchant Shipping Act. The Act applies to all finds of wreck in UK territorial waters, or to finds recovered from beyond the 12nm limit but subsequently brought into territorial waters. Should any material which falls within the legal definition of 'wreck' be recovered during works associated with the proposed Project the RoW must be notified, following the procedures outlined in the project-specific PAD;
- *Treasure Act (1996).* The Act is supplemented by the Treasure (Designation) Order 2002. Finders of gold and silver objects more than 300 years old and prehistoric base metal assemblages, as defined in the Act, are required to report and deliver such finds to the Coroner;
- *Burial Act (1857).* Under this Act a licence must be granted prior to the removal of human remains from deliberately deposited contexts. In the unlikely event that human remains are discovered during works associated with the proposed Project, the remains will be protected under this Act; and
- *The Planning (Listed Buildings and Conservation Areas, Wales) Regulations (2012)*. This Act provides for the development and implementation of both a National Development Framework for Wales and Strategic Development Plans. It should be noted that planning law falls within the remit of local authorities, which extends to MLWS.

12. In addition to UK and Welsh specific legislation, this assessment takes account of a number of international legislative procedures and guidelines. These include:

- European Convention on the Protection of the Archaeological Heritage (Valetta) (1992);
- UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001);
- United Nations Convention on the Law of the Sea (UNCLOS) (1982);
- International Council of Monuments and Sites (ICOMOS) Charter on the Protection and Management of Underwater Cultural Heritage (1996) (the Sofia Charter);
- The European Convention of the Archaeological Heritage of Europe (Revised) (1992); and
- The World Heritage Convention (1972).

24.2.2. National Planning Policy

National Policy Statements

13. The Government's policy for the delivery of major energy infrastructure is set out in the overarching National Policy Statement (NPS) for Energy (NPS EN-1; Department for Energy and Net Zero (DENZ) 2023a), and the National Policy Statement for Renewable Energy Infrastructure (EN-3; DENZ 2023b). This is discussed in detail in **Chapter 02: Regulatory and Planning Policy Context**.

14. National Policy Statements on Energy have been designated by the UK government to guide decision-making on Nationally Significant Infrastructure Projects (NSIPs), consented under the Planning Act 2008. It should be noted that these NPS apply only to offshore wind projects that exceed 350 MW in capacity; they would not therefore directly guide decision-making on the proposed Project. They are considered relevant, nevertheless, as they were written to guide decision-making on offshore wind projects.

15. Both NPS EN-3 (2023) and the overarching NPS EN-1 (2023) contain several policies relevant to marine archaeology and cultural heritage. NPS EN1, highlights potential adverse impacts on the historic environment from construction, O&M and decommissioning of energy infrastructure (section 5.9.1). It states that projects must demonstrate that the significance of heritage assets (and their settings) and potential impacts upon them have been adequately identified, minimised and mitigated sections (5.9.9-5.9.21). Planning decisions will be based on the evidence and supporting documents provided in the application, including the outcome of consultations and, where required, expert advice (sections 5.9.22-5.9.36).

16. NPS EN-3 (2023) similarly highlights the need to avoid adverse impacts on cultural heritage assets identified offshore. It is suggested that the most effective means of protection is through micro-siting and routing of developments to avoid known and potential cultural heritage assets, thus leaving the assets *in-situ* (sections 2.8.76; 2.8.255; 2.10.137). This can be achieved through the implementation of exclusion zones, in which no works are permitted (2.8.253). It is further recommended that a project-specific WSI is prepared post-consent and submitted to the regulator for approval prior to the onset of development works (2.8.78).

17. In accordance with the guidance outlined in NPS EN-1 and EN-3, the significance of cultural heritage assets identified in previous assessments (Coracle Archaeology 2024a & b) is outlined in **Sections 24.4** and **24.8** of this chapter. Appropriate mitigation is detailed in sections 24.7-24.9; this will be expanded further in the project-specific WSI. This includes the use of archaeological exclusion zones (AEZs), designed to ensure preservation of identified cultural heritage assets *in-situ*. A summary of national policy is provided in **Table 24-1**.

UK Marine Policy Statement

18. Paragraphs 2.6.6.1 to 2.6.6.9 of the UK Marine Policy Statement (MPS; 2011) state that the marine historic environment includes all aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged. It recognises that these assets are a finite and irreplaceable resource, and should therefore be conserved in a manner appropriate and proportionate to their significance. This includes both preservation *in-situ* and preservation by record. Significantly, the MPS also states that undesignated heritage assets should be afforded similar protection to designated assets.

19. As works associated with the proposed Project have the potential to result in adverse effects on the historic environment (from both direct and indirect impacts), including damage to or destruction of heritage assets, all available evidence has been used to identify and assess the significance of cultural heritage assets located within the Offshore Development Area. The significance of these assets and recommended mitigation is outlined in **Sections 24.8** and **24.9** of this chapter.

Table 24-1 A summary of national planning policy relevant to marine archaeology and cultural heritage

Summary of policy	How and where it is considered in the chapter
NPS EN-1 Section 5.9.1: construction, operation and decommissioning of energy infrastructure can result in adverse impacts on the historic environment 5.9.9: the applicant must undertake an assessment of any likely significant impacts as part of the EIA process, and describe appropriate mitigation 5.9.10: applicants must ensure that the significance of all heritage assets has been adequately assessed and presented in the ES chapter 5.9.12: the applicant should ensure that the extent of the impact of the proposed development on the significance of the heritage assets can be properly understood from the application and supporting documents 5.9.16: a documentary record of the past is not as valuable as preservation *in-situ* 5.9.21: where there is the possibility that a development may impact as yet undiscovered heritage assets, the applicants must ensure that appropriate procedures are in place for the identification and treatment of such assets	The significance of both known and previously unidentified cultural heritage assets has been assessed and documented in the DBA and archaeological assessment of marine and landfall geophysical survey data, presented in **Appendices 24A** and **24B**. This includes the results of high-resolution survey work, both offshore and at the landfall location. Archaeological assessments are summarised and presented in the Baseline Section (**Section 24.5**); sources used for these assessments are summarised in **Section 24.4.4**). The methodology used for the assessment of impacts is described in **Section 24.4.1**; the impact assessment is presented in **Section 24.8** and **Table 24-12**. In accordance with NPS-EN1, this includes a description of mitigation for significant adverse impacts. Mitigation for significant adverse impacts on marine cultural heritage assets is outlined in **Section 24.8** and **Table 24-11** below. In accordance with NPS-EN3, the use of AEZs is described in **Section 24.7**; their size and locations are presented in **24.8** and **Table 24-12**. Mitigation for any as-yet unidentified assets will be outlined in the project-specific Protocol for Archaeological Discoveries (PAD); this will be submitted to the regulator for review and approval alongside the WSI (**Section 24.7**; paragraph 155).
NPS EN-3: adverse impacts on identified heritage assets must be avoided where possible 2.8.73: applicants should include details on how avoidance has been achieved and provide proposals for mitigation 2.8.76: micro-siting / routing provides developer with flexibility to accommodate the discovery of previously unknown marine archaeology 2.8.77: to inform micro-siting, applicants should undertake high-resolution survey work to assess impacts of proposed developments on potential heritage assets 2.8.78: applicants should submit a project-specific WSI 2.8.252: avoidance of heritage assets to ensure their preservation *in-situ* is the most effective form of protection	

Summary of policy	How and where it is considered in the chapter
2.8.253: most effective means of achieving avoidance is through implementation of exclusion zones	
UK MPS: recognises that the marine cultural heritage resource is finite and irreplaceable and (paragraphs 2.6.6.1 to 2.6.6.9). 2.6.6.3: the marine historic environment should be protected in a manner proportionate to its significance 2.6.6.3: opportunities should be taken to contribute to knowledge and understanding of the past by capturing evidence from the historic environment and ensuring it is publicly available 2.6.6.5: undesignated assets should be afforded similar protection to designated assets 2.6.6.8: there should be a general presumption in favour of the conservation of heritage assets	The archaeological significance of each identified asset has been assessed, following the criteria outlined in **Section 24.4.2**. In accordance with the UK MPS, undesignated assets are considered no less important than designated ones; impacts to these heritage assets and appropriate mitigation are described in **Sections 24.8-24.9**. This includes the use of AEZs, designed to ensure preservation *in-situ*.

24.2.3. Welsh Planning Policy

Planning Policy (Wales)

20. Planning Policy Wales (11th edition) was published in February 2021 and contains the principal guidance for the management and safeguarding of the historic environment in the planning process. It is supported by a series of technical advice notes (TANs), which seek to clarify and outline relevant policy for different sectors. This includes TAN 24: the historic environment, which outlines the need for consideration of cultural heritage assets in the planning process (paragraphs 4.2-4.10).

Welsh National Marine Plan

21. The Welsh National Marine Plan (WNMP) was developed in accordance with the MCA (2009) and the UK MPS. It is designed to last for 20 years from its publication in 2019. Objective 7 of the WNMP states that valuable landscapes, seascapes and historic assets should be protected and promoted, while encouraging the enjoyment and stewardship of Welsh coasts and seas. This is supported by policies SOC_05 and SOC_07, which state that proposed developments must demonstrate how they will avoid, minimise or mitigate impacts to cultural heritage assets and seascapes, while encouraging opportunities to enhance those assets. Accordingly, mitigation measures relevant to the proposed Project are outlined in **Sections 24.8-24.9** of this chapter.

Future Wales: The National Plan 2040

22. Future Wales: the National Plan 2040 was published in 2021. It is a 20-year national development plan for Wales, designed to address key national priorities through the planning system. It is informed by the Welsh National Marine Plan and complements Planning Policy (Wales) and the supplementary TANs.

Table 24-2. A summary of regional planning policy relevant to marine archaeology and cultural heritage

Summary of policy	How and where it is considered in the chapter
Planning Policy (Wales) contains the principal guidance for the management of the historic environment, including the use of TANs. TAN 24 outlines the need for consideration of cultural heritage assets throughout the planning process.	The significance of both known and previously unidentified cultural heritage assets has been assessed and documented in the DBA and archaeological assessment of marine and landfall geophysical survey data, presented in **Appendices 24A** and **24B**. These are summarised and presented in the Baseline Section below (**24.5**); sources used for these assessments are summarised in **Section 24.4.4**. The methodology used for the assessment of impacts is described in **Section 24.4**; the impact assessment is presented in **Section 24.8** and **Table 24-12**. This includes a description of mitigation for significant adverse impacts.
WNMP SOC_05: proposals must demonstrate how potential impacts on cultural heritage assets will be avoided, minimised or mitigated (in order of preference) SOC_07: proposals must demonstrate how potential impacts on seascapes will be avoided, minimised or mitigated (in order of preference).	

24.2.4. Guidance

23. This assessment has been compiled in accordance with industry best practice and relevant offshore renewables and marine historic environment guidance. These include:

- Chartered Institute for Archaeologists (CIfA) guidelines: *Standard & guidance for archaeological desk-based assessment* (2014);
- *Managing the marine historic environment of Wales*, Cadw (2020);
- *The marine historic and natural environment marine area statement*, Natural Resources Wales (NRW) and the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW; 2022);
- *Heritage impact assessment in Wales*, Cadw (2017a);
- *Setting of historic assets in Wales*, Cadw (2017b);
- *Conservation principles for the sustainable management of the historic environment in Wales*, Cadw (2011);
- Joint Nautical Archaeology Policy Committee (JNAPC) *Code of practice for seabed development* (1998);
- COWRIE *Historic environment guidance for the offshore renewable energy sector* (2007);
- COWRIE *Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy* (2008);
- COWRIE *Guidance for offshore geotechnical investigations and historic environment analysis: guidance for the renewable energy sector* (2011);
- *The design manual for roads and bridges* (Standards for highways 2019);
- *Offshore renewables protocol for archaeological discoveries*, the Crown Estate and Wessex Archaeology (2014); and
- *Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects*, the Crown Estate and Wessex Archaeology (2021).

24.3 Stakeholder Engagement and Consultation

24. Consultation with statutory and non-statutory organisations is a key element of the EIA process. Consultation with regards to marine archaeology and cultural heritage has been undertaken to inform the approach to, and scope of, the assessment contained within this chapter.

25. Stakeholders for the proposed Project include statutory consultees, landowners, local communities and other sea users. In addition to the statutory consultation process, there has been ongoing engagement with statutory and non-statutory consultees to steer the development of the proposed Project.

26. A stakeholder meeting was held on 28 March 2023 with representatives from the Royal Commission on the Ancient and Historical monuments of Wales (RCAHMW), the Applicant and Coracle Archaeology; further telephone and email consultations were held between the RCAHMW and Coracle Archaeology in November 2023 and January 2024. Additional meetings were held digitally between the RCAHMW and Coracle Archaeology in March and April 2024, following revisions to the Offshore Development Area for the proposed Project. Both email and telephone consultations were held with Archaeological Planning Officers at the Dyfed Archaeological Trust (DAT) and at the DAT Historic Environment Record (HER). A summary of stakeholder consultations is presented in **Table 24-3**.

24.3.1. Summary of Stakeholder Consultations

Table 24-3. Summary of the key issues raised by consultees and how each issue was addressed

Consultee	Consultation type and date	Comment raised	How issue has been addressed and location of response in chapter
Scoping			
RCAHMW	Screening and scoping opinion; July 2022	A programme of marine archaeological geophysical survey should be put in place to ensure that the marine archaeological resource is fully understood	Archaeological assessment of supplied marine geophysical data has been undertaken and presented in **Appendix 24B**. The results of the review have been used to inform the baseline environment, summarised in **Section 24.5**. Potential impacts to anomalies identified in the assessment of geophysical survey data are presented in **Section 24.8**.
RCAHMW	Screening and scoping opinion; July 2022	Formal reference should be made to the Historic Environment (Wales) Act 2016 and policy SOC_05 of the WNMP	Both the Historic Environment (Wales) Act 2016 and the WNMP have been used to inform the assessments contained within this chapter. Relevant sections of the Act and WNMP are summarised in **Sections 24.2.1** and **24.2.3** respectively.

Consultee	Consultation type and date	Comment raised	How issue has been addressed and location of response in chapter
RCAHMW	Screening and scoping opinion; July 2022	A project-specific WSI must be prepared and submitted following Crown Estate guidance (2021)	A project-specific WSI will be prepared as a condition of any consent granted. This will follow the guidelines outlined in the Crown Estate 2021.
Pre-application			
RCAHMW	Digital meeting (March 2023)	Request that marine archaeological assessments begin at MHWS and encompass the intertidal zone	The assessment of marine archaeology and cultural heritage extends from MHWS at Freshwater West to the edge of the Array Area, encompassed by the Offshore Development Area. The Study Area is summarised in **Section 24.4.3.**
RCAHMW	Digital meeting (March 2023)	Copies of processed geophysical survey data relating to each AEZ will be deposited with the RCAHMW. Required formats will be agreed in advance	Processed geophysical survey data relating to the AEZs outlined here will be provided to the RCAHMW following the completion of the Project, as outlined in **Section 24.7.**
RCAHMW	Digital meeting (March 2024)	Meeting to discuss proposed changes to the OfECC and the potential to submit revised archaeological assessment of marine geophysical survey data post-submission of ES. Completion of surveys and review of the revised assessments (and subsequent WSI) will likely be a condition of consent.	**Section 24.9** outlines additional mitigation measures. This includes a commitment to undertake archaeological assessment of marine geophysical survey data for the revised OfECC. The revised document will be provided to the RCAHMW for review and approval and be used to inform the project-specific WSI.
RCAHMW	Digital meeting (April 2024)	Meeting to discuss further revisions to the OfECC. Agreement that existing and open-source datasets could be used to update the archaeological assessments.	Data sources are detailed in **Section 24.4.4**; the baseline environment is outlined in **Section 24.5.**

Consultee	Consultation type and date	Comment raised	How issue has been addressed and location of response in chapter
DAT	Telephone and email (March and April 2023)	It was agreed that a 1 km buffer around the Array Area and a 500 m buffer around the proposed offshore export cable route corridor was sufficient to enable the assessment of archaeological potential	A 1 km buffer was applied around the Array Area and 500 m buffer around the OfECC. This constituted the Study Area for the DBA, as outlined in **Section 24.4.3** to inform the assessment of archaeological potential. In accordance with industry standard, the Study Area for the ES chapter is restricted to the Offshore Development Area, as no impacts to identified assets are expected to occur beyond the project boundary. This is outlined in **Section 24.4.3.**

24.4 Approach to Assessment

24.4.1. Assessment Methodology

27. **Chapter 05: EIA Approach and Methodology** provides a summary of the general impact assessment methodology applied in this ES. The following sections provide further detail on the specific methodology used to assess the potential impacts on marine archaeology and cultural heritage. Where necessary, differences in methodology or terminology to that outlined in **Chapter 05: EIA Approach and Methodology** are highlighted.

28. The approach to the assessment of cumulative impacts, transboundary impacts and interrelated effects is provided in **Sections 24.11** to **-24.13**.

29. The significance of potential effects has been evaluated using a systematic approach together with the expert judgement of the specialist consultant. The systematic approach is based on the identification of the importance / value of receptors and their sensitivity to the proposed Project, together with the predicted magnitude of the potential impact.

30. The methodology summarised below follows the guidance and principles outlined in Cadw's *Managing the marine historic environment in Wales* (2020), *Heritage impact assessment in Wales* (2017a) and *Conservation principles* (2011). Archaeological assessments are broadly derived from *The Design Manual for Roads and Bridges* (Standards for highways 2019).

24.4.2. Significance Criteria

Magnitude of Impact

31. The scale or magnitude of potential impacts (both beneficial and adverse) is determined by a combination of three criteria: scale of change, spatial extent of change and duration of change, as outlined in **Chapter 05: EIA Approach and Methodology**, **Section 5.4.9**.

32. The magnitude of change is a measure of the scale or extent of change in baseline (existing) conditions, irrespective of the value of the heritage assets affected, assessed on a scale of

negligible to very high. Changes to historic assets can be either adverse (e.g. direct impacts to cultural heritage assets from trenching or seabed clearance activities) or beneficial (e.g. additional protection through partial or total burial of an asset). The terminology used to define magnitude criteria specific to marine archaeology and cultural heritage are outlined in **Table 24-4** below and used throughout this assessment. In this instance, cultural heritage asset refers to known and identified historic assets, geophysical anomalies and deposits of palaeo-environmental interest, as highlighted in the baseline section below (**24.5**).

Table 24-4. A summary of the magnitude criteria that are associated to specific impacts

Magnitude Criteria	Definition
Very high	**Adverse:** Total loss or major alteration of the cultural heritage asset, or its setting, removing the asset's value **Beneficial:** Large scale or major improvement to the asset, or its setting, e.g. through increased protection, access or enhancement
High	**Adverse:** Loss of one or more key elements of the cultural heritage asset, substantially reducing the asset's value **Beneficial:** Significant improvements to the asset
Medium	**Adverse**: Slight physical alteration of the cultural heritage asset not affecting key elements, slightly reducing the asset's value **Beneficial:** Improvements to key characteristics of the asset or its setting
Low	**Adverse:** Very slight or negligible alteration of the cultural heritage asset **Beneficial:** Minor benefit to one, or a small number of key features or elements of the cultural heritage asset
Negligible	**Adverse:** Almost no alteration of the cultural heritage asset. **Beneficial:** Almost no alteration of the asset

Sensitivity of Receptor

33. The methods used for the assessment of development impacts begin with an assessment of the sensitivity of the receptor. Following the guidance outlined in the UK MPS, NPS EN-1 and Cadw's *Conservation principles* (2011), this requires an assessment of the significance of the historic asset, assessed on a scale ranging from negligible to very high. Significance can be defined as the sum of cultural heritage values, including evidential, historical, aesthetic, and communal values; receptor sensitivity is defined as the degree to which a receptor would be affected by an impact.

34. The sensitivity of the receptor is characterised by its vulnerability and importance (significance, in heritage terms), as outlined in **Chapter 05: EIA Approach and Methodology**, **Section 5.4.10**. Any impacts to heritage assets will be considered permanent and irreversible; for the purposes of this assessment, recoverability of the asset is not relevant.

35. The criteria for defining receptor sensitivity for the purpose of the assessment on marine archaeology and cultural heritage are provided in **Table 24-5**. These definitions are based on Cadw's *Conservation principles* (2011). The UK MPS notes that heritage assets are a finite and irreplaceable resource; any impacts to marine heritage assets are considered permanent and irreversible and this is reflected in the criteria outlined below. Following the UK MPS, undesignated assets can also be considered of similar significance (sensitivity) as designated or protected assets (e.g. **high**).

Table 24-5. A summary of the criteria determining a receptor's sensitivity

Receptor Sensitivity Criteria	Definitions
Very High	Cultural heritage assets of international importance
High	Designated wrecks and scheduled monuments Heritage assets of national importance Maritime losses where the position is known and has been positively identified Targets of high archaeological potential identified in the geophysical survey.
Medium	Cultural heritage assets of regional importance Targets identified in the geophysical survey of medium archaeological potential Obstructions potentially indicative of wreckage or submerged features
Low	Targets of low potential identified in the geophysical survey Stray archaeological find spots
Negligible	Targets identified through the assessment of geophysical survey data as likely to represent a natural feature

Significance of Effect

36. As set out in **Chapter 05: EIA Approach and Methodology**, an Impact Assessment Matrix (IAM) is used to determine the significance of effect, which is a function of the sensitivity of the receptor and the magnitude of the impact, as shown in **Table 24-6**. Definitions of the significance of effect are provided in **Table 24-7.**

37. The matrix provides a framework for the consistent and transparent assessment of predicted effects across all receptor topics. However, it is important to note that the matrix acts as a guide and that assessments allow for the application of expert judgement.

Table 24-6. Significance matrix

		Value / Sensitivity				
		Very High	**High**	**Medium**	**Low**	**Negligible**
Magnitude	**Very high**	Major	Major	Moderate	Moderate	Minor
	High	Major	Moderate	Moderate	Minor	Negligible
	Medium	Moderate	Moderate	Minor	Negligible	Negligible
	Low	Moderate	Minor	Negligible	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible

38. The matrix provides levels of effect significance ranging from major to negligible. Assignment of significance is undertaken with consideration of embedded mitigation measures; embedded mitigation measures (including project design measures and best practice) are presented in **Section 24.7**. Details of additional mitigation and associated definitions can be found in **Section 24.8**.

39. It is important to note that, as recognised in the UK MPS, the marine archaeological resource is finite and irreplaceable. Any direct impacts on it are therefore likely to be permanent. For the purposes of this assessment, any adverse effect considered **major**, **moderate** or **minor** is deemed significant and requires mitigation. This is accepted as best practice in the management of the marine archaeological and palaeo-environmental resource.

Table 24-7. A summary of the definitions of each significant of effect criteria

Significance Category	Definitions	Significant / Not Significant Effect
Major	A large and detrimental change to a valuable / sensitive cultural heritage asset; likely or apparent exceeding of accepted (often legal) threshold. Or A large and beneficial change, resulting in improvements to the baseline result (for example through the total burial of previously exposed heritage assets, aiding preservation *in-situ*). These effects may represent key factors in the decision-making process. The cultural heritage resource is finite and irreplaceable; major adverse effects are likely to result in the total loss of the asset.	Significant
Moderate	A medium scale change to a cultural heritage asset. Given the finite nature of the archaeological resource, any impact considered moderate will be considered significant, requiring mitigation. Or A positive moderate effect is a medium scale change that results in significant improvements to baseline conditions, for example through the partial burial of an asset (added protection). These effects, if adverse, are likely to be important at a local scale and on their own could have a material influence on decision making.	Significant
Minor	A small change to a cultural heritage asset. Given the finite nature of the marine archaeological resource, a minor impact is still considered significant and requires mitigation. Or A small positive change, but not one that is likely to be a key factor in the overall balance of issues.	Significant
Negligible	A very small change that is so small and unimportant that it can be disregarded. Effects which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error. These effects are unlikely to influence decision making irrespective of other effects.	Not Significant

24.4.3. Study Area

40. The Study Area for the assessment of marine archaeology and cultural heritage comprises the offshore components of the proposed Project, encapsulated within the Offshore Development Area, from MHWS at Freshwater West (**Volume 5: Figure 24-1**). This includes both the OfECC and the Array Area. Impacts to cultural heritage assets located above MHWS are outlined in **Chapter 09: Onshore Historic Environment and Cultural Heritage**.

41. This chapter is based on several project-specific marine archaeological assessments undertaken by Coracle Archaeology, including a DBA (2024a) and an archaeological review of marine geophysical and landfall survey data (2024b; **Appendices 24A** and **24B**). The results of

these assessments have been synthesised in the marine archaeology and cultural heritage technical report (Coracle Archaeology 2024c; **Appendix 24C**). The DBA assessed the Offshore Development Area from MHWS at Freshwater West, as well as a wider study area (WSA) extending 1 km around the Array Area and 500 m either side of the OfECC as it narrows towards the Pembrokeshire coast (**Volume 5: Figure 24-2**). This WSA was agreed in advance with RCAHMW and DAT, as outlined in **Table 24-3**.

42. The WSA enables an assessment of the archaeological potential of the area and contextualises the nature of the archaeology within the Offshore Development Area, whilst highlighting notable sites in the vicinity of the proposed Project. It also provides an indication of the potential to encounter unknown and unexpected archaeological sites and features while undertaking project-specific activities. Following revisions to the route of the OfECC in January and April 2024, the DBA and technical report were revised to remove assets no longer located within the Offshore Development Area or the WSA for earlier iterations of the route. Unless stated explicitly, heritage assets located beyond the revised Offshore Development Area are not considered in this report.

43. The archaeological review of marine geophysical and landfall survey data assessed the Offshore Development Area; as the zone of influence (ZoI) for marine archaeology is considered the footprint of the red line boundary of the proposed Project – in this instance, the Offshore Development Area – no additional buffer is required.

24.4.4. Data sources

44. The assessment set out in this chapter is based on project-specific marine archaeological assessments undertaken by Coracle Archaeology, including a DBA (2024a) and an archaeological review of marine geophysical and landfall survey data (2024b). These assessments were intended to identify known and potential sites of archaeological and palaeo-environmental interest that may be affected by the proposed Project. These assessments are summarised below and have been used to assess the potential impact of the proposed Project on the marine archaeology and cultural heritage resource, as presented in this chapter.

Desk Study

Marine Archaeological Desk-Based Assessment

45. The DBA assessed the Offshore Development Area and a WSA, as defined above. This included a documentary and cartographic search utilising a variety of data sources to locate all known cultural heritage assets in the Offshore Development Area, and to identify the archaeological potential of the area. Sources utilised included:

Wales

- RCAHMW National Monuments Records of Wales (NMRW);
- DAT Historic Environment Records (HER);
- Cadw's Register of Historic Landscapes;
- Records held by the National Museum of Wales (NMW); and
- Geophysical survey data held by the integrated marine data and information system (iMarDIS), University of Bangor.

UK

- Records of wrecks and obstructions as held by the UKHO Admiralty Marine Data Portal;

- UKHO review of cartography, historic charts and sailing directions;
- Historic maps and charts as held by the National Library of Scotland (NLS);
- Records held by the Archaeology Data Service (ADS);
- Marine Environment Data Information Network (MEDIN);
- British Geological Survey (BGS) regional guide and previous work in the area;
- Readily accessible published sources and grey literature (e.g. results from previous studies); and
- Relevant strategic environmental assessment (SEA) reports (e.g. UK Continental Shelf SEA archaeological baseline) and coastal survey assessment reports.

International

- European Marine Observation and Data Network (EMODnet); and
- Wrecksite.eu website.

46. The DBA included all known and potential maritime cultural heritage assets identified from these sources. Records located within the Offshore Development Area and WSA were assigned a unique Coracle Archaeology number for ease of identification (in the format **CA00**). Where relevant, these are referenced throughout this chapter.

47. OfECC revisions have resulted in assigned CA numbers no longer running concurrently. Eight previously identified assets were located in older iterations of the Offshore Development Area, but are now located beyond it. These comprise assets **CA3**-**5**, **CA11**, **CA35**, **CA40** and **CA44-45**. These assets will not be considered in this report. Two assets were originally reported in the WSA but now fall within the revised Offshore Development Area (**CA60** and **CA64**); two additional assets (**CA65**-**66**) were identified within the latest route iteration, and are included. A full gazetteer of cultural heritage assets is provided in **Appendix 24A**.

Archaeological Review of Marine Geophysical Survey Data

48. Project-specific marine geophysical survey data were collected by N-SEA between September and December 2022. This included the collection of multibeam echosounder (MBES), side-scan sonar (SSS), sub-bottom profiler (SBP) and marine magnetometer datasets. Full details of survey methods can be found in **Appendix 24B**, Coracle Archaeology (2024b) and N-SEA (2023).

49. Collected survey data were supplied by the client and assessed on behalf of Coracle Archaeology by colleagues at Coastal and Offshore Archaeological Research Services (COARS), University of Southampton (Coracle Archaeology 2024b). The results of this assessment are summarised below and have been used to assess the potential impact of the proposed Project on the marine archaeological and cultural heritage resource. Geophysical anomalies with archaeological potential were assigned a unique Coracle Archaeology number (>**CA1000**); a full gazetteer of geophysical anomalies is provided in **Appendix 24B**.

50. Marine geophysical survey data was collected for an earlier iteration of the Offshore Development Area. Consequently, there are currently significant gaps in the geophysical survey coverage and in the assessment presented below (**Volume 5: Figure 24-3**). Further surveys are required to assess the revised OfECC; it is anticipated that, in consultation with the RCAHMW, these will be undertaken post-consent. These will require archaeological assessment, following the methodologies outlined in Coracle Archaeology (2024b; **Appendix 24B**).

Site-Specific Surveys

Landfall Surveys at Freshwater West

51. Site-specific landfall surveys were conducted in May 2023. This included the assessment of two potential export cable landfall locations, one situated in the centre of the beach at Freshwater West (southern option) and one located to the north, in the area known as Gravel Bay (northern option). The latter is now the preferred option and is taken through to the assessment of marine archaeology and cultural heritage.

52. A 300 m survey grid was established at each survey area, extending 150 m either side of the potential offshore export cable centreline. This was subsequently subdivided into 5 m transects, using a Global Positioning System (GPS) with an accuracy of ≤0.5 m. The surveys, comprising electro-magnetic conductivity (Geophex GEM-2 multi-frequency broadband electro-magnetic instrument), hand-held metal detector (using a Minelab X-Terra 705) and walkover surveys, were conducted along these transects, parallel to the retreating waterline. All surveys were undertaken by Coracle Archaeology personnel; terrestrial geophysical survey data were processed and assessed by Headland Archaeology and TigerGeo; full details of the survey methodology can be found in Coracle Archaeology (2024b).

24.5 Baseline

53. The following sections describe the baseline environmental conditions relating to the Offshore Development Area. It is divided into two main sections, submerged prehistory and the palaeo-environment, and marine cultural heritage. This includes assets identified in desk-based assessments and geophysical anomalies with archaeological potential identified in the offshore and landfall surveys.

24.5.1. Existing Baseline

Submerged Prehistory and the Palaeo-Environment

54. Throughout the Late Devensian period (c. 60-11.5 kilo annum (ka)), the British-Irish Ice Sheet (BIIS) was the dominant feature determining the palaeo-climate and depositional history of the area (Clark *et al*. 2012; Chiverrell *et al*. 2013; Scourse *et al*. 2019). The BIIS reached its maximum extent in the Celtic Sea at c. 24.3-23 ka, extending to a position west of the Isles of Scilly, though it is noteworthy that southern Pembrokeshire is believed to have remained ice-free (Chiverrell *et al*. 2013; John 2019).

55. Following this maximum extension, the BIIS began to regress towards the northern Irish Sea Basin; the retreat was rapid and driven by climatic warming, sea-level rise, mega-tidal amplitudes and reactivation of meridional circulation in the North Atlantic. The extension and retreat of the BIIS along St George's Channel and into the Celtic Sea resulted in the deposition of thick Pleistocene deposits (Blundell *et al*. 1968; Garrad 1977), typically associated with the Cardigan Bay Formation.

56. The BIIS was the last in a series of major glaciations that took place throughout the Pleistocene (c. 2.5 million years ago to 11.5 ka). There remains considerable uncertainty, however, regarding the extent of Pleistocene ice sheets in the area of the proposed Project. It was suggested by both Stephens (1966) and Mitchell (1968) that the geomorphology of the island of Lundy may be a product of glacial processes, modified by periglacial and post-glacial surface processes. This included widespread smoothing and lineation of granite bedrock surfaces, potentially indicative of sub-glacial ice moulding, dry channels interpreted as subglacial meltwater channels, and the presence of large areas of erratic gravels and cobbles, typically seen as representative of transport by ice. It was argued therefore by Mitchell (1968; 1972)

that the last glaciation over Lundy occurred during either the Anglian glaciation (marine isotope stage (MIS) 12; c. 478-424 ka), or the Wolstonian (MIS 10-6; c. 352-130 ka).

57. Recent investigations (e.g. Rolfe *et al*. 2012; 2014; Rolfe 2015) have challenged this assumption. Utilising Aluminium-26 (^{26}Al) / Beryllium-10 (^{10}Be) cosmogenic exposure dating of the glaciated bedrock surfaces, it is suggested that the last glaciation of Lundy occurred at c. 40-35 ka, or during MIS 4-3. This too has been challenged by Carr *et al*. (2017), based on a revised interpretation of the geomorphological and cosmogenic exposure data. It is argued that Lundy remained ice-free during the Devensian glaciation, with the cosmogenic dates relating to surface lowering during a prolonged period of sub-aerial granite weathering. Ongoing investigations on Lundy continue nevertheless to support MIS 4 glaciation, with deglaciation in MIS 3.

58. Offshore, glacial deposits from the north-east of Lundy were evaluated by Gibbard *et al*. (2017), using borehole data collected for the Atlantic Array offshore wind farm, c. 26 km east of the proposed Project, supplemented with coarse-resolution bathymetric data (based on the EMODnet DTM at 1/8 * 1/8 minutes resolution). It was suggested that glacial till deposits were present below marine deposits, lending credence to the hypothesis that these deposits might be associated with the Upper Till Member of the Cardigan Bay Formation (see for example Tappin *et al*. 1994).

59. Detailed analysis of the offshore borehole deposits has yet to occur, however (e.g. Carr *et al*. 2017), and the interpretation of the glacigenic sediments remains unsubstantiated. It is notable that the seabed south of Lundy does not contain any visible gorge or moraine deposits, potentially indicative of grounded ice. Rather, bedrock is incised by an east-west palaeo-channel network, likely associated with lowstand drainage from the Taw-Torridge valleys in north Devon.

60. It is suggested nevertheless by Gibbard *et al*. (2017) that the north-east Celtic Sea witnessed at least three phases of glaciation:

- One related to the southern limits of a Late Devensian MIS 2 Welsh Ice Cap;
- An earlier Devensian glaciation (MIS 4–3), associated with the BIIS; and
- A third, older glaciation associated with ice that filled both the eastern Celtic Sea and the outer and central Bristol Channel.

61. The latter is attributed typically to the Caernarfon Bay Formation, and is likely associated with onshore deposits recorded at Fremington, north Devon. This is refuted by Carr *et al*. (2017), who prefer instead the existing model of the extent, dynamics and timing of the BIIS, highlighted by both McCarroll *et al*. (2010) and Clark *et al*. (2012). This model places the BIIS significantly to the west of Lundy and not extending beyond the Celtic Sea or reaching the northern coastline of Cornwall and Devon.

62. Using this model, the proposed Project lies at the eastern extent of the MIS 2 glacial limit, though a revision by Chiverrell *et al*. (2013) places this limit c. 15 km east of the Array Area, crossing the Offshore Development Area c. 26 km to the north of the array (see Coracle Archaeology, 2024a). It is possible, therefore, that an ice sheet may have extended to the east of Lundy during the mid- to late-Devensian period, into the OfECC.

63. The retreat of the BIIS and the concomitant rise in sea levels resulted in the submersion of coastal areas surrounding the Celtic Sea. Perceptions of the rate of change of relative sea-level (RSL) have been constrained by studies using a number of sea level index points (SLIPs). The most recent review of SLIPs for the British Isles has been presented by Shennan *et al*. (2018),

which highlights only one SLIP for south Wales, derived from the submerged forest deposits at Freshwater West.

64. To supplement the radiocarbon-dated SLIPs, glacial isostatic adjustment (GIA) models have been used to predict broad patterns of RSL change over longer periods of time. GIA models predict sea levels of c. 30 m below mean sea-level (MSL) at the start of the Holocene (11.7 ka), rapidly rising to c. 8 m below MSL at Freshwater West by 7-8 ka, with a subsequent reduced rate of RSL rise to the present day.

65. Further offshore, in St George's Channel, RSL has been modelled and combined with tidal amplitude data for sectors of the BIIS since the last glacial maximum (LGM) at c. 22 ka (see Scourse *et al*. 2018). At the approximate position of the glacial limit, Scourse *et al*. (2018) suggest that RSL was c. 60 m below MSL between 20 to 14 ka, rising to c. 40 m below MSL at the end of the last glaciation, before following the Holocene curves predicted for Pembrokeshire. The modelled RSL suggests that the land bridge between Wales and Ireland in St George's Channel disappeared with the retreat of the BIIS.

66. The RSL history of the area (based on Scourse *et al*. 2018) suggests that the proposed Array Area would have been inundated during MIS 2. Following the models for the BIIS proposed by both Gibbard *et al*. (2017) and Chiverrell *et al*. (2013), it is likely also to have been beneath ice prior to inundation, further reducing the potential of the area to reveal any evidence for submerged palaeo-landscapes suitable for human occupation (see also Coracle Archaeology 2024a).

67. Indeed, the survival potential for palaeo-environmental material associated with submerged palaeo-landscapes in this area of the Celtic Sea is generally regarded as relatively low, primarily as a result of high-energy conditions including strong tidal currents which sweep through St George's Channel, to the north-west of the proposed Project. Such conditions are reflected on the seabed by lag gravel deposits or scoured bedrock, and result in minimal preservation of former landscapes. Exceptions can occur, however, in the form of infilled depressions (including palaeo-channels) which may have collected and protected material (Westley and Edwards 2017).

68. Assessments of the supplied project-specific SBP data have highlighted thick Quaternary deposits across both the Array Area and the southern part of the OfECC as it moves towards the shore. These consist primarily of late Devensian glacial deposits. In the area where the OfECC approaches landfall at Freshwater West, mobile sediments appear to sit above the underlying geology; many of these features are likely to consist of till clays, sands and gravels, with boulders visible in the array area.

69. A number of channel features are visible within the Offshore Development Area, though these lack any associated lateral floodplain features. Rather, a multi-phased incision is traceable between adjacent survey lines (Coracle Archaeology 2024b). These are likely to be late Pleistocene deposits, formed as a result of pro-glacial processes and subsequent catchment drainage. The geoarchaeological potential of these deposits is likely to be low, as no deposits or features attributable to temperate environments, conducive to occupation, have been observed. These deposits do, however, have the potential to further understanding of late glacial dynamics in the eastern Celtic Sea (see Coracle Archaeology 2024b).

70. The palaeo-environmental potential of the landfall location at Freshwater West is somewhat better understood (Coracle Archaeology 2024a), with a number of the most significant cultural heritage assets within the OfECC found on the beach itself. These include submerged forest deposits and an associated occupation site (**CA8**-**CA10**; Coracle Archaeology 2024a; **Table**

24-8; **Volume 5: Figure 24-4**), first identified by Leach (1913) in the spring and summer of 1912.

71. The most westerly (seaward) of the peat deposits was reinvestigated in the summer of 1960 by Wainwright (1961; 1963; **Volume 5: Figure 24-5**), who also encountered one small tranchet axe and a few flint flakes from the surface of the blue clay, sealed by the peat. Sampling of the peat at the low water mark by Godwin suggested that the pollen assemblage was dominated by *Quercus* (oak) and *Alnus glutinosa* (alder), with the latter also present in the macrofossil record along with a series of other aquatic / wetland plant species (in Wainwright 1961; 1963 Appendix II). The macrofossils indicated a transition from fen woodland at the base of the sequence to 'more muddy conditions' at the top. The lower wood peat was radiocarbon dated to 5210-4550 calibrated (cal.) BC (Q-530; 5960±120 BP; Godwin & Switsur 1964).

72. Another exposure of intertidal peat (**CA12**) is recorded in the Dyfed HER (primary reference number (PRN) 126540), c. 90 m to the south-west from the location of Leach's submerged forest as recorded by the RCAHMW. This includes two parallel bands of peat, a few metres wide. The seaward band contains tree stumps and branches; the landward exposure is reported to contain human footprints, potentially of both adults and children, as well as cloven hoof prints. The peat appears to sit on a grey clay of possible marine or estuarine / riverine origin, overlying a reddish brown clay with frequent stone inclusions, similar to the glacial till.

73. It is noteworthy that georectification of the map produced by Leach (1913: Figure 2), coupled with the site descriptions provided by Wainwright (1959; 1961; 1963), centres the most seaward submerged forest exposure and occupation surface on Ordnance Survey Great Britain (OSGB) grid reference SR 8805 9969 (World Geodetic System 1984 (WGS84) Universal Transverse Mercator (UTM) 30N 357120 5724790), c. 350 m west of the position of the forest recorded by the RCAHMW (national primary reference number (NPRN) 524740; see **Volume 5: Figure 24-5**). The landward submerged forest exposure is mapped by Leach (1913) on SR 8832 9973 (WGS84 UTM 30N 357390 5724840), c. 120 m south of its recorded position in the NMRW. This peat surface is often exposed on the beach following storm activity when the sand is temporarily stripped away, most recently in both 2016 and 2020 (Mountain Man 2023).

74. In April 2021, a peat bed with tree remains and an underlying brown soil were reported at SR 88370 99784 (WGS84 UTM 30N 357435 5724891), covering an area c. 20 m x 50 m. This peat surface is likely to be associated with the inner submerged forest exposure. This location is 90 m south of the RCAHMW record and 60 m northeast of the approximate position provided by Leach (1913), suggesting that the submerged forest is more laterally extensive than considered previously.

75. At Gravel Bay, at the northern end of the beach, a newly recorded submerged forest was reported in March 2020 (Mountain Man 2023; **CA9**; **Volume 5: Figure 24-4**). This consisted of an undulating peat surface with abundant pools and occasional tree remains, extending over an area of c. 100 x 30 m, centred on SN 8806 0047 (WGS84 UTM 30N 357116 5725573). These peats are not recorded in the NMRW or in the DAT HER datasets.

76. No exposures of peat were visible on the surface of the beach during landfall surveys conducted in May 2023, presumably as a result of elevated levels of mobile beach sand. The number of exposures recorded in the past across the beach, combined with the nature of submerged forest deposits suggests, nevertheless, that the deposits are extensive laterally and may be encountered at both proposed landfall options. Assessment of the electro-magnetic landfall data for both the northern and southern options suggested that the sand is not magnetically uniform at depth, which may indicate further the presence of the submerged forest deposits at these locations.

77. The Palaeolithic and Mesolithic lithic artefact database (PaMELA; Wessex Archaeology & Jacobi 2014) also includes a large number of locations from which Mesolithic material has been recovered in and around the beach at Freshwater West. Most of these records are inaccurate spatially, and appear to relate to the submerged forest identified by Leach (1913) or excavations by Wainwright (1961; 1963) in the Little Furznip / Gupton Burrows area. The PaMELA database does, however, cite a collection at the Ashmolean Museum recorded as derived from Broomhill Burrows, the dune sequence to the north of the Castlemartin Corse stream which enters the bay to the east of the submerged forest. The 'soil drift' deposit may extend under the beach, and into the Celtic Sea, though this is not visible in the iMarDIS MBES dataset collected in 2017, which shows mainly undifferentiated seabed sand and bedrock outcrops. At present, no seismic data (sub-bottom profiler) is available for the intertidal and nearshore area that may provide an indication of the lateral continuity of buried deposits.

78. The DBA makes it clear that the potential for encountering deposits of palaeo-environmental interest during works associated with the proposed Project at Freshwater West is high. In contrast, assessment of the supplied project-specific SBP data highlighted thick Quaternary deposits throughout the Offshore Development Area, consisting primarily of late Devensian glacial deposits. A number of channel features were also visible, though these lack any associated lateral floodplain features. These are likely to be late Pleistocene deposits, formed as a result of pro-glacial processes and subsequent catchment drainage, and lacking deposits or features attributable to temperate environments which were conducive to past human occupation. The palaeo-environmental potential of these deposits is considered therefore to be low.

Maritime Cultural Heritage

79. A total of 41 cultural heritage assets were identified within the Study Area, encompassing the Offshore Development Area from MHWS at Freshwater West, including those outlined above (**CA8**-**10**; **CA12**). These assets include 25 wrecks, two aircraft, two obstructions, one maritime named location, four findspots, three sites, one monument, two features and one geophysical anomaly identified by previous surveys in the area (**Table 24-8**; **Volume 5: Figure 24-6 to 24-8**). Following revisions to the OfECC, eight assets identified previously are now located beyond the Offshore Development Area, including **CA3-5, CA11**, **CA35**, **CA40** and **CA44-45**. These will not be considered in this report.

80. Wrecks and obstructions discussed below are generally referred to using the UKHO designations of 'live' or 'dead'. 'Live' refers to those sites where a location is known, which has been verified by recent surveys. 'Dead' refers to events that have been recorded as occurring in a certain location, but for which no site has been detected by repeated, or the most recent, surveys.

81. There are no World Heritage sites, Scheduled Monuments, Protected Wreck sites, Registered Parks and Gardens or Registered Battlefields in proximity to the Offshore Development Area. The proposed Project does, however, intersect with the Milford Haven Waterway Historic Landscape Area, principally the West Angle to Freshwater West coastal strip. Within the Offshore Development Area, this is limited to a small area at the northern extent of Freshwater West, measuring c. 0.5 hectares (**Volume 5: Figure 24-9**).

Table 24-8 Llŷr floating offshore wind project Offshore Development Area gazetteer entries

CA no.	Name	Type	Date	Status	Easting (UTM 30N)	Northing (UTM 30N)	Source
1	*Highland Home*	Wreck*	1895	Live	354054	5725512	UKHO; RCAHMW
		Wreck (artefacts)			356766	5724240	RCAHMW
2	*Willemoes of Thuro*	Wreck	1924	Live	357165	5725301	RCAHMW
6	Unknown	Wreck	Unknown	Live	334513	5701421	RCAHMW
					334580	5701370	UKHO
7	Unknown	Wreck	Unknown	Dead	334174	5697983	UKHO
8	Submerged forest	Feature	Mesolithic	n/a	357411	5724974	RCAHMW
			Prehistoric	n/a	357274	5724404	Dyfed HER
9	Submerged forest	Feature	Prehistoric	n/a	357048	5725613	n/a
10	Occupation site	Site	Mesolithic	n/a	357169	5724802	Dyfed HER
12	Footprints	Monument	Prehistoric	n/a	357368	5724895	Dyfed HER
13	*Mary E Wadham*	Wreck	1888	Reported loss	357299	5724737	RCAHMW
14	*Georges Andre*	Wreck	1916	Reported loss	332026	5691342	RCAHMW
15	*Mysotis*	Wreck	1916	Reported loss	332026	5691342	RCAHMW
16	*Roger Bushell*	Wreck	1974	Reported loss	341684	5713649	RCAHMW
17	Freshwater West Maritime named location	Seascape	Multiperiod	n/a	357214	5725151	RCAHMW
18	*Brothers*	Wreck	1819	Reported loss	357214	5725151	RCAHMW
19	*Hope*	Wreck	1823	Reported loss	357214	5725151	RCAHMW
20	*Princess Elizabeth*	Wreck	1825	Reported loss	357214	5725151	RCAHMW
21	*Cherokee*	Wreck	1831	Reported loss	357214	5725151	RCAHMW
22	*Blessing*	Wreck	1834	Reported loss	357214	5725151	RCAHMW
23	*Express*	Wreck	1836	Reported loss	357214	5725151	RCAHMW
24	*Unknown*	Wreck	1840	Reported loss	357214	5725151	RCAHMW
25	*Dove*	Wreck	1841	Reported loss	357214	5725151	RCAHMW
26	*Mary Ann*	Wreck	1841	Reported loss	357214	5725151	RCAHMW
27	*Gram Para*	Wreck	1855	Reported loss	357214	5725151	RCAHMW
28	*Unknown*	Wreck	1860	Reported loss	357214	5725151	RCAHMW
29	*Thomas M Reed*	Wreck	1879	Reported loss	357214	5725151	RCAHMW

CA no.	Name	Type	Date	Status	Easting (UTM 30N)	Northing (UTM 30N)	Source
30	*Barabara*	Wreck	1881	Reported loss	357214	5725151	RCAHMW
31	*Astronomer*	Wreck	1886	Reported loss	357214	5725151	RCAHMW
32	*Margaret Ann*	Wreck	1918	Reported loss	357214	5725151	RCAHMW
33	*Vickers Wellington XII Mp638*	Aircraft	1944	Reported loss	357214	5725151	RCAHMW
					357269	5724804	Dyfed HER
34	*Armstrong Whitworth Whitley V Z6941*	Aircraft	1941	Reported loss	330696	5694525	RCAHMW
36	Unclassified	Obstruction	Unknown	Live	339350	5712607	RCAHMW
37	Unclassified	Obstruction	Unknown	Dead	325968	5695474	UKHO
38	Bronze hoard	Site	Bronze Age	n/a	357266	5725003	Dyfed HER
39	Landing point at Gumption Barrows Bridge	Site	Post Medieval	n/a	357499	5724870	RCAHMW
41	Prehistoric flint flake	Findspot	Prehistoric	n/a	357065	5725101	NMW
42	Red deer metapodial	Findspot	Prehistoric	n/a	357265	5725103	NMW
43	Arrowhead and Chert Pebble	Findspot	Bronze Age	n/a	357169	5724802	Dyfed HER
60	Bones	Findspot	Unknown	n/a	357078	5724101	Dyfed HER
64	*Hope*	Wreck	1901	Reported loss	354529	5719998	RCAHMW
CA65	*Saint Jacques*	Wreck	1917	Live	353795	5722922	RCAHMW; UKHO
					353793	5722953	
					353827	5722936	
		Wreck (boiler?)	Unknown	Unknown	353518	5722375	RCAHMW
CA66	ERS21_0106	Anomaly	Unknown	Live	337286	5710386	RCAHMW

*Located beyond the Offshore Development Area

82. The *Highland Home* (**CA1**) was a British iron-hulled barque of 1371 gross registered tonnage (grt), built at Leith in 1886. On 10th November 1895, the *Highland Home* became separated from the steam tug *Warrior* while under tow, with the loss of 20 lives (wrecksite.eu). The wreck is located beyond the revised Offshore Development Area, at a depth of c. 21 m below lowest astronomical tide (LAT; UKHO number 68924). The RCAHMW also records a wreck at this location, though it is unnamed in its database (NPRN 240879). The archaeological review of marine geophysical survey data identified a wreck at this location, with visible wreckage covering an area of c. 80 x 46 m (Coracle Archaeology 2024b).

83. Artefacts from the wreck, including the ship's bell, have been recovered from a location c. 3 km to the south-east of the recorded position of the wreck (**CA1**; NPRN 273100; **Volume 5: Figure 24-3**), within the Offshore Development Area. Both the location of the wreck and the recovered artefacts are recorded in **Table 24-8**. No geophysical survey data were available for the area in which the ship's artefacts were recovered, though it would appear to be an isolated findspot. It is unlikely that further remains are to be found at this location. As the wreck clearly lies beyond the revised Offshore Development Area, it will not be considered further in this report.

84. One live wreck is recorded on the beach at Freshwater West. The *Willemoes of Thuro* (**CA2**) was a wooden schooner of 186 grt, built at Svenburg in 1911 (NPRN 273193; **Volume 5: Figure 24-7**). This vessel ran ashore at Freshwater West in December 1924 while on passage from Caernarfon to Erquy, with the loss of one life. It is exposed routinely by winter storms (Coracle Archaeology 2024a and b) and was known previously as the 'upside-down wreck' (NPRN 420445). No remains of the wreck were visible on the surface at the time of the survey in May 2023, and no areas of high conductivity or magnetic susceptibility anomalies were identified in proximity to the recorded location of the *Willemoes* in the electro-magnetic (EM) survey data. This is presumed to be a result of elevated levels of mobile beach sand.

85. A north-south aligned wreck (**CA1025**) is clearly visible in the geophysical survey data for the OfECC, associated with a number of SSS and magnetic anomalies (**Volume 5: Figure 24-10**). The location of the wreck site corresponds to **CA6**, originally recorded as a sonar contact at the end of WWII. Scour is visible at the bow and stern of the vessel, up to 2 m deep and extending up to 9 m north and south of the wreck. Two large pieces of debris are also visible on the seabed, c. 7 m and 11 m west of the wreck, measuring c. 7 m and 4 m in length respectively. Both these linear features are likely to be part of the ship's rigging and may be the remains of beams or masts. Additional debris can be seen close to the stern of the wreck at its north-eastern end; a further cluster of debris is visible on the seabed c. 33 m north-east of the stern.

86. The profile of the ship is indicative of a large open deck with a mid-ship housing and a steam engine, though it is probable that it also carried a pair of masts or beams. It is likely that it is late 19th or early 20th century in origin and used for the transport of goods (e.g. a cargo ship, a collier or a trawler). A review of reported wreck sites in the wider area identified one potential candidate for this ship, with a similar deck layout and dimensions - the *Hungate*, a steel screw steamer of 204 grt, registered in Grimsby in October 1900 (Coracle Archaeology 2024b). It is notable that the UKHO database records this wreck as 'dead' (UKHO number 11875), at a location c. 4 km south-east of the southern extent of the Offshore Development Area, and c. 21 km from the current wreck position. This 'dead' location would suggest that the assigned coordinates are incorrect (see Coracle Archaeology 2024b; **Appendix 24B**).

87. An additional live wreck is recorded in the UKHO data within the Offshore Development Area. The SS *Saint Jacques* (**CA65; Volume 5: Figure 24-7**) was a French steel-hulled steamship of c. 2459 grt, built in Dunkirk in 1909. The vessel was struck by a torpedo fired from U-boat *UC-51* on 15 September 1917 while *en route* from Barry to North Africa with a cargo of coal. The engine room was wrecked and flooded, resulting in the loss of five crew. The remaining crew took to lifeboats and were rescued by the trawlers *Sidmouth* and *Barry* and the rescue tug HM *Frances Batey* (NPRN 273164). The wreck measures c. 88 x 11 x 9.5 m and lies at a depth of c. 33 m below LAT, with debris visible on either side of the hull and keel (UKHO 58707).

88. Two areas of debris are located c. 35 m to the south-east (NPRN 518627) and 30 m to the south (NPRN 518626) of the wreck respectively. The wreck site is recorded in an area for which there is currently no project-specific geophysical survey data, though iMarDIS high resolution

bathymetry acquired in 2017 shows a low-lying outline with a higher central section and outlying upstanding elements, possibly corresponding to the areas of debris noted above.

89. An additional findspot associated with the wreck is reported by the RCAHMW c. 675 m to the south-west (NPRN 240744). This is described in the record as 'an oiler'; for the purposes of this report it is presumed to be a boiler, though it is possible that it refers to an oil tank. Neither iMarDIS high-resolution bathymetry data nor project-specific survey data are available currently for this location, though it is notable that there is no live record in this area on the UKHO database. At present, this is assumed to be an isolated findspot. This will be reviewed following the archaeological assessment of newly collected geophysical survey data. All sites associated with the wreck are recorded in **Table 24-8.**

90. A number of other wreck sites were identified in the Offshore Development Area in the DBA, including one dead wreck (**CA7**) and 20 reported losses (**CA13-16**; **CA18-32; CA64**). Fifteen of these (**CA18-32**) are recorded at a maritime-named location (**CA17**) on the beach at Freshwater West. These locations serve to highlight the archaeological potential of the area, based on the number of reported maritime losses recorded in the vicinity (Coracle Archaeology 2024a; **Appendix 24A**). These losses have been assigned a temporary spatial coordinate by the RCAHMW, representing the centre of the generalised area in which the loss was recorded, pending additional information becoming available. The location should not be seen therefore as indicative of the presence or absence of physical remains. No anomalies were visible in the assessment of the landfall or marine geophysical survey datasets for **CA7**, **CA13-16** or **CA18-32**, and no features were visible on the surface during the landfall walkover surveys. These wrecks will not be considered further in this assessment.

91. One loss (the *Hope*; **CA64**; NPRN 272405; **Volume 5: Figure 24-7**) is located in an area for which we presently have no geophysical survey data. Descriptions of the loss (involved in a collision 'five mile south-east of St Ann's Head') and the lack of a corresponding record in the UKHO dataset suggests that it should be considered a loss report, rather than the physical location of a wreck site and it will not be considered further in this assessment. This will be re-evaluated following the archaeological review of additional geophysical survey data; any mitigation will be captured in the WSI.

92. No new wreck sites were positively identified during the archaeological review of marine geophysical survey data. The proposed Project will, however, be installed in an area of considerable maritime activity in the past, at both local and international levels, evident in the number of reported losses within the Offshore Development Area (e.g. **CA13-16**; **CA18-32; CA64**). It is not possible to discount entirely the potential for encountering unknown maritime cultural remains during works associated with the proposed Project. The likelihood of doing so can be considered moderate.

93. Two aircraft losses are recorded within the Offshore Development Area (**CA33-4**), including one (**CA33**) at the maritime named location (**CA17**) described above. A Vickers Wellington Xii Mp638 (**CA33**) is reported to have belly-landed on the beach on 9 April 1944. It is believed that the aircraft was recovered intact and no remains have been reported at this location (Coracle Archaeology 2024a). An alternative location for this aircraft is recorded in the Dyfed HER, c. 350 m to the south. No remains of this aircraft were identified during landfall surveys in May 2023.

94. An Armstrong Whitworth Whitley V Z6941 aircraft (**CA34; Volume 5: Figure 24-8**) was also reported in the DBA, located within the Array Area. The aircraft reportedly ditched into the sea c. 35 km southwest of Milford Haven on 2 October 1941 (Coracle Archaeology 2024a). The seabed in this area shows a series of bedforms and the occasional boulder, with no anomalies

in the area that might suggest the presence of ferrous material just below the seabed surface (Coracle Archaeology 2024b).

95. As yet, no remains of these aircraft have been confirmed at their given locations, nor have any aviation remains been detected during the review of marine geophysical survey datasets (Coracle Archaeology 2024b). It is important, nevertheless, to note that the ephemeral nature of aircraft crash sites at sea and the difficulties inherent in accurately recording crash site locations means that remains may not always be present at the stated locations. These locations should be seen as providing an indication that aviation remains may exist at, or in proximity to, the general area. The potential for encountering aviation remains during works associated with the proposed Project must therefore be considered moderate. If remains are encountered, they would be designated automatically as Controlled Sites under the PMRA 1986.

96. There are two obstructions recorded in the Offshore Development Area (**CA36**-**7**). No corresponding signatures were visible in the geophysical survey data, and they will not be considered further in this assessment.

97. Two further sites were recorded in the Offshore Development Area (**CA38**-**39**), in addition to those associated with the submerged forest deposits described above (**CA10**). These include the location of a Bronze Age hoard (**CA38**) and a landing place (**CA39**), both located on the beach at Freshwater West (Coracle Archaeology 2024a). The Bronze Age hoard appears to be an isolated findspot: no similar finds have been found in the area, and it is not considered part of an associated cohesive monument or feature. The landing place is located c. 800 m from the preferred landfall option at Freshwater West; the proposed Project is unlikely to impact these sites and they will not be considered further in this assessment.

98. Four further findspots were identified in the DBA, including a prehistoric flint flake (**CA41**), the metapodial bone of a red deer (**CA42**) a Bronze Age arrowhead with a chert pebble (**CA43**) and a number of bones (**CA60; Volume 5: Figure 24-7**). The origin and date of the bones is not recorded, and they were reburied subsequently. The coordinates provided for this record place the findspot c. 850 m to the south-west of the dune sequence, in the intertidal zone, which would suggest that it is spatially inaccurate. All these items are considered to be casual, isolated finds (i.e. not associated with corresponding sites or monuments) and will not be considered further in this assessment.

99. No new cultural heritage assets were identified positively during the landfall surveys conducted at Freshwater West, though a linear anomaly running approximately south-west-north-east is visible in the geophysical survey data in the northern survey area (Coracle Archaeology 2024b; **Appendix 24B**). This was also recorded in geophysical surveys undertaken for the Greenlink Interconnector cable, where it was identified as a relict MoD listening cable (Cotswold Archaeology 2019). A linear feature may also be visible in the metal detections in the southern survey area, c. 35 m from the proposed survey centreline, though the readings are too sparse (c. 20 m apart) to discount the possibility that the alignment is more than coincidence (Coracle Archaeology 2024b and c; **Appendix 24C**). The majority of the remaining detections are located around MHWS and are likely to be indicative of bits of metal washed onshore by the tide. These are not considered archaeologically significant, and will not be considered further in this assessment.

100. The northern extent of the Offshore Development Area intersects with the West Angle to Freshwater West coastal strip, part of the Milford Haven Waterway Historic Landscape Area. (**Volume 5: Figure 24-9**). This consists of a c. 7 km strip of high, hard-rock sea cliff. The historic landscape of the strip is characterised by a variety of archaeological sites, including military

installations dating from the 16th to the 20th centuries and the Grade II listed 19th century fort on Thorn Island, now converted to a hotel. An Iron Age hillfort is also located on the cliffs to the south of West Angle Bay; none of these sites or monuments are located in the Offshore Development Area or below MHWS, and they are unlikely to be impacted by offshore elements of the proposed Project. They will not be considered further here.

101. The archaeological assessment of marine geophysical survey data identified 29 geophysical anomalies with archaeological potential. Of these, five are considered to be of high, and 12 of medium, archaeological potential. Twenty-five of the identified anomalies are located beyond the current iteration of the OfECC. These will not be impacted by the proposed Project and will not be considered further in this report.

102. This report focuses solely on the four anomalies located within the OfECC (**CA1025-6**; **CA1028-9)**. As noted above, there are currently significant gaps in the geophysical survey data coverage, following the route revisions of April 2024. Further geophysical surveys will be undertaken post-submission, including the collection of additional MBES, SBP, SSS and marine magnetometer data. These will be assessed archaeologically by Coracle Archaeology, following the methodologies outlined in **Appendix 24B** and summarised below, thus ensuring that the marine archaeology and cultural heritage within the Offshore Development Area has been assessed fully. Discussions with the RCAHMW in March 2024 established that the archaeological assessment of these data is likely to be a condition of the consent licence (**Table 24-3**).

103. Supplied geophysical datasets were assessed for anomalies with archaeological potential, with selection based on the presence of multiple lines of evidence (confirming datasets). Anomalies were defined based on their potential to be of archaeological interest, and classified using the following criteria:

- **High potential** - identified typically by multiple geophysical datasets and can be positively identified as being an archaeological site (e.g. wreck) or of archaeological interest;
- **Medium potential** - identified typically by multiple geophysical datasets, and strongly suggestive of the presence of anthropogenic feature(s) which may be of archaeological interest, but cannot be classified or identified visually (e.g. cannot be identified positively as a wreck);
- **Low potential** - identified usually by a single geophysical dataset (typically magnetics and / or sss) that suggest a possible anthropogenic feature that may have archaeological significance and that differs in character from those identified as having no potential; or
- **No potential** - geological features such as boulders or known (and often mapped) anthropogenic features such as cables, anchorages etc.

104. One of the remaining four anomalies is considered to be of high archaeological potential (**CA1025**), corresponding to the recorded wreck site of **CA6**, and described above. Two geophysical anomalies are considered to be of medium archaeological potential. These include:

- **CA1026**, a cluster of SSS anomalies in an area of scour between bedforms (**Volume 5: Figure 24-11**)**;** and
- **CA1029**, two magnetic anomalies measuring 255 and 21 nT respectively (**Volume 5: Figure 24-12**).

105. The remaining anomaly (**CA1028**) is a single magnetic anomaly, located in proximity to a series of small boulders. It is considered to be of low archaeological potential, and will not be considered further in this report.

106. A number of geophysical anomalies identified during the archaeological assessment of data collected for the Project Erebus offshore windfarm were also included in the latest update of the RCAHMW dataset. These include two anomalies considered by the archaeological consultants of Project Erebus to be of medium archaeological potential (MSDS 2021a):

- **ERS21_0103**, a small mound with protruding features visible in the SSS dataset and with a moderate magnetic signature. This anomaly is located c. 5 m beyond the Offshore Development Area, within the WSA (**CA74**; Coracle Archaeology 2024a; **Appendix 24A**); Given the potential for material associated with this anomaly to be located within the Offshore Development Area it is included in this discussion; and
- **ERS21_0106**, a series of parallel linear features visible in the SSS dataset (**CA66**; NPRN 800237; Blue Gem Wind 2021). The anomaly is located on two magnetometer lines but has no corresponding signature in the Erebus magnetic data (MSDS 2021a).

107. No corresponding anomalies were visible at these locations during the archaeological assessment of project-specific marine geophysical survey data collected for the proposed Project. Detailed assessment of these locations in the data collected for the proposed Project suggests that they are located in an area of migrating bedforms characterised by numerous upstanding features, indicative of boulders. A geological origin is considered likely for both these anomalies; both are considered by this assessment to be of low archaeological potential.

108. Six further geophysical anomalies of uncertain archaeological potential identified by Project Erebus are also included in the Offshore Development Area, including:

- **ERS21_MAG_1280**;
- **ERS21_MAG_1287**;
- **ERS21_MAG_1296**;
- **ERS21_MAG_1298**;
- **ERS21_MAG_1312**; and
- **ERS21_MAG_1314**.

109. All were defined as magnetic contacts with no seabed expression (Blue Gem Wind 2021; MSDS 2021a). Detailed assessment of these locations in the datasets collected for the proposed Project suggests that they should be considered of low archaeological potential (see also **Section 24.11**).

24.5.2. Future Baseline

110. This section considers any changes to the baseline conditions described above that might occur over the lifespan of the proposed Project, but in their absence (i.e. in the event that the Project is not installed).

111. Changes in baseline conditions are most likely to occur as a result of shifting sediments offshore, which have the potential to cover currently exposed heritage assets identified above, and thus afford them greater protection, or to expose them further, resulting in potential deterioration. Equally, it is likely that cultural heritage assets identified on the beach at Freshwater West will be exposed or buried further by storms and associated shifting levels of mobile sediment during the life of the proposed Project. This includes the *Willemoes of Thuro*

(**CA2**) and the submerged forest / peat deposits described above (**CA8-10; CA12**). This has occurred routinely in the past, with the *Willemoes* last reported as exposed in 2014.

112. It is also possible that climate change and associated changes in storm patterns, such as increased frequency or intensity, will result in changes to sediment movement. At Freshwater West, this could result in more frequent or intense beach stripping and greater exposure of intertidal assets. A precise prediction, however, would require detailed study of sediment dynamics at the beach and the local influence of storms versus other factors (including, for example, anthropogenic disruption to sediment supply further along shore).

113. The effect of climate change on fully submerged assets offshore is much harder to predict. There is still relatively little research on the subject (see Gregory *et al.* 2022) and the complexity of local sediment dynamics in response to hydrodynamic forcing is such that detailed predictions based on available data are not possible.

114. More certain is the effect of sea-level rise, which in this area is projected to increase by c. 0.4-0.7 m by 2100 (potentially exceeding 1 m in the worst-case scenario) with variation dependant on future carbon emissions (Met Office Hadley Centre 2018). This will result in assets recorded in the intertidal zone at Freshwater West gradually becoming submerged more frequently and for longer periods (e.g. **CA2**; **CA8-10**; **CA12**).

115. The Greenlink Interconnector cable is being installed currently at Freshwater West. The interconnector cable will pass under Gravel Bay, the preferred landfall option, using horizontal directional drilling (HDD). Archaeological assessments were undertaken for the project to ensure that potential impacts on cultural heritage assets were avoided, minimised or mitigated (Cotswold Archaeology 2019; Coracle Archaeology 2022). The choice of installation method, combined with project-specific archaeological assessments, suggest that it is unlikely to impact on the future baseline.

24.6 Scope of the Assessment

116. An EIA Scoping Report for the proposed Project was submitted to NRW Marine Licensing Team (MLT) in April 2022. The Scoping Report was also shared with relevant consultees, inviting comment on the proposed approach adopted by the Applicant. A Scoping Opinion was received from NRW MLT by the Applicant in July 2022. Based on this Scoping Opinion and further consultation, potential impacts on marine archaeology and cultural heritage that were scoped into the assessment are described below. No impacts have been scoped out of this assessment.

117. This assessment considers the design parameters of the proposed Project that are predicted to result in the greatest environmental impact, known as the 'realistic worst-case scenario'. The realistic worst-case scenario represents, for any given receptor and potential impact on that receptor, various options in the Design Envelope that would result in the greatest potential for change to the receptor in question. Given that the realistic worst-case scenario is based on the design option (or combination of options) that represents the greatest potential for change, there is confidence that the development of any alternative options within the design parameters will give rise to effects no greater or worse than those included in this impact assessment.

118. The design scenarios identified below have therefore been selected as those having the potential to result in the greatest effect on marine archaeology and cultural heritage within the Offshore Development Area. These scenarios have been selected from the details provided in **Chapter 04: Description of the Proposed Project**.

119. A number of activities during the construction phase of the proposed Project have the potential to impact directly or indirectly on known or previously unidentified marine archaeological and cultural heritage assets. These include:

- Seabed preparation and route clearance;
- Excavation and backfill of the subsea cable trench;
- Horizontal directional drilling (HDD) in the nearshore, intertidal and foreshore areas;
- Installation of cable protection over cable-crossing points;
- Removal of redundant out-of-service (OOS) cables; and
- Installation of anchoring and mooring lines.

120. Prior to installation of the offshore project components, a programme of seabed clearance will be undertaken. The nature of the seabed clearance activities will be confirmed following the acquisition of additional geophysical survey data post-submission, which will provide a more accurate picture of the nature of the seabed within the OfECC.

121. As the following assessment is based on a realistic worst-case scenario, it is assumed that seabed clearance activities will include the removal of boulders and potential unexploded ordnance (pUXO), sandwave levelling and a pre-lay grapnel run (PLGR). The exact nature of the equipment used for PLGR will be defined post-consent; as worst-case scenario, it is anticipated that PLGR will be undertaken along the centreline of the cable route. Grapnels typically have a footprint on the seabed of c. 1 m, with a maximum penetration depth of c. 1 m.

122. The levelling of sandwaves and megaripples located within the Offshore Development Area will be necessary to facilitate the installation of export cables as well as anchoring and mooring points in the Array Area. Geotechnical survey data collected post-consent will define the extent of sandwave levelling; given the mobile nature of sandwaves, their exact location will be defined through additional geophysical survey. As a realistic worst-case scenario, the maximum length of sandwave levelling along the route of the OfECC is predicted to be 10.3 km per cable, with a maximum width of seabed disturbance of 25 m per cable. The maximum area of seabed requiring sandwave levelling per cable is predicted therefore to be c. 310, 524 m^2, or 0.31 km^2; the maximum volume of material to be moved is c. 900,550 m^3.

123. The methodology utilised for sandwave levelling has yet to be determined, though it is anticipated that it will be conducted from a dredging vessel utilising high-pressure water pumps. These pumps will loosen the sediment on the seabed and bring it onboard; the sediment will then be redeposited on the seabed within the OfECC. If the recovered sediment is redeposited on the seabed then it has the potential to impact upon cultural heritage assets through a change in local sediment dynamics. It is important to note that any such changes can be either beneficial or adverse, resulting in both greater burial and protection of identified assets (beneficial) or increased erosion (adverse).

124. Route clearance may also require the removal of large boulders identified within the OfECC by existing or additional geophysical surveys. Large boulders are defined as those greater than 30 cm; these will be relocated to a minimum distance of 15 m perpendicular to the cable route. The exact procedure for boulder clearance will be agreed with the NRW post-consent. A realistic worst-case scenario suggests the use of a SCAR Plough with a maximum footprint of 15 m (7.5 m either side of the cable centreline).

125. The proposed Array Area covers an area of 45 square kilometres (km^2), in which the majority of infrastructure associated with the proposed Project will be located. This includes the WTGs,

floating substructures, mooring and inter-array cables (IACs). Water depths within the Array Area vary from 65 m – 75 m below LAT.

126. The WTGs will be arranged in a string or star layout, with each connected to the next by IACs. The final WTG in the string will be connected to a subsea connector that links the IACs to the export cables; the subsea connector will be positioned on a concrete plinth on the seabed, with a maximum footprint of 64 m^2.

127. The methods for mooring each of the floating barges that hold the WTGs has yet to be determined; at present, both tensioned and cantenary spread moorings are under consideration. Tensioned moorings moor the floating WTG vertically to the seabed under tension, allowing for horizontal but preventing vertical movement. Cantenary spread moorings, in contrast, hold the platform in place using the weight and curved shape of the mooring itself. Using this system, the lower section of the mooring rests on the seabed and acts as a counter-weight with the assistance of clump weights (a maximum of 25 per mooring line).

128. The maximum number of mooring lines required for each barge will not exceed eight regardless of mooring type selected (a maximum of 80 in total); for cantenary spread moorings, up to 150 m of the mooring line may be in contact with the seabed. Tensioned moorings will have a maximum footprint on the seabed of 100 m^2, cantenary spread moorings 700 m^2.

129. Anchoring solutions for the barges include drag embedment anchors, driven or drilled piles. The maximum number of anchors required for each WTG will not exceed eight; in a worst-case scenario, the maximum diameter of the chosen anchoring method will not exceed 6 m (drag embedment anchor; 3.5 m for drilled piles and 3 m for driven piles). The maximum penetration depth of the pile will not exceed 55 m (drilled / driven piles). Drag embedment anchors will have a maximum seabed footprint of 76.5 m^2 per anchor (compared to 15 m^2 for both piling options). The total footprint of the chosen anchoring system will not exceed 6120 m^2 for drag embedment anchors, 1200 m^2 for drilled or driven piles.

130. A maximum of 11 IACs will be installed between the WTGs. To accommodate the floating nature of the barges, the IACs will allow for movement in the water column; each IAC will have a maximum length of 1.6 km, including a maximum of 1.55 km on the seabed. Where possible, the cables will be buried to a target depth of 1.2 m (a minimum of 0.8 m), with a maximum trench width of 25 m per cable. Where burial is not possible, cable protection will be required to a maximum width of 5 m, using the methods described below (paragraph 133).

131. The exact method of cable burial has yet to be determined, though jet-trenching is the preferred option as it minimises seabed disturbance. Jet-trenching fluidises the seabed to facilitate cable burial; displaced sediments are then left to resettle and bury the cable in place. If this is not possible, a subsea cable plough will be utilised (worst-case scenario). The cable will pass through the plough, which lifts a section of substrate allowing the cable to be buried beneath the sediment. The cable plough has a maximum footprint of 15 m, equating to 7.5 m either side of the cable centreline.

132. It is anticipated that two offshore export cables will be installed within the OfECC, transmitting electricity from the Array Area to the landfall location. Each cable will have a maximum length of 49 km. The cables will be laid in separate trenches, with a minimum separation of 50 m between the cables, utilising either jet-trenching or subsea cable plough. The installation of each cable has the potential to disturb the seabed in a corridor up to 25 m wide; the total width of disturbance is a maximum of 50 m. Target burial depth for the majority of the export cable is 1.2 m, or a minimum of 0.8 m. In the nearshore area, parallel to the beach from the

HDD exit point to c. 1.7 km the target burial depth is 1.5 m; along the eastern edge of Turbot Bank the target burial depth is 2 m for c. 4.5 km. The maximum trench width, and thus the width of seabed disturbance will be 25 m, regardless of burial depth. A realistic worst-case scenario suggests a total area of 2.45 km^2 of the seabed may be disturbed by offshore export cable installation.

133. In areas where burial is not possible (e.g. over exposed bedrock), cable protection will be required. Areas requiring protection will be defined by post-installation surveys; at present, it is assumed that 4.9% of the offshore export cables may require protection (c. 2400 m of each cable). Cable protection options include rock placement, concrete mattressing and sand grout bags to a maximum width of 5 m and a maximum height of 1.5 m. In the nearshore area, where the minimum burial depth is not achievable, cables will be protected using iron articulated pipe protection, to a maximum of 11,000 m (or 22.4%) of each cable.

134. Five potential cable-crossing points have been identified within the Offshore Development Area (**Table 24-9**). Cable protection may be required at four of these crossing points, this may include rock placement, concrete mattressing or sand grout bags. No additional protection will be required for crossing Greenlink, as both cables will be installed via HDD in the area where they intersect.

Table 24-9 Cable crossings within the Offshore Development Area

Cable	Kilometre point (KP)
Celtic Array cables	2-3
Celtic Array cables	3-4
RPL cable line 1	7-8
OSM Telecom Cables	31-31
Greenlink Interconnector	48-49

135. The offshore export cables will make landfall at Freshwater West. Two landfall options were selected originally; one situated in the centre of the beach (southern option) and one located to the north, in the area known as Gravel Bay (northern option). The latter is now the preferred option. The export cables will be installed via HDD beneath the intertidal zone to a depth of c. 40 m. Up to two ducts will be installed with a maximum length of 1500 m, exiting at water depths of 3-8 m below LAT. The HDD ducts will have a maximum diameter of 660 mm, with a separation between HDD exit points of c. 50 m in the nearshore area. Entry pits will be located above MHWS and are therefore beyond the remit of this assessment. At present, no trenching is anticipated at Freshwater West.

136. A summary of the design scenarios considered for this assessment is provided in **Table 24-10.** As stated above, the marine archaeological resource is finite and irreplaceable. No distinction can be made therefore between different types of direct impact to a cultural heritage asset: a direct impact from a plough, for example, is considered the same as a direct impact from a driven pile. Any direct impact to a cultural heritage asset is likely to result in the destruction or modification of the asset, substantially reducing or removing its value.

Table 24-10. Design scenario considered for the assessment

Potential impact	Design scenario	Justification
Construction		
Direct impacts causing damage to, or loss of, archaeological assets and deposits during construction works. Direct impacts causing disturbance to, or destruction of, relationships between archaeological assets and deposits and their wider setting during construction works. Direct impacts causing damage to, or loss of, submerged prehistoric landscapes and palaeo-environmental receptors during construction works. Indirect impacts causing increased erosion resulting in exposure or burial of cultural heritage assets and submerged palaeo-landscapes, primarily as a result of actions which mobilise seabed sediment.	PLGR: in a worst-case scenario, the grapnel has 1 m footprint on the seabed, with a maximum penetration of 1 m. For multiple passes, footprint will not exceed 15 m. Seabed-levelling: Sediment to be dredged onto dredging vessel and redeposited within the OfECC. Maximum length of sandwave levelling = 10.3 km per cable; maximum area = 0.31 km^2. Boulder clearance: SCAR plough (realistic worst-case scenario). Maximum footprint 15 m (7.5 m either side of cable centreline). Maximum of 60 days. Cable burial and installation: Two offshore export cables. Jet-trenching or burial by cable plough to a target burial depth of 1.2 m. Maximum target burial depth within sectors of the OfECC = 2 m. Worst-case scenario: each cable has 25 m wide impact on seabed or a total of 50 m. Cable length = 49 km max. Total area of seabed impacted by cable installation (length of cable by maximum footprint of disturbance): total area of 2.45 km^2. Changes in sediment dynamics from installation activities expected to be localised and temporary. Coarse grained sediments (e,g, sand / gravel) are likely	The design scenarios presented are the realistic worst-case, and represent the greatest area of seabed disturbance arising from installation activities. These include seabed preparation and route clearance works, cable installation, cable protection and HDD works at landfall location. No other methods considered in the Project design envelope would result in greater impacts to archaeological assets or submerged palaeo-landscapes.

Potential impact	Design scenario	Justification
	to be redeposited within 50 m of original location in thicknesses up to several metres; from 50 to 500 m localised deposition likely to be tens of centimetres. Fine sediment is unlikely to be redeposited in measurable thickness. Cable protection: concrete mattressing, rock berms or sand grout bags. Maximum width 5 m; maximum height 1.5 m. Estimated that up to 4.9 % of export cable may require protection. Protection may also be required at four cable crossing points. Articulated pipe protection used in nearshore area for c. 11,000 m (22.4% of each cable). Inter-array cable: 11 IACs, maximum length of each cable 1.6 km, including 1.55 km on seabed. Mooring of WTGs on floating barges: Maximum number of moorings for each WTG = 8; Maximum number of moorings = 80.; Diameter of piles = maximum of 3.5 m; Maximum penetration depth = 55 m; and Maximum diameter of anchors = 6m; Drag embedment anchors will have a maximum seabed footprint of 76.5 m^2 per anchor.	

Potential impact	Design scenario	Justification
	HDD installation: Entry point above MHWS. Two ducts with maximum length of 1500 m. Exit points separated by c. 50 m in the nearshore area in water depth of 3-8 m below LAT. Maximum diameter of ducts = 660 mm; anticipated burial depth = 40 m. pUXO: nature and extent of pUXO clearance will be dependent on the results of surveys conducted post-consent. Seabed impact is not expected to exceed the worse-case scenarios for installation described above.	
Operation and maintenance		
Direct impacts causing damage to, or loss of, archaeological assets and deposits during O&M works. Direct impacts causing disturbance to, or destruction of, relationships between archaeological assets and deposits and their wider setting during O&M works. Direct impacts causing damage to, or loss of, submerged palaeo-landscapes and receptors during O&M works. Indirect impacts causing increased erosion resulting in exposure or burial of cultural heritage assets and submerged palaeo-landscapes, primarily as a	Anchoring of repair and maintenance vessels. Increased scour or change in sediment dynamics from cable protection at cable crossing points. Scour from rock berms will be limited to tens of cm in depth, up to a few metres away from the berm. Increased scour or change in sediment deposition from barge mooring points. Scour will extend a maximum of 10 m from mooring points, to a depth of a few metres. Swept area as a result of movement of mooring chains on the seabed will not exceed 50 m in either direction; sediments will be redeposited naturally with no discernible change to localised sediment transport / dynamics.	This is the greatest area of seabed disturbance arising from the O&M phase. Any other development scenario will result in no greater disturbance.

Potential impact	Design scenario	Justification
result of changes in scour or sedimentation regimes.		
Decommissioning		
As the marine archaeological resource is finite and irreplaceable, impacts upon cultural heritage assets during the construction phase will be permanent. Impacts during decommissioning are considered to be analogous to the construction phase as the impact will have occurred already.	Analogous to construction phase.	Analogous to construction phase.

24.6.1. Impacts Scoped out of assessment

137. No impacts were scoped out of the assessment for marine archaeology and cultural heritage during EIA scoping and all impacts presented during scoping were taken through to this assessment.

24.6.2. Assessment Assumptions and Limitations

138. This assessment was conducted in accordance with the standards and guidance outlined in **Section 24.2.4.** There are nonetheless a number of limitations to the assessment; these are outlined below.

139. Archaeological assessment of marine geophysical survey data was conducted for an earlier iteration of the Offshore Development Area. Revisions to the route of the OfECC in April 2024 resulted in considerable gaps in the assessment presented here: geophysical survey data has yet to be collected for the revised OfECC, so the assessment presented here must be viewed as incomplete. Archaeological review of collected marine geophysical data for the revised OfECC will be undertaken post-submission, following the methodology outlined in the review of marine geophysical and landfall survey data (Coracle Archaeology 2024b; **Appendix 24B**). This will include the assessment of additional marine magnetometer, SSS, MBES and SBP datasets.

140. This will result in a revised *Archaeological assessment of marine geophysical and landfall survey data*, submitted to the RCAHMW for their review and comment. This assessment will then be incorporated into the project-specific WSI. Discussions with the RCAHMW in March 2024 indicated that the archaeological assessment of these data is likely to form a condition of consent (**Table 24-3**). No installation works associated with the proposed Project will be undertaken prior to the satisfactory completion of those assessments.

141. Although supplied geophysical survey data was considered to be of sufficient quality to provide a robust archaeological assessment for parts of the Offshore Development Area, seismic survey data (SBP) was acquired within the frequency band 2-16 kHz. This type of higher frequency system is suitable for producing high-resolution images that are capable of resolving small features and identifying acoustic impedance in sub-surface deposits. It is, however, limited by shallow seabed penetration, typically only tens of metres in optimal conditions. For much of the survey area, the full depth of the Quaternary sedimentary sequence, down to

underlying bedrock, is not visible in the collected data. Nevertheless, given that the most spatially extensive activities (e.g. export cables, IACs, mooring points and lines) will only affect the seabed and upper few metres of the Quaternary sequence, the available SBP data is regarded as sufficiently robust to assess these impacts.

142. In contrast, activities which penetrate the seabed to significant depth are much more limited in scale. The worst case scenario of 80 piles of 3.5 m diameter, each with a footprint of up to 15 m^2, would result in a total footprint of penetration into deeper Quaternary layers of c. 0.0012 km^2. This equates to less than 0.1 percent of the total area of the Offshore Development Area. It is further moderated by the fact that the Quaternary deposits extend over tens of kilometres, i.e. far beyond the zone of the immediate impact of each pile.

143. Landfall electromagnetic and metal detector surveys were conducted within a 300 m survey grid, extending 150 m either side of the proposed offshore export cable centreline at both the southern and northern options. The northern survey area was constrained, however, by the presence of rocks and cliff walls at its northern extent, so it was not possible to achieve 300 m transects across the entire survey area; the longest transect was c. 250 m, and the shortest 100 m. The majority of transects measured c. 180-200 m. As cultural heritage assets are unlikely to be located beneath the cliff, this is not considered to have had any significant impact on the assessment.

144. A number of assumptions and limitations are also inherent in the use of desk-based sources to identify maritime cultural heritage assets. One of the greatest limitations when researching known and potential offshore cultural heritage is the difficulty of locating recorded maritime losses. For many losses, the location of the sinking of the vessel comprises a general area description, such as 'lost near Milford Haven' or 'floundered 25 miles south by south-west of St Ann's Head'. This indicates that the potential exists to encounter unrecorded cultural remains, rather than providing a definitive identification that cultural remains are present at a given location. This is particularly true of ships that ran aground on the foreshore, where salvage and natural high-energy conditions combine to result in often-poor survival of archaeological material. Where necessary, these records are identified as reported losses in both the DBA and in the baseline described above.

145. Similarly, the ephemeral nature of aviation crash sites at sea and the difficulties inherent in accurately recording crash site locations means that remains are rarely present at their stated locations. These locations should only be seen as providing an indication that aviation remains may exist at, or in proximity to, the general area.

146. Recorded maritime losses are also heavily biased towards the 19th and 20th centuries, when more comprehensive records of losses began to be compiled. Many wrecks have been identified through sonar survey, but this too presents difficulties as the location of many of these wrecks was recorded using global positioning systems (GPS), which until relatively recently was accurate to only 100 m (Baird 2009; Satchell 2012); or by DECCA which could provide accuracy to only one kilometre. Further discussion of the limitations of desk-based sources is provided in the DBA (Coracle Archaeology 2024a; **Appendix 24A**).

147. The discussion summarised in the baseline section and outlined in detail in the DBA (Coracle Archaeology 2023b) includes all HER, NMRW, NMW and UKHO entries. Records of 'dead' wrecks are also included; though they may not have been detected in recent surveys, the recorded locations may still contain remains of cultural heritage interest. Given locational discrepancies (Satchell 2012), the possibility that wrecks lie beyond previous search areas cannot be discounted.

148. The archaeological assessment of marine geophysical survey data does, however, assist in redressing these limitations: these datasets provide an accurate and up-to-date picture of what is present on the seabed at the time the survey was undertaken. Each of the locations of reported losses and wreck sites derived from the various databases were examined to assess the presence or absence of marine cultural heritage assets. Only cultural heritage assets that were confirmed through assessment of the geophysical survey data are considered in the impact assessment below.

24.7 Embedded Mitigation, Management Plans and Best Practice

149. As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on marine archaeology and cultural heritage (see **Table 24-11**). The design of the proposed Project therefore includes embedded mitigation measures and reference to various management plans that will be produced as conditions of consent, and which will further mitigate potential impacts. This approach has been employed to demonstrate commitment to mitigation measures by including them in the design of the proposed Project; these measures have been considered within the assessment presented in **Section 24.8** below. Assessment of sensitivity, magnitude and therefore significance includes the implementation of these measures.

150. In accordance with policies outlined in NPS EN-3, WNMP and professional guidance (The Crown Estate and Wessex Archaeology 2021), this includes:

- The use of AEZs. AEZs enable the *in-situ* preservation of cultural heritage assets. AEZs apply to any activities that disturb the seabed, within which all development-related activities will be prohibited. The suggested extent of each AEZ is the radius of a circle centred on the given location and based on the available geophysical survey data, including the lateral distribution of visible features, extent and direction of scour, and the likelihood for debris to have spread away from the site (the debris field). AEZs have been designed to encompass all debris / structures visible on the seabed, with an added dimension to adequately protect both potentially buried remains and the potential for mobile debris associated with the direction (and extent) of the scour;
- The implementation of a project-specific WSI. This will be submitted to the RCAHMW and DAT for review and approval prior to the onset of works associated with the proposed Project. The WSI will ensure compliance with relevant legislation and policy and outlines how, when and why archaeological mitigation measures identified in this chapter will be implemented. It will be produced following the guidance outlined in the Model Clauses for Archaeological Written Schemes of Investigation (Crown Estate and Wessex Archaeology 2021), and on completion of the review of geophysical survey data for the revised OfECC;
- The implementation of a project-specific PAD. The PAD sets out best practice in the reporting of finds of archaeological interest during works associated with the proposed Project. It sets out clearly the protocols and procedures that must be followed in the event of any unexpected archaeological finds during works that disturb the seabed, and includes appropriate archaeological briefings (toolbox talks; TBT) for all personnel involved in activities that may disturb the seabed, foreshore or intertidal zone. The PAD will be in place for the life of the Project and will be updated routinely should details, such as key stakeholders, change;
- Archaeological review of additional marine geophysical survey data, should further surveys be acquired for engineering or design purposes. This can assist in locating previously unidentified assets, or in the assessment of archaeological potential or

condition of known assets, all of which could influence the establishment of AEZs. This is in addition to the review of the acquired data for the OfECC described above;

- Archaeological input into the design and location of proposed geotechnical surveys. Information derived from geotechnical surveys can provide invaluable geoscientific and archaeological information that can verify, as well as supplement, interpretations derived from geophysical (primarily SBP) data alone. Following the best practice guidance in Cowrie (2011), archaeological input into proposed geotechnical investigations is required to ensure that the archaeological and geoscientific potential of the surveys is maximised. This is particularly important given that areas of seabed occupied by infrastructure installed by the proposed and neighbouring Projects are likely to be unavailable for future intrusive sampling. For the Study Area, the archaeological review of both marine geophysical survey data and existing literature suggests that the palaeo-environmental potential of the channels currently identified in the SBP dataset is low (Coracle Archaeology 2024b). Deposits recovered from these channels during geotechnical investigations have the potential, however, to enhance understanding of late Pleistocene glacial dynamics in the eastern Celtic Sea. The use of optically-stimulated luminescence (OSL) techniques to date deposits recovered from these channel features, collected during geotechnical site investigations, could provide valuable geochronological information which would serve to inform the late Pleistocene record of this area. Mitigation will include the production of a detailed method statement which outlines strategies designed to ensure that the archaeological potential of any geotechnical investigations is optimised (COWRIE 2011); the method statement will be sent to the RCAHMW for review and approval prior to the onset of planned works; and
- Geoarchaeological assessment of samples recovered by proposed geotechnical surveys. Based on the archaeological input into geotechnical investigations outlined above and, if deemed necessary by the archaeological contractor in consultation with the archaeological curator, geoarchaeological assessment of samples recovered by the geotechnical investigations will be required. Following the guidance outlined in COWRIE (2011), a staged approach will be adopted, comprising a geoarchaeological review of geotechnical logs and photographs and proceeding through to more detailed recording and sampling stages as necessary. Precise workflows would be set out in a detailed method statement which outlines strategies for sample recovery, storage, handling and sampling, following guidance in COWRIE (2011) and the Crown Estate and Wessex Archaeology (2021). Implementation of these strategies will ensure that the archaeological and geoscience potential of recovered samples is maximised. Any method statements will be sent to the RCAHMW for review and approval prior to the onset of planned works.

151. Should it not be possible to avoid AEZs during the construction and installation phase of the proposed Project, a full programme of archaeological assessment will be conducted to assess the cultural heritage asset contained within. This may include diver or remotely-operated vehicle (ROV) survey. Further details will be provided in the project-specific WSI.

152. In addition to the embedded mitigation and good practice measures outlined above, the current preference for HDD technology for the installation of the offshore export cable at Freshwater West will limit potential impacts on known heritage assets and deposits of palaeo-environmental interest at the landfall location. Should any ground-disturbance works be undertaken at Freshwater West, including geotechnical investigations along the proposed route of the HDD, then additional mitigation will be necessary. This would include a programme of archaeological monitoring (a watching brief) and geoarchaeological / palaeo-environmental sampling. If required, additional method statements will be prepared and submitted to both DAT and the RCAHMW for review and approval prior to the onset of works.

Table 24-11. Mitigation measures, management plans and best practice adopted as part of the proposed Project

Embedded Mitigation Measures, Management Plans and Best Practice	Justification
Design Embedded Measures	
Development and application of AEZs	The imposition of AEZs ensure in-situ preservation of identified marine archaeological and cultural heritage assets. AEZs apply to any activities that disturb the seabed, within which all development-related activities will be prohibited. The size and extent of AEZs will vary depending on the asset; AEZs are designed to encompass all features associated with the heritage asset (including buried remains) and the potential for associated debris fields. The location and extent of AEZs will be agreed in advance with stakeholders, following their review of the WSI
Development and application of a PAD	Protection of previously unidentified marine cultural heritage assets encountered during works
Archaeological review of additional marine geophysical survey data	To locate previously unidentified marine cultural heritage assets and/or verify the condition of previously identified assets
Use of HDD at the landfall locations	To avoid direct impacts to cultural heritage assets on the foreshore or intertidal zone
Archaeological input into offshore geotechnical investigations	To ensure the absence of potential archaeology in the proposed locations and to ensure the palaeo-environmental potential of the recovered samples is optimised
Geoarchaeological assessment of geotechnical samples	To ensure the archaeological and geoscience potential of recovered samples is maximised
Management Plans	
Marine archaeological WSI	All works will be undertaken in accordance with the project-specific WSI. This ensures compliance with relevant legislation and provides further detail on implementation of marine archaeological mitigation. The WSI will be agreed with stakeholders prior to the commencement of works associated with the proposed Project.

24.8 Assessment of Environmental Effects

153. The impacts and effects (both beneficial and adverse) associated with the construction, O&M and decommissioning of the proposed Project are outlined in the sections below. The assessments take into account the embedded mitigation measures described in **Section 24.7** above.

154. It is important to reiterate that the marine archaeological and cultural heritage resource is considered finite and irreplaceable, in accordance with national policy and guidance (e.g. the UK MPS). Direct impacts on these assets are considered irreversible, as the assets are unable to recover; direct impacts from a plough or from cable trenching, for example, are considered

identical to direct impacts from a driven pile or from the movement of moorings on the seabed. Any direct impact will reduce the value of the asset, regardless of the cause. The assessment that follows is divided therefore into direct and indirect impacts only. Assets with similar characteristics (e.g. geophysical anomalies considered to be of medium archaeological potential) are grouped together.

24.8.1. Direct Impacts on Archaeological Assets From the Construction Phase

155. The significance of each of the cultural heritage assets described below has been assessed, ranging from very high to negligible, based on the criteria outlined in **Table 24-5**. It is important to recognise that the significance of the asset (defined here as sensitivity of the receptor) is usually, though not exclusively, synonymous with archaeological potential described elsewhere (e.g. Coracle Archaeology 2024b; **Appendix 24B**). As the marine archaeological resource is finite and irreplaceable, in line with industry standards and best practice, **major**, **moderate** and **minor** effects are considered significant and will require mitigation.

156. Planned construction works that could potentially have a direct impact on marine archaeology and cultural heritage assets are outlined in **Section 24.6** above, including realistic worst-case scenarios. These include activities associated with seabed clearance, anchoring / mooring lines for the floating WTGs, cable installation, and protection and additional protection at cable crossing points. Sandwave levelling is anticipated to be required along a maximum length of 10.35 km for each cable, with a maximum volume of material to be moved equating to 900,550 m^3. At present no AEZs or cultural heritage assets are located in areas where sandwave levelling is expected, with **CA65** and **CA6** located at distances of c. 4 km and 5.5 km respectively from potentially affected areas. This will require reassessment following the review of additional project-specific survey data collected for the OfECC.

157. Five cable crossings have been identified within the Offshore Development Area (**Table 24-9**), though given the use of HDD where the Greenlink Interconnector and the proposed Project intersect, only four will require additional cable protection. As the final route of the offshore export cables within the OfECC has yet to be determined, the exact location of the crossing points is not yet known. Similarly, the extent of cable protection required in areas where burial is not possible will only be defined following post-installation surveys. As a worst-case scenario, it is anticipated that 4.9% of the route of the offshore export cables may require protection in the form of concrete mattressing, rock placement or sand grout-bags, with an additional 22.4% protected by articulated piping in the nearshore areas. It should be noted that the mitigation outlined below applies equally to the installation of cable protection, and any AEZs must be respected. At present, no AEZs are located in proximity to in-service cables identified along the route. This too will require reassessment following the review of additional survey data to be collected post determination, prior to the commencement of construction.

Palaeo-Environmental Deposits (Offshore)

Sensitivity of the Receptor

158. Assessment of the supplied project-specific SBP data highlighted thick Quaternary deposits throughout the Offshore Development Area, consisting primarily of late Devensian glacial deposits. A number of channel features were also visible, though these lack any associated lateral floodplain features. These are likely to be late Pleistocene deposits, formed as a result of pro-glacial processes and subsequent catchment drainage. The geoarchaeological potential of these deposits is likely to be low, as no deposits or features attributable to temperate environments, conducive to occupation, have been observed in the geophysical survey data acquired to date. Following the criteria outlined in Table 24-5, the sensitivity of the receptor

is considered **low**. This will require reassessment following the archaeological review of marine geophysical survey data for the revised OfECC.

Magnitude of Impact

159. Any direct impacts to offshore palaeo-environmental deposits from the construction phase of the proposed Project are likely to result in a detrimental change to the asset. Given the linear nature of the works (e.g. ploughing) and their small footprint (e.g. piling and anchoring), any impact would be localised, resulting in slight physical change to the asset. The magnitude of impact is therefore considered **medium**.

Significance of Effect

160. The magnitude of impact upon identified deposits of palaeo-environmental interest is considered **medium**; the sensitivity of the receptor is considered **low**. Following the matrices outlined in **Table 24-6**, the overall significance of effect is considered **negligible**, or not significant. This will require reassessment following the archaeological review of marine geophysical survey data for the revised OfECC.

161. Project-specific embedded mitigation includes archaeological input into geotechnical investigations undertaken for the proposed Project, and the subsequent geoarchaeological assessment of recovered samples (see **Section 24.7**). This will ensure that the geoarchaeological potential of the investigations is maximised. With this mitigation, the significance of effect can be upgraded to **minor** (beneficial).

Palaeo-Environmental Deposits (Freshwater West)

Sensitivity of the receptor

162. Exposures of submerged forests, intertidal peat and documented occupation sites at Freshwater West (**CA8-10**; **CA12**) suggests that the palaeo-environmental potential of the landfall location must be considered high. Given the potential of these sites and deposits to contribute to the understanding of the palaeo-environment of south-west Wales, including sea-level change in the Celtic Sea more broadly, these must be regarded as heritage assets of national importance. Following the criteria outlined in **Table 24-5**, the sensitivity of the receptor must therefore be considered **high**.

Magnitude of Impact

163. Despite the sensitivity of these receptors, it is reasonable to assume that any such deposits that may be impacted by the proposed Project represent a fraction of a much more extensive landscape. The proposed use of HDD at a depth of approximately 40 m beneath the beach and intertidal zone and the absence of cable burial for a maximum of c. 11,000 m from the HDD punch-out location seaward (KP 48-38), means that there is unlikely to be any direct impact on these deposits from the proposed Project. The magnitude of impact is therefore considered **negligible**.

Significance of Effect

164. The sensitivity of palaeo-environmental deposits at Freshwater West is considered **high**; the magnitude of impact of the proposed Project is considered **negligible**. Using the matrix outlined in **Table 24-6**, the overall significance of effect is considered to be **negligible**, or not significant.

165. It is important to note that should any geotechnical investigations or additional geophysical surveys be undertaken to assess the route of the proposed HDD, these will require further archaeological assessment. Project-specific embedded mitigation includes a watching brief

and geoarchaeological sampling during any works that disturb the beach and inter-tidal zone (**Section 24.7**); if new geoarchaeological data results from this mitigation, this has the potential to upgrade the significance of effect to **minor** (beneficial). As stated in **Section 24.7**, any new geophysical survey data collected on behalf of the proposed Project will also require archaeological assessment, including sub-bottom data used to assess the nature of deposits at the HDD punch-out location. A TBT will be provided to works crews on the terms of the PAD to ensure that any unexpected archaeological discoveries are mitigated appropriately (**Section 24.7**). This will include representatives of any dive team assisting with cable installation at the HDD exit point.

Known Wreck Sites and Geophysical Anomalies with High Archaeological Potential: Offshore

166. This section identifies the significance of effect of direct impacts on known wreck sites and geophysical anomalies with high or medium archaeological potential identified offshore. Geophysical anomalies considered of low archaeological potential are not considered in this assessment. As direct impacts will have a similar effect on anomalies or sites that share similar characteristics, they are grouped together for the purposes of assessment.

Sensitivity of the Receptor(s)

167. There is the potential for direct impacts during the construction phase of the proposed Project upon one known wreck site whose location was confirmed during the archaeological review of marine geophysical survey data, and one live wreck identified in the UKHO dataset. The reported location of **CA6** corresponds to the location of **CA1025**, a geophysical anomaly with high archaeological potential (a clearly visible, largely intact wreck site). The wreck was previously recorded as unknown by the UKHO; this assessment has tentatively identified it as the *Hungate*, a steamer that foundered in October 1904. No project-specific geophysical survey data is available for the location of the live wreck, the SS *Saint Jacques* (**CA65**). A wreck site is visible however in the iMarDIS high-resolution MBES data acquired in 2017; in accordance with the criteria outlined in **Section 24.4.2** and **Table 24-5**, the sensitivity of these receptors is considered **high**.

Magnitude of Impact

168. Any direct impacts to these marine cultural heritage assets have the potential to result in their total loss or major alteration. The magnitude of impact is therefore considered **very high**.

Significance of Effect

169. The sensitivity of both **CA6** / **CA1025** and **CA65** is considered **high**; the magnitude of any direct impact is considered **very high**. Using the significance matrix presented above (**Table 24-6**), the overall significance of effect is considered **major**. This will be mitigated through the imposition of AEZs of 75 m radius over each asset, designed following the methodology outlined above (**Section 24.7**). With this mitigation in place, the residual significance is considered **negligible**, or not significant. At present, the AEZ assigned to **CA65** is centred on the location recorded by the UKHO; the size and exact location of this AEZ may be revised following the archaeological review of newly acquired project-specific survey data collected post determination.

Known Wreck Sites: Freshwater West

Sensitivity of the Receptor

170. The proposed project has the potential to directly impact one known wreck located on the beach at Freshwater West (the *Willemoes of Thuro;* **CA2**). This wreck was not visible during landfall surveys possibly owing to elevated levels of mobile beach sand; it has, however, been

recorded routinely on the beach. In accordance with the criteria outlined in **Section 24.4.2** and **Table 24-5**, the sensitivity of the receptor is considered **high**.

Magnitude of Impact

171. The proposed use of HDD at the landfall location, to a depth of c. 40 m beneath the beach, suggests that the magnitude of impact on the asset should be considered **negligible**. It should also be noted that the asset is located at the southern landfall option, which is no longer under consideration for the proposed Project.

Significance of Effect

172. The sensitivity of the receptor is considered **high**; the magnitude of impact is considered **negligible**. Consequently, the overall significance of effect is also considered **negligible**. As this is the location of a known wreck, following the precautionary principle, an AEZ of 50 m radius has nevertheless been assigned. This AEZ has been designed following the methodology outlined in Coracle Archaeology 2024b and summarised in **Section 24.7** above.

Geophysical Anomalies with Medium Archaeological Potential

Sensitivity of the Receptor

173. Following route revisions in April 2024, only two anomalies of medium archaeological potential were identified in areas of the Offshore Development Area with geophysical survey coverage (**CA1026**; **CA1029**). Following the criteria outlined in **Section 24.4.2** and **Table 24-5**, the sensitivity of these receptors is considered **medium**.

Magnitude of Impact

174. Any direct impacts to these assets during the construction phase of the project would be irreversible, potentially resulting in the total loss of the asset. The magnitude of impact is therefore considered **very high**.

Significance of Effect

175. The sensitivity of these receptors is considered **medium**; the magnitude of impact is potentially **very high**. The overall significance of effect is therefore assessed as **moderate**. This will be mitigated through the imposition of AEZs of 30 m and 40 m radius respectively. These have been designed following the methodology outlined in **Section 24.7**. With this mitigation in place, the residual significance of effect is considered **negligible**, or not significant.

Previously Unidentified Heritage Assets

176. No other potential wreck sites were identified within the Offshore Development Area using the marine geophysical survey data available. The proposed Project will, however, be installed in an area of considerable maritime activity in the past at both local and international levels, and it is not possible to discount the potential for encountering unknown maritime cultural remains. The likelihood of doing so is considered moderate. Any previously unknown discoveries will be mitigated through the implementation of the project-specific PAD. The PAD outlines:

- The actions that need to be undertaken in the event that anything potentially archaeological is encountered;
- The likely nature of any potential archaeological discoveries;
- The roles and responsibilities of the installation teams; and
- Contact details for the archaeological consultant and key stakeholders.

24.8.2. Indirect Impacts to Marine Archaeological Assets During the Construction Phase

177. A number of activities associated with the construction phase have the potential to have indirect impacts on marine archaeology and cultural heritage, primarily through sediment disturbance, which could result in either greater deposition or erosion affecting assets. These include seabed clearance works (including sandwave levelling), cable trenching, installation of anchors and moorings and the deposition of external cable protection. These activities are outlined in detail in **Section 24.6** (**Table 24-10**).

178. The location of the HDD entry and exit points (above MHWS and at water depths of 3-8 m below LAT respectively) will ensure that no indirect impacts will occur on assets identified on the beach at Freshwater West (e.g. **CA2**; **CA8-10**; **CA12**). Therefore no assessment of these assets is considered necessary.

Palaeo-Environmental Deposits (Offshore)

Sensitivity of Receptor

179. As stated above, the late Pleistocene deposits identified in the SBP data are considered to be of low archaeological potential. The sensitivity of the receptor is also therefore considered **low**.

Magnitude of Impact

180. Indirect impacts on palaeo-environmental deposits may result from the redisposition of sediment as a result of seabed clearance activities and trenching, or installation activities associated with the mooring of the WTGs (e.g. piling). Changes in sediment dynamics associated with seabed clearance, trenching and anchor point installation are, however, expected to be localised and temporary, with the majority of coarser grained sediments redeposited within 50 m of their original location. Fine sediments are unlikely to be redeposited in measurable thicknesses (**Table 24-10**). The magnitude of impact is therefore considered to be **low**.

Significance of Effect

181. The sensitivity of the receptor is considered **low**, and the magnitude of impact is also considered to be **low**. The significance of effect can therefore be characterised as **negligible** and no mitigation is required.

Known wreck sites and geophysical anomalies with high archaeological potential

Sensitivity of the Receptor(s)

182. There is potential for indirect impacts during the construction phase of the proposed Project upon one known wreck site whose location was confirmed during the archaeological review of marine geophysical survey data (**CA6**; **CA1025**), and one live wreck reported by the UKHO (**CA65**). The sensitivity of these receptors is considered **high**.

Magnitude of Impact

183. Indirect impacts to marine cultural heritage assets are likely to be restricted to the movement of sediment as a result of seabed clearance (including sandwave levelling and re-deposition of removed sediment), cable installation and protection and anchoring, as outlined in **Section 24.6**. Dispersal of sediment is expected to be localised and temporary, with the majority of coarser grained sediments redeposited within 50 m of their original location (**Table 24-10**). Any of these activities may result in increased protection (e.g. through partial or total burial) or deterioration of the asset through the dispersal of protective sediments; this will depend on the location of the asset relative to the seabed operations (including the re-deposition of

sediment within the OfECC as a result of sandwave levelling) and the amount and type of sediment mobilised. Given the minimal, temporary and localised nature of the impacts (**Section 24.6**), the magnitude of impact is considered nevertheless to be **low**.

Significance of Effect

184. The sensitivity of **CA6** / **CA1025** and **CA65** is considered **high**, the magnitude of impact is considered **low**. The overall significance of effect can therefore be characterised as **minor** (adverse). Conversely, the movement and re-deposition of sediment within the OfECC has the potential to result in a significance of effect that can be characterised as **minor** (beneficial) through partial or total burial of the assets.

185. Any adverse impacts will be mitigated by AEZs of 75 m radius, designed following the methodology outlined in Coracle Archaeology (2024b) and summarised in **Section 24.7**. With this mitigation in place, the residual significance of effect is considered **negligible**. It should be noted that the dumping of spoil collected during sandwave levelling within an AEZ is strictly prohibited. The size and exact location of the AEZ assigned to **CA65** may be revised following the archaeological review of new project-specific geophysical survey data collected post-determination.

Geophysical anomalies with medium archaeological potential

Sensitivity of the Receptor

186. Two anomalies with medium archaeological potential were identified in the revised iteration of the Offshore Development Area (**CA1026; CA1029**). The sensitivity of these receptors is considered **medium**.

Magnitude of Impact

187. As stated previously, indirect impacts to marine cultural heritage assets are likely to be restricted to the movement of sediment as a result of seabed clearance (including sandwave levelling), cable installation and protection, and anchoring (see **Section 24.6**). Dispersal of sediment is expected to be localised and temporary, with the majority of coarser grained sediments redeposited within 50 m of their original location (**Table 24-10**). Any of these activities may result in increased protection (e.g. through partial or total burial) or deterioration of the asset through the dispersal of protective sediments; this will depend on the location of the asset relative to the seabed operations and the amount and type of sediment mobilised. However, given the minimal, temporary and localised nature of the impacts (**Section 24.6**), the magnitude of impact is considered to be **low**.

Significance of Effect

188. The sensitivity of the receptor has been identified as **medium**, the magnitude of impact as **low**. In accordance with the criteria outlined in **Table 24-6**, the overall significance of effect can therefore be characterised as **negligible**. Adherence to AEZs already in place will nevertheless provide additional protection to these assets. Dumping of spoil within AEZs is strictly prohibited.

Further Mitigation and Residual Effects

189. Both direct and indirect impacts upon the identified heritage assets from the construction phase of the proposed Project will be mitigated through the imposition of AEZs, ranging in radius from 30-75 m. These are summarised in **Table 24-12**. With this mitigation in place, the residual significance of effect is reduced to **negligible** for all identified heritage assets.

24.8.3. Direct Impacts on Archaeological Assets During O&M

190. The vast majority of potential impacts upon marine archaeology and cultural heritage assets will occur in the construction phase of the proposed Project. There is, however, the potential for a number of impacts on the assets described above during the operational phase, primarily from planned maintenance activities. This includes direct impacts caused by anchoring of maintenance vessels, or the reapplication of cable protection. Impacts may also occur if cables are repaired, replaced or reburied in areas beyond their original routing.

191. Direct impacts during the O&M phase are considered analogous to the construction phase in terms of the sensitivity of the receptor and magnitude of impact. This applies to each of the assets outlined in **24.5** above. As noted, any direct impact on a cultural heritage asset is irreversible, and the magnitude of impact must therefore be characterised as **very high**.

192. The use of mitigation outlined above, including AEZs and the implementation of the project-specific PAD, will serve to mitigate direct impacts on both known and previously unknown cultural heritage assets throughout the operational phase of the Project. Utilisation of both AEZs and a PAD are intended throughout the lifetime of the project and must be respected. With this mitigation in place, the residual significance of effect of works during the O&M phase is reduced to **negligible**, regardless of the sensitivity of the receptor.

193. Owing to the use of HDD, no impacts will occur on heritage assets identified at Freshwater West during the O&M phase of the project, and no further mitigation is required.

24.8.4. Indirect Impacts on Archaeological Assets During O&M

194. The principal indirect impact on assets during the O&M phase comprises the development of long-term changes in localised sediment dynamics and scouring caused by the interaction between installed seabed infrastructure, seabed sediment and natural water flow. As noted above, such changes have the potential to impact assets via enhanced exposure or burial. Relevant infrastructure include the anchor points and lines of the floating barges, IACs and cable protection. Temporary and localised changes may also result from anchoring by maintenance vessels.

195. These indirect impacts will only affect assets located offshore on the seabed or buried at shallow depths (less than a few metres burial). The use of HDD at the landfall location and the lack of cable burial for c. 11,000 m from the HDD exit point seaward means that there will be no, or very low-lying, infrastructure exposed on the nearshore seabed; even where articulated pipe protection is used, changes in sediment caused by its presence will be minimal and localised. Consequently, no indirect impacts will occur on heritage assets identified at Freshwater West or in the nearshore area (**CA2**; **CA8**-**10**; **CA12**) during the O&M phase, and no further mitigation is required.

Palaeo-Environmental Deposits (Offshore)

Sensitivity of Receptor

196. As stated above, the late Pleistocene deposits identified in the SBP data are considered to be of low archaeological potential. The sensitivity of the receptor is also therefore considered **low**.

Magnitude of Impact

197. Indirect impacts to palaeo-environmental deposits (offshore) may result from the redisposition of sediment as a result of the installation of seabed structures, potentially resulting in exposure and erosion, or burial and enhanced protection. Long-term changes in sediment dynamics associated with the proposed seabed structures are, however, expected

to be localised and minor. The largest scour effects occur at the anchor points for the WTG, where exposed pile ends could result in scour of the order of a few metres depth and up to ten metres from the pile end. Much smaller effects result from the low-lying deposits of cable protection. At rock berms, scour is likely to be restricted to a distance of a few metres and a depth of tens of centimetres. Considering the extensive nature of the palaeo-environmental deposits in question, both horizontally (kilometres) and vertically (metres to tens of metres in terms of thickness), the magnitude of impact is therefore considered **low**.

Significance of Effect

198. The sensitivity of the receptor is considered **low**; the magnitude of impact is also considered **low**. The significance of effect can therefore be characterised as **negligible** and no mitigation is required.

Known Wreck Sites and Geophysical Anomalies with High Potential: Offshore

Sensitivity of Receptor

199. There is potential for indirect impacts during the construction phase of the proposed Project on one known wreck site whose location was confirmed during the archaeological review of marine geophysical survey data (**CA6** / **CA1025**), and one live wreck recorded by the UKHO (**CA65**) in an area for which there is currently no project-specific geophysical survey data. The sensitivity of these receptors is considered **high**.

Magnitude of Impact

200. Both wreck sites are located in the OfECC, 7 km (**CA6**) and 35 km (**CA65**) from the Array Area respectively. Consequently, indirect impacts to these wrecks are restricted to the movement of sediment caused by placement of cable protection, should any be required at these locations. As noted above, the impact of scour and sediment movement by such protection is minimal and localised to a distance of a few metres and a depth of tens of centimetres (**Table 24-10**). As such, the magnitude of impact is considered **low**.

Significance of Effect

201. The sensitivity of the receptors is considered **high**, the magnitude of impact is considered **low**. Therefore, the overall significance of effect can be characterised as **minor**. Mitigation, in the form of AEZs of 75 m radius, is already in place for these assets. With this mitigation in place, the residual significance of effect is reduced to **negligible**, or not significant.

Geophysical Anomalies with Medium Archaeological Potential

Sensitivity of Receptor

202. Two anomalies of medium archaeological potential were identified in the revised iteration of the Offshore Development Area (**CA1026**; **CA1029**). The sensitivity of these receptors is considered **medium**.

Magnitude of Impact

203. Both anomalies are located beyond the Array Area, c. 2.5 km distant in the case of **CA1026** and c. 16 km distant for **CA1029**. Consequently, indirect impacts are restricted to the movement of sediment caused by the placement of cable protection, should any be required in these locations. As noted above, the impact of scour and sediment movement by such protection is minimal and localised to a distance of a few metres and a depth of tens of centimetres (**Table 24-10**). As such, the magnitude of impact is considered **low**.

Significance of Effect

204. The sensitivity of the receptor has been identified as **medium**, the magnitude of impact as **low**. The overall significance of effect can therefore be characterised as **negligible**. Adherence to AEZs already assigned to these geophysical anomalies will nevertheless provide additional protection to these assets.

24.8.5. Decommissioning Effects

205. The exact nature of decommissioning activities has yet to be determined. It should be noted that the majority of impacts to marine archaeology and cultural heritage assets will have occurred in the construction phase; direct and indirect impacts from decommissioning activities are considered analogous to the construction phase and no additional mitigation is considered necessary. This approach is accepted as industry standard for marine archaeology. It is important to reiterate that both the AEZs and the PAD should be respected for the lifetime of the project, including decommissioning. With this mitigation in place, the overall significance of effect is reduced to **negligible**, regardless of the sensitivity of the receptor.

206. Additional archaeological assessments may be required once the exact nature of the decommissioning strategy is confirmed. These should be agreed in advance with the RCAHMW and DAT.

24.8.6. Summary of Residual Environmental Effects

207. This chapter of the ES has assessed the potential environmental effects on marine archaeology and cultural heritage from the construction, O&M and decommissioning phases of the proposed Project. Where significant effects have been identified, additional mitigation has been considered and incorporated into the assessment.

208. The proposed Project has the potential to impact on a number of identified cultural heritage assets, including two known wreck sites (**CA6** / **CA1025**; **CA65**) and two geophysical anomalies with medium archaeological potential (**CA1026**; **CA1029**). Mitigation has been proposed for these heritage assets in the form of AEZs; with this mitigation in place, the residual effect of the proposed Project has been assessed as **negligible**. A summary of likely significant impacts, mitigation and residual effects is provided in **Table 24-12.**

24.9 Summary of Additional Mitigation Measures

209. Geophysical survey data has yet to be collected for a section of the OfECC, following route revisions in April 2024. Once collected, it is imperative that this data is assessed archaeologically. It is anticipated that this will occur post-consent. Once the data has been assessed, a report will be submitted to the RCAHMW for review and approval. This assessment will be used to update the project-specific WSI, including the addition of any new AEZs or sampling strategies for deposits of palaeo-environmental interest; this will also be issued to the curator for their approval, prior to the onset of works.

210. The use of HDD as the preferred installation method will serve to protect known heritage assets at Freshwater West, including palaeo-environmental deposits of high archaeological potential. Should any ground-disturbance works associated with the proposed Project be undertaken at Freshwater West, additional mitigation will be required. This includes geotechnical investigations associated with the proposed route of the HDD along the beach and intertidal zone.

211. Mitigation for any such works would include a programme of archaeological monitoring and palaeo-environmental / geoarchaeological sampling and assessment, following the staged methodology outlined by COWRIE (2011). Should it be necessary, detailed method statements

will be submitted to DAT and the RCAHMW for review and approval prior to ground-disturbance works.

24.9.1. Monitoring

212. Review of the effectiveness of AEZs and the impact of the proposed Project on the marine archaeological resource is recommended throughout the lifetime of the Project. The project-specific WSI and PAD will include monitoring procedures and will outline reporting protocols in the event of an accidental incursion into an AEZ.

213. The archaeological review of all new geophysical survey data collected for the proposed Project is also recommended, should any new surveys be required for engineering or maintenance purposes. Following this review, revisions may be made to the AEZs outlined above, and new AEZs may be imposed. This is in addition to the archaeological review of data acquired for the revised OfECC, described above.

214. Following consultation, the RCAHMW requested access to the raw geophysical data relevant to each of the identified AEZs. This will facilitate monitoring and review of AEZs by the national curator throughout the lifetime of the proposed Project and after decommissioning, which could provide a valuable baseline record against which future changes, unrelated to the proposed Project, can be assessed.

24.10 Summary of Effects and Conclusions

215. This section summarises the residual significant effects of the proposed Project on marine archaeology and cultural heritage, following the implementation of proposed mitigation.

216. The assessment presented in **Section 24.8** highlighted the potential for both direct and indirect impacts on a number of recorded marine archaeology and cultural heritage assets. These include one known wreck and corresponding geophysical anomaly, one live wreck reported by the UKHO in an area of the OfECC for which there is currently no project-specific geophysical survey data, and two further geophysical anomalies considered of medium archaeological potential. Using the mitigation outlined above, the residual significance of effect on these assets is assessed as **negligible**, or not significant. This is summarised in **Table 24-12** .

Table 24-12.Assessment summary

Potential Impact	Receptor	Receptor Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Significance of Effect
Construction						
Direct impacts on known wrecks and high potential geophysical anomalies (offshore)	**CA6 / CA1025; CA65**	High	Very high	Major (adverse)	AEZ (75 m)	Negligible
Direct impacts on known wreck (Freshwater West)	**CA2**	High	Negligible	Negligible	AEZ (50 m; precautionary)	Negligible
Direct impacts on palaeo-environmental deposits (Freshwater West)	**CA8-CA10; CA12**	High	Negligible	Negligible	None required	Negligible
Direct impacts on medium potential geophysical anomalies	**CA1026**	Medium	Very high	Moderate (adverse)	AEZ (30 m)	Negligible
Direct impacts on medium potential geophysical anomalies	**CA1029**	Medium	Very high	Moderate (adverse)	AEZ (40 m)	Negligible
Direct impacts on palaeo-environmental deposits (offshore)	**N/A**	Low	Medium	Negligible	None required	Negligible
Indirect impacts on known wrecks and high potential geophysical anomalies (offshore)	**CA6 / CA1025; CA65**	High	Low	Minor (adverse) / Minor (beneficial)	AEZ (75 m)	Negligible
Indirect impacts on known wreck (Freshwater West)	**CA2**	High	Negligible	Negligible	AEZ (50 m; precautionary)	Negligible
Indirect impacts on palaeo-environmental deposits (Freshwater West)	**CA8-CA10; CA12**	High	Negligible	Negligible	None required	Negligible

Potential Impact	Receptor	Receptor Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Significance of Effect
Indirect impacts on medium potential geophysical anomalies	**CA1026**	Medium	Low	Negligible	AEZ (30 m)	Negligible
Indirect impacts on medium potential geophysical anomalies	**CA1029**	Medium	Low	Negligible	AEZ (40 m)	Negligible
Indirect impacts on palaeo-environmental deposits (offshore)	**N/A**	Low	Low	Negligible	None required	Negligible
Operation and Maintenance						
Direct impacts on known wrecks and high potential geophysical anomalies (offshore)	**CA6 / CA1025; CA65**	High	Very high	Major (adverse)	AEZ (75 m)	Negligible
Direct impacts on medium potential geophysical anomalies	**CA1026; CA1029**	Medium	Very high	Moderate	AEZ (40 m and 30 m)	Negligible
Direct impacts on known wreck (Freshwater West)	**CA2**	High	Negligible	Negligible	AEZ (50 m, precautionary)	Negligible
Direct impacts on palaeo-environmental deposits (Freshwater West)	**CA8-CA10; CA12**	High	Negligible	Negligible	None required	Negligible
Direct impacts on palaeo-environmental deposits (offshore)	n/a	Low	Medium	Negligible	None required	Negligible
Indirect impacts on known wrecks and high potential geophysical anomalies (offshore)	**CA6 / CA1025; CA65**	High	Low	Minor (adverse)	AEZ (75 m)	Negligible

Potential Impact	Receptor	Receptor Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Significance of Effect
Indirect impacts to marine archaeology and cultural heritage assets	**CA1026; CA1029**	Medium	Low	Negligible	AEZ (40 m, 30 m)	Negligible
Indirect impacts on known wreck (Freshwater West)	**CA2**	High	Negligible	Negligible	None required	Negligible
Indirect impacts on palaeo-environmental deposits (Freshwater West)	**CA8-CA10; CA12**	High	Negligible	Negligible	None required	Negligible
Indirect impacts on palaeo-environmental deposits (offshore)	**N/A**	Low	Low	Negligible	None required	Negligible
Decommissioning						
Direct and indirect impacts from the decommissioning phase are considered analogous to the construction phase. No additional mitigation is required.						

24.11 Cumulative Effects of the Project

24.11.1. Introduction

217. Cumulative effects are those effects upon receptors arising from the proposed Project alongside all existing and / or reasonably foreseeable projects, plans and activities that result in cumulative effects with any element of the proposed Project. Existing projects are generally considered as part of the baseline and as such are considered within the impact assessment presented in **Section 24.8**.

218. This section assesses potential cumulative effects on marine archaeology and cultural heritage from identified projects, plans and activities that have the potential to act cumulatively with the proposed Project.

219. PINS Advice 17: Cumulative Effects Assessment (CEA; 2019) suggests that CEA follows a four-stage process. The aim of this approach is to accurately determine relevant projects and associated relationships with scoped in receptors identified in the ES, to be included within the inter-project CEA.

220. The approach to the assessment of cumulative effects is detailed in **Appendix 5A: Approach to Cumulative Effects Assessment**, and is summarised in **Table-24-13**.

Table-24-13 PINS Advice 17 Stages of the CEA process

CEA Stage	Activity
Stage 1	Determine a zone of influence (ZoI) via desk study for each topic receptor scoped into the ES. This will establish a *long list* of projects within each ZoI that will be shortlisted in Stage 2. This list of plans and projects/activities is drawn up through a desk study of planning applications, development plan documents, relevant development frameworks and any other available sources to identify 'other development' within the ZoI. Information on each project (location, development type, status, etc.) is documented, along with the certainty or tier assigned to the 'other development' (i.e. confidence it will take place in the current form and when it will take place in relation to the project). PINS notes that the project should then consult with the relevant planning authority/ authorities and statutory consultees regarding the long list.
Stage 2	Screening of the long list identified in Stage 1, to establish a short list for the CEA. Screening is based on the criteria presented in the scoping report and subsequent comments by the regulator and statutory consultees. PINS has provided inclusions/ exclusion threshold criteria, against which the potential for 'other development to give rise to significant cumulative effects by virtue of overlaps in temporal scope, the scale and nature of the 'other developments' and /or receiving environment, or any other relevant factors is assessed. From this assessment, a shortlist of 'other developments' to be included in the CEA is produced. It is noted that documented information on each of the 'other developments' is likely to be high level at this stage, outlining the key issues to take forward.
Stage 3	Gathering of all information available on short listed projects generated in Stage 2. At this stage all available data and information about the shortlisted projects that will be included in the CEA is collected to inform the assessment. This should utilise the most current information for each project in the public domain, and assess the assumptions and limitations of the information collected on each shortlisted project.
Stage 4	Each of the shortlisted projects are reviewed in turn by the different topics to assess whether cumulative effects may arise and the nature of those effects (i.e. beneficial or adverse). The significance of the effects on environmental receptors

CEA Stage	Activity
	is established within each ES technical chapters. Where significant adverse cumulative effects are identified, mitigation measures are also considered within the CEA alongside the mechanism to secure that mitigation, e.g. consent condition requirements.

24.11.2. Scope of Cumulative Effects Assessment for marine archaeology and cultural heritage

221. Cumulative effects on marine archaeology and cultural heritage may arise from the interaction of impacts from the proposed Project during installation and operation, and impacts from other planned or consented projects in the wider vicinity.

222. As detailed in **Section 24.6**, the greatest risk of impact to marine archaeology from the proposed Project is related to direct impacts on cultural heritage assets and submerged palaeo-landscapes, including seabed clearance operations, trenching and burial of cables and the mooring of WTGs, as well as placement of cable protection (**Table 24-10**). Accordingly, the greatest risk for cumulative impacts would be expected to relate to these effect pathways. Given the highly localised nature of direct impacts on marine archaeological receptors, the ZoI for cumulative assessment is considered to be the spatial extent of the proposed Project below MHWS, synonymous with the Offshore Development Area. Plans or projects with potential to overlap spatially with this ZoI have been subject to the cumulative effects assessment.

223. Potential cumulative indirect effects relevant to marine archaeology are also possible. These comprise changes in sediment regime caused by installation and operation of the infrastructure associated with the proposed Project in addition to that associated with other planned or consented projects. These may result in increased burial or exposure of receptors.

224. Initial screening of the Stage 1 long list has short-listed seven projects with the potential to give rise to cumulative effects on marine archaeology and cultural heritage by virtue of confirmed overlap, or potential for overlap, with the ZoI of the proposed Project. These are presented in **Table 24-14**. Of these, one has been decommissioned (the mWave Demonstrator); it will not be considered in this assessment of cumulative effects.

Table 24-14 List of projects considered for the marine archaeology and cultural heritage cumulative effects assessment

Project Name/Developer	Project Type	Tier and Status	Approx. distance from the proposed Project
Greenlink Interconnector	Interconnector cable	Consented	Shared landfall location at Freshwater West (Gravel Bay). Cable continues within Offshore Development Area for c. 1.2 km, before exiting to the south-west and passing within 100 m of the Llŷr OfECC at its closest point.
Project Erebus	Floating OWF	Consented	c. 5 km north-west of the proposed Array Area. Llŷr OfECC route overlaps with that of Erebus for c. 5 km.
Project Valorous	Floating OWF	Concept/In-planning	c. 4 km west of the proposed Project

Project Name/Developer	Project Type	Tier and Status	Approx. distance from the proposed Project
South Pembrokeshire Demonstration Zone	Wave energy array / offshore substation	Pre-application	c. 11 km north-east of the proposed Array Area; c. 8 km east of the OfECC
Gywnt Glas	Floating OWF	Concept/In-planning	c. 8 km south-west of the proposed Project
Llywelyn	Floating OWF	Concept/In-planning	c. 15 km south-west of the proposed Project
mWave Demonstrator	Wave energy array	Completed (decommissioned)	38 km north-east of the Project Array, c. 1 km off the landfall at Freshwater West and within the Project OfECC

225. Two short-listed projects have a partial spatial overlap with the ZoI of the proposed Project: the Greenlink Interconnector and Project Erebus (**Volume 5: Figure 24-13**). The Greenlink Interconnector cable is a 500 MW submarine interconnector cable linking the UK and Ireland, with landfalls at Freshwater West, Wales and Co. Wexford, Ireland. The Welsh landfall is located within the preferred northern option for the offshore export cable of the proposed Project, at Gravel Bay. Greenlink is currently using HDD to install two cable ducts at Freshwater West, with entry pits c. 500 m inland of MHWS. The ducts will run for approximately 1.2 km before punching out c. 3 m below LAT and exiting the Offshore Development Area of the proposed Project. Offshore installation works include seabed clearance activities (including PLGR) and cable burial to a target depth of 0.75-1.5 m. From the punch-out point, the route of the Greenlink Interconnector proceeds south-west before turning west c. 3.5 km from the Pembrokeshire coast. There is no further overlap with the proposed Project Offshore Development Area, though the Greenlink route does come to within 100 m of the OfECC at one location, where the latter turns sharply to the south as it proceeds out into the open sea (**Volume 5: Figure 24-13**).

226. Project Erebus is a demonstration-scale floating offshore wind development, located c. 5 km to the north-west of the proposed Project. The project has recently received consent. Spatial overlap between the Erebus red line boundary (RLB) and the ZoI of the proposed Project is restricted to a c. 5.5 km-long zone, c. 10 km north of the Llŷr 1 Array Area, where the OfECCs of both projects coincide. Works associated with Project Erebus in this area include seabed clearance activities (including boulder clearance and PLGR), sandwave levelling, cable burial to a target depth of up to 3 m, installation of cable protection by concrete mattressing, rock bags or rock dumping (where required) and subsequent post-installation maintenance (Blue Gem Wind 2021). These are broadly similar to the activities that will be undertaken by the proposed Project in this part of the OfECC; a summary of worst-case design scenarios considered for the proposed Project are outlined in **Section 24.6**, **Table 24-10**. A minimum separation distance of 150 m will be maintained between the export cables of Erebus and the proposed Project at all times. An assessment of cumulative effects for both Greenlink and Project Erebus is provided below.

227. Four other projects have the potential to overlap with the ZoI of the proposed Project. These include three FOWFs (Valorous, Gywnt Glas and Llywelyn) located within 15 km of the

proposed Project, and one demonstration area (South Pembrokeshire Demonstration Zone) with the potential to support three wave energy areas. This project is currently in a pre-application stage and includes the development of a Multi-connection Offshore Substation (MOS) capable of linking multiple OWFs to a single export cable.

228. The application boundaries for all these projects have the potential to overlap with the Offshore Development Area. Six potential landfall locations for the proposed export cable associated with South Pembrokeshire Demonstration Zone are under consideration, including one at Freshwater West. Both Gwynt Glas and Llewelyn are located to the south-west of the proposed Project, while Valorous is to its west. Offshore export cables associated with these projects are likely to either run across, or in close proximity to, the Offshore Development Area.

229. All four projects are, however, in pre-application or at the concept / planning stage, and confirmed application boundaries are not yet available. Following the approach to CEA set out in **Appendix 5A**, there is currently insufficient detail available on the design and installation methodologies of these projects to undertake a robust and meaningful assessment. These four projects are therefore screened out of further consideration in this assessment of cumulative effects. It should be noted that, should any of these projects proceed beyond the planning and / or pre-application stages, detailed archaeological assessments will be undertaken for each of these projects as part of the planning process. This will include the archaeological assessment of marine geophysical survey data. Any assets identified by those surveys are likely to be protected through the implementation of AEZs specific to those projects; where there is spatial overlap, these four projects must respect the AEZs set out in this chapter and the project-specific WSI (see also Coracle Archaeology 2024b). This will ensure that adverse cumulative effects on marine archaeology and cultural heritage are avoided.

24.11.3. Cumulative effect assessment

230. Only marine cultural heritage assets that fall within the ZoI influence of the proposed Project and overlapping areas of both Greenlink and Project Erebus will experience potential cumulative effects from the projects.

231. Full assessment of the impacts of the Greenlink Interconnector and Project Erebus on the marine archaeological resource within their application boundaries were undertaken during the permitting process, including the production of detailed WSIs (Coracle Archaeology 2022 for Greenlink; MSDS 2021b for Project Erebus). These WSIs ensured that direct and indirect impacts on the marine archaeological resource were avoided, minimised or mitigated, primarily through project-specific AEZs. Project-specific PADs were also prepared, thus mitigating the impact of the projects on as yet unidentified cultural heritage assets.

232. Three known heritage assets identified by the proposed Project are located in proximity to the route of the Greenlink Interconnector. These comprise the wreck of the *Willemoes of Thuro* (**CA2**), located c. 250 m to the south of the Greenlink cable route, the wreck of the SS *Saint Jacques* (**CA65**), located c. 300m south-east of the Greenlink cable route, and the submerged forest deposits identified at Gravel Bay (**CA9**). The latter are nominally located c. 25 m to the north of the Greenlink Interconnector, though their full lateral extent is unclear (see **Section 24.5**). No geophysical anomalies with high or medium archaeological potential were identified by archaeological assessments for the Greenlink Interconnector within the Offshore Development Area of the proposed Project.

233. One historic asset (**CA16**) and eight geophysical anomalies are recorded in the area of overlap between the proposed Project and Project Erebus. The wreck of the *Roger Bushell* (**CA16**)

appears to be a reported loss; no corresponding geophysical anomalies were recorded by either project at this location and it will not be considered further here.

234. Eight geophysical anomalies identified by archaeological assessments undertaken for Project Erebus are located within the ZoI of the proposed Project. These include two considered by Project Erebus (MSDS 2021a) to be of medium archaeological potential:

- **ERS21_0103** (NPRN 800236; **CA74**). This is described as a small mound with protruding features visible in the SSS dataset, with a moderate magnetic signature (MSDS 2021a). **CA74** is located c. 5 m beyond the Offshore Development Area, within the WSA. Given the potential for debris associated with this anomaly to be located within the ZoI of the proposed Project, it is considered in this cumulative assessment; and
- **ERS21_0106** (NPRN 800237; **CA66**), described as a series of parallel linear features visible in the SSS dataset.

235. Both these geophysical anomalies were assigned AEZs of 25 m radius by Project Erebus (BlueGem Wind 2021; MSDS 2021a). Detailed assessment of the geophysical datasets collected for the proposed Project suggests that these anomalies should be considered of low archaeological potential, following the criteria outlined in **Section 24.4.2.** Anomaly **ERS21_0103** is a slightly elevated area within a series of bedforms, with a small depression c. 3 m in diameter to the west. A magnetic anomaly of 9 nT (**M-1127-ESR-M-BSP**) is located close to the mound; this is likely to be modern debris. Anomaly **ERS21_0106** has no corresponding signature in the MBES, SBP or magnetic dataset and is located within an area of mobile, east-west migrating bedforms. The geophysical data collected for the proposed Project also shows that the wider areas around each anomaly are characterised by numerous upstanding features, making a geological origin (e.g. boulders) likely. There is nothing in the most recent dataset to suggest that these anomalies are of medium archaeological potential, and for the purposes of this assessment their archaeological potential is considered to be low. In accordance with the methodology outlined in **Section 24.4**, the sensitivity of these receptors is also considered to be **low** and they will not be considered further here.

236. A further six geophysical anomalies were identified by Project Erebus with an uncertain archaeological potential (Blue Gem Wind 2021; MSDS 2021a). These include:

- **ERS21_MAG_1280**, **ERS21_MAG_1287, ERS21_MAG_1296, ERS21_MAG_1298, ERS21_MAG_1312:** magnetic contacts with no seabed expression. A temporary AEZ of 15 m radius was assigned for each of these (MSDS 2021a); and
- **ERS21_MAG_1314**, a magnetic contact with no seabed expression. This was assigned a temporary AEZ of 25 m (MSDS 2021a).

237. None of these anomalies were visible in the latest geophysical datasets acquired for the proposed Project (Coracle Archaeology 2024b). This may be the result of mobile sandwaves in this part of the OfECC, covering and uncovering anomalies or moving them to other locations, or a difference between the survey parameters of both projects (e.g. the location of magnetometer track lines). Given the lack of signature in the latest datasets, the maintenance of the temporary AEZs imposed around **ERS21_MAG_1280**, **ERS21_MAG_1287, ERS21_MAG_1296, ERS21_MAG_1298, ERS21_MAG_1312 and ERS21_MAG_1314** is not considered necessary. These anomalies will not be considered further in this assessment.

238. A number of palaeo-channels and stacked facies are also present in the area of overlap between Project Erebus and the proposed Project. These have been attributed to late Pleistocene, proglacial processes and subsequent catchment drainage (Coracle Archaeology 2024b; **Section 24.5**).

24.11.4. Cumulative direct impacts on marine archaeology from the construction phase

239. The following impact assessment follows the same methodology as that for the *Assessment of environmental effects* above (**Section 24.8**). The significance of each of the cultural heritage assets described below has been assessed, ranging from very high to negligible, based on the criteria outlined in **Table 24-5**. It is important to recognise that the significance of the asset (here defined as sensitivity of the receptor) is usually, though not exclusively, synonymous with archaeological potential described elsewhere (e.g. Coracle Archaeology 2024b; **Appendix 24B**). As stated previously, the marine archaeological resource is finite and irreplaceable; in line with industry standards and best practice, **major**, **moderate** and **minor** effects are considered significant and require mitigation.

240. Direct impacts that have the potential to impact the marine archaeology and cultural heritage resource are outlined in **Section 24.6**. In the areas of overlap between projects, these are limited to activities associated with cable installation, including seabed clearance, cable burial and, where required, installation of additional protection.

Palaeo-environmental deposits (offshore)

Sensitivity of the receptor

241. Assessment of the supplied project-specific SBP data identified Quaternary deposits within the area overlapped by the ZoI of the proposed Project and the Erebus consent boundary. These consist primarily of late Pleistocene glacial deposits. A number of channel features were also visible, though these lack any associated lateral floodplain features. These are likely to have formed as a result of pro-glacial processes and subsequent catchment drainage. The geoarchaeological potential of these deposits is considered **low**, as no deposits or features attributable to temperate environments, conducive to occupation, have been observed in the geophysical survey data acquired to date. Following the criteria outlined in **Table 24-5**, the sensitivity of the receptor is also considered **low**. No offshore palaeo-environmental deposits were observed in the area of overlap between Greenlink and the proposed Project.

Magnitude of cumulative impact

242. Any direct cumulative impacts to offshore palaeo-environmental deposits from the construction phases of the proposed Project and Project Erebus are likely to result in a detrimental change to the asset. Given the linear nature of the works in the area of overlap (e.g. PLGR and ploughing) and the minimum separation distance of 150 m between the export cables of both projects, these impacts are likely to be highly localised. In addition, the relatively thick (up to several metres) deposits of surficial sand covering the buried Quaternary deposits compared to the proposed depth of cable burial (a maximum of 3 m for Erebus; 1.2 m target depth for the proposed Project) further reduces the likelihood of direct cumulative impacts to localised areas, including during the levelling of sandwaves. Cumulative impacts are likely therefore to result only in a slight physical change to the asset. Following the criteria outlined in **Table 24-4**, the magnitude of impact is considered **medium**.

Significance of cumulative effect

243. The magnitude of impact upon identified deposits of palaeo-environmental interest is considered **medium**; the sensitivity of the receptor is considered **low**. Following the matrices outlined in **Table 24-6**, the overall significance of effect is considered **negligible**, or not significant. The presence of two sets of high voltage electricity cables in close proximity on or below the seabed may, however, increase the cumulative significance of effect to **minor** (adverse) as a result of restricted access to these deposits post-installation. This would be mitigated through archaeological input into design and assessment of geotechnical

investigations, already in place as part of embedded mitigation (**Section 24.7**). With this mitigation in place, the cumulative residual significance of effect would be reduced to **negligible** or **minor** (beneficial) through the provision of additional geoarchaeological data.

Palaeo-environmental deposits (Freshwater West)

Sensitivity of the receptor

244. Submerged forest deposits were identified at Gravel Bay (**CA9**) in the DBA prepared for the proposed Project (Coracle Archaeology 2024a; **Appendix 24A**). These are located c. 25 m to the north of the Greenlink route and within the ZoI of the proposed Project. A number of other submerged forest deposits and associated sites are located further south at Freshwater West (**CA8**; **CA10**; **CA12**). As a result, the palaeo-environmental potential of the landfall location must be considered high. Given the potential of these sites and deposits to contribute to the understanding of the palaeo-environment of south-west Wales, including sea-level change in the Celtic Sea more broadly, these must be regarded as heritage assets of national importance. Following the criteria outlined in **Table 24-5**, the sensitivity of the receptor is therefore considered **high**.

Magnitude of cumulative impact

245. The use of HDD as an installation method at Freshwater West by both Greenlink and the proposed Project suggests that there is unlikely to be any direct impact on these deposits from either project. The magnitude of cumulative direct impact is therefore considered **negligible**.

Significance of cumulative effect

246. The sensitivity of palaeo-environmental deposits at Freshwater West is considered **high**; the magnitude of cumulative impact is considered **negligible**. In accordance with the criteria outlined in **Table 24-6,** the overall cumulative significance of effect is considered **negligible**. This may be reassessed following the results of any geotechnical investigations undertaken for the proposed Project, as outlined in project-specific embedded mitigation (see **Section 24.7**).

Known wreck sites

Sensitivity of the receptor

247. The only known wreck sites located in proximity to the ZoI of the proposed Project and either Greenlink or Project Erebus are the *Willemoes of Thuro* (**CA2**) located on the beach at Freshwater West, and the SS *Saint Jacques* (**CA65**), located on the seabed in c. 35 m water depth, c. 3.8 km south-west of Freshwater West. **CA2** was not visible during landfall surveys owing to elevated levels of mobile beach sand; it has, however, been recorded routinely on the beach in recent years. **CA65** is located within the revised OfECC, in an area for which there is presently no project-specific geophysical survey data. It is, however, clearly visible on high resolution MBES data collected in 2017 and hosted on the iMarDIS data portal. The wreck consists of a low-lying outline with an elevated central mound and surrounding upstanding features, possibly indicative of outlying debris. Following the criteria outlined in **Table 24-5**, the sensitivity of both **CA2** and **CA65** is considered **high**.

Magnitude of cumulative impact

248. The wreck of the *Willemoes of Thuro* (**CA2**) is located c. 250 m south of the route of the Greenlink cable. It will not therefore be impacted by Greenlink installation activities and there is no cumulative direct impact. The use of HDD at the landfall location by Greenlink and its planned use for the proposed Project, further suggests that the magnitude of cumulative impact on the asset should be considered **negligible**. It should also be noted that the asset is

located at the southern landfall option for the proposed Project, which is no longer under consideration.

249. Similarly, **CA65** is located c. 300m south-east of the route of the Greenlink cable. It will not therefore be impacted by Greenlink installation activities, and no cumulative direct impact has been identified. The magnitude of cumulative impact on this asset is also considered **negligible**.

Significance of cumulative effect

250. The sensitivity of both receptors is considered **high**; the magnitude of cumulative impact in both cases is considered **negligible**. In accordance with the significance matrix presented in **Table 24-6**, the overall significance of cumulative effect is also considered **negligible**. As these are the locations of known wrecks, AEZs were nevertheless assigned (50 m radius for **CA2**; 75 m radius for **CA65**; **Section 24.8**; Coracle Archaeology 2022; 2024b), thus affording both further protection.

24.11.5. Cumulative indirect impacts on archaeological assets from the construction phase

251. A number of activities associated with the construction phase have the potential to impact marine archaeology and cultural heritage indirectly, primarily through sediment disturbance, which could result in either increased burial (beneficial) or exposure (adverse) of identified assets. In the areas of overlap between the proposed Project and both Greenlink and Project Erebus, the only activities comprise those associated with cable installation, including seabed clearance works, cable trenching, and the deposition of external cable protection. These activities are outlined in detail in **Section 24.6** (**Table 24-10**).

252. The use of HDD at Freshwater West and the location of the HDD entry and exit ducts (c. above MHWS and in water depths of 3-8 m LAT for the proposed Project; c. 500 m above MHWS and c. 700 m below MHWS for Greenlink) will ensure that no indirect impacts will occur on assets identified on the beach at Freshwater West (e.g. **CA2**; **CA9**). No cumulative assessment of indirect impacts on these assets is considered necessary.

Palaeo-environmental deposits (offshore)

Sensitivity of receptor

253. As stated above, the late Pleistocene deposits identified in the area of overlap between the proposed Project and Project Erebus are considered to be of low archaeological potential, indicative of pro-glacial processes and subsequent catchment drainage. Following the criteria outlined in **Table 24-5,** the sensitivity of the receptor is also considered **low**.

Magnitude of cumulative impact

254. Cumulative indirect impacts to palaeo-environmental deposits may result from the redisposition of sediment as a result of seabed clearance activities and trenching. Changes in sediment dynamics associated with seabed clearance and trenching are, however, expected to be localised and temporary, with the majority of coarser grained sediments redeposited within 50 m of the original location (**Table 24-10**). Fine sediments are unlikely to be redeposited in measurable thicknesses. Given the similar installation methods proposed for both Erebus and the proposed Project, these impacts will be correspondingly similar. It should be noted that the minimum separation distance between the export cables of both projects is 150 m, while the temporary nature of the sediment dispersal further suggests that there is unlikely to be a cumulative indirect impact from both projects, as works associated with the projects will not take place simultaneously. The magnitude of cumulative impact is therefore considered **low**.

Significance of cumulative effect

255. The sensitivity of the receptor is considered **low**, and the magnitude of cumulative impact is also considered **low**. Using the significance matrix presented in **Table 24-6**, the significance of cumulative effect can be characterised as **negligible** and no mitigation is required.

Known wreck sites (offshore)

Sensitivity of receptor

256. The sole known wreck located offshore and in proximity to the ZoI of the proposed Project and either Greenlink or Project Erebus is the SS *Saint Jacques* (**CA65**), c. 3.8 km south-west of Freshwater West. As stated above, and following the criteria outlined in **Table 24-5,** the sensitivity of the receptor is considered **high**.

Magnitude of cumulative impact

257. The wreck (**CA65**) lies in proximity to the installed route of the Greenlink cable and within the OfECC of the proposed Project. Although it will not experience direct cumulative impacts during the construction phase, indirect impacts must be considered as these can have effects which extend beyond the zone of direct impact (principally the redisposition of sediment as a result of seabed clearance activities and trenching).

258. As described above and in **Table 24-10,** changes in sediment dynamics associated with the similar cable installation activities for both Greenlink and the proposed Project are expected to be localised and temporary. The majority of coarser grained sediments will be redeposited within 50 m of the original location and fine sediments passing beyond 50 m are unlikely to be redeposited in measurable thicknesses. As **CA65** is located c. 300 m from the route of the Greenlink cable, a cumulative impact is considered highly unlikely. The temporary nature of the sediment dispersal further suggests that there is unlikely to be a cumulative indirect impact, as works associated with both projects will not take place simultaneously. The magnitude of cumulative impact is therefore considered to be **negligible.**

Significance of cumulative effect

259. The sensitivity of the receptor is considered **high**; the magnitude of cumulative impact is considered **negligible**. In accordance with the significance matrix presented in **Table 24-6**, the overall significance of cumulative effect is also considered **negligible** and no mitigation is required.

24.11.6. Cumulative direct impacts on archaeological assets during O&M

260. The majority of potential impacts on marine archaeology and cultural heritage assets would occur in the construction phase of each of the identified projects which overlap with the ZoI of the proposed Project (Greenlink Interconnector and Project Erebus). There is, however, the potential for impacts on cultural heritage assets during the operational phase, primarily from maintenance activities. This includes direct impacts caused by the anchoring of maintenance vessels or the reapplication of cable protection for any of the cables associated with Greenlink, Erebus or the proposed Project. Impacts may also occur if cables are repaired, replaced or reburied in areas beyond their original routing. Direct impacts during the O&M phase are considered analogous to the construction phase in terms of the sensitivity of the receptor and magnitude of impact.

261. With respect to cumulative effects, a distinction can also be made between assets which are highly localised, such as individual wrecks or geophysical anomalies, and those that are spatially extensive. The latter include submerged palaeo-landscapes and palaeo-environmental deposits.

262. For the area of overlap between the proposed Project and Greenlink, localised assets comprise the wrecks of the *Willemoes of Thuro* (**CA2**) and SS *Saint Jacques* (**CA65**); no localised assets were identified in the overlap between Project Erebus and the proposed Project. Moreover, given the mitigation in place for all projects (AEZs and project-specific PADs for all projects; the use of HDD at Freshwater West), direct cumulative effects during the O&M phase to known cultural heritage assets are considered to be **negligible** and therefore not significant in EIA terms. They will not be considered further in this section.

263. In contrast, spatially extensive assets, such as submerged palaeo-landscapes, have the potential to experience multiple direct impacts occurring at different times and places under the O&M phases of different projects. These are considered for cumulative effects assessment.

Palaeo-environmental deposits (offshore)

Sensitivity of receptor

264. As stated above, spatially extensive assets located within both the ZoI of the proposed Project and the Project Erebus consent boundary comprise late Pleistocene glacial deposits. Following the criteria outlined in **Table 24-5** the sensitivity of these assets is considered **low**.

Magnitude of cumulative impact

265. Multiple direct impacts could occur at different times and places during the O&M phases of both Project Erebus and the proposed Project, with each impact potentially resulting in an adverse effect. The seabed works undertaken are likely nevertheless to be relatively localised, i.e. focussed on specific areas requiring maintenance, and would take place in areas which had already been disturbed by the initial cable installation. The impact of maintenance work would be reduced further by the fact that the export cables for both projects will be separated by a minimum distance of 150 m. Furthermore, across large parts of the overlapping OfECCs for Erebus and the proposed Project, relatively thick (up to several metres) deposits of surficial sand cover the buried late Pleistocene deposits. Consequently, the magnitude of cumulative impact is considered **low**.

Significance of cumulative effect

266. Following the criteria outlined in **Section 24.4**, the sensitivity of the receptor has been identified as **low** and the magnitude of cumulative impact as **low**. The overall significance of effect can therefore be characterised as **negligible**, or not significant. No project-specific mitigation is considered necessary.

Palaeo-environmental deposits (Freshwater West)

Sensitivity of receptor

267. A number of submerged forest / intertidal peats are located at Freshwater West, within the Offshore Development Area and in proximity to the route of the Greenlink Interconnector (**CA8-10; CA12**). The exposure represented by **CA9** is located just c. 25 m to the north of the Greenlink route. Following the criteria outlined in **Table 24-5** the sensitivity of these assets is considered **high**.

Magnitude of cumulative impact

268. The use of HDD at Freshwater West suggests that no impacts will occur on the submerged forests / intertidal peats during the O&M phase of either Greenlink or the proposed Project. The magnitude of cumulative impact is therefore considered **negligible.**

Significance of cumulative effect

269. In accordance with the criteria outlined in **Table 24-4** and **Table 24-5**, the sensitivity of the receptor has been identified as **high**, and the magnitude of cumulative impact as **negligible**. The overall significance of effect can therefore be characterised as **negligible** and no project-specific mitigation is considered necessary.

24.11.7. Cumulative indirect impacts on archaeological assets during O&M

270. The principal indirect impact on assets during the O&M phase comprise the development of long-term changes in localised sediment dynamics and scouring caused by the interaction between installed seabed infrastructure, seabed sediment and natural water flow. As noted above, such changes have the potential to impact assets via enhanced erosion or burial. In areas of overlap between the projects, the installed infrastructure protruding above the seabed comprises solely cable protection. Temporary and localised changes may also result from anchoring by maintenance vessels. These indirect impacts will only affect assets located offshore on the seabed or buried at shallow depths (less than a few metres burial).

271. The use of HDD at the landfall location means that there will be no exposed infrastructure that may influence local sediment dynamics. Consequently, no indirect impacts will occur on heritage assets identified at Freshwater West (e.g. **CA2**; **CA9**) during the O&M phase, and no further consideration is required in terms of cumulative effects.

Palaeo-environmental deposits (offshore)

Sensitivity of receptor

272. The late Pleistocene deposits identified in the SBP data in the zone of overlap between the proposed Project and Project Erebus are considered to be of low archaeological potential. Following the criteria outlined in **Table 24-5**, the sensitivity of the receptor is also considered **low**.

Magnitude of cumulative impact

273. Indirect cumulative impacts on palaeo-environmental deposits during the O&M phase may result from the redisposition of sediment following changes in sediment dynamics caused by placement of cable protection. Possible effects include localised scouring (enhanced erosion; adverse) and re-deposition of scoured sediment elsewhere (enhanced burial; beneficial). Long-term changes in sediment dynamics associated with cable protection are, however, expected to be localised and minor. Scour at rock berms is likely to be restricted to a distance of a few metres and a depth of tens of centimetres (**Table 24-10**). Given that the export cables for Erebus and the proposed Project will be separated by a minimum distance of 150 m, this reduces the potential for combined scour impacts generated by two sets of cable protection. Moreover, within the area of overlap between Erebus and the proposed Project, large areas of seabed are covered by thick deposits of sand. These are likely to be suitable for cable burial, and extensive zones of cable protection are considered unlikely in this area. Considering the extensive nature of the palaeo-environmental deposits, both horizontally (kilometres) and vertically (metres to tens of metres in terms of thickness), the magnitude of impact is deemed to be **low**.

Significance of cumulative effect

274. The sensitivity of the receptor is considered **low**, and the magnitude of cumulative impact is also considered **low**. Following the methodology outlined in **Section 24.4**, the significance of cumulative effect can therefore be characterised as **negligible**. No mitigation is required.

Known wrecks (offshore)

Sensitivity of receptor

275. The sole known wreck located offshore and in proximity to the ZoI of the proposed Project and either Greenlink or Project Erebus is the SS *St Jacques* (**CA65**), located c. 300 m from the Greenlink Interconnector. As stated above, and following the criteria outlined in **Table 24-5**, the sensitivity of the receptor is considered **high**.

Magnitude of cumulative impact

276. Indirect cumulative impacts during the O&M phase are produced by the redisposition of sediment caused by disruption of natural sediment dynamics from placement of cable protection (**Table 24-10)**. Possible effects include localised scouring (enhanced erosion; adverse) and re-deposition of scoured sediment elsewhere (enhanced burial; beneficial). Long-term changes in sediment dynamics associated with cable protection are, however, expected to be localised and minor. As highlighted above and in **Table 24-10,** adverse effects such as scour caused by rock berms are restricted to a distance of a few metres. As the route of the Greenlink cable is c. 300 m from **CA65**, this suggests that there will be no cumulative indirect effects during the O&M phase. The magnitude of cumulative impact is therefore considered **negligible**.

Significance of cumulative impact

277. The sensitivity of the receptor is considered **high**; the magnitude of cumulative impact is considered **negligible**. In accordance with the significance matrix presented in **Table 24-6**, the overall significance of cumulative effect is also considered **negligible** so no mitigation is required.

24.11.8. Cumulative impacts on archaeological assets during decommissioning

278. As outlined in **Section 24.8.5**, the exact nature of decommissioning activities for the proposed Project has yet to be determined. It should be noted that the majority of impacts to marine archaeology and cultural heritage assets will have occurred in the construction phase; direct and indirect impacts from decommissioning activities are considered analogous to the construction phase and no additional mitigation is considered necessary. This approach is accepted as industry standard for marine archaeology.

279. It is important to reiterate that AEZs should be respected for the lifetimes of all the considered projects (Greenlink, Erebus, the proposed Project), including decommissioning. With this mitigation in place, the overall significance of effect is reduced to **negligible**, regardless of the sensitivity of the receptor.

280. Additional archaeological assessments may be required once the exact nature of the decommissioning strategy is confirmed. These should be agreed in advance with the RCAHMW and DAT.

24.11.9. Summary of Residual Cumulative Effects

281. Cumulative effects on archaeological assets are possible where other projects overlap with the ZoI of the proposed Project. Projects with sufficient information on their design and methodology to enable robust cumulative effects assessment include the Greenlink Interconnector, which reaches landfall at Freshwater West and crosses the northernmost part of the Llŷr Offshore Development Area, and Project Erebus. The route of the proposed export cables for the latter intersects with the OfECC of the proposed Project for c. 5 km.

282. Two known wreck sites (**CA2; CA65**) and one prehistoric submerged forest deposit (**CA9**) have been identified in the overlapping areas. The significance of both direct and indirect cumulative effects on these assets is considered **negligible**, and therefore not significant in EIA terms. No additional mitigation is required. Adherence to AEZs established by all projects will nevertheless ensure that the residual significance of effect is **negligible**. Two geophysical anomalies considered to be of medium archaeological potential were identified by Project Erebus within, or immediately adjacent to, the ZoI of the proposed Project (**ERS21_0103**, **CA74**; **ERS_0106**, **CA66**; MSDS 2021a); subsequent assessment of these locations in the dataset collected for the proposed Project suggests that they should be considered of low archaeological potential and they were not considered in this assessment of cumulative effects.

283. Late Pleistocene palaeo-environmental (glacial) deposits were, however, identified in areas where the installation of two sets of high voltage electricity cables on or below the seabed raises the potential for cumulative impacts as a result of restricted future access to these deposits. The cumulative significance of effect on these deposits is considered **minor** (adverse). This would be mitigated through archaeological input into design and assessment of geotechnical investigations, as outlined above (see **Section 24.7**). With this mitigation in place, the overall cumulative significance of effect would be reduced to **negligible** or **minor** (beneficial) through the provision of additional geoarchaeological data.

24.12 Inter-related Effects of the proposed Project

284. The term 'Inter-related' takes into account the environmental interactions ('inter-relationships') with other receptors within the proposed Project. These are referred to in the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 and further described in **Chapter 31: Inter-related Effect Assessment.**

285. As set out in PINS Advice Note 17 (PINS), 2019, *inter-related -project effects*, or 'interrelationships between topics', derive from combinations of different project-specific impacts which, when acting together on the same receptor, could result in a new or different effect, or an effect of greater significance than the project effects, when considered in isolation.

286. Inter-related effects comprise the following:

- *Project lifetime effects*: effects that have the potential to occur during more than one phase of the proposed Project (i.e. construction, O&M, or decommissioning) and also to interact in a way that could potentially create a more significant effect than if it was assessed in isolation; and
- *Receptor-led effects*: effects that have the potential to interact, spatially and temporally, to create inter-related effects on a receptor.

287. **Chapter 31: Inter-related Effects Assessment** details the approach to the inter-related effects assessment. It includes a description of the likely inter-related effects that may occur as a result of the proposed Project on marine archaeology and cultural heritage.

24.12.1. Inter-related Project lifetime effects

288. It should be noted that any direct impacts to marine archaeology and cultural heritage during the construction and installation phase of the project have the potential to be permanent and irreversible. Any direct impact upon a cultural heritage asset is therefore likely to have occurred during the construction phase. These impacts have been discussed above in **Section 24.8;** these will be mitigated through adherence to the project-specific AEZs outlined above.

289. Indirect effects, primarily changes to the sediment regime resulting in enhanced exposure or burial of archaeological assets, are related to the activities which cause direct effects (i.e. they are caused, over the lifetime of the project, by installation of seabed infrastructure). Temporary changes to the sediment regime can also be caused by maintenance activities. The significance of these effects has been addressed in **Section 24.8.**

290. Impacts from decommissioning are considered analogous to construction. Overall, no inter-related impacts have been identified that will result in a more significant, or additional effect on a receptor, than the impacts already discussed throughout these three key stages. Therefore, no further assessment of Project lifetime effects is considered necessary.

291. It is important to recognise that the marine cultural heritage resource should not be viewed in isolation, but rather as part of a larger cultural heritage resource that encompasses onshore, offshore and the coastal littoral. This is especially true where heritage assets relating to marine archaeology or the maritime historic landscape are located above MHWS, or with regard to palaeo-environmental deposits that may extend onshore, beyond the dune sequence at the head of the beach at Freshwater West. The onshore resource is assessed in **Chapter 09: Onshore Historic Environment and Cultural Heritage**. At present, no impacts have been identified in this assessment that would also impact the onshore heritage resource.

24.12.2. Inter-related receptor-led effects

292. Receptor-led effects assess all effects with potential to interact (spatially and temporally), to create combined effects on a receptor. With respect to marine archaeology and cultural heritage assets and the works associated with the proposed Project, effects comprise either direct effects caused by the installation of seabed infrastructure (either temporary or permanent) or indirect effects caused by changes in the sediment regime resulting directly from the emplacement of that infrastructure. These can occur during installation or maintenance. The following impact pathways are therefore considered relevant:

- Seabed clearance and installation activities; and
- Routine maintenance operations

293. The potential for interrelated effects to arise from these pathways is set out in **Table 24-15** below, divided into project lifetime effects, where there is interaction during different Project phases. Given the link between installed seabed infrastructure and changes in sediment regime, these interrelated effects are analogous to the indirect effects outlined in **Sections 24.6** and **24.8**. Full details can be found in these sections; as stated, the significance of these effects is considered **negligible**. No further assessment of inter-related receptor-led effects is considered necessary.

Table 24-15 Interrelated effects on marine archaeology and cultural heritage

Effect	Residual effect significance per project phase			Combined effects over project Lifetime
	Constr.	O&M	Decomm.	
Increased levels of scour or changing sediment dynamics resulting in the exposure or burial of identified heritage assets	Negligible / slight beneficial	Negligible / slight beneficial	n/a	Negligible / slight beneficial

24.13 Transboundary Effects

294. A transboundary effect refers to the impacts or effects of a project that extend beyond the boundaries of the United Kingdom and have the potential to affect the environment of other countries within the European Economic Area (EEA). These effects can occur either from the proposed Project on its own or when combined with the effects of other projects or activities in the wider geographical area.

295. No transboundary effects to marine archaeology and cultural heritage have been identified during this assessment.

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