Chapter 15
Marine Archaeology

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

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ORIEL WIND FARM PROJECT

Environmental Impact Assessment Report
Chapter 15: Marine Archaeology

MDR1520B
EIAR – Chapter 15
A1-C01
March 2024

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15 MARINE ARCHAEOLOGY

15.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) provides an assessment of the potential impacts of the Oriel Wind Farm Project (hereafter referred to as the "Project") on marine archaeology. Specifically, this chapter considers the potential impact of the Project below the Low Water Mark (LWM) during the construction, operational and maintenance, and decommissioning phases.

The archaeology and cultural heritage assessment of the Project above the LWM (i.e. of the onshore and intertidal zone) is presented in volume 2C, chapter 26: Cultural Heritage (including archaeological and architectural heritage).

The assessment presented is informed by the following chapters:

- Chapter 26: Cultural Heritage (volume 2C);
- Chapter 7: Marine Processes; and
- Chapter 8: Benthic Subtidal and Intertidal Ecology.

This chapter summarises information contained within the following technical report:

- Appendix 15-1: Marine Archaeology Technical Report.

The details and competencies of the specialist who prepared this chapter can be found in volume 2A, chapter 1: Introduction.

15.2 Purpose of this chapter

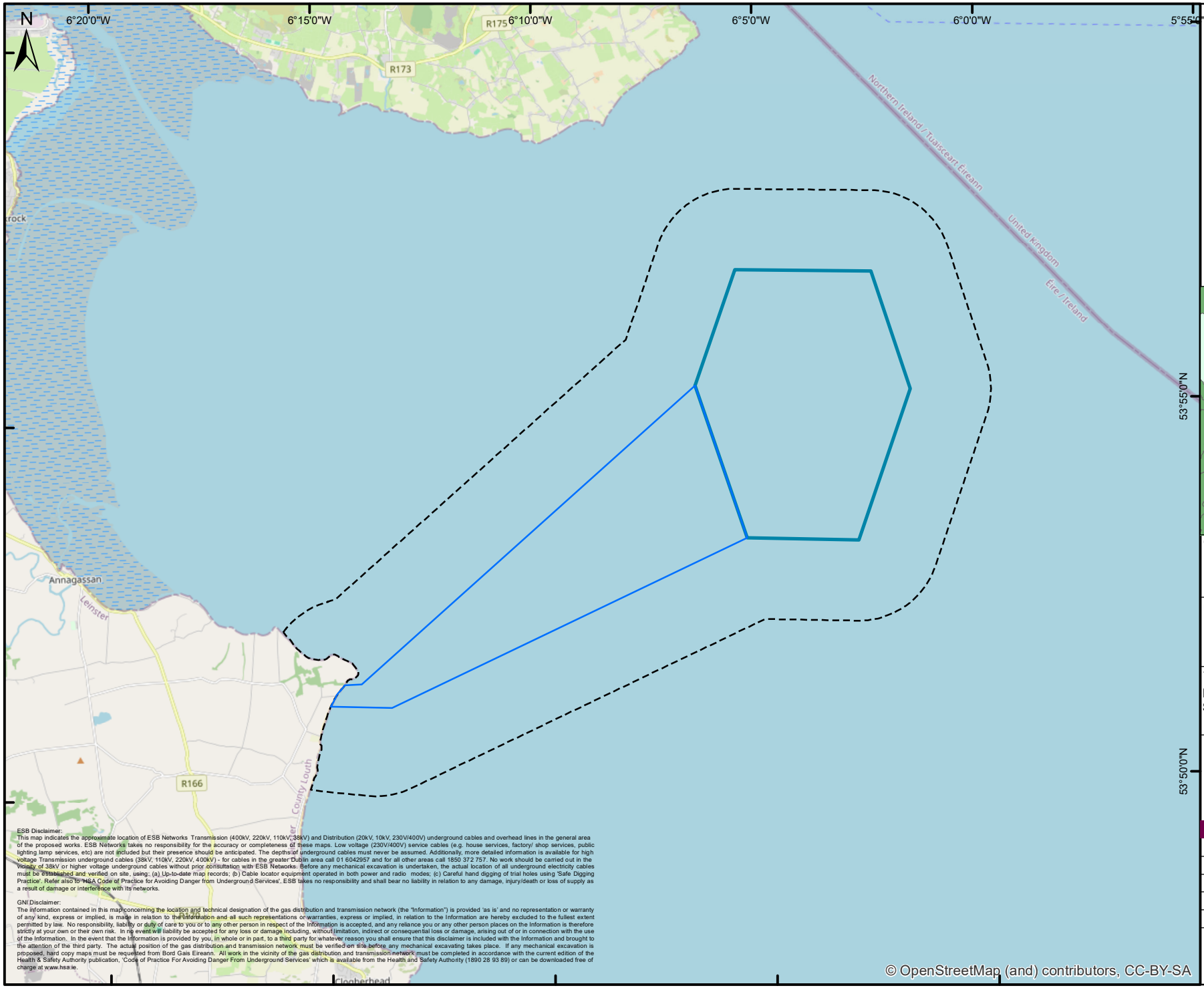
The primary purpose of this EIAR chapter is to provide an assessment of the likely direct and indirect significant effects of the Project on marine archaeology. In particular, this EIAR chapter:

- Presents the existing environmental baseline established from desk studies and site-specific surveys (section 15.7);
- Identifies any assumptions and limitations encountered in compiling the environmental information (section 15.7.8);
- Presents an assessment of the potential likely significant effects on marine archaeology arising from the Project (section 15.10) based on the information gathered and the analysis and assessments undertaken. An assessment of potential cumulative impacts is provided in section 15.11 and an assessment of transboundary effects is outlined in section 15.12; and
- Highlights any necessary monitoring (section 15.10.6) and/or measures (see section 15.10.5) to prevent, minimise, reduce or offset the likely significant environmental effects identified in the assessment (section 15.10).

15.3 Study area

The Marine Archaeology Study Area is shown in Figure 15-1. This has been defined as the area encompassing the offshore wind farm area and offshore cable corridor plus an additional 2 km buffer, up to the LWM, to allow the site-specific data to be put into a wider context and to further characterise its archaeological potential. The Marine Archaeology Study Area has been agreed in consultation with the Underwater Archaeology Unit of the National Monuments Service (NMS) and is based on professional judgement.

The intertidal area (between LWM and High Water Mark (HWM)) is not included in the Marine Archaeology Study Area as it has been assessed as part of volume 2C, chapter 26: Cultural Heritage (in volume 2C) and so is not duplicated here.



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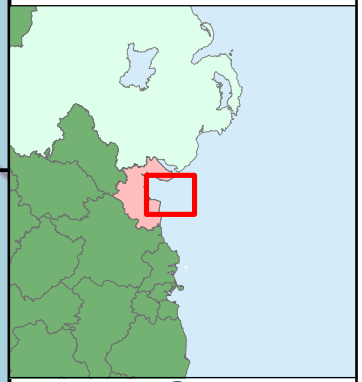
Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Marine Archaeology Study Area

Data Sources: Client



Client
ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project
Oriel Wind Farm Project

Title
Figure 15-1
Marine Archaeology Study Area

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Issue Details

Drawn By: NA	**Project No.** EOR0822 (MDR1520B)
Checked By: NG	**File Ref:** EOR0822_MAR_E_1400_FINAL
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Scale: 1:125,000 @ A4	**Projection:** ITM (IRENET95)
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15.4 Policy context and legislation

15.4.1 International law

Legislation acting to protect submarine archaeological remains in Ireland is based on international law, including the United Nations Convention on the Law of the Sea 1982 (UNCLOS, 1982) and the European Convention on the Protection of the Archaeological Heritage (Revised) 1992 (the Valletta Convention). The United Nations Educational, Scientific and Cultural Organisation's Convention on the Protection of the Underwater Cultural Heritage 2001 (UNESCO, 2001) was ratified by Ireland in 2001. This convention provides that a States Party shall use the best practicable means to prevent or mitigate any adverse effects that might arise from activities under its jurisdiction incidentally affecting underwater cultural heritage sites.

15.4.2 National legislation

Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023

Marine archaeological heritage is protected primarily under the Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023, in particular Parts 3 and 5 of the Act.

Archaeological heritage is defined in Section 2 of the 2023 Act as relevant things (structures, wrecks, ritual or ceremonial site, sites of historic events, battlefields, sites with legendary or mythological associations, any layer or feature not natural in origin) of archaeological interest and archaeological objects. Archaeological objects are objects situated at or removed from a relevant thing of interest or a monument that, by reason of the archaeological interest attached to it or of its association with any historic event, period, subject or person has a cultural, monetary, or scientific value greater than its intrinsic value.

A 'wreck' is defined in Section 2 of the 2023 Act as '*any form of watercraft or vessel…or aircraft or any part or element thereof, lying on, in or under the seabed or land covered by water, and any things contained in or on such watercraft, vessel or aircraft, or any objects which were formerly so contained'*.

Diving or general interference with any wreck which is more than one hundred years old or an archaeological object which is lying on, in or under the seabed or on or in land covered by water is prohibited except in accordance with a licence issued by the Minister for Housing, Local Government and Heritage under Part 5 of the Act. A licence is also needed under the same provisions of the Act to survey a wreck or archaeological object or a wreck that is protected by an underwater heritage order. Therefore, a licence is required to dive, survey or disturb any protected wreck site or for targeted searches for archaeological objects underwater.

Merchant Shipping (Salvage and Wreck) Act 1993

The Merchant Shipping (Salvage and Wreck) Act of 1993 contains provisions which can be used for the protection of historic wrecks.

Under the Merchant Shipping (Salvage and Wreck) Act 1993 the Director of the National Museum of Ireland has a statutory role regarding dealing with notifications from receivers of wreck or unclaimed wreck and the retention on behalf of the State of unclaimed wreck if it is of archaeological interest.

15.4.3 Policy context

Planning policy on renewable energy infrastructure is presented in volume 2A, chapter 2: Policy and Legislation. Planning policy, specifically in relation to marine archaeology is contained in the Offshore Renewable Energy Development Plan (OREDP) (Department of Communications, Energy and Natural Resources (DCNER), 2014), the National Marine Planning Framework (NMPF) (Department of Housing, Planning and Local Government (DHPLG), 2021) and the Louth County Development Plan (LCDP) 2021-2027. The OREDP, NMPF and LCDP include guidance on what matters are to be considered in the assessment. These are summarised in Table 15-1 to Table 15-3 below.

In February 2023, the 'OREDP II - National Spatial Strategy for the transition to the Enduring Regime' was published in draft and subject to consultation. The key objectives of OREDP II are:

- *"Assess the resource potential for ORE in Ireland's maritime area;*

- *Provide an evidence base to facilitate the future identification of Broad Areas most suitable for the sustainable deployment of ORE in Ireland's maritime area; and*
- *Identify critical gaps in marine data or knowledge and recommend prioritised actions to close these gaps".*

The OREDP II will provide an evidence base to facilitate the future identification of Broad Areas of Interest most suitable for the sustainable deployment of ORE in Ireland's maritime area, to be assessed in greater detail at regional scale. This assessment will subsequently inform the identification of more refined areas as part of the designation process for Designated Maritime Area Plans (DMAP).

When published, the OREDP II will update the original OREDP published in 2014.

Table 15-1: Summary of OREDP provisions relevant to marine archaeology.

Summary of OREDP – Suggested project level mitigation measures	How and where considered in the EIAR
Marine and Coastal Archaeology and Wrecks	
Direct disturbance of unknown and known sites: Conform to National Monuments Acts 1930-2004 and follow National Monuments Service (NMS) codes of practice; carry out seabed investigations prior to installation; avoid sites of interest and exclusion zones; submit any recovered artefacts to NMS; avoid protected and other sites of interest.	See volume 2A, chapter 4: Consideration of Alternatives regarding site selection. This chapter and the supporting technical appendix (appendix 15-1: Marine Archaeology Technical Report) conforms to National Monuments Act (NMA) legislation by considering the baseline conditions and significance of effect on known and potential marine archaeological receptors. These are identified in sections 15.7 and 15.10 of this chapter. There are no NMS codes of practice specific to offshore wind farm development. An initial programme of geophysical and geotechnical survey has been undertaken to support the EIAR Measures included in the Project are presented in section 15.8.2 and further referenced in section 15.10 and include proposals for Archaeological Exclusion Zones (AEZs) and avoiding sites of archaeological interest.
Changes to sediment regime: Conform to National Monuments Acts 1930-2004 and follow NMS codes of practice; carry out seabed investigations prior to installation in consultation with the Underwater Archaeology Unit of NMS; avoid sites of interest and exclusion zones; record and report potential archaeological and vessel remains to NMS.	
Data acquisition: Conform to National Monuments Acts 1930-2004 and follow NMS codes of practice; record and report potential archaeological and vessel remains to NMS.	

Table 15-2: Summary of NMPF provisions relevant to marine archaeology.

Summary of NMPF provision	How and where considered in the EIAR
Heritage Assets	
Proposals that demonstrate they will contribute to enhancing the significance of heritage assets will be supported. Proposals unable to contribute to enhancing the significance of heritage assets will only be supported if they demonstrate that they will avoid, minimise, or mitigate harm to the significance of heritage assets. If it is not possible to minimise or mitigate harm, then the public benefits for proceeding with the proposal must outweigh the harm to the significance of the heritage assets.	This chapter considers the baseline conditions and significance of effect on known and potential marine archaeological receptors. These are identified in sections 15.7 and 15.10 of this chapter. An initial programme of geophysical and geotechnical survey has been undertaken to support the EIAR and further seabed investigations will be undertaken as part of the measures included in the Project set out in section 15.8.2. Measures included in the Project are presented in section 15.8.2 and include proposals for Archaeological Exclusion Zones (AEZs) and avoiding sites of archaeological interest.

Table 15-3: Summary of LCDP provisions relevant to marine archaeology.

Summary of LCDP provision	How and where considered in the EIAR
BHC 1	
To protect archaeological sites and monuments, underwater archaeology, and archaeological objects, which are listed in	Measures included in the Project are presented in section 15.8.2. Where known underwater

Summary of LCDP provision	How and where considered in the EIAR
the Record of Monuments and Places and to seek their preservation in situ (or at a minimum, preservation by record) through the planning process and having regard to the advice and recommendations of the National Monuments Service of the Department of Housing, Local Government and Heritage and the principles set out in the 'Framework and Principles for the Protection of the Archaeological Heritage'.	archaeological assets are identified these will be preserved in situ or mitigated by preservation by record.

15.5 Consultation

Table 15-4 below summarises the issues identified during consultation activities undertaken to date, which are relevant to marine archaeology, together with how these issues have been considered in the preparation of this EIAR chapter. Volume 2A, chapter 6: Consultation provides details on the types of consultation activities undertaken for the Project between 2019 and 2024 and the consultees that were contacted.

Table 15-4: Summary of key issues raised during consultation on marine archaeology.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
October 2019	Historic Environment Division of Department of Agriculture, Environment and Rural Affairs in Northern Ireland – Email directly with Historic Environment Marine Advisor in Northern Ireland (NI).	Consultation response confirming transboundary impacts on marine archaeology in NI can be scoped out of the EIAR.	See section 15.12 on Transboundary effects.
February 2021	Underwater Archaeology Unit, National Monuments Service DHLGH – Telecon with the NMS	Approval of Marine Archaeology Study Area and approach to Baseline Methodology. Cultural Heritage chapter (including intertidal zone) and Marine Archaeology should be incorporated into a single EIAR chapter or set consecutively within the EIAR with a combined non-technical summary to ensure there is no gap in the assessment and the proposed mitigation strategy is consistent.	The EIAR is structured into separate volumes for onshore and offshore topics. However, this chapter signposts to volume 2C, chapter 26: Cultural Heritage for detailed assessment of the intertidal zone. A combined non-technical summary is provided on cultural heritage. Specialists for both assessments interacted to ensure no gaps.
November 2023	Underwater Archaeology Unit, National Monuments Service DHLGH – Teams meeting	Consultation on the introduction of the Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023 and approach to mitigation of marine archaeology receptors.	The application of the Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023 is discussed in section 15.4.2 and where relevant, throughout. The measures included in the Project to reduce the potential for impacts on marine archaeology are presented in section 15.8.2. and detailed fully in volume 2A, appendix 5-10: Marine Archaeological Management Plan.

15.6 Methodology to inform the baseline

15.6.1 Desktop study

Information on marine archaeology within the Marine Archaeology Study Area was collected through a detailed desktop review of existing studies and datasets.

The key sources (i.e. data and reports) used to inform the baseline characterisation of the Marine Archaeology Study Area are summarised in Table 15-5 below. These sources provide the most up-to-date data for this assessment.

The sources outlined were consulted for information related to the known and potential archaeological record in the Marine Archaeology Study Area. In addition, a range of secondary documentary sources were consulted to inform appendix 15-1: Marine Archaeology Technical Report which, in turn, informed this chapter. These are listed in the references section of appendix 15-1: Marine Archaeology Technical Report.

Table 15-5: Summary of data sources.

Title	Source	Year	Author
Wreck Viewer, Wreck Inventory of Ireland Database	National Monuments Service	2024	National Monuments Service
Historic Environment Viewer – Sites and Monuments Record database	National Monuments Service	2024	National Monuments Service
World Wide Wrecks and Obstructions	UK Hydrographic Office (UKHO)	2024	UKHO
INFOMAR – Integrated online mapping project	Geological Survey Ireland and Marine Institute	2024	Geological Survey Ireland and Marine Institute
Geological Survey Ireland Spatial Resources – Public Data Viewer	Geological Survey of Ireland	2024	Geological Survey of Ireland
Sediment characteristics within the offshore cable corridor	Chapter 7: Marine Processes	2023	RPS
Archaeological Assessment for Oriel Offshore Wind Farm Development North-western Irish Sea (Annex 1 of appendix 15-1: Marine Archaeology Technical Report)	N/A	2007	The Archaeological Diving Company Ltd (ADCO)
Underwater Archaeological Impact Assessment, Oriel Wind farm, Dundalk Bay and Dunany, Co. Louth (Annex 2 of appendix 15-1: Marine Archaeology Technical Report)	N/A	2021	ADCO
ADMIRALITY Marine Data Portal – UKHO Database	UKHO	2021	N/A

15.6.2 Site-specific surveys

In order to inform the EIAR, site-specific surveys were undertaken, following provision of a Foreshore Licence from the NMS's Underwater Archaeology Unit in the Department of Culture, Heritage and the Gaeltacht (DCHG). A summary of the surveys undertaken to inform the marine archaeology assessment is outlined in Table 15-6.

Table 15-6: Summary of site-specific survey data.

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Archaeological Assessment for Oriel Offshore Wind Farm Development North-western Irish Sea	Offshore wind farm area	Geophysical survey (side-scan sonar, magnetometry and multi-beam)	IMAR Survey Ltd and ADCO	2006	Annex 1 of the Marine Archaeology Technical Report (Appendix 15-1).
Archaeological Assessment of Geophysical Survey data	Offshore wind farm area and offshore cable corridor	Geophysical survey (side-scan sonar, magnetometry and multi-beam)	Ultrabeam Ltd for Alphamarine Survey Ltd and ADCO	2019	Annex 2 of the Marine Archaeology Technical Report (Appendix 15-1).
Archaeological Assessment of Geotechnical data	Offshore wind farm area and offshore cable corridor	Geotechnical Investigations - boreholes	Geoquip and ADCO	2019	Annex 2 of the Marine Archaeology Technical Report (Appendix 15-1).

A further geophysical survey of the offshore wind farm area and cable corridor was completed in 2022 and the data has been assessed by a suitably qualified archaeologist and will be forwarded to the NMS for review in 2024 (as required by the conditions of the Foreshore Licence). Any changes to the baseline will be subject to further consultation with the NMS and any mitigation will be discussed and agreed in advance of further geotechnical surveys and construction.

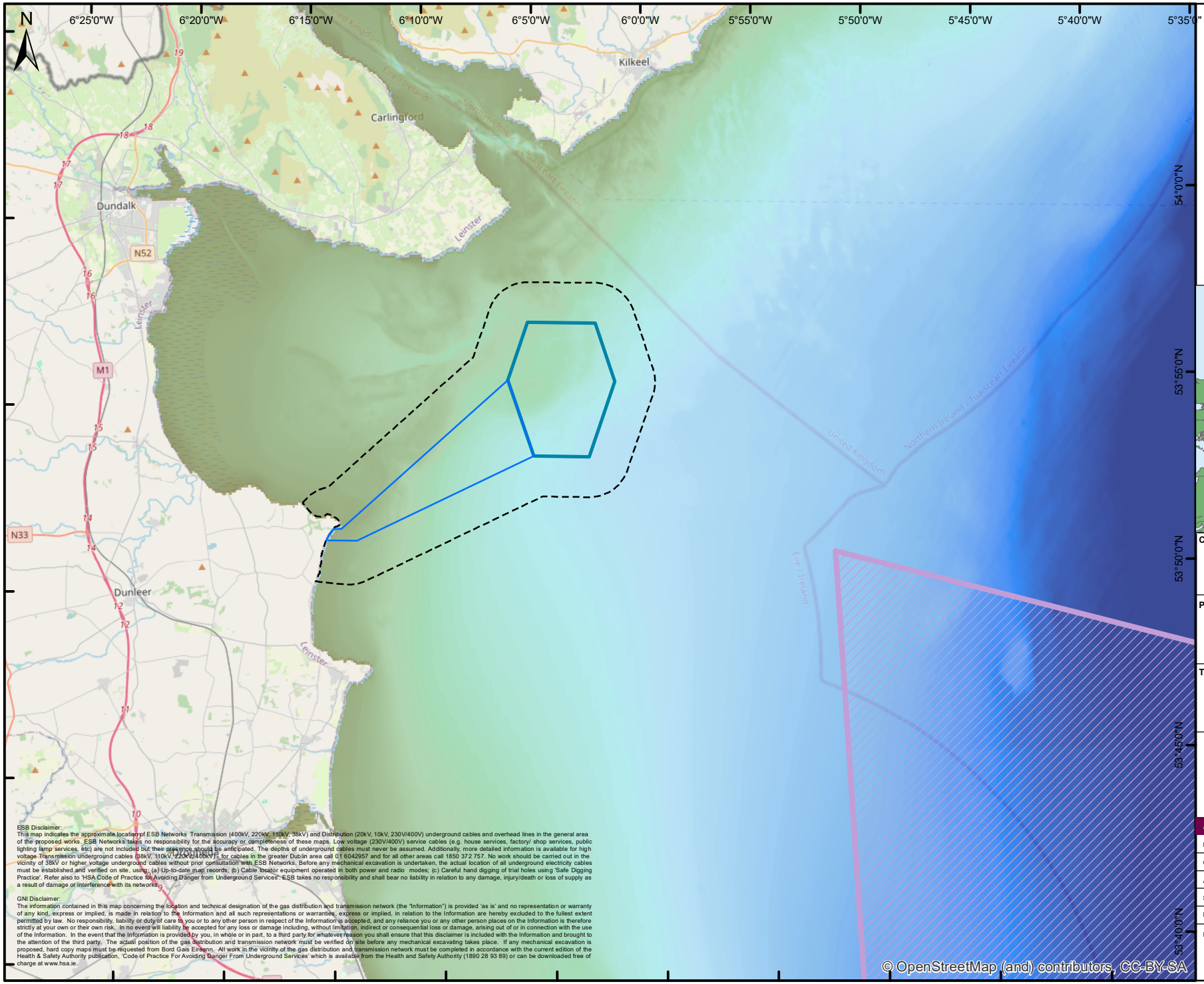
15.7 Subtidal baseline environment

15.7.1 Seabed topography

The Marine Archaeology Study Area occupies part of the Irish seabed which comprises shallow Quaternary deposits some distance from the Western Trough, identified as a potential former glacial lake (Flemming, 2005) (Figure 15-2, Figure 15-3). Pleistocene outcrops, infilled channels and ridges recorded in the Irish Sea suggest relict periglacial conditions during periods when the seabed was potentially exposed (Flemming, 2005). The Quaternary deposits comprise glacial tills, clay, pebbles and mud. Due to shallow waters and tidal currents much of the seabed is covered in recent sediment and gravel furrows from the Holocene as confirmed by the 2006 survey results (ADCO, 2007).

The side scan sonar survey undertaken within the offshore wind farm area in 2006 (ADCO, 2007) recorded the seabed as predominantly covered in sand and gravel. No significant areas of rock outcropping were identified, and the area was characterised as having soft sediment mobility. Sand ripples and gravel ripples were recorded and rock whilst recorded in places was not considered a predominant feature. This picture is in keeping with expectations as the offshore wind farm area lies to the east of the shallow and sediment-rich Dundalk Bay. The bathymetry surveys undertaken in 2006 and 2019 (ADCO, 2007, 2021) recorded three main seabed topographic types, presented in full in the Marine Archaeology Technical Report (appendix 15-1: Marine Archaeology Technical Report). Post-glacial seabed erosion has taken place to some extent across parts of the offshore wind farm area. Where greater depths of modern sediment survive, the greater the chance for preservation of former palaeolandscapes at significant depth.

The sediment characteristics within the offshore cable corridor have been obtained from chapter 7: Marine Processes. The Marine Archaeology Study Area lies within the western Irish Sea Mud Belt, a palaeo-glacial basin filled with marine Holocene sediment. While there is no indication of exposed bedrock, the seabed substrate within the Marine Archaeology Study Area includes a band of rocks and boulders on the north and eastern part of the offshore wind farm area while coarse sediments, sand and mud occupy much of the central area of the offshore wind farm area. Coarse sediments and mud also occupy much of the offshore cable corridor.



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Legend

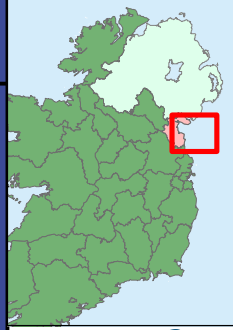
- Offshore Wind Farm Area
- Offshore Cable Corridor
- Marine Archaeology Study Area
- Glacial Lake

Bathymetry, depth in metres

High : 5

Low : -90

Data Sources: Client, EMODnet



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Project

Oriel Wind Farm Project

Title Figure 15-2

Marine Archaeology Study Area and predicted location of glacial lake.

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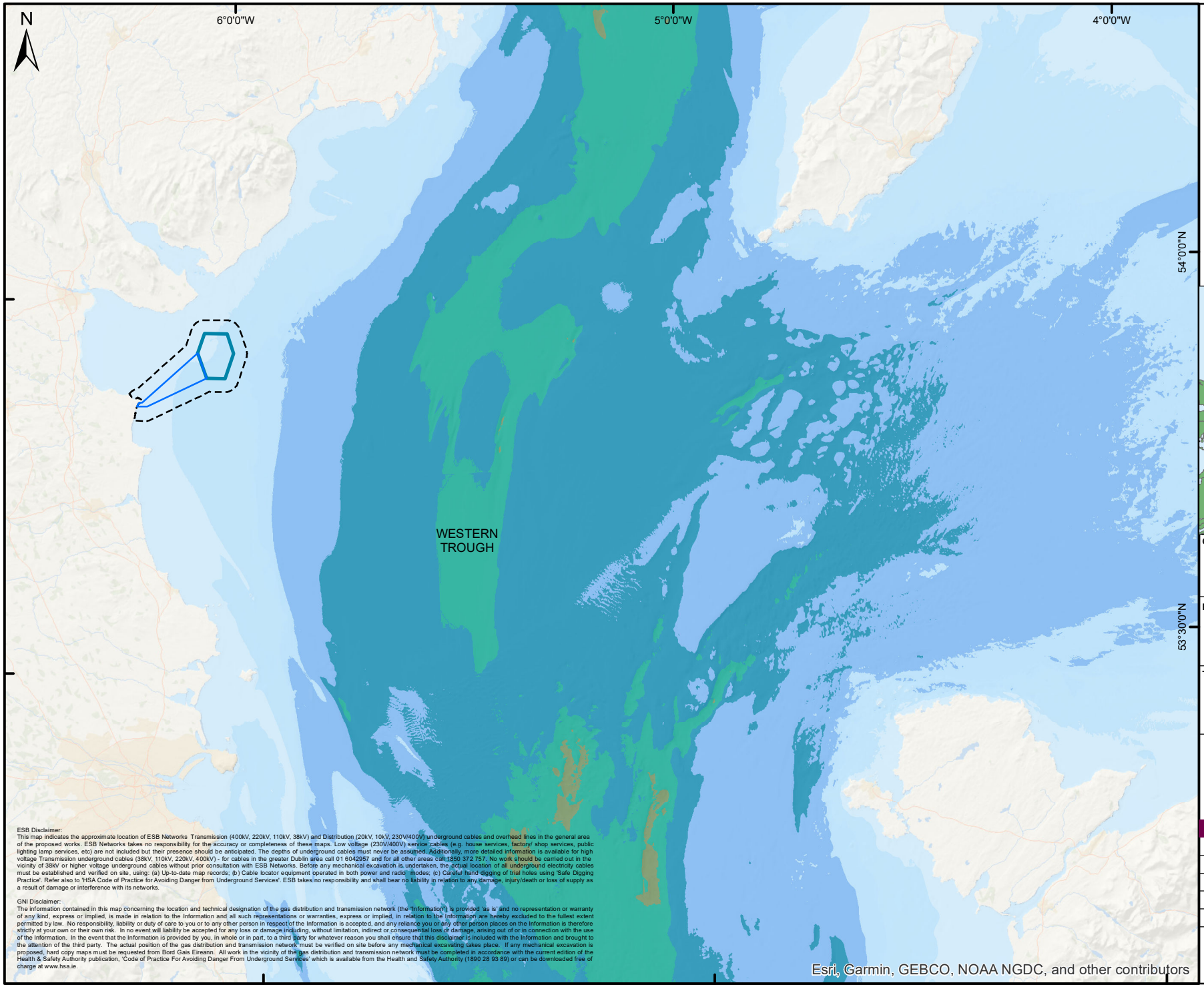


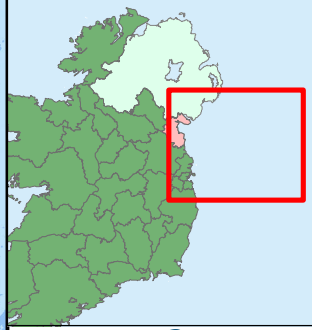
Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Marine Archaeology Study Area

Bathymetry, depth in metres

- 0-20
- 20-40
- 40-60
- 60-100
- 100-140
- >140

Data Sources: Client, EMODnet



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Project

Oriel Wind Farm Project

Title **Figure 15-3**
Location of Marine Archaeology Study Area in relation to main seabed topographic features

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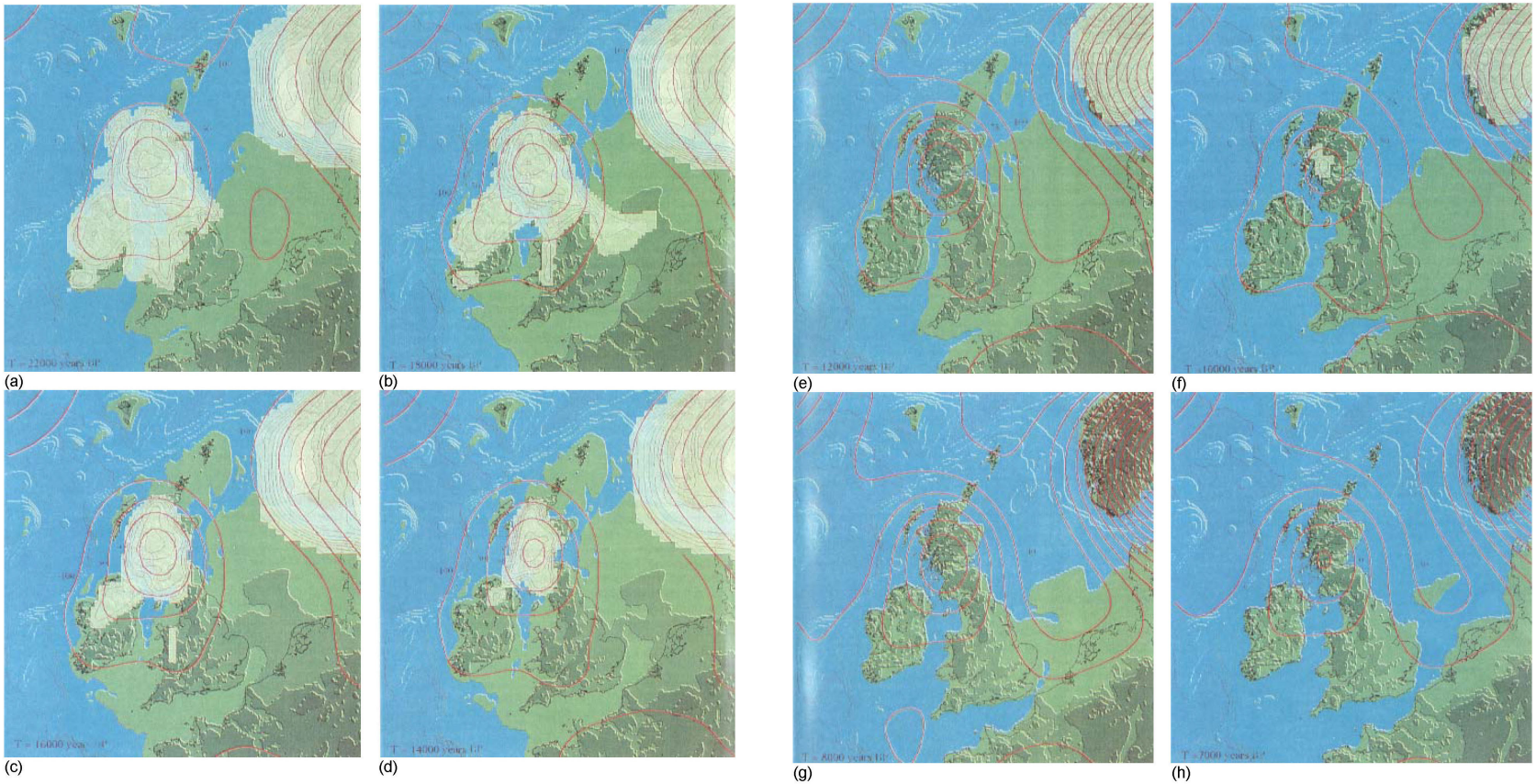
15.7.2 Submerged prehistoric archaeological potential

During the Pleistocene the Irish Sea most likely either formed dry land (inter-glacial) as part of the land mass that connected Ireland with Britain and mainland Europe or was covered in an ice sheet (glaciation). During periods of glaciation the seabed of the Irish Sea would have been uninhabitable but during inter-glacial periods there is a potential for periglacial occupation during periods when the seabed would have formed dry land. However, the effects of repeated glaciations, marine transgressions and associated fluvial activity mean that the potential for the survival of any archaeology from this period within the Marine Archaeology Study Area is unlikely.

The last glaciation, the Devensian (c. 20,000 BP), covered most of Ireland in ice, including the Marine Archaeology Study Area, although part of southwest Ireland remained ice free during this epoch. The subsequent phases of ice melt and the rise in sea level meant that by c. 18,000 BP the Western Trough appears as periglacial lake (Flemming, 2005; Figure 15-4). Considering the maps derived from analysis of sediment deposits on the seabed of the Irish Sea used by Flemming (Figure 15-4), the Marine Archaeology Study Area became free of ice c. 14,000 BP and formed dry land close to the shore of a possible glacial lake. By 12,000 BP sea level rose and inundated most of the Marine Archaeology Study Area apart from its western extent which was eventually submerged by c. 7,000 BP. As the Marine Archaeology Study Area was exposed as dry land it could have been occupied by hominids exploiting the shoreline of the glacial lake. As it was submerged there is a potential for early Mesolithic occupation of the still exposed shoreline in the western extent of the Marine Archaeology Study Area up until c. 7,000 BP. More recent studies (Westley and Henry, 2015) suggest that sea level rise following the retreat of the ice meant that by c. 16,000 BP Ireland was completely cut off from mainland Europe and Britain (Figure 15-4).

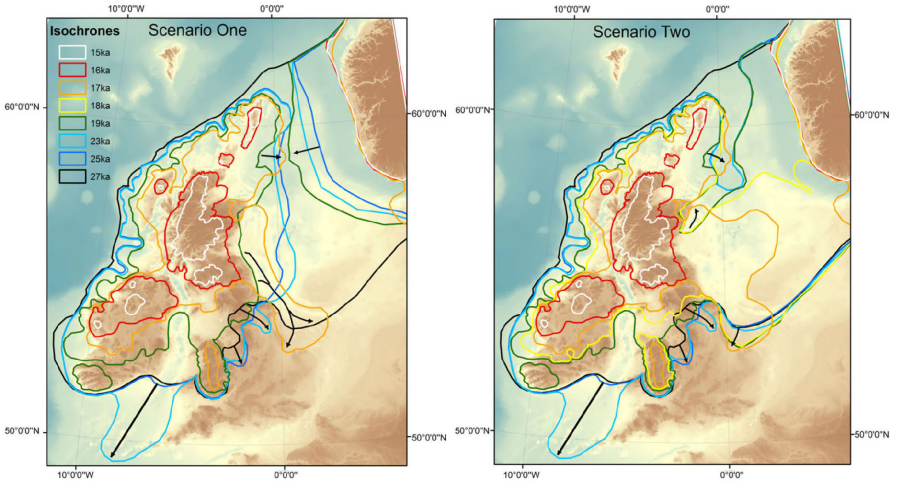
There is currently no evidence of human occupation of Ireland during the Palaeolithic (Wessex Archaeology, 2005). During the periods of glaciation most of Ireland would have been uninhabitable and therefore it is not surprising that evidence of Palaeolithic occupation is limited. Only two Palaeolithic artefacts are identified within the Irish record comprising a derived struck flint recovered from a gravel quarry in Co. Louth (Mitchell and Ryan, 1997) and a butchered bear patella dating to 10,500 BC found in a cave in Co. Clare (Dowd, 2016). However, given the number of Palaeolithic coastal sites in Britain there must have been periods when the Irish seabed was exposed, and Palaeolithic communities were potentially living and hunting along the shoreline of the potential glacial lake (Figure 15-4).

Generally, the Marine Archaeology Study Area lies in a sheltered area where prehistoric sites, or organic deposits and landscapes, if present, could be preserved. However, due to the level of erosion and the paucity of evidence, it is considered unlikely that evidence of Palaeolithic occupation will be found within the Marine Archaeology Study Area. The effects of repeated glaciations, marine transgressions and associated fluvial activity mean that the potential for the survival of any archaeology from this period within the Marine Archaeology Study Area is unlikely. However, if peat and organic muds are present close to the modern shoreline, there is a potential for geoarchaeological/paleoenvironmental evidence within the offshore cable corridor. In addition, where these sediments are present there is a good potential for organic preservation as confirmed by the discovery of a Mesolithic fish trap in County Dublin (McQuade and O'Donnell, 2007). The presence of Mesolithic occupation along the east coast of Ireland suggests that the potential for Mesolithic evidence within the western extent of the Marine Archaeology Study Area cannot be entirely ruled out.



Flemming 2005.
Isobase maps of predicted shorelines, shoreline locations and ice sheet limits fro selected epochs. (a) 22,000 years BP corresponding to the adopted time of maximum glaciation over the British Isles, (b) 18,00 years BP corresponding to the time of the onset of deglaciation of the lrage ice sheets, (c) 16,000 years BP, (d) 14,000 years BP, (e) 12,000 years BP, (f) 10,000 years BP, (g) 8,000 years BP, (h) 7,000 years BP. The maximum ice heights for these epochs are: 1,500m at the time of the glacial maximum at 22,000 years BP, 1,400m at 18,000 years BP, 1,300m at 16,000 years BP, 1,000m at 14,00 years BP and 400m at 10,000 years BP. Palaeowater depths are also indicated with contours at 50, 100, 150 and 200m. Isobase contour intervals are 50m for (a) to (d), 25m for (e) and (f) and 10m for (g) and (h). (After Lambeck, 1995).

Clark *et al* 2010.
Isochrone of ice retreat of the BIIS; succesive margin positionsin years ka BP. In Scenario One; *Early and complete break up of North Sea ice and a surge lobe down the east coast of England* we also recontruct the Tamen Readvance of Norwegian ice. Scenario Two; *Two-stage deglaciation of the North Sea with a persistent ice dome in the south*, adopts a more cautious view regarding the Tampen advance - it merely maintains its position. In both scenarios significant advances are marked with black arrows.



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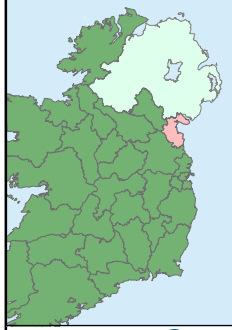

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ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project
Oriel Wind Farm Project

Title **Figure 15-4**

Maps showing potential retreat of ice sheet and rise in sea level.

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Issue Details

Drawn By: NA	**Project No.** EOR0822 (MDR1520B)
Checked By: KL	**File Ref:** EOR0822_MAR_T_1458_FINAL
Approved By: KL	
Scale: not to scale @ A4	**Projection:** -
Date: 28/02/2023	-

15.7.3 Maritime archaeology

Maritime archaeological sites and materials can be defined as the physical remains of boats and ships that have been wrecked, sunk or have foundered, aircraft losses and artefacts which rest upon the seabed as a result of being jettisoned or lost overboard (e.g. anchors, cannon, fishing gear). Records of known wreck sites and losses in Irish waters are biased towards the post-Medieval and Modern periods. The existence and survival of Palaeolithic watercraft are highly speculative in Ireland. However, during the Bronze and Iron Age sea-going vessels could have been lost.

The maritime archaeological record of the Marine Archaeology Study Area has been considered in terms of the following broad temporal phases.

Early Prehistoric (Palaeolithic to Mesolithic)

The potential for survival of evidence of early prehistoric maritime activity in Ireland is low and there is currently no known evidence of watercraft that pre-date the Mesolithic in Western Europe. The discovery of isolated Palaeolithic artefacts dating to a period when Ireland was cut off from Britain and Europe suggests that any occupation dating to this period may have been facilitated by sea travel perhaps using simple watercraft, log boats or rafts, used for coastal journeys and fishing (McGrail, 1987 and Dunkley 2016). However, no evidence of Palaeolithic seafaring craft is known from the Irish record.

Several sites have been identified along the east coast of Ireland. These largely comprise of shell midden sites, such as those discovered at Rockmarshall, Co. Louth and Sutton, Co. Dublin, and these were discovered with assemblages of worked flints. As Ireland had been cut off from Britain by this period, colonisation of Ireland would not have been possible without the use of sea craft (Smith, 1992). These will likely have been log rafts, simple skin boats or dugout canoes (McGrail, 1987, 2001).

Watercraft may have been used in the rivers and estuaries in Ireland, for coastal journeys, fishing expeditions and possibly longer journeys in favourable weather. They are likely to have become increasingly important to the Mesolithic inhabitants with rising sea levels. However due to the paucity of evidence and fluvial activity across the Marine Archaeology Study Area the potential for the survival of any archaeology associated with the maritime environment from the Mesolithic period is low.

Neolithic and Bronze Age

No evidence of Neolithic or Bronze Age maritime activity has been recorded in the Marine Archaeology Study Area. A small number of dugout canoes/log boats have been identified and recovered from coastal locations along the east coast of Ireland. These include two from Ballylig in Larne Lough, Co. Antrim (O'Sullivan and Breen, 2007) and the Greyabbey Bay log boat found in Co. Down. A further log boat was found at Gormanstown, County Meath under 2 m of sand during offshore trenching (Brady, 2002). This discovery confirmed the potential for offshore preservation as the site was 1 km from the shoreline. Based on the available evidence and professional judgement there is therefore a low to moderate potential for remains of such vessels to be present within the Marine Archaeology Study Area.

The Bronze Age was a period of technological innovation and of expansion of trade and exchange networks, facilitated by the introduction of new forms of boats both for ocean and coastal/riverine trade. Clear advances occurred in maritime technology during this period and an increasingly substantial maritime archaeological record allows a less speculative understanding of maritime culture than for earlier periods.

Iron Age and Roman

Seafaring and the spread of trade and ideas continued through these periods. A hoard of gold objects found in Broighter, Co Derry in 1896 contained a small model of a boat generally thought to be of a hide covered vessel and as such the earliest example of one found within Ireland (Breen and Forsythe, 2004) and would have been suitable for crossing the Irish Sea.

Although Ireland was never occupied by the Romans, the trade link in material culture between the Iron Age Irish and the Romans are evident along the east coast of Ireland. At Lambay Island, thought to potentially have been a trading port, a group of burials were discovered containing Roman brooches similar to those found in northern England during the first century AD, whilst a boat built in a distinctive Mediterranean technique was found in 1968 in County Westmeath (Farrell, 1989).

Together with the evidence for substantial commercial trade this suggests that Iron Age and Roman maritime traffic may have passed through the Marine Archaeology Study Area. It is also likely that many more vessels of this period were lost than the available archaeological evidence suggests, increasing the potential that remains from this period are present within the limits of the Marine Archaeology Study Area.

Early Medieval and Medieval

Records of known wreck sites and losses in Irish waters are biased towards the Post-Medieval and Modern periods. Most of the major towns and cities along the east Irish coast, including Dublin, were developed by the Danish and Norse Vikings who frequently navigated the Irish Sea. Remains of Viking vessels have been found in construction of waterfronts, quays etc in Dublin and other cities along the east coast. Log boats dating to this period have been found in lakes and rivers, but it is still possible that they could also be found in a maritime context.

The Anglo-Norman invasion of Ireland began in 1169 AD involving large numbers of seafaring vessels crossing the Irish Sea. By the middle of the 13th century, castles and the refortification of ports along the east coast ensured Norman control. This period saw an increase in population leading to an increase in trade. In addition, Ireland became involved in military campaigns such as providing men and supplies to support the 14th century English campaign against Scotland (McCaughan and Appleby, 1989).

The level of Medieval maritime activity suggests that the potential presence of Medieval period shipwrecks in the Marine Archaeology Study Area is moderate to good.

Post Medieval and Modern

The growth of commercial maritime travel beginning in the Late Medieval period continued and expanded in the Post-Medieval period. This resulted in an increase in importance of the Irish Sea as a major sea lane, both between Britain and Ireland and the length of the British and Irish Isles. In addition, military campaigns in the 18th century saw French attempts to invade Ireland and several vessels were lost off the east coast. This led to an almost permanent presence by the British Navy in Irish coastal waters.

The loss of shipping through wrecking starts to be recorded systematically after c. 1750, which represents the birth of pre-modern navigation. There are 172 historic wrecking events associated with Dundalk Bay, which is a significant number for a bay only 14 km long (between Cooley Point in the North and Dunany Point in the South) and 11 km wide. This includes 163 recorded wrecks whose specific locations are not known and nine known wreck-site locations, two of which occur within the proposed offshore cable corridor.

From the 18th century onwards, records were kept of ship losses, with records becoming more detailed from the 19th century. There are a number of recorded wrecking events attributed to a known topographic reference point (e.g. 53 events attributed broadly to Dundalk Bay), while 14 events are particular to Annagassan. In relation to the Project, it is to be noted that Dunany Point is the topographic location for 16 recorded shipwreck events. The Dunany reefs present a key navigation hazard in this area and the reefs are mentioned in several of the records for wrecking at Dunany (Annex 2 of appendix 15-1: Marine Archaeology Technical Report). There is one eighteenth-century loss, which is that of the *Mary Ann*; a vessel of New York that was *en route* to Liverpool with a cargo of rum, tobacco and slaves (W00209)[1]. The *Mary Ann* became stranded on a beach opposite the house of Robert Subthorpe. Almost a century later, in 1880, the *Parkside* was a wooden brigantine or brig of Whitehaven that weighed 132 tons (W00224)[1]. The *Parkside* was *en route* from Newport to Dundalk with six crew and a cargo of coal when the vessel became stranded in a southeast force 8 gale and was totally wrecked at Dunany. Additional identified wrecks include the *Empire of Peace* (W00149) a Liverpool Barque lost in 1881 located off the coast of Sea Bank and the *Topaz* (W00248), which was a three masted Glasgow Schooner lost in 1891. The wreck site of the *Topaz* is recorded to lie within the offshore cable corridor (Figure 15-5).

During the First World War, HMS *Cullist* (W00485), a 1.030-ton British decoy ship was torpedoed and sank approximately 24 miles off the coast of Clogherhead. During the First and Second World War, submarine activity was prevalent in the Irish Sea and the remains of a number of U boats have been found though none from within the Marine Archaeology Study Area.

[1] Please note these are recorded losses and therefore coordinates on their location are not available. As a result they are not shown on Figure 15-5.

The post-Medieval and modern periods present the greatest potential for unrecorded archaeology to be discovered. The increasing incorporation of metal structural elements into vessel designs during this period means that wrecks for the 19th and early 20th centuries are also often more visible on the seabed than their wooden predecessors. They are visible to bathymetric and geophysical survey, and also generate strong magnetic anomalies, and this greater visibility is reflected in the increased number of known wrecks (i.e. those that have been located on the seabed) for the period under discussion, in contrast to the periods discussed previously.

Summary

The archaeological potential by period and the likely value of any archaeological remains which may be present within the Marine Archaeology Study Area is summarised in Table 15-7. The value of a heritage asset is, in accordance with the National Monuments Act 1930, based on the historical, architectural, traditional, artistic or archaeological interest attached to it. The importance of archaeological receptors is therefore assessed by considering the receptor's age, type, rarity, survival, condition, fragility and vulnerability, group value, historical associations, scientific interest and community value.

Table 15-7: Summary of archaeological potential and value.

Receptor	Potential	Value
Submerged Prehistoric occupation	Low	National
Palaeoenvironmental/Geoarchaeological Evidence	Low to Moderate	Regional – National
Early Prehistoric Maritime Evidence	Low	National
Bronze Age Maritime Evidence	Low to Moderate	Regional – National
Iron Age – Roman Maritime Evidence	Low to Moderate	Regional – National
Early Medieval – Medieval Maritime Evidence	Moderate to Good	Regional – National
Post Medieval – Modern Maritime Evidence	Low to Moderate	Local – Regional – National

15.7.4 Desktop study

Data for known shipwrecks and recorded shipping losses within the Marine Archaeology Study Area were obtained as appropriate from the NMS Wreck Inventory of Ireland Database (WIID) and the site-specific surveys undertaken in 2006 and 2019 (Annexes 1 and 2 of appendix 15-1: Marine Archaeology Technical Report). These datasets provide a general picture of maritime casualties in the Marine Archaeology Study Area in the last 150 to 200 years but should not be viewed as representing the totality of even the more recent potential maritime archaeological remains in the area.

The desktop data obtained in 2024 does not contain any records of loss attributed to coordinates within the Marine Archaeology Study Area, but the wider area of Dundalk Bay has a high volume of recorded loss attributed to it.

Recorded losses represent maritime and aviation losses that are known to have occurred in the vicinity but to which no specific location can be attributed. Recorded losses are often grouped with reference to a geographic, hydrographic or other point of reference, making the positional data of these records unreliable. However, they do provide information on the historical marine traffic of the general region and therefore the archaeological potential. Recorded losses may be attributed to unknown anomalies identified by the geophysical survey or they may be positioned outside the Marine Archaeology Study Area.

The rocky environment of Dunany reefs presents a harsh seabed for the preservation of wreckage, particularly timber wreckage, where the shallow water depths and the exposed nature of the reefs would ensure that any vessel running aground there would be broken up quickly or would be pushed off the reefs into calmer waters.

15.7.4.1 National Monuments Service

There are 17 records held by the NMS attributed to positions within the Marine Archaeology Study Area, 13 of these relate to geophysical anomalies that were identified in the 2006 geophysical survey. All of these were archaeologically assessed as geological at the time (see Annex 2 of appendix 15-1: Marine Archaeology Technical Report).

Of the four remaining records, two relate to wreck sites and one to a possible wreck site. The final record (W11435) states "*We regret that we are unable to supply descriptive details for this record at present*" and therefore no further information is known about this entry.

The two wreck sites are records of the *Topaz* (W00248) and an unidentified wreck site (W00276) (Figure 15-5). The *Topaz* was a Glasgow registered iron steamship lost in 1891. The ship weighed 168/353 tons and measured 161 feet long and was *en route* from Workington to Dundalk, carrying a cargo of steel rails, with a crew of nine when it was lost in a west-southwest force 4 wind. The record reports that she struck a reef, drifted into deeper water and sank. The reef must have been Dunany reef. The crew took to their lifeboat and landed at Greenore, Co. Louth. The ship and cargo were insured, so Lloyds employed a diver called Rigden/Rizdon to salvage the steel rails during 1892–1893. The rails, engines and working gear were removed. The vessel's masts were also removed, and the area was buoyed. In 1977 the hull was still almost intact. The boiler and stern stand almost 3 m high off the seabed and the greatest depth recorded was 23 m. Wreck W00276 (Figure 15-5) was also identified to the south of this site and is simply recorded as an unidentified wreck beside that of *Topaz*. The charted position places W00276 350 m south-southeast of *Topaz*. In addition, a possible wreck (W00529) was identified during the Irish National Seabed Survey, located 860 m southeast of the offshore wind farm area.

The final record relates to that of a possible wreck site (W00529) that was identified during a National Seabed Survey and is described as being 5 m long, 2 m wide with a height of 3 m off the seabed. It lies in a general sea depth of 29 m and is located within the Marine Archaeology Study Area, approximately 850 m southeast of the offshore wind farm area.

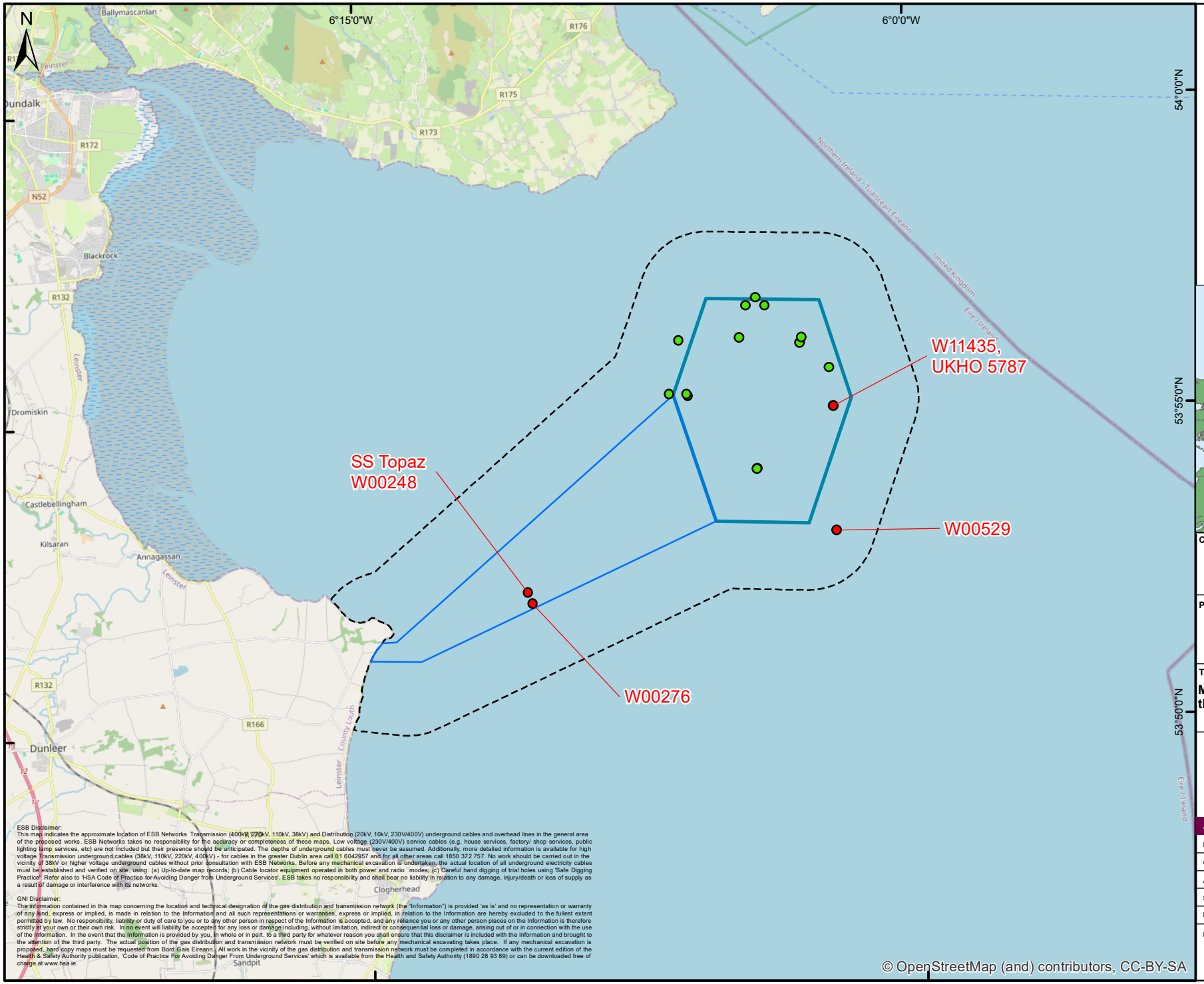
Geophysical survey data collected in 2019 has not identified material at the locations of these three sites, however both the Topaz and W00276 are located in muddy sediments and therefore there remains the possibility that they are buried, and that material of archaeological significance exists at these locations.

15.7.4.2 INFOMAR

INFOMAR hold only one record within the Marine Archaeology Study Area, ID295 which records the wreck of the *Topaz*, as described in section 15.7.4.1.

15.7.4.3 UKHO

The UKHO hold three records within the Marine Archaeology Study Area, all three are recorded as live. One record (UKHO 5762) represents the foundation block for the Oriel anemometer mast and, as such, is not archaeological in nature. UKHO 5867 relates to the wreck of the *Topaz*. The final record, UKHO 5787, was recorded in 2003 as both wreck and notable debris measuring 5m in length. UKHO 5787 corresponds with the recorded position of NMS record W11435 and therefore suggest that material may be present at this location. The 2019 geophysical surveys did not identify material at this location, and no further information that may indicate the origin of this debris is known, however, it is possible that archaeological material may be buried in the soft sediment.



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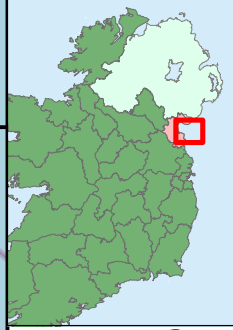
Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Marine Archaeology Study Area
- Desktop Data
- Geological Anomalies

Data Sources: Client



Client
ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project
Oriel Wind Farm Project

Title
Figure 15-5
Marine archaeology identified within the desktop records

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Issue Details

Drawn By: NG	**Project No.** EOR0822 (MDR1520B)
Checked By: NG	**File Ref:** EOR0822_MAR_T_1463_FINAL
Approved By: AOS	
Scale: 1:150,000 @ A4	**Projection:** ITM (IRENET95)
Date: 15/03/2024	Geographic Co-ordinates: ETRS89

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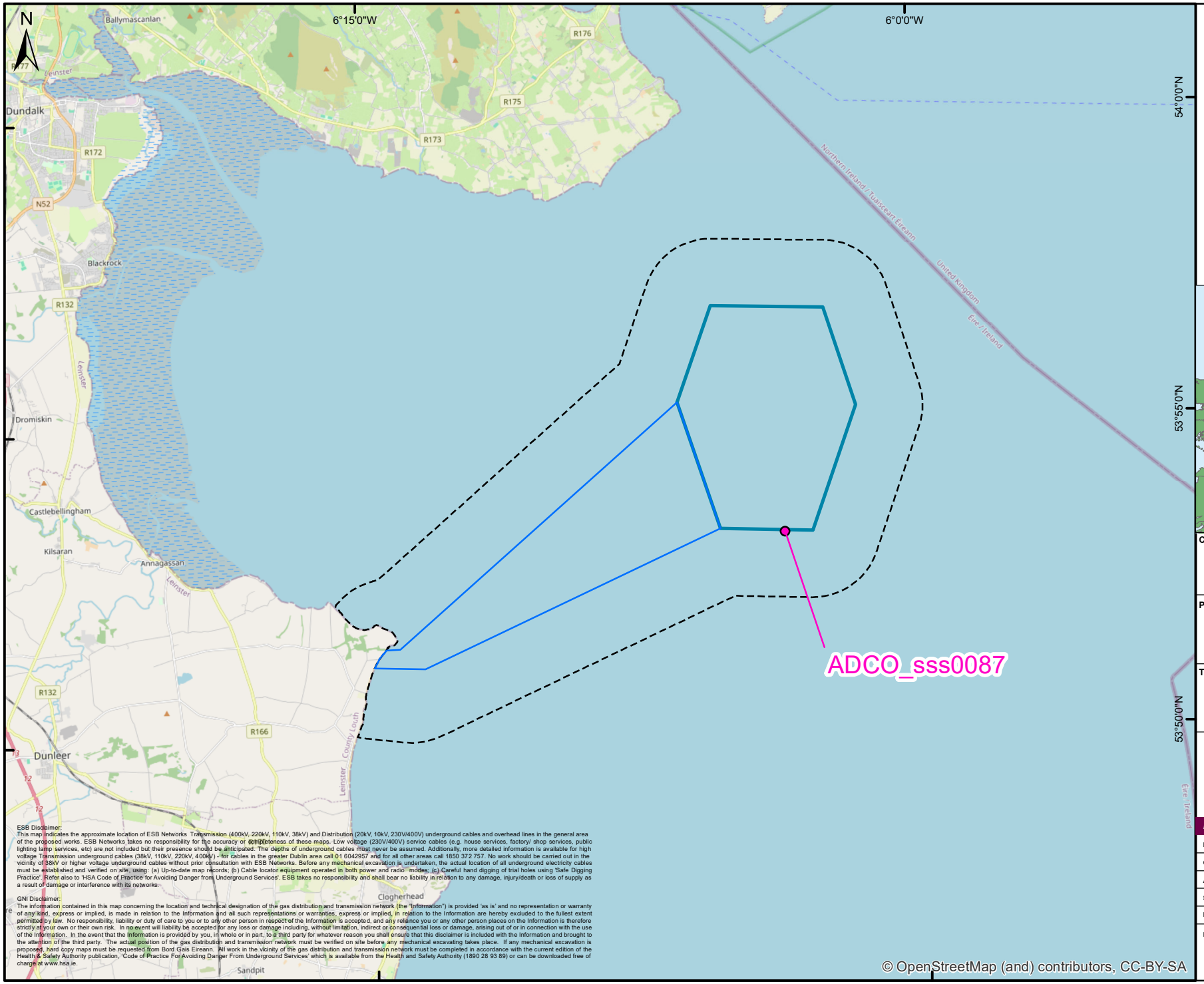
15.7.5 Geophysical survey

A number of geophysical anomalies were identified during the 2006 survey within the offshore wind farm area (Annex 1 of appendix 15-1: Marine Archaeology Technical Report), which have since been classified as Wreck Sites on the WIID (W111145-W11157 and W11435). This comprised 14 sites, 11 of which lie within the offshore wind farm area and three of which lie close to the offshore wind farm area boundary. However, the report that identified those features concluded that they are 'probably not archaeological in nature' (Annex 1 of appendix 15-1: Marine Archaeology Technical Report). The features identified comprise isolated rock or boulders (W11148, W11149, W11150, W11154) SS1-3, 8) and concentrations of cobbles or other possible snag points (W11144, W11145, W11146, W11147, W11148, W11153, W11155, W11156, W11157). The 2006 data had one instance of correspondence of the snag point with the magnetometer data (W11144) suggesting that this feature was manmade in origin (Annex 2 of appendix 15-1: Marine Archaeology Technical Report). W11144 is located outside the Project area. All anomalies identified during the 2006 survey will be avoided in the final design plan.

The results of the 2019 geophysical surveys included the identification of 88 side-scan sonar targets, 87 of which were interpreted as boulder/s by Ultramarine (ADCO, 2021). Archaeological assessment of the side scan sonar data undertaken by ADCO corroborated these findings. As these have no archaeological potential they will not be considered in this report. The locations of the contacts will be shared with Oriel Wind Farm Limited for operational awareness and included in the Archaeological Management Plan (ADCO, 2021).

The one contact that may be anthropogenic in nature (SSS_0087) has been interpreted as a single item of debris measuring 3.3 m in length and registered a slight magnetometry reading, suggesting a content of ferrous metal. The feature is located on the southern border of the offshore wind farm area and does not correspond to any desktop records (Figure 15-6).

A further geophysical survey of the offshore wind farm area and cable corridor was completed in 2022 and the data has been assessed by a suitably qualified archaeologist and will be forwarded to the NMS for review in 2024 (as required by the conditions of the Foreshore Licence). Any changes to the baseline will be subject to further consultation with the NMS and any mitigation will be discussed and agreed in advance of further geotechnical surveys and construction.



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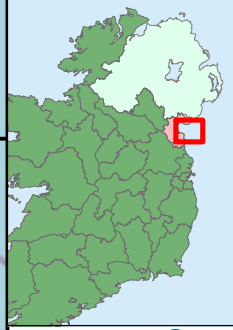
Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- SSS Target
- Marine Archaeology Study Area

Data Sources: Client



Client
ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project
Oriel Wind Farm Project

Title
Figure 15-6
Marine archaeology identified through the 2019 geophysical survey.

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Issue Details

Drawn By:	NG	**Project No.**	EOR0822 (MDR1520B)
Checked By:	NG	**File Ref:**	EOR0822_MAR_T_1464_FINAL
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Scale:	1:150,000 @A4	**Projection:**	ITM (IRENET95)
Date:	12/03/2024		Geographic Co-ordinates: ETRS89

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15.7.6 Geotechnical investigations

A programme of geotechnical investigations was conducted in 2019, including seven boreholes within the proposed offshore wind farm area and six boreholes within the proposed offshore cable corridor.

None of the borehole logs report the observation of anthropogenic features such as timber, metal or ceramic, and none record peat or related organic strata that might indicate the presence of submerged palaeo-landscapes.

In conclusion the results of the geotechnical investigations undertaken to date suggest that the potential for submerged palaeo-landscapes within the limits of the Marine Archaeology Study Area is low.

15.7.7 Future baseline scenario

The European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (hereafter the EIA Regulations 2018) require that "*a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*" is included within the EIAR.

In the event that the Project is not constructed, an assessment of the future baseline conditions has been carried out and is described below.

The Marine Archaeology Study Area lies in an area where there is vessel activity (see chapter 13: Shipping and Navigation) and consequently there is a potential for future loss of vessels at sea caused by weather, sea change and collision with other vessels. With the continual natural fluvial movement of the seabed there is also the potential for undocumented and buried wreck sites to become visible and currently visible wreck sites to become buried by the sediment. Should shifting sediments cause previously unidentified marine archaeology to become exposed, it is expected that this will degrade naturally over time.

15.7.8 Data validity and limitations

The data sources used in this chapter are detailed in Table 15-5 above. The data used are the most up to date publicly available information which can be obtained from the applicable data sources as cited. The data are therefore limited by what is available and by what has been made available, at the time of writing the EIAR.

No data limitations have been expressed in the 2021 ADCO assessment nor has any been identified as part of the assessment included in this EIAR. It is therefore considered that the data employed in this assessment are robust and sufficient for the purposes of the impact assessment.

15.8 Key parameters for assessment

15.8.1 Project design parameters

The project description is provided in volume 2A, chapter 5: Project Description. Table 15-8 outlines the project design parameters that have been used to inform the assessment of potential impacts of the construction, operation and maintenance and decommissioning phases of the Project on marine archaeology.

Due to the potential for unexpected ground conditions and obstructions, the final route and length of the offshore export cable and offshore inter array cables will be confirmed during construction (see design flexibility details in chapter 5: Project Description (volume 2A). For the purposes of the assessment presented in section 15.10, the maximum length of cables has been considered to ensure the potential for maximum impact is assessed. Should the lengths of cables be less than those specified (e.g. 15 km of offshore cable is constructed), then the potential for effects will be the same (or slightly less) than those outlined in the assessment in section 15.10. An alternative route within the offshore wind farm area or offshore cable corridor could lead to potential changes in the assessment presented in section 15.10, however measures (including implementation of Archaeological Exclusion Zones (AEZs)) are proposed in section 15.8.2 to avoid impacts on archaeology.

Table 15-8: Project design parameters considered for the assessment of potential impacts on marine archaeology.

Potential impact	Phase[1]			Project design parameters	Justification
	C	O	D		
Removal or disturbance of seabed sediments leading to effects on prehistoric land surfaces, wreck sites and artefacts	✓	✓	✓	**Construction Phase** 1,041,621 m^2 of seabed disturbance (including temporary disturbance as well as permanent footprint and scour and cable protection) due to: • Sand wave clearance for 10% of inter-array cables and 10% of offshore cable: total area disturbed: 85,500 m^2; • Use of jack-up vessel during foundation installation, with two jack-up events per Wind Turbine Generator (WTG) and four jack-up events for the offshore substation (OSS) - total area disturbed: 54,000 m^2; • Installation of 41 km inter-array cables - total area disturbed: 410,000 m^2; (and total cable protection footprint: 205,000 m^2); • Installation of 16 km offshore cable with seabed disturbance width of 10 m; total area of seabed disturbance for offshore cable corridor: 160,000 m^2 (and total cable protection footprint for offshore cable corridor: 80,000 m^2); and • Seabed footprint due to installation of 25 WTG monopile foundations and scour protection and one OSS foundation and scour protection - Total seabed footprint including scour protection is: 47,121 m^2. 297,000 m^3 sediment removed due to: • Seabed preparation activities (sand wave clearance) for 26 (i.e. 25 x WTGs + 1 x OSS) monopile foundations and offshore cable corridor, 38,000 m^3; • Installation of 41 km inter-array cables with trench width 1 m and burial depth of 3 m, 123,000 m^3; and • 16 km offshore cable corridor with trench width 3 m for the offshore cable and burial depth of 3 m for each, 144,000 m^3. Installation duration of 15 months. **Operational and Maintenance Phase** 387,000 m^2 of seabed disturbance due to: • Component replacement activities using jack-up vessel associated with 25 WTGs (average of two major component replacements per year); • Inter-array cables: seven repair events and seven reburial events over the lifetime of the Project; and • Offshore cable: three subtidal repair events and three subtidal reburial events over the lifetime of the Project. Operational phase of 40 years. **Decommissioning Phase** Parameters for seabed disturbance are assumed to be the same as for the construction phase but	The greatest area and volume of near-surface sediments affected leading to the greatest potential for effects on prehistoric land surfaces, wreck sites and artefacts.

Potential impact	Phase[1] C	O	D	Project design parameters	Justification
				without the seabed preparation activities for monopile foundations.	
Removal or disturbance of deeply buried sediments leading to effects on prehistoric land surfaces	✓	✗	✗	**Construction Phase** 26 (i.e. 25 x WTG and 1 x OSS) monopile foundations (9.6 m diameter, 35 m depth).	Monopile foundations have a penetration depth of 35 m, leading to potential for direct impacts to more deeply buried prehistoric land surfaces.
Disturbance of sediment causing sediment deposition on the seabed resulting in potential effects on archaeological receptors	✓	✓	✓	**Construction Phase** WTGs and OSS installed on monopile foundations: • Drilled installation of 9.6 m diameter pile. • Installation of inter-array and offshore cables: • Disturbance of seabed material a 1 m wide trench for inter-array cables, 3 m wide trench for offshore cable and 3 m deep trench; and • Modelled cable lengths over areas of sand and muddy sand. Installation duration of 15 months. **Operational and Maintenance Phase** Cable repair/reburial activities: • Inter-array cables: seven repair events and seven reburial events; and • Offshore cable: three repair events and three reburial events (three subtidal and three intertidal). Operational phase of 40 years. **Decommissioning Phase** WTGs and (OSS) on monopile foundations: • Cutting and removal of monopile foundations to approximately 2 m below seabed. Removal of inter-array and offshore cables: • Disturbance of seabed material from a 1 m wide and 3 m deep trench for the inter-array cables and 3 m wide and 3 m deep trench for the offshore cable.	Greatest volume of sediment released into the water column and associated sediment deposition has the largest potential to impact upon, and subsequently affect archaeological assets. See chapter 7: Marine Processes for further justification.
Alteration of sediment transport regimes.	✗	✓	✗	**Operational and Maintenance Phase** WTGs and OSS installed on monopile foundations: • Presence of 25 WTG foundations and 1 OSS foundation of 9.6 m diameter throughout the water column; • Minimum spacing 944 m; • Inclusion of scour protection for each foundation with a radius of 24 m *(from the centre of the foundations)*; and • Operational phase of 40 years.	The scour protection was defined as the largest dimension described within volume 2A, chapter 5: Project Description, i.e. extending 19.2 m beyond the monopile structure.

1. C= Construction, O = Operation, D = Decommissioning

15.8.2 Measures included in the Project

As part of the project design process, a number of measures were included in the Project to reduce the potential for impacts on marine archaeology (see Table 15-9). These measures include designed-in and

management measures (controls). As there is a commitment to implementing these measures, they are considered inherently part of the design of the Project and have therefore been considered in the assessment presented in section 15.8.3 (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

The measures included in the Project are subject to the approval of the National Monuments Service.

Table 15-9: Measures included in the Project.

Measures included in the Project	Justification
An archaeologist(s) experienced in maritime archaeology will be retained for the duration of the relevant works in all phases of the Project to provide onboard archaeological monitoring where required. The following measures will be implemented to allow monitoring of the activities: • The timescale for the construction phase works will be made available to the archaeologist, with information on where and when ground and seabed disturbances will take place. • Where appropriate the archaeologist will carry out watching briefs of work. • It is essential that the Applicant gives sufficient notice to the archaeologist/s in advance of the construction phase works commencing. This will allow for prompt arrival on site to resolve further survey work, and to monitor ground and seabed disturbances. As often happens, intervals may occur during the construction phase. In this case, it is also necessary to inform the archaeologist(s) as to when seabed disturbance works will recommence. • Archaeological monitoring will be licensed by the Department of Housing, Local Government and Heritage and licences must be applied for and granted before site works commence. Licence applications take four weeks to be processed once received by the Department. Sufficient lead-time must be allowed for the project programme to facilitate such work (recommended lead-times of not less than eight weeks). • In the event of archaeological features or material being uncovered during the construction phase, it is crucial that any machine work cease in the immediate area to allow the archaeologist/s to inspect any such material. Once the presence of archaeologically significant material is established, full archaeological recording of such material is recommended. If it is not possible for the construction works to avoid the material, full excavation would be recommended. The extent and duration of excavation will be a matter for discussion between the Applicant and the licensing authorities. • The Applicant will maintain a core of a suitable archaeological team / archaeological dive-team be on standby during all phases of the Project to deal with any such rescue excavation. Secure facilities will be provided on or near sites where further investigation is required along with buoying of any such area. • The Applicant will maintain adequate funds to cover further survey, excavation, post-excavation analysis, and any testing or conservation work required should be made available. • All vessel traffic will be restricted as to avoid any of the selected sites and their environs.	To provide archaeological monitoring where activities have potential to disturb the seabed. To record archaeological remains that may be affected by pre-construction operations. All works to be undertaken with necessary licences from the NMS.

Measures included in the Project	Justification
Spoil will not be dumped on any of the selected sites or their environs. The National Museum of Ireland (NMI) Advice notes for completing an application form for a Licence to Alter/Export an archaeological object April 2022 will be followed should archaeological objects require exportation. Protocols will be included in the Marine AMP for such events.	
An archaeologist(s) experienced in maritime archaeology to be consulted in the preparation of any pre-construction ROV/diver surveys and, if appropriate, in monitoring/checking of data.	To avoid impacts on unrecognised archaeological sites and/or to improve understanding of identified sites of potential archaeological importance. All works to be undertaken with necessary licences from the NMS.
The identification and implementation of Archaeological Exclusion Zones (AEZs) around sites identified as having a known important archaeological potential. No construction activities are proposed to take place within AEZs. In the unlikely event that avoidance is not possible, such work can only proceed within AEZs with the permission of the NMS and will be subject to any additional requirements that the NMS will impose. It is proposed that marine geophysical survey comprising high frequency sidescan sonar and magnetometry survey is conducted at the two known shipwreck locations W00248 (*Topaz*) and W00276 (unnamed), the sss087 to provide additional information on each wreck site that allows for the accurate positioning and mapping of each site. Such survey may be supported by an integrated multi-beam bathymetry survey and sub-bottom profile survey, and by archaeological dive inspection. An Archaeological Exclusion Zone (AEZ) measuring 100 m in radius from the centre-point of each site will be identified for both locations, within which no intrusive work should take place. The exclusion zone will protect each site from indirect impacts associated with anchor placement, side-casting of cable trench risings and related activities. The side scan sonar features recorded from the 2006 survey data will also be subject to further survey and if wreckage potential is indicated, then the sites will be protected from impacts by establishing AEZs around each location.	AEZs are required in order to avoid the potential for direct impacts on, and therefore preserve sites of identified archaeological importance, as directed by the National Monuments Act.
All anomalies of unconfirmed archaeological potential to be taken into account during final design and avoided where possible. If they are likely to be impacted, these anomalies would undergo further archaeological investigation. Should these anomalies prove to be of archaeological importance then future AEZs or temporary AEZs (TAEZs) may be implemented following consultation with NMS.	To avoid the potential for direct impacts on sites of archaeological importance.
Provision of a Marine Archaeological Management Plan (see volume 2A, appendix 5-10: Marine Archaeological Management Plan). The Marine Archaeological Management Plan will inform the construction, operational and maintenance and decommissioning phases of the Project. The Plan will facilitate the recording and reporting of any archaeological material discovered during installation and maintenance works. The Plan will address protocols for the archaeological review and assessment of target features that cannot be avoided by construction activities, and that include ROV and/or archaeological diver inspection and preservation by record. Preservation by record is the last resort once all other options have been considered The Plan	To enable the protection and, if necessary, recording of any sites/objects of archaeological significance identified during the course of the development. All works to be undertaken with necessary licences from the NMS.

Measures included in the Project	Justification
will also address archaeological monitoring protocols required for seabed disturbance activities that will take place across the offshore wind farm area and offshore cable corridor.	
The Applicant will retain all cores of anthropogenic material, lithics to allow for archaeological assessment (e.g. carbon dating) and protocols will be included in the Marine AMP for such assessments, details of which will be agreed with the NMS in advance of construction. All required licences will be in place prior to such activities taking place.	In view of the potential for the presence of palaeo-landscapes.
Commitment to the ongoing monitoring of known archaeological receptors through the acquisition of relevant spatial survey data. This monitoring will include the appropriateness of, and adjustments that need to be made to, AEZs through the lifetime of the Project.	Changes to marine archaeology receptors during the lifetime of offshore wind projects are not well known. Industry guidance (Wessex Archaeology 2007) suggests that monitoring methods, set out in the Marine Archaeological Management Plan, may include periodic reporting on adherence to exclusion zones and the results of watching briefs. Periodic reporting will provide a potential beneficial effect through regional mapping of accessible data and provision of publicly accessible data post-consent (described but currently not quantifiable).
Mitigation of unavoidable direct impacts on known sites of archaeological importance. Options include (i) preservation by record and (ii) stabilisation.	To offset the effects of disturbance/destruction of irreplaceable archaeological remains. This work will be undertaken in accordance with necessary licences from the NMS.
Implement the measures included in the 'Framework and Principles for the Protection of the Archaeological Heritage' (Department of Arts, Heritage, Gaeltacht and the Islands, 1999) and any future guidance that is published by the relevant Department.	To enable the protection and, if necessary, recording of any sites/objects of archaeological significance identified during the course of the development. All works to be undertaken with necessary licences from the NMS.

Best practice favours the preservation in situ of archaeological remains, therefore the ideal mitigation for archaeological remains is avoidance. Currently, four sites have been identified to have the potential for archaeological material present. These include: the two wrecks recorded in the desktop data (the *Topaz* (W00248) and an unidentified wreck (W00276)), a live UKHO record that corresponds with the recorded position of an NMS record (UKHO 5787 and W11435) and is described as a wreck measuring 5 m in length (Figure 15-7), and the piece of debris identified through the 2019 geophysical surveys (Figure 15-6). A 100 m AEZ is proposed around each site based on professional judgement to avoid the potential for any impacts during the construction, operational and maintenance and decommissioning phases (Figure 15-7). Details are given in in Table 15-10.

The appropriateness and effectiveness of the AEZs and condition of the archaeological assets will be monitored through the acquisition of survey data during the lifetime of the Project. Data relating to the marine archaeology assets will be archived with NMS at the outset of the Project and as it is collected through its lifetime.

Table 15-10: Proposed AEZs within the Project.

ID	Description	Latitude	Longitude	Easting	Northing	AEZ (m)
W00248	The recorded location of the *Topaz*.	53.8702	-6.1764	-	-	100
W00276	Recorded location of an unnamed wreck site identified in the desktop data.	53.86722	-6.17444	-	-	100
W11435	Corresponds with live UKHO record 5867 and is described as a	53.91814	-6.03577	-	-	100

ID	Description	Latitude	Longitude	Easting	Northing	AEZ (m)
	wreck measuring 5m in length.					
sss087	a piece of debris that measures 3.3 m in length	-	-	693154	5974937	100

Thirteen anomalies have been identified from the 2006 geophysical survey to lie within the Marine Archaeology Study Area, although their signatures were not clear enough to identify what they represent. In order to facilitate the design of the Project, AEZs are not proposed for these anomalies. However, as a precautionary approach, the final project design has avoided these features. The locations of these anomalies are also included in volume 2A, appendix 5-10: Marine Archaeological Management Plan for operational awareness. It was considered by the archaeological assessments of geophysical and geotechnical surveys (ADCO 2007 (Annex 1 of appendix 15-1: Marine Archaeology Technical Report) and ADCO 2021 (Annex 2 of appendix 15-1: Marine Archaeology Technical Report) that the geophysical anomalies are likely to be natural in origin (e.g. boulders, seabed features). However, further surveys are proposed to confirm the anomalies as outlined in Table 15-9.

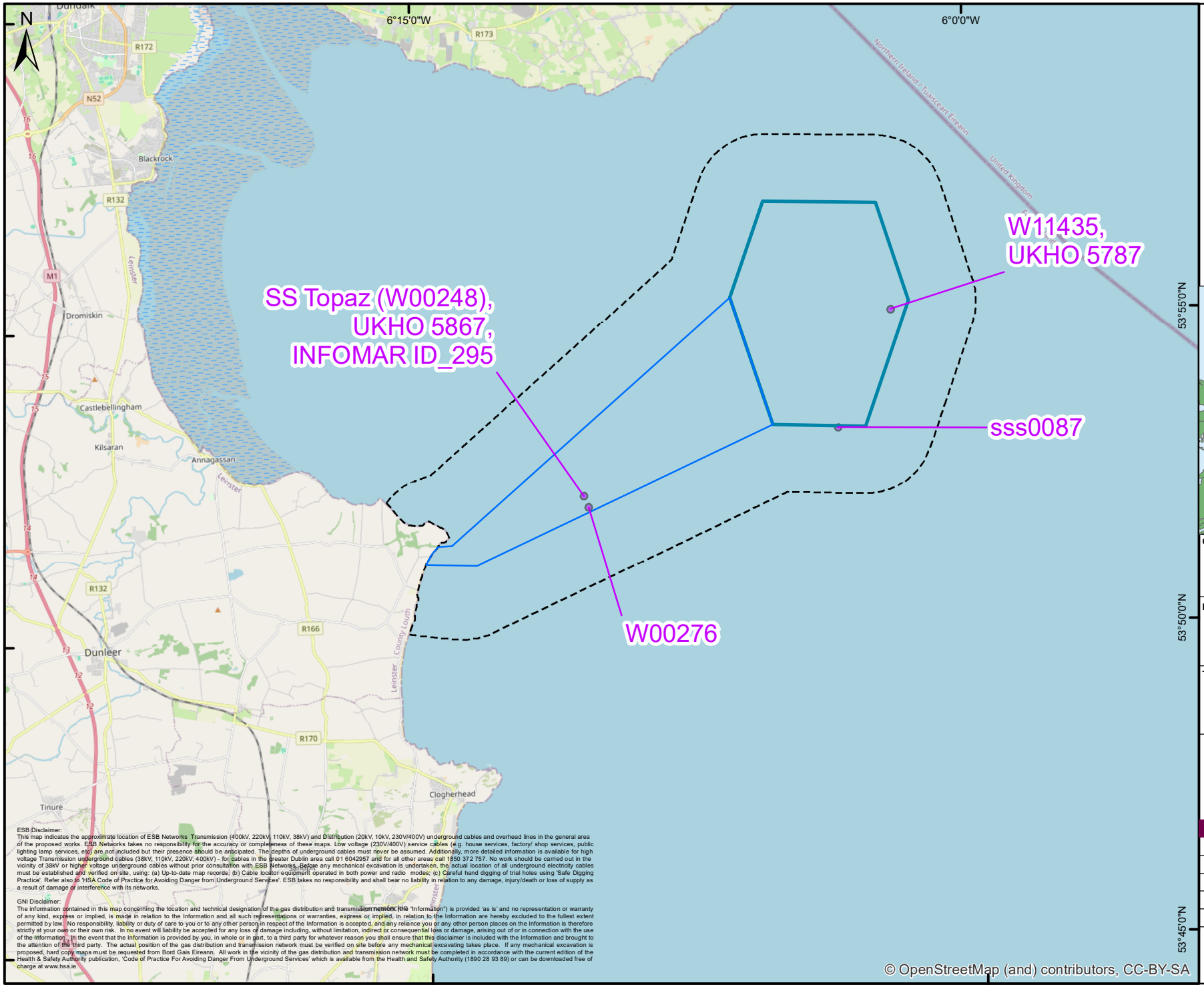
Where preservation *in situ* is not practicable, disturbance of archaeological sites or material should be offset by appropriate and satisfactory measures, also known as preservation by record. In these circumstances, the effects of the Project may be offset by carrying out excavation and recording prior to impact occurring. The impact of the Project may also be offset by restabilising sites that have been destabilised but not destroyed.

Previously unknown wrecks, archaeological sites or material may be encountered during the course of the installation, maintenance and/or decommissioning of a scheme. Archaeological watching briefs will provide for the reporting of archaeological discoveries made during the course of the Project. This will cover the reporting and investigation of unexpected archaeological discoveries encountered, informed by the guidance of appropriately qualified archaeologists. This protocol will further make provision for the establishment of Temporary Archaeological Exclusion Zones around areas of possible archaeological interest, for prompt archaeological advice and, if necessary, for archaeological inspection of important features prior to further activity taking place in the vicinity. This protocol will comply with the Merchant Shipping Act 1993 including notification of the Receiver of the Wreck.

In view of the potential for the presence of palaeo-landscapes and associated prehistoric sites and unidentified wrecks, archaeologists will be consulted in advance of pre-construction site preparation activities. Watching briefs will be implemented be appropriate where seabed material is brought to the surface. These proposals may be refined on the basis of the results of any further marine geophysical, geotechnical or diver/Remotely Operated Vehicle (ROV) surveys.

During future geotechnical work for detailed design, provision will be made for the complete recovery of cores, where feasible. The geoarchaeological analysis of geotechnical work will be carried out by a qualified and experienced geoarchaeologist and will include a sediment deposit model. This will determine the importance of the buried seabed sediments and the potential for palaeoenvironmental and submerged prehistoric evidence. It will identify geoarchaeological significant deposits (e.g. peat) that have the potential to provide evidence on past climate, vegetation change and human activity and make recommendations for any further pre-construction surveys or geoarchaeological laboratory investigations.

Further geophysical survey, geotechnical and ROV/diver survey programmes will be designed inclusive of archaeological objectives to assist in further site evaluation and to support further advice concerning mitigation.



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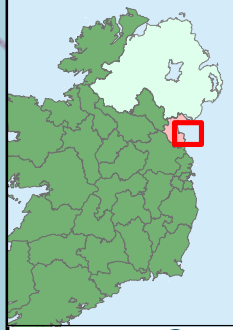
Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Marine Archaeology Study Area
- Archaeological Exclusion Zone (AEZ)

Data Sources: Client



Client
ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project
Oriel Wind Farm Project

Title
Figure 15-7
Proposed Archaeological Exclusion Zones within the Project.

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Issue Details

Drawn By: NG	**Project No.** EOR0822 (MDR1520B)
Checked By: NG	**File Ref:** EOR0822_MAR_T_1465_FINAL
Approved By: AOS	
Scale: 1:150,000 @ A4	**Projection:** ITM (IRENET95)
Date: 15/03/2024	Geographic Co-ordinates: ETRS89

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15.8.3 Impacts scoped out of the assessment

No impacts have been scoped out of this assessment.

15.9 Impact assessment methodology

15.9.1 Overview

The assessment on marine archaeology has followed the methodology set out in volume 2A, chapter 3: Environmental Impact Assessment Methodology. Specific to marine archaeology, the following guidance documents have also been considered:

- Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects, Parts 1 and 2 April 2018 (DCCAE, 2018);
- Guidelines on the information to be contained in Environmental Impact Assessment Reports, (Environmental Protection Agency (EPA), 2022);
- Advice notes for preparing Environmental Impact Statements (draft) (EPA, 2015);
- Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects (Department of Communications, Climate Action and Environment, 2017);
- Guidance of Assessment of Cumulative Impact on the Historic Environment from Offshore Renewable Energy (Cowrie, 2008);
- Ships and Boats: Prehistory to Present – Selection Guide. Available: Ships and Boats: Prehistory to Present (Historic England 2017); and
- Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment (English Heritage, 2008).

In addition, this assessment has considered the legislative framework as defined by (see appendix 15-1: Marine Archaeology Technical Report):

- United Nations Convention on the Law of the Sea 1982;
- European Convention on the Protection of the Archaeological Heritage 1992 (the Valetta Convention);
- UNESCO Convention on the Protection of the Underwater Cultural Heritage 2001;
- Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023; and
- Merchant Shipping (Salvage and Wreck) Act 1993.

15.9.2 Impact assessment criteria

The criteria for determining the significance of effects involves defining the magnitude of the impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in volume 2A, chapter 3: Environmental Impact Assessment Methodology.

The overall effect of any impact of development has a strong correlation to the sensitivity of the receptor, its value and vulnerability. Value can be indicated by designated status although there is always the potential for unknown high value marine archaeological receptors to be discovered as the world's seabed remains largely unexplored. Vulnerability can include the condition of the receptor, the degree to which it can be affected by changes to the environment, such as can occur to buried organic deposits when they are disturbed or may depend on the depth to which they are buried.

The criteria for defining impact magnitude in this chapter are outlined in Table 15-11 below.

Table 15-11: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition
High	Total loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse)
	Large scale or major improvement or resource quality; extensive restoration or enhancement and research potential; major improvement of attribute quality (Beneficial)
Medium	Loss of or alteration to, key elements/features of the baseline conditions (Adverse)
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality and research potential (Beneficial)
Low	Minor change from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline conditions will be unchanged (Adverse)
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial)
Negligible	No or very slight change from baseline conditions (Adverse)
	Very minor benefit to, or positive addition of one or more characteristics, features or elements (Beneficial)

The capability of a receptor to accommodate change and its ability to recover if affected is a function of its sensitivity. Receptor sensitivity is typically assessed via the following factors:

- Adaptability - the degree to which a receptor can avoid or adapt to an effect;
- Tolerance - the ability of a receptor to accommodate temporary or permanent change without significant adverse impact;
- Recoverability - the temporal scale over and extent to which a receptor will recover following an effect;
- Value - a measure of the receptor's importance, rarity and worth, and
- Marine archaeology receptors cannot adapt, tolerate or recover from impacts resulting in damage or loss caused by development. As a result, the sensitivity of a receptor can only be determined through its value.

Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment (English Heritage, 2008) has been used as guidance for defining the sensitivity of marine archaeology receptors in this assessment as no equivalent guidance exists for Ireland at the time of writing. The significance of a historic asset 'embraces all the diverse cultural and natural heritage values that people associate with it, or which prompt them to respond to it'. Significance is determined by the following value criteria:

- Evidential value - deriving from the potential of a place to yield evidence about past human activity;
- Historical value - deriving from the ways in which past people, events and aspects of life can be connected through a place to the present. It tends to be illustrative or associative;
- Aesthetic value - deriving from the ways in which people draw sensory and intellectual stimulation from a place; and
- Communal value - deriving from the meanings of a place for the people who relate to it, or for whom it figures in their collective experience or memory. Communal values are closely bound up with historical (particularly associative) and aesthetic values but tend to have additional and specific aspects.

Ships and Boats: Prehistory to Present - Selection Guide (Historic England, 2017) sets criteria of value to shipwrecks specifically that are defined as:

- Period;
- Rarity;

- Documentation;
- Group value;
- Survival/condition; and
- Potential.

The criteria for defining value, and therefore sensitivity, in this chapter are outlined in Table 15-12 below.

Table 15-12: Definition of terms relating to the value (and therefore sensitivity) of the receptor.

Value	Definition
Very High	Singular or excellent example and/ or high potential to contribute to knowledge and understanding. Receptors with a demonstrable international or national dimension to their importance are likely to fall within this category. Wrecked ships and aircraft that are protected under the Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023 or with an international dimension of their importance as well as as-yet undesignated sites that are demonstrably of very high archaeological value. Known submerged prehistoric sites and landscapes with a confirmed presence of largely in situ artefactual material or palaeogeographic features with demonstrable potential to include artefactual and/or palaeoenvironmental material, possibly as part of a prehistoric site or landscape.
High	Good example and/or high potential to contribute to knowledge and understanding. Includes shipwrecks and aircraft that are protected under Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023 as well as as-yet undesignated sites that do not have statutory protection or equivalent significance, but have high potential based on an assessment of their importance in terms of build, use, loss, survival and investigation (BULSI). Prehistoric deposits with high potential to contribute to an understanding of the palaeoenvironment.
Medium	Average example and/or moderate potential to contribute to knowledge and understanding and/or outreach. Includes wrecks of ships and aircraft that do not have statutory protection or equivalent significance, but have moderate potential based on an assessment of their importance in terms of BULSI. Prehistoric deposits with moderate potential to contribute to an understanding of the palaeoenvironment.
Low	Below average example and/or low potential to contribute to knowledge and understanding and/or outreach. Includes wrecks of ships and aircraft that do not have statutory protection or equivalent significance, but have low potential based on an assessment of their importance in terms of BULSI. Prehistoric deposits with low potential to contribute to an understanding of the palaeoenvironment.
Negligible	Poor example and/or little or no potential to contribute to knowledge and understanding and/or outreach. Assets with little or no surviving archaeological interest.

The significance of the effect upon marine archaeology is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 15-13. Where a range of significance of effect is presented in Table 15-13, the final assessment for each effect is based upon expert judgement.

For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of the EIA Regulations.

Table 15-13: Matrix used for the assessment of the significance of the effect.

Sensitivity of receptor	Magnitude of impact			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major
Very High	Minor	Moderate or Major	Major	Major

15.10 Assessment of significance

The potential impacts arising from the construction, operational and maintenance and decommissioning phases of the Project are listed in Table 15-8 along with the project design parameters against which each impact has been assessed.

A description of the potential effect on marine archaeology receptors caused by each identified impact is given below.

15.10.1 Removal or disturbance of near surface seabed sediments leading to effects on prehistoric land surfaces, wreck sites and artefacts

Three wreck sites are recorded within the desktop data obtained for the Project, the *Topaz* (W00248), an unidentified wreck (W00276) and a wreck described as measuring 5 m in length (W11435) (Figure 15-5). In addition, geophysical survey assessment has recorded a number of anomalies within the offshore wind farm area of unknown importance. Of note within the geophysical anomalies identified during the 2019 surveys is debris (sss0087), located within the offshore wind farm area and measuring 3.3 m in length, that may be of archaeological interest if it is not of natural origin (Figure 15-6). The baseline assessment has also concluded that there is a potential for archaeological receptors of a local to national importance to be buried in the seabed. The impact is applicable during the construction, operational and maintenance and decommissioning phases.

Construction Phase

Magnitude of impact

The installation of the Project infrastructure may result in the removal or disturbance of seabed sediments leading to effects on prehistoric land surfaces, wreck sites and artefacts. Construction activities will include the installation of 25 WTGs and one OSS on monopile foundations (with associated seabed preparation activities), 41 km of inter-array cables and 16 km of offshore cable, over a period of 15 months.

The impact of the construction of monopile foundations for the wind turbines and offshore substation will be localised and specific to the extent of the foundation footprint. Monopile foundations are likely to affect sediments to a depth of 35 m.

The impacts of the installation of inter-array cables and offshore cable on known and potential receptors will be limited to the relatively narrow corridor of the cable trench. The spatial extent of the impact on any archaeological receptors can thus be considered to be local because the impact will be localised and specific to the extent of the cable trench but where they do occur will be generally high adverse and irreversible and result in a permanent change to the receptor. The impact of the use of jack-up barges and other vessels with anchor placement have the potential to have a localised high adverse impact on seabed sediments.

The impact is predicted to be of local spatial extent, long term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. However, when taking into account the measures included in the Project discussed in Table 15-9 the magnitude of impact is considered to be negligible.

Sensitivity of the receptor

As described above there are three recorded wreck sites, one piece of debris and a number of geophysical anomalies within the Project and there is potential for archaeological receptors of a local to national importance to be buried in the seabed.

The value assigned to a wreck site is site specific. A ship may have historic importance at a local, regional or national level as a result of its association with a historic event or figure. Wartime losses, or vessels whose sinking was associated with a loss of life, may have a level of importance directly associated with that loss of life. Vessels which are key to, or representative of, specific periods of maritime development may also be regarded as important. Alternatively, a vessel may have a level of archaeological importance based on its rarity of its representation within the maritime archaeological record and/or its cargo. Due to the non-renewable and finite nature of wrecks, where construction impacts coincide with a receptor, it will not recover, resulting in permanent change. Wrecks are considered to be of high vulnerability, low recoverability and of low to high value. The overall sensitivity of two of the recorded wrecks (W00248 and W00276) are considered to be medium to high.

Potential prehistoric archaeological receptors and associated land surfaces within the Project would be considered to be of national importance in contributing to our understanding of Ireland's and Europe's earliest human populations and should be regarded as high value receptors. Although no prehistoric archaeological receptors are currently identified within the Marine Archaeology Study Area, they are assessed here as there is potential for discovery during the construction phase. Due to their non-renewable and finite nature, prehistoric archaeological receptors will not recover from direct construction impacts, where these coincide with the receptor. This will result in a permanent change to the receptor. Prehistoric archaeological receptors and associated land surfaces are considered to be of moderate to high vulnerability, low recoverability and are considered to have a potential high sensitivity value when considering the criteria set out in Table 15-12.

Buried palaeoenvironmental remains are deemed to be of moderate vulnerability, low recoverability and are considered to have a medium sensitivity value when considering the criteria set out in Table 15-12.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium to high. The effect will, therefore, be of **negligible or minor adverse significance**, which is not significant in EIA terms.

Operational and Maintenance Phase

Magnitude of impact

Operational and maintenance activities for the Project, including component replacement activities involving the use of jack-up vessels and cable repair/reburial activities, may result in the removal or disturbance of seabed sediments leading to effects on prehistoric land surfaces, wreck sites and artefacts.

The impact from component replacement activities and cable repair/reburial activities are likely to be less than the impact parameters as described for the construction phase and as such will have been mitigated ahead of or during the construction phase. However, where component replacement activities and cable repair/reburial activities do impact on potential near surface prehistoric land surfaces, wreck sites and artefacts, this impact will be localised, high adverse and irreversible and result in a permanent change to the receptor as the receptor will be lost. The impacts of the use of jack-up barges and other vessels with anchor placement have the potential to have a localised high adverse impact on seabed sediments (indirect impacts due to changes in sediment disposition are addressed in section 15.10.2).

The impact is predicted to be of local spatial extent, long term duration, continuous and low reversibility. It is predicted that the impact would affect the receptor directly. However, following the use of designed-in and management measures the overall magnitude of impact is considered to be negligible.

Sensitivity of the receptor

The sensitivity of the receptor is as assessed for the construction phase.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium to high. The effect will, therefore, be of **minor adverse significance**, which is not significant in EIA terms.

Decommissioning Phase

The effects of decommissioning activities are expected to be the same or lesser than the effects from construction. The effect will therefore be of **minor adverse significance**, which is not significant in EIA terms.

15.10.2 Removal or disturbance of deeply buried sediments leading to effects on prehistoric land surfaces

There is potential for ancient land surfaces and archaeological remains of regional to national importance to be deeply buried in the seabed.

Construction Phase

Magnitude of impact

The installation of Project infrastructure within the offshore wind farm area may result in the removal or disturbance of deeply buried sediments leading to effects on prehistoric land surfaces. Construction activities will include the installation of 25 WTGs and one OSS on monopile foundations to a maximum depth of 35 m.

Given the widespread extent and depth of any palaeo-landscapes and the relatively limited spatial extent of the Project, the impact on buried ancient land surfaces and associated archaeological remains will be localised and will leave the majority of any landscape surfaces intact. However, where impacts do occur, they will generally be direct, long term and continuous. The installation of the monopiles will affect the full sediment sequence. The depths of the monopiles means that they will also disturb more deeply buried remains that have the potential to contain Palaeolithic evidence.

The impact is predicted to be of local spatial extent, long term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor directly. However, following the measures included in the Project described in Table 15-9 the overall magnitude of impact is therefore considered to be negligible.

Sensitivity of the receptor

There is potential for ancient land surfaces and archaeological remains of local to national importance to be deeply buried in the seabed. Geotechnical investigations have not reported the observation of anthropogenic features such as timber, metal or ceramic, and none record peat or related organic strata that might indicate the presence of submerged palaeo-landscapes. The potential for palaeoenvironmental evidence is considered to be low to moderate. The potential for prehistoric sites is considered to be low, however where present, prehistoric sites would be regarded to be of potential national importance in contributing to our understanding of Ireland's and Europe's earliest human populations and should be regarded as a high value receptor. Due to their non-renewable and finite nature, prehistoric archaeological receptors will not recover from direct construction impacts. This will result in a permanent change to the receptor.

Deeply buried palaeoenvironmental remains are deemed to be of moderate vulnerability, low recoverability and are considered to have a medium sensitivity value when considering the criteria set out in Table 15-12. Prehistoric archaeological receptors and associated land surfaces are considered to be of moderate to high vulnerability, low recoverability and are considered to have a potential high sensitivity value when considering the criteria set out in Table 15-12.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium to high. The effect will, therefore, be of **minor adverse significance**, which is not significant in EIA terms.

15.10.3 Disturbance of sediment causing sediment deposition on the seabed resulting in potential effects on archaeological receptors

As described above there are two wreck sites within the offshore cable corridor, a number of geophysical anomalies within the offshore wind farm area and there is potential for archaeological receptors of a local to national importance to be buried in the seabed. The impact is applicable during the construction, operational and maintenance and decommissioning phases.

Construction Phase

Magnitude of impact

The installation of Project infrastructure may result in the disturbance of sediment causing sediment deposition on the seabed resulting in potential effects on archaeological receptors. Construction activities will include the installation of 25 WTGs and one OSS on drilled monopile foundations, and 41 km of inter-array cables and 16 km of offshore cable, over a period of 15 months.

Any potential effect on the archaeological record caused by sedimentation is considered to be indirect. The drilling of the monopiles and ploughing/jetting of the inter-array cables and offshore cable can have effects on the sediments protecting archaeological receptors in the local area.

Drilled pile installation modelling (see chapter 7: Marine Processes) in a range of hydrodynamic conditions predicted that the effects on the sediment regime will be limited and localised in nature due to the limited quantity of material released. Marine processes modelling has been utilised in this section in order to assess the effect of sedimentation as an indirect impact.

Modelling of inter-array cable ploughing/jetting activities predicted that due to the water depth and considering that trenching operations mobilise material near the seabed, the impact is low due to the small increase in sediment depth associated with this, with most material settling close to the origin of release and no discernible level of sedimentation occurring beyond the offshore wind farm area.

Modelling of offshore cable jetting activities predicted that the sediment plume extends both north and south of the offshore cable corridor as it is dispersed by tidal flows but with low impact due to the small increase in sediment depth associated with this (10-100 mm, with an average depth increase of approximately 10 mm within the offshore cable corridor and surrounding area – see appendix 7-1: Marine Processes Technical Report), with most material settling close to the offshore cable corridor.

The results of the modelling therefore indicate that the indirect impact from drilled pile installations on the archaeological resource will be negligible whilst the geographical extent of sedimentation during inter-array and offshore cable installation activities will be small and localised with minimal increase in sediment deposition. The indirect effect on the archaeological receptor could either be beneficial - for example burying currently exposed receptors can provide protection from erosion - or adverse, for example exposing receptors currently close to the surface of the seabed will leave receptors vulnerable to erosion. However, the effect will be limited away from the monopile due to the small increase in sediment depth (approximately 1-10 mm). There will be local zones immediately adjacent to the monopile where there will be a much greater depth of sediments due to the deposition of drill chippings (chapter 7: Marine Processes).

The impact is predicted to be of local spatial extent, short to long term duration, intermittent and medium reversibility as the sediment continues to be dispersed by natural tidal flows avoiding a long term, continuous impact. It is predicted that the impact will affect the receptor indirectly. The magnitude of impact is therefore, considered to be negligible.

Sensitivity of the receptor

As described above, there are records of two wreck sites within the offshore cable corridor, a number of geophysical anomalies within the offshore wind farm area and there is potential for archaeological receptors

of local to national importance to be buried in the seabed. The sensitivity of the receptors is therefore, considered to be medium to high.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium to high. The effect will, therefore, be of **minor adverse significance,** which is not significant in EIA terms.

Operational and Maintenance Phase

Magnitude of impact

Operational and maintenance activities for the Project, including cable repair/reburial activities, will result in the disturbance of sediment causing sediment deposition on the seabed resulting in potential effects on archaeological receptors.

Cable repair/reburial activities will have a small and localised effect, considered to be less than that during the construction phase of the Project, on sediment deposition (see chapter 7: Marine Processes). The indirect effect on the archaeological receptor could either be beneficial (burying currently exposed receptors) or adverse (exposing receptors currently close to the surface of the seabed) however the effect will be limited due to the small increase in sediment depth).

The impact is predicted to be of local spatial extent, short to long term duration, intermittent and medium reversibility as the sediment continues to be dispersed by natural tidal flows avoiding a long-term impact. It is predicted that the impact will affect the receptor indirectly. The magnitude of impact when considering the criteria as set out in Table 15-11 is therefore considered to be negligible.

Sensitivity of the receptor

For the reasons described above for the construction phase, marine archaeological receptors are deemed to be of low to moderate vulnerability, moderate to high recoverability and of low to high value. The sensitivity of the receptor is therefore, considered to be medium.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **minor adverse significance** with is not significant in EIA terms.

Decommissioning Phase

Magnitude of impact

The decommissioning of Project infrastructure may result in the disturbance of sediment causing sediment deposition on the seabed resulting in potential effects on archaeological receptors. Decommissioning works will involve the cutting and removal of 25 WTGs and one OSS monopile foundation to approximately 2 m below the seabed and the removal of cables. These activities will result in a minimal increase in sediment deposition (see chapter 7: Marine Processes). The indirect effect on the archaeological receptor could either be beneficial (burying currently exposed receptors) or adverse (exposing receptors currently close to the surface of the seabed) however the effect will be limited due to the small increase in sediment depth (1-10 mm, as modelled for the construction phase).

The impact is predicted to be of local spatial extent, short to long term duration, intermittent and medium reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

For the reasons described above for the construction phase, marine archaeological receptors are deemed to be of low to moderate vulnerability, moderate to high recoverability and of low to high value. The sensitivity of the receptor is therefore, considered to be medium.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **minor adverse significance**, which is not significant in EIA terms.

15.10.4 Alteration of sediment transport regimes

As described above there are two wreck sites within the offshore cable corridor, a number of geophysical anomalies within the offshore wind farm area and there is potential for archaeological receptors of a local to national importance to be buried in the seabed. The impact is applicable during the construction, operational and maintenance and decommissioning phases.

Operational and Maintenance Phase

Magnitude of impact

The presence of Project infrastructure may lead to changes in waves and littoral currents, leading to changes in sediment transport. The project design parameters include for 26 monopile base foundations of 9.6 m in diameter and associated scour protection extending 19.2 m in radius beyond the foundation, with a minimum spacing of 960 m between the centre of each foundation.

Residual currents are effectively the driver of sediment transport and therefore any changes to residual currents would have a direct impact on sediment transport which would persist for the lifecycle of the Project. However, if the presence of the foundation structures does not have a significant influence on either tide or wave conditions, they cannot therefore have a significant effect on the sediment transport regime. Chapter 7: Marine Processes has assessed that the presence of the foundation structures will not have a significant influence on either tide or wave conditions through modelling as described in section 15.10.3.

For the marine processes modelling the residual current and sediment transport was simulated with the foundations in place, with the increased number of structures. The changes due to the presence of the foundations are very small (often in the order of the model convergence criteria) beyond the immediate vicinity of the structure.

During both calm and storm conditions the variation in residual currents and therefore sediment transport processes is limited both in magnitude and spatially. The post-construction regime showed virtually no difference from the baseline scenario.

Cable installation will comprise the burial of both the inter-array and offshore cables. The cables will be buried to a maximum depth of 3 m, with a minimum depth of 0.5 m. In some areas where sufficient burial depth cannot be achieved cable protection may be required depending on the specific ground conditions. Due to the limited nature of the tidal current magnitude the protection required is modest with inter-array protection of 2 m in height and 10 m wide and offshore cable protection being 2 m in height and 10 m wide.

The cable protection will be provided by suitable rock placement or mattressing which allows for low profile protection and features tapering to minimise disruption to flow patterns and scour. The locations where cable protection may be required would be rocky outcrops which are located in areas offshore; mid-way along the offshore cable corridor and at various locations across the offshore wind farm area. These outcrops have more limited sediment transport potential. No material will be placed in the intertidal area and landfall location; the cable will be installed by trenching through the intertidal zone to the depth required. Impacts on sediment transport pathways would be negligible due to both the scale and the locations of the cable protection.

The magnitude of the impact on sediment transport is predicted to be of local spatial extent, long term duration, continuous and high reversibility. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

As described above there are three recorded wreck sites, one piece of debris, a number of geophysical anomalies within the Project and the potential for archaeological receptors of a local to national importance to be buried in the seabed.

The value assigned to a wreck site is site specific. A ship may have historic importance at a local, regional or national level as a result of its association with a historic event or figure. Wartime losses, or vessels whose sinking was associated with a loss of life, may have a level of importance directly associated with that loss of life. Vessels which are key to, or representative of, specific periods of maritime development may also be regarded as important. Alternatively, a vessel may have a level of archaeological importance based on its rarity of its representation within the maritime archaeological record and/or its cargo. Due to the non-renewable and finite nature of wrecks, where construction impacts coincide with a receptor, it will not recover, resulting in permanent change. Wrecks are considered to be of high vulnerability, low recoverability and of low to high value. The overall sensitivity of two of the recorded wrecks (W00248 and W00276) are considered to be medium to high.

Potential prehistoric archaeological receptors and associated land surfaces within the Project would be considered to be of national importance in contributing to our understanding of Ireland's and Europe's earliest human populations and should be regarded as high value receptors. Although no prehistoric archaeological receptors are currently identified within the Marine Archaeology Study Area, they are assessed here as there is potential for discovery during the construction phase. Due to their non-renewable and finite nature, prehistoric archaeological receptors will not recover from direct construction impacts, where these coincide with the receptor. This will result in a permanent change to the receptor. Prehistoric archaeological receptors and associated land surfaces are considered to be of moderate to high vulnerability, low recoverability and are considered to have a potential high sensitivity value when considering the criteria set out in Table 15-12.

Buried palaeoenvironmental remains are deemed to be of moderate vulnerability, low recoverability and are considered to have a medium sensitivity value when considering the criteria set out in Table 15-12.

Significance of the effect

Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium to high. The effect will, therefore, be of **minor adverse significance**, which is not significant in EIA terms.

15.10.5 Mitigation and residual effects

The assessment of impacts has concluded that there are no significant effects with the implementation of the measures included in the Project. Therefore, no measures over those outlined in section 15.8.2 are required.

Residual effects

With the implementation of the measures included in the Project (section 15.8.2), the residual effects are as outlined in the assessment provided in section 15.10.

15.10.6 Future monitoring

No marine archaeological monitoring additional to that described in section 15.8.2 is considered necessary for the Project.

15.11 Cumulative impact assessment

15.11.1 Methodology

The Cumulative Impact Assessment (CIA) takes into account the impact associated with the Project together with other projects. The projects selected as relevant to the CIA presented within this chapter are based upon the results of a screening exercise (see volume 2A, appendix 3-1: Cumulative Impact Assessment Screening Annex). Each project has been considered on a case-by-case basis for screening in or out of this

chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

The approach to CIA examines the effects of the Project alongside the following projects if they fall within the Zone of Influence (ZoI) for marine archaeology:

- Other projects with consent but not yet constructed/construction not completed;
- Other projects in a consent application process but not yet determined (including planning applications, foreshore lease/licence applications, Dumping at Sea Permit applications;
- Other projects currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact; and
- Projects, which satisfy the definition of 'relevant maritime usage' under the Maritime Area Planning Act (2021) (i.e. wind farm projects designated as 'Relevant Projects' or 'Phase 1 Projects') including Arklow Bank II, Bray Bank and Kish Bank; North Irish Sea Array, Codling Wind Park (I and II).

No projects were screened in for the CIA for marine archaeology as there are no projects within the Marine Archaeology Study Area with spatial or temporal overlap with the Project.

15.12 Transboundary effects

The Marine Archaeology Study Area lies outside Northern Ireland territorial waters and the Project is considered unlikely to affect known and potential receptors that lie within these waters. This has been agreed following consultation with the Marine Historic Environment Advisor at the Historic Environment Division on behalf of the Department of Agriculture, Environment and Rural Affairs (DAERA) (see section 15.5).

15.13 Interactions

A description of the likely inter-related effects arising from the Project on Marine Archaeology is provided in volume 2C, chapter 32: Interactions.

15.14 Summary of impacts, mitigation measures and residual effects

Information on Marine Archaeology within the Marine Archaeology Study Area was collected through a desktop review of existing datasets, site-specific surveys and consultation.

Table 15-14 presents a summary of the potential impacts, mitigation measures and residual effects in respect to marine archaeology.

The impacts assessed include:

- Removal or disturbance of near surface seabed sediments leading to effects on prehistoric land surfaces, wreck sites and artefacts;
- Removal or disturbance of deeply buried sediments leading to effects on prehistoric land surfaces;
- Disturbance of sediment causing sediment deposition on the seabed resulting in potential effects on archaeological receptors; and
- Alteration of sediment transport regimes.

Overall, it is concluded that there will be no significant effects arising from the Project during the construction, operational and maintenance or decommissioning phases.

No other projects have been identified that have the potential to result in cumulative impacts with the Project in relation to marine archaeology receptors.

No potential transboundary impacts have been identified in regard to effects of the Project.

Table 15-14: Summary of potential environment effects, mitigation and monitoring.

Description of impact	Phase C	Phase O	Phase D	Measures included in the Project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Removal or disturbance of near surface seabed sediments leading to effects on prehistoric land surfaces, wreck sites and artefacts	✓	✓	✓	Archaeological input into pre-construction survey specifications and analysis; Identification and implementation of AEZs; Avoidance of unknown geophysical anomalies; Production and implementation of a Marine Archaeological Management Plan; Archaeologists to be consulted in advance of pre-construction site preparation activities; Commitment to archaeological monitoring during all phases of the Project; Commitment to apply and implement all relevant licenses for archaeological monitoring, excavation and export of archaeological object (where required), Commitment to the ongoing monitoring of known archaeological receptors through the acquisition of relevant spatial survey data; and Mitigation of unavoidable direct impacts through preservation by record or stabilisation.	C: Negligible O: Negligible D: Negligible	C: Medium to High O: Medium to High D: Medium to High	C: Minor adverse O: Minor adverse D: Minor adverse	N/A	C: Minor adverse O: Minor adverse D: Minor adverse	None
Removal or disturbance of deeply buried sediments leading to effects on prehistoric land surfaces	✓	×	×		C: Negligible	C: Medium to High	C: Minor adverse	N/A	C: Minor adverse	None
Disturbance of sediment causing sediment deposition on the seabed resulting in potential effects on archaeological receptors	✓	✓	✓		C: Negligible O: Negligible D: Negligible	C: Medium to High O: Medium D: Medium	C: Minor adverse O: Minor adverse D: Minor adverse	N/A	C: Minor adverse O: Minor adverse D: Minor adverse	None
Alteration of sediment transport regimes.	×	✓	×		O: Negligible	O: Medium to high	O: Minor adverse	N/A	O: Minor adverse	None

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