Liverpool Bay CCS Ltd

HYNET CARBON DIOXIDE TRANSPORTATION AND STORAGE PROJECT - OFFSHORE

Environmental Statement
Volume 2, chapter 11: Marine Archaeology

EHE7228B
Liverpool Bay CCS Limited
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Offshore ES
Marine Archaeology

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RPS

Prepared for:

Liverpool Bay CCS Limited

Glossary

Term	Meaning
Bathymetry	The measurement of water depth in oceans, seas and lakes.
"Do Nothing" Scenario	The environment as it would be in the future should the proposed project not be developed.
Effect	The consequence of an impact.
Environmental Impact Assessment	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
Gazetteer	A geographical index or dictionary
Impact	A change that is caused by an action.
Magnitude	Size, extent and duration of an impact.
Mitigation Measure	Measure which would avoid, reduce, or remediate an impact
Non-statutory stakeholder	Organisations with whom the regulatory authorities may choose to engage who are not designated in law but are likely to have an interest in a proposed development.
Palaeochannel	A geological term describing a remnant of an inactive river or stream channel that has been filled or buried by younger sediment
Palaeoenvironmental	An environment of a past geological age
Project	The HyNet Carbon Dioxide Transportation and Storage Project.
Project Design Envelope	Also known as the Rochdale Envelope, the PDE concept is routinely utilised in both onshore and offshore planning applications to allow for some flexibility in design options, particularly offshore, and more particularly for foundations and turbine type, where the full details of the project are not known at application submission but where sufficient detail is available to enable all environmental impacts to be appropriately considered during the EIA.
Proposed Development	The offshore components of the Project which are subject of this Environmental Statement, as described in volume 1, chapter 3.
Residual Impact	Residual impacts are the final impacts that occur after the proposed mitigation measures have been put into place, as planned.
Scoping Opinion	Sets out the Secretary of State's response to the Applicants Scoping Report and contains the range of issues that the Secretary of State, in consultation with statutory stakeholders, has identified should be considered within the EIA.
The Applicant	This is Liverpool Bay CCS Ltd.

Acronyms

Acronym	Description
AD	Anno Domini
ALSF	Aggregate Levy Sustainability Fund
AEZ	Archaeological Exclusion Zone
BC	Before Christ
BGS	British Geological Survey
BP	Before Present
CCS	Carbon Capture and Storage
CEA	Cumulative Effects Assessment
CLV	Cable Lay Vessel
CPAT	Clwyd-Powys Archaeological Trust

Acronym	Description
ED50	European Datum 1950
EIA	Environmental Impact Assessment
ES	Environmental Statement
HE	Historic England
HER	Historic Environment Record
HDD	Horizontal Directional Drilling
HSC	Historic Seascape Character
JFS	James Fisher Subtech
JNAPC	Joint Nautical Archaeology Policy Committee
LAT	Lowest Astronomical Tide
MMO	Marine Management Organisation
MASA	Marine Archaeology Study Area
MPS	Marine Policy Statement
MHWS	Mean High Water Springs
NLO	Named Location
NRHE	National Record of the Historic Environment
NMRW	National Monuments Record Wales
NSC	Non-Submarine Contact
O&M	Operation and Maintenance
OP	Oil Platform
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OWF	Offshore Wind Farm
PAD	Protocol for Archaeological Discoveries
PDE	Project Design Envelope
PoA	Point of Ayr
RCAHMW	Royal Commission on the Ancient and Historic Monuments of Wales
ROV	Remotely Operated Vehicle
TAEZ	Temporary Archaeological Exclusion Zone
UKHO	United Kingdom Hydrographic Office
UNESCO	United Nations Educational, Scientific and Cultural Organization
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
WCPS	West Coast Palaeoandcape Survey
WIS	Western Irish Sea
WNMP	Welsh National Marine Plan
WSI	Written Scheme of Investigation
WWII	World War II

Units

Unit	Description
%	Percentage
cm	Centimetre (distance)
dB	Decibel (unit used to measure the intensity of sound)
ft	Feet (distance)
Hz	Hertz (frequency)
KHz	Kilohertz (frequency)
km	Kilometres (distance)
km^2	Square kilometres (area)
m	Meters (distance)
mm	Millimetres (distance)
mg/l	Milligrams per litre
nm	Nautical miles (distance; 1nm = 1.852km)
nT	Nanotesla (magnetic flux density)

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11 MARINE ARCHAEOLOGY

11.1 Introduction

This Marine Archaeology Environmental Statement (ES) provides an assessment of the potential impacts of the HyNet Carbon Dioxide Transportation and Storage Project (hereafter referred to as "the Project") and the offshore components of the project (hereafter referred to as "the Proposed Development"). on marine archaeology. Specifically, this chapter considers the potential impact of the Proposed Development seaward of Mean High Water Springs (MHWS) during the construction, operations and maintenance, and decommissioning phases.

The chapter draws upon information contained within the Marine Archaeology Technical Report (volume 3, appendix N).

11.2 Purpose of this chapter

In summary, the primary purpose of an Environmental Statement is to support applications for the Proposed Development under the relevant legislation, set out in volume 1, chapter 2. In particular this ES chapter:

- presents the existing environmental baseline established from desk studies, site-specific surveys and consultation;
- identifies any assumptions and limitations encountered in compiling the environmental information;
- sets out embedded mitigation measures;
- presents the potential environmental effects, including culminative effects, on marine archaeology arising from the Proposed Development, based on the information gathered and the analysis and assessments undertaken; and
- highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects of the Proposed Development on marine archaeology.

11.3 Study area

The Proposed Development area which has been considered by this assessment for offshore can be broken down into three parts:

- the Area of Project Physical Work;
- the Eni Proposed Development Area; and
- the wider Marine Archaeology Study Area (MASA).

The Area of Project Physical Work covers a restricted area in which Proposed Development activities and the insertion of new infrastructure including cable laying, well drilling and platform construction, as well as associated activities such as sand wave clearance are to be focused.

The Eni Development Area covers a wider area. While the main Proposed Development impacts will be focused within the Area of Project Physical Work associated impacts such as vessel anchoring may occur within the Eni Development Area. As such both areas have been treated as the 'Site', and all archaeological remains within have been assessed.

The wider MASA forms a 2 km buffer around the Eni Development Area, up to MHWS and has been defined to better characterise the archaeological resource within the offshore parts of the site.

11.4 Policy and legislative context

11.4.1 National policy statements and regional marine plans

The Proposed Development spans both English and Welsh waters and therefore policy and legislation from both areas is relevant to this assessment. Key policy relevant to this ES chapter includes the Marine Policy Statement (MPS), Welsh National Marine Plan (WNMP) and North West Inshore and North West Offshore Coast Marine Plans. A full review of relevant legislation and policy is set out within volume 1, chapter 2.

The MPS, in paragraph 2.6.6.3, states that heritage assets in the marine environment "s*hould be conserved through marine planning in a manner appropriate and proportionate to their significance*", adding that, "opportunities should be taken to contribute to our knowledge and understanding of our past by capturing evidence from the historic environment and making this publicly available, particularly if a heritage asset is to be lost".

With reference to non-designated heritage assets in the UK marine environment the MPS states, in paragraph 2.6.6.5, that the "Many heritage assets with archaeological interest in these areas are not currently designated as scheduled monuments or protected wreck sites but are demonstrably of equivalent significance. The absence of designation…does not necessarily indicate lower significance and the marine plan authority should consider them subject to the same policy principles as designated heritage assets…based on information and advice from the relevant regulator and advisors".

When considering possible damage to or destruction of heritage assets by development proposals, the MPS states in paragraph 2.6.6.9 that "the marine plan authority should identify and require suitable mitigating actions to record and advance understanding of the significance of the heritage asset before it is lost".

The WNMP (Table 11.1) includes Policy SOC_05 relating to Heritage Assets which recognises the importance of protecting the underwater historic environment and as such proposals should demonstrate appropriate consideration of the potential impacts of developments in order to prevent substantial loss or harm. It also highlights that development proposals should consider opportunities to better understand and promote the historic environment.

The WNMP Implementation Guidance (Welsh Government, 2020) highlights that the absence of designated historic assets should not suggest that non designated heritage assets are of less importance and points out that given the difficulties with investigating underwater heritage, the significance of many marine historic assets has not as yet been established and so all such assets should be considered by proposals.

The guidance advises that all proposals should demonstrate compliance with relevant national and regional legislation and guidance. The relevant regional Welsh archaeological trust should be consulted for the historic environment records and the Royal Commission on the Ancient and Historic Monuments of Wales (RCAHMW) or their extensive database of marine historic assets. Any assessment should also be undertaken in accordance with guidelines set out by the Chartered Institute for Archaeologists and best practise guidance notes for the marine historic environment.

The guidance highlights that proposals should demonstrate the potential impact on relevant historic assets and that there should be a general presumption in favour of preservation or enhancement of historic assets.

Further advice in relation specifically to the Proposed Development has been sought through consultation with archaeological curators including the RCAHMW and Historic England (HE).

Table 11.1 sets out how the ES chapter has responded to the specifications of the MPS and WNMP, detailing commitments in relation to each specification.

Table 11.1: Summary Of The MPS And WNMP

Summary of key points in MPS and WNMP relevant to marine archaeology	How and where considered in the ES chapter
Heritage assets in the marine environment "should be conserved through marine planning in a manner appropriate and proportionate to their significance" and "opportunities should be taken to contribute to our knowledge and understanding of our past by capturing evidence from the historic environment and making this publicly available, particularly if a heritage asset is to be lost" (paragraph 2.6.6.3 of MPS)	The ES has considered the significance of all known and potential heritage assets within the MASA. This is discussed further in section 11.7 below. The mitigation measures adopted as part of the Proposed Development including any future geophysical and geotechnical surveys undertaken will produce new archaeological data and understandings of the historic marine environment of the area. The results of these investigations will ultimately be made publicly available. This is discussed further within the outline Written Scheme of Investigation (WSI) which accompanies this ES chapter.
The absence of designation…does not necessarily indicate lower significance and the marine plan authority should consider them [non designated heritage assets] subject to the same policy principles as designated heritage assets…based on information and advice from the relevant regulator and advisors (paragraph 2.6.6.5 of MPS)	The ES has considered the significance of all known and potential heritage assets within the MASA. This is discussed further in sections 11.10 and 11.11 of this report. Consultation to date with the relevant regulator and advisors is set out in Table 11.3 and will be ongoing.
The marine plan authority should identify and require suitable mitigating actions to record and advance understanding of the significance of the heritage asset before it is lost (paragraph 2.6.6.9 of MPS)	The mitigation measures adopted as part of the Proposed Development include archaeological input into any future geophysical and geotechnical surveys and review of the resulting data. This will produce new archaeological data and understanding of the historic marine environment of the area. The results of these investigations will ultimately be made publicly available. This is discussed further in the outline WSI, which has also been prepared to support the Environmental Impact Assessment (EIA) which will set out the high-level mitigation strategy for approval by the regulator and advisors.
WNMP SOC_05: Historic Assets Proposals should demonstrate how potential impacts on historic assets and their settings have been taken into consideration and should, in order of preference: a. avoid adverse impacts on historic assets and their settings; and/or b. minimise impacts where they cannot be avoided; and/or c. mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Opportunities to enhance historic assets are encouraged.	The ES has considered the significance of all known and potential heritage assets within the MASA. This is discussed further in sections 11.10 and 11.11 of this report. The mitigation measures adopted as part of the Proposed Development include archaeological input into any future geophysical and geotechnical surveys and review of the resulting data. This will produce new archaeological data and understanding of the historic marine environment of the area. The results of these investigations will ultimately be made publicly available. This is discussed further in section 11.7 below. An outline WSI has also been prepared to support the EIA which will set out the high-level mitigation strategy for approval by the regulator and advisors.
The absence of designated historic assets should not suggest that non designated heritage assets are of less importance and so all such assets should be considered by proposals (paragraph 95 of WNMP Implementation Guidance) Proposals should demonstrate compliance with relevant national and regional legislation and guidance. The relevant regional Welsh archaeological trust should be consulted for the historic environment records and the RCAHMW for their extensive database of marine historic assets. Any assessment should also be undertaken in accordance with guidelines set out by the Chartered Institute for Archaeologists and best practise guidance notes for the marine historic environment (paragraph 96 of WNMP Implementation Guidance)	The ES has considered the significance of all known and potential heritage assets within the MASA and has consulted the RCAHMW and HER datasets as specified. This is discussed further in section 11.4. Table 11.1 and Table 11.2 demonstrate how the ES has complied with National and Regional Policy Statements. Marine Archaeology Technical Report volume 3, appendix N, confirms the baseline methodology and section 11.4 confirms that the baseline assessment was undertaken in accordance with relevant legislation and guidance.

Summary of key points in MPS and WNMP relevant to marine archaeology	How and where considered in the ES chapter
Proposals should demonstrate the potential impact on relevant historic assets and that there should be a general presumption in favour of preservation or enhancement of historic assets (paragraph 98 and 100)	

The assessment of potential changes to marine archaeology has also been made with consideration to the specific policies set out in the North West Inshore and North West Offshore Coast Marine Plans (Marine Management Organisation (MMO, 2021). Key provisions are set out in Table 11.2 along with details as to how these have been addressed within the assessment.

Table 11.2: North West Inshore And North West Offshore Marine Plan Policies Relevant To Marine Archaeology

Policy	Summary of key points in Marine Plans relevant to marine archaeology	How and where considered in the ES chapter
NW-HER-1	This policy aims to conserve and enhance marine and coastal heritage assets by considering the potential for harm to their significance. This consideration will not be limited to designated assets and extends to those non-designated assets that are, or have the potential to become, significant. The policy will ensure that assets are considered in the decision-making process and will make provisions for those assets that are discovered during developments.	The potential for harm to the significance of marine heritage assets by the Proposed Development has been assessed in section 11.11, which includes the assessment of designated and non-designated marine heritage assets identified within the MASA. Mitigation measures have been adopted as part of the Proposed Development to protect the known archaeological assets and make provisions for those assets that are discovered during the Proposed Development in the form of the production of an outline WSI and Protocol for Archaeological Discoveries (PAD) which accompany this ES.

11.4.2 Legislation

Relevant policy and legislation to marine archaeology up to MHWS include the following:

- The World Heritage Convention (1972);
- United Nations Convention on the Law of the Sea (1982);
- Protection of Wrecks Act (1973);
- Ancient Monuments and Archaeological Areas Act (1979);
- Planning (Listed Buildings and Conservation Areas) Act (1990);
- Protection of Military Remains Act (1986);
- Merchant Shipping Act (1995);
- International Council of Monuments and Sites Charter on the Protection and Management of Underwater Cultural Heritage (1996) (the Sofia Charter);
- United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Protection of the Underwater Cultural Heritage (2001);
- Historic Environment (Wales) Act 2016;

- National Heritage Act (2002); and
- Marine and Coastal Access Act (2009).

11.4.3 Guidance

This chapter of the ES has been developed in accordance with the following guidelines:

- Planning Policy Wales Technical Advice Note 24: The Historic Environment;
- Managing the Marine Historic Environment of Wales (Cadw/Welsh Government, 2020);
- Historic England's (HE's) Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment (English Heritage (now Historic England), 2008);
- Conservation Principles for the Sustainable Management of the Historic Environment in Wales (Cadw, 2011);
- Code of Conduct (Chartered Institute for Archaeologists, 2014 (updated 2022));
- Standard and Guidance for Historic Environment Desk Based Assessment (Chartered Institute for Archaeologists, 2014 (updated 2020));
- COWRIE Historic Environment Guidance for the Offshore Renewable Energy Sector (Wessex Archaeology, 2007);
- Offshore Renewables Protocol for Archaeological Discoveries (PAD) (The Crown Estate, 2014);
- Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Gribble and Leather, 2010);
- Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects (The Crown Estate, 2021);
- Marine Geophysics Data Acquisition, Processing and Interpretation, Guidance Notes (English Heritage, 2013, currently under review by MSDS Marine for Historic England);
- Identifying and Protecting Palaeolithic Remains (English Heritage, 1998);
- Military Aircraft Crash Sites (English Heritage, 2002);
- Aircraft Crash Sites at Sea (Wessex Archaeology, 2008); and
- Code of Practice for Seabed Development (Joint Nautical Archaeology Policy Committee, 2006).

11.5 Consultation

A summary of the key issues raised during consultation activities undertaken to date specific to Marine Archaeology is presented in Table 11.3 below.

Table 11.3: Summary of Key Consultation Issues Raised During Consultation Activities Undertaken for The Proposed Development Relevant To Marine Archaeology

Date	Consultee and type of response	Issues raised	Response to issue raised and/or were considered in this chapter
January 2023	The Scoping Opinion contained no responses from consultees relevant to	N/A	

Date	Consultee and type of response	Issues raised	Response to issue raised and/or were considered in this chapter
	Marine Archaeology		
June 2023	Historic England (HE) – email to invite consultation	HE have been approached as part of the project consultation. Correspondence via email has confirmed that HE are not a statutory consultee on Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) applications, however, the Eni is continuing to seek consultation opportunities with HE.	Consultation awaited.
June 2023	Royal Commission on the Ancient and Historic Monuments of Wales (RCAHMW) – consultation meeting	Introduction to the offshore elements of the Proposed Development; discussion of geophysical data coverage, noting the data is not full coverage; discussion of the location of *Resurgam* (Protected Wreck) and re-routing of the cables around the protected area; discussion on Archaeological Exclusion Zones (AEZs) and current routing of some cables through AEZs. Agreed a way forward which has been reflected in the documents produced as part of this application.	Key issues to be addressed are the lack of full coverage data and the routing of some cables through AEZs. Lack of full coverage data: This issue is dealt with through a commitment to collect and assess full coverage data prior to seabed impacts. This data will be reviewed by a competent and experienced marine archaeological geophysicist. Routing of cables through AEZs: This assessment makes a commitment to either investigate the AEZs and to amend them if appropriate, or to re-route around them and assess the wider area. There will be no impacts to AEZs by construction activities. The WSI will clearly set out how this investigation and mitigation is to be achieved.

11.6 Data sources

11.6.1 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 and datasets are summarised in Table 11.4 below, and additional sources are referred to throughout the report.

The principal archaeological archives relating to the MASA area are the National Record of the Historic Environment (NRHE) as held by HE and the National Monuments Record Wales (NMRW) as held by RCAHMW. Designated datasets from HE and Cadw were also reviewed, as was the dataset of remains designated under the Protection of Military Remains Act. Data from the United Kingdom Hydrographic Office (UKHO) is a further resource, of which MSDS Marine holds in house and is utilised to corroborate positional information of known wrecks and obstructions on the seabed. In addition, Historic Environment Record (HER) data was obtained from Clwyd-Powys Archaeological Trust (CPAT), who also provided National Museum of Wales (NMW) data. Merseyside HER data was also obtained. Additionally Historic Seascape Characterisation data was used (note the coverage of this dataset includes English waters only). Finally British Geological Survey (BGS) data was also obtained, and other published and unpublished sources were reviewed and incorporated.

Table 11.4: Summary Of Key Desktop Sources

Title	Source	Year	Author
Historic England (HE) designated data	Historic England	2023 (extract)	Multiple (national dataset)
Cadw designated data	Cadw	2023 (extract)	Multiple (national dataset)
List of wrecks designated under the Protection of Military Remains Act, 1986	https://explore-marine-plans.marineservices.org.uk/	2023 (viewed)	Multiple (national dataset)
Wrecks and Obstructions dataset	UKHO	2023 (extract)	Multiple (national dataset)
National Record of the Historic Environment (NRHE) data	Historic England	2023 (extract)	Multiple (national dataset)
Royal Commission on the Ancient and Historic Monuments of Wales (RCAHMW) data	RCAHMW	2023 (extract)	Multiple (national dataset)
Clwyd-Powys Archaeological Trust (CPAT) Historic Environment Record (HER) data including National Museum of Wales (NMW) data	CPAT	2023 (extract)	Multiple (regional dataset)
Merseyside HER data	Merseyside HER	2023 (extract)	Multiple (regional dataset)
Historic Seascape Characterisation	Maritime Archaeology and SeaZone	2011	Maritime Archaeology and SeaZone
Platform and Well Ground Model Consultancy Report | Liverpool Bay Offshore United Kingdom. Fugro, Boskalis, Eni	Fugro 2023, Phase 2b Platform and Well Ground Model Consultancy Report | Liverpool Bay Offshore United Kingdom. Fugro, Boskalis, EN	2023	Fugro
Geology of the seabed and shallow subsurface: The Irish Sea	British Geological Survey (BGS)	2015	Mellett *et al*.
United Kingdom Offshore Regional Report (ORR): The geology of the Irish Sea.	BGS	1995	Jackson *et al*.
Liverpool Bay Sheet 53°N-04°". 1: 250,000 Series: Seabed Sediments and Quaternary Geology	BGS	1984	BGS
Anglesey Sheet 53°N- 06°". 1: 250,000 Series: Quaternary Geology	BGS	1990	BGS
The West Coast Palaeolandscape Survey (WCPS)	Aggregate Levy Sustainability Fund (ALSF) report.	2011	Fitch S, Gaffney V, Ramsey E, and Kitchen E
Archaeological Assessment of Geophysical and Hydrographic Data.	Hy-Net Carbon Dioxide Transportation and Storage Project. Archaeological Assessment of Geophysical and Hydrographic Data. Report 2023/MSDS23250/1	2023	MSDS Marine

11.6.2 Site-specific surveys

In addition to the desk-based sources, a comprehensive marine geophysical survey was carried out for the Proposed Development. The survey comprised multi-beam bathymetry; side-scan sonar, magnetometer and sub-bottom profiler surveys, to inform a detailed understanding of the seabed anomalies, topography and underlying geological formations of the seabed. An archaeological review of the geophysical data has been carried out and is presented in MSDS Marine (2023) with a detailed summary in volume 3, appendix N. A summary of the surveys undertaken to inform the Marine Archaeology ES is outlined in Table 11.5.

Table 11.5: Summary Of Site-Specific Survey Data

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Sidescan sonar	Within the Area of Project Physical Work and Hoyle Bank	Sidescan Sonar survey to characterise seabed and existing assets	James Fisher Subtech (JFS), reviewed archaeologically by MSDS Marine	2022	James Fisher Subtech, 2022. LBA and CCS Acoustic Survey 2022. Ref: 12377-OPS-REP-002; MSDS Marine 2023 Hy-Net Carbon Dioxide Transportation and Storage Project. Archaeological Assessment of Geophysical and Hydrographic Data. Report 2023/MSDS23250/1
Multibeam	Within the Area of Project Physical Work and Hoyle Bank	Survey to characterise seabed and existing assets	James Fisher Subtech (JFS) reviewed archaeologically by MSDS Marine	2022	James Fisher Subtech, 2022. LBA and CCS Acoustic Survey 2022. Ref: 12377-OPS-REP-002; MSDS Marine 2023 Hy-Net Carbon Dioxide Transportation and Storage Project. Archaeological Assessment of Geophysical and Hydrographic Data. Report 2023/MSDS23250/1
Magnetometer	Within the Area of Project Physical Work and Hoyle Bank	Survey to characterise seabed and existing assets	James Fisher Subtech (JFS) reviewed archaeologically by MSDS Marine	2022	James Fisher Subtech, 2022. LBA and CCS Acoustic Survey 2022. Ref: 12377-OPS-REP-002; MSDS Marine 2023 Hy-Net Carbon Dioxide Transportation and Storage Project. Archaeological Assessment of Geophysical and Hydrographic Data. Report 2023/MSDS23250/1
Sub-bottom Profiler	Within the Area of Project Physical Work and Hoyle Bank		XOcean reviewed archaeologically by MSDS Marine	2022	XOcean 2022, 00469-SHW-ENG-BATH Project Results and Interpretation Report. 00469-SHW-ENG-BATH; MSDS Marine 2023 Hy-Net Carbon Dioxide Transportation and Storage Project. Archaeological Assessment of Geophysical and Hydrographic Data. Report 2023/MSDS23250/1

Further details on data collection, positioning, quality and limitations are included within the volume 3, appendix N, as are details relating to the methods used for the desk-based assessment and archaeological assessment

of geophysical and hydrographic data. These methods and sources have been used to undertake the baseline assessment, which is summarised in the following section 11.7.

11.7 Existing baseline description

The marine archaeology baseline includes consideration of:

- submerged prehistory and palaeolandscapes;
- maritime and coastal remains;
- aviation crash sites; and
- historic Seascape Character.

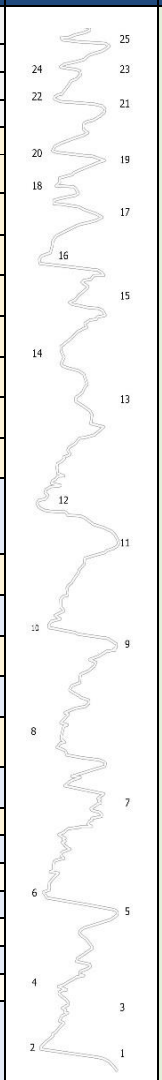
The main archaeological periods discussed in this report are listed in Table 11.6.

Table 11.6: Archaeological Periods And Dates Referred To In This ES

Broad Period	Sub-Period	Date
Palaeolithic	Lower	c.970,000 – 150,000 BP
	Middle	150,000 – 40,000 BP
	Upper	40,000 – 10,000 BP
Mesolithic	Early	8,000 BC – 7,000 BC
	Late	7,000 – 4,000 BC
Neolithic	Early	4,000 – 3,300 BC
	Middle	3,300 – 2,900 BC
	Late	2,900 – 2,200 BC
Bronze Age		2,600 – 700 BC
Iron Age		800 BC – 43 AD
Roman		43 – 410 AD
Early Medieval		410 – 1,066 AD
Medieval		1,066 – 1,540 AD
Post Medieval		1,540 – 1,901 AD
Modern		1,901 AD – Present

For the assessment of submerged prehistory, additional periods relating to Quaternary chronology are referred to. These are summarised in Table 11.7.

Table 11.7: Quaternary Chronology (Based On Historic England, N.D., With Dates From Lisiecki And Raymo, 2005)

Stage		Age		Climate	Marine Isotope Stage		Epochs and Periods		
Main	Sub.	Start	End		Stages	Record			
Beestonian		970,000	936,000	Interglacial	25		Pleistocene	Early Pleisto.	Lower Palaeolithic
		936,000	917,000		24				
		917,000	900,000	Interglacial	23				
		900,000	866,000	Stadial	22				
		866,000	814,000	Sequence poorly understood but evidence for a series of small expansions of the British Ice Sheet marking at least 4 interstadials and 5 warm episodes.	21				
		814,000	790,000		20				
Bruhnes-Matuyama reversal (c. 780kBP)		790,000	761,000		19			Middle Pleistocene	
Cromerian Complex		761,000	712,000		18				
		712,000	676,000		17				
		676,000	621,000		16				
		621,000	563,000		15				
		563,000	524,000		14				
		524,000	478,000		13				
Anglian		478,000	424,000	Stadial	12				
Hoxnian		424,000	374,000	Interglacial	11				Middle Palaeolithic
Wolstonian/ Saalian complex	Unnamed	374,000	337,000	Stadial?	10				
	Purfleet	337,000	300,000	Interglacial	9				
	Early	300,000	243,000	Stadial?	8				
	Aveley	243,000	191,000	Interglacial	7				
	Late	191,000	123,000	Stadial	6				
Ipswichian		123,000	109,000	Interglacial	5e			Late Pleistocene	
Devensian			109,000	96,000	Stadial	5d			
	Early	Chelford	96,000	87,000	Interstadial	5c			
			87,000	82,000	Stadial	5b			
		Brimpton	82,000	71,000	Interstadial	5a			
			71,000	57,000	Stadial	4			
	Mid	Upton Warren	57,000	29,000	Interstadial	3			
	Late	Dimlington	29,000	14,700	Stadial	2			Upper Pal
		Windemere	14,700	12,900	Interstadial				
		Loch Lomond	12,900	11,700	Stadial				
Holocene		11,700	Present	Interglacial	1		Holocene		Meso.

11.7.1 Summary of designated heritage assets

One designated heritage asset lies within the Area of Project Physical Work. This is:

- The Protected Wreck of the *Resurgam* (volume 3, appendix N). The *Resurgam* was an experimental submarine built in 1870. It is designated under the Protection of Wrecks Act 1973, and has an associated designated area with a 300 m radius. The wreck itself lies within the MASA but the designated circle extends to within the Area of Project Physical Work and Eni Development Area.

Two other designated heritage assets lie within the Study Area, but beyond the Area of Project Physical Work and the Eni Development Area. These are:

- The Scheduled wreck of the *Lelia*, a paddle steamer built in 1864 and associated with the British involvement in the American Civil War (volume 3, appendix N). It is designated under the Ancient

Monuments and Archaeological Areas Act 1979 and lies within the MASA, c. 10 m beyond the Eni Development Area boundary, on its eastern side.

- The Grade II Listed Point of Ayr Lighthouse, thought to have been built in c. 1776 (volume 3, appendix N). It is designated under the Planning (Listed Buildings and Conservation Areas) Act 1990, and lies c. 1 km to the east of the proposed Landfall site and Eni Development Area.

11.7.2 Summary of non-designated heritage assets

A series of non-designated heritage assets lie within the Area of Project Physical Work, Eni Development Area, and MASA. These are summarised below and are based on all available desk-based and geophysical data, tying in information from pre-existing datasets (Table 11.8) and the archaeological assessment of geophysical survey data undertaken as part of this project (MSDS Marine, 2023). Full details can be found within volume 3, appendix N. Magnetic anomalies are listed separately in volume 3, appendix N.

There are a total of 134 records within the MASA, 176 within the Eni Development Area, and 110 within the Area of Project Physical Work, giving a total of 420 records (including the three designated assets detailed above). The majority relate to heritage assets however, a number of geophysical anomalies have been interpreted as of being geological in nature. These are included in Table 11.8 below and gazetteer for completeness but are not considered further.

The remainder of the records include a range of wreck and potential wreck sites, other maritime remains (ranging from the remains of oil platforms to navigation beacons, unidentified obstructions, and other potential debris), palaeolandscape features, terrestrial features and records deriving from documentary evidence, including Named Locations (NLOs) of vessels lost in the area where there are currently no known seabed remains.

Table 11.8: Summary Of Non-Designated Heritage Assets

Broad Category	Type	Area of Project Physical Work	Eni Development Area	Study Area
Wreck remains	Wreck	2	30	20
	Wreck (possible)			1
	Wreck (probable)		1	
	Wreck or Ballast mound		1	
	Wreck or beacon		2	
	Wreck or debris		2	1
	Wreck or Wreckage (possible)		1	
	Wreck/Geology			1
	Wreckage		13	
	Possible wreck	3		6
	Possible wreck or cargo			2
	Possible wreckage		1	
Other maritime remains	Anchor, chain and cable		2	
	Beacon		3	
	Chain, Cable, or Rope	4		1
	Collapsed platform		1	
	Debris	5	3	3
	Debris - likely infrastructure	20		1
	Disused wartime tower			1

Broad Category	Type	Area of Project Physical Work	Eni Development Area	Study Area
	Fisherman's fastener		1	3
	Fishing gear	3		
	Tower		2	
	Foul		2	
	Geophysical anomaly - debris		1	2
	Geophysical anomaly - origin unknown		3	
	Geophysical anomaly - possible debris		2	
	Geophysical anomaly - potential anchor cable			1
	Mound	1		2
	Obstruction		3	2
	Obstruction: Non-submarine contact		3	2
	Pipe			1
	Platform		1	
	Possible oil rig leg		1	
	Potential debris	32	1	5
	Unidentified object			1
	Unidentified obstruction	9	75	3
	Unknown	1		
	Seabed disturbance	1		
	Linear feature	3		4
	Masonry			1
	Mattresses	2		
	Spoil ground		1	
Geological features	Geology	5	10	1
	Likely geological	14	1	2
Palaeolandscape Features	Glacial tunnel valley			1
	Footprints			1
Terrestrial and Coastal Features	Terrestrial - Anti-glider poles			1
	Terrestrial - boundary stone			2
	Terrestrial - Lifeboat house			1
	Terrestrial - Lighthouse			1
	Terrestrial - lifeboat station			1
	Terrestrial - lighthouse cottages			1
	Terrestrial - Pillbox			6
	Terrestrial - Summer camp			1
	Terrestrial asset - holiday park			1
	Terrestrial asset - lighthouse cottages			1
	Terrestrial asset - Swimming baths			1
	Terrestrial- slipway			1

Broad Category	Type	Area of Project Physical Work	Eni Development Area	Study Area
	Terrestrial - Event			3
	Terrestrial - Findspot			1
	Terrestrial - position in error	2	1	
	Test record.		4	
Documentary Records	NLO			1
	Aircraft (NLO)		2	7
	Wreck (NLO)	2	1	27
	Wreck (not found)	1	1	
	Navigational aid shown on historic maps			6
	Seascape			2
	Grand Total	**110**	**176**	**134**

11.7.3 Submerged prehistoric archaeology

The prehistoric archaeological record of the UK covers the period from the earliest hominin occupation, potentially as far back as 970,000 BP, to the end of the Iron Age and the Roman invasion of Britain by Claudius in AD 43. The coastline of the UK changed drastically during this period and large tracts of what is now the seabed were once subaerially exposed. The UK has been affected by several glacial events over the last 1 million years; including the Anglian (480 ka BP to 430 ka BP), the Wolstonian (350 ka BP to 132 ka BP), and the Devensian (122 ka BP to 10 ka BP), and intervening marine transgressions all of which have influenced archaeological potential.

Prehistoric archaeological potential is gauged with reference to evidence for human activity in the UK during each period, and the contemporary environment within the Site. Depositional environment and post-depositional factors are also key to understanding potential, and as such geological deposits present within the Site form an important consideration in understanding archaeological, palaeoenvironmental and palaeolandscape potential. Deposits with potential for prehistoric archaeological remains, or palaeoenvironmental information are generally those laid during periods of aerial exposure or by fluvial process, rather than sub-glacial or marine deposits. However, there is also potential for archaeological material to be redeposited or reworked within secondary contexts as a result of fluvial erosion or glacial processes (Hosfield and Chambers, 2004), this has been taken into account within the assessment.

Assessment of geophysical, geotechnical and desk-based sources has led to the identification of three main Quaternary units within the Site, overlying bedrock. The Quaternary units represent the environmental shift from glacially and proglacially dominated conditions of the Devensian (represented by Unit III and II), to later potentially pre-transgressional environments (possibly represented by Units II and I), followed by the modern active marine environment which characterises the Site today (Unit I). Full details are presented within volume 3, appendix N.

11.7.3.1 Middle and upper palaeolithic

Unit III and Unit II derive from these periods. Unit III is associated with the Cardigan Bay Formation, thought to have been laid down as a sub glacial deposit in the Wolstonian or Devensian glaciation. Unit III therefore holds very limited archaeological potential. However, material may survive on the surface of the unit where later subaerial exposure may have occurred.

Unit II represents the late Devensian Western Irish Sea A Formation. This unit is thought to reflect glacial, glaciomarine or deltaic/prodeltaic conditions during the Devensian, and evidence of channelling to the west of the Site may reflect outwash deposits or other glacial features which may extend to within the Site. The

inhospitable conditions represented by the bulk of the unit indicate limited archaeological potential, though the surface of the unit (if subaerially exposed following glacial retreat) may hold archaeological potential where not eroded by later forces. Palaeoenvironmental remains may also survive within this unit.

The chronology of landscape changes in the area during the Upper Palaeolithic to Mesolithic indicate the likelihood that the western half of the Site was submerged by 10k BP (by the end of the Upper Palaeolithic), with eastern areas and the cable route being submerged from 8k to 6k BP.

11.7.3.2 Mesolithic

Unit I is interpreted as the Surface Sands Formation. This formation includes two members. The lower (earlier) SL2 member, represents intertidal to marine environments. A borehole taken to the south-west of the Site produced evidence of reed beds dating to 9,200 BP within this member, indicating a potential pre-inundation land surface dating to the early Mesolithic. Landscape modelling by Fitch *et al.* (2011) also indicate potential for fluvial features within this Unit, which (when coupled with current sea level curve data) indicate potential within the eastern half of the Site from 10k BP. The southern part of the cable route also holds particular potential for Mesolithic remains, given the proximity of Mesolithic remains on the north west coastline (e.g. at Rhyl and early Neolithic middens within 1 km of the Landfall site). There is potential for both palaeoenvironmental and archaeological remains to be present within this unit, however, subsequent marine transgression has eroded the upper parts of this deposit, potentially affecting preservation. The Unit may also hold evidence of the modern marine sediments represented by the SL1 member of the Surface Sands Formation. There is potential for redeposited archaeological remains in this member.

11.7.4 Maritime and coastal remains

This section considers the potential for remains relating to coastal and maritime cultural landscapes defined as evidence of 'human utilisation of maritime space by boat, settlement, fishing, hunting, shipping and its attendant subcultures, such as pilotage, lighthouse and seamark maintenance' (Westerdahl, 1992). Remains considered therefore range from shipwrecks or other durable evidence such as cargos and ballast, to features including navigational aids, sailing marks, ports, harbours and jetties. Other coastal remains which do not necessarily relate to boat use are also considered, including fish traps and other evidence of human interaction with the sea or coast, such as coastal wartime features.

11.7.4.1 Prehistoric to Romano-British

While trade networks and maritime travel are evidenced throughout prehistory by the movement of ideas, goods and people, faunal assemblages indicate that maritime activities such as fishing were focused in coastal areas during the prehistoric and Roman periods, with limited evidence for marine exploitation from the Neolithic and throughout much of prehistory. Direct physical evidence of maritime craft dating to the prehistoric or Romano-British periods is very rare, though examples of watercraft exist from the Mesolithic period onward. There have been no finds of maritime remains dating to the prehistoric or Romano-British periods within the Area of Project Physical Work, Eni Development Area, or wider MASA. Mesolithic and later footprints and a findspot of a Roman brooch are recorded from the wider MASA, the former in the intertidal zone at Formby, and the latter at the mouth of the River Dee, indicating general activity in these periods (further supported by the presence of major Roman centres such as at Chester, c. 30 km south-east of the MASA, and other scattered settlement on the Wirral and North Wales coast (Allen *et al.,* 2016), though given the rarity of maritime remains the potential for such remains to occur within the Site is extremely limited.

11.7.4.2 Early medieval to medieval

Maritime technology and activity continued to develop in the early medieval and medieval periods. Invaders, and then settlers from Scandinavia and other areas brought new boat building technologies and opportunities for trade which led to the growth of a number of major ports around the coast of the UK (Hutchinson, 1997; Friel, 2003). In the north-west of England and North Wales activity in this period is attested to by place name evidence and historical records. A possible Norse ship has also been identified at Meols, c. 10 km east of the

MASA. The results of radiocarbon dating, and dendrochronology are awaited to confirm the date and origin of the vessel, however, its potential presence and the wider evidence of Scandinavian activity in the area demonstrates the potential for maritime activity in the area during this period.

During the medieval period major centres were active at Parkgate, Chester and Burton on the River Dee, and during the 13th century Liverpool, which had previously been a fishing village, developed trade routes across the Irish Sea, gradually increasing its dominance through trade, first with Ireland and later with other British colonies. More locally, the remains of the 12th century Prestatyn Castle have been excavated c. 650 m south of the MASA, indicating medieval activity in the area.

The early medieval and medieval periods were therefore characterised by increasing maritime activity within the area of the Site. However, while activity increased maritime finds from these periods are still rare. Additionally, no remains dating to these periods are known from within the Site or MASA, and the potential for any remains of maritime craft or coastal activity dating to these periods is considered to be limited.

11.7.4.3 Post-medieval to modern

Maritime activity increased during the post-medieval period, led by local trading ports such as Liverpool, which by the 17th century had seen vast expansion and was trading with British colonies around the world. Numerous historic trading routes, active in the post-medieval period, are thought to have crossed the Eni Development Area and Area of Project Physical Work (Alvarez-Palau and Dunn, 2019), mirrored by aids to navigation including the Point of Ayr Lighthouse (Grade II Listed), which lies within the MASA, 1 km west of the landfall site, and other navigational aids such as buoys are mapped on charts.

Potential for maritime remains therefore increases from the post-medieval period onward with the development of ports along adjacent coastlines, such as Liverpool, and increases in the number of shipping routes crossing the area. The modern period, with its increase in trade, transport and two World Wars also marks a period in which potential is increased, and the role of Liverpool in the convoy system in addition to other wartime activity increases potential in the area. In addition to these changes, developments in shipbuilding technology also occurred: vessels were increasingly constructed of iron (from the 18th century), and then steel, leaving more durable traces on the seabed which can be detected using modern survey techniques. Documentation of losses also increased, and a total of 30 records of lost vessels are recorded within the Area of Project Physical Work, Eni Development Area and MASA, with the majority (21 records) dating from the 19th century, and others dating from the 18th century (one record) and 20th century (seven records).

The potential for remains of these periods to occur within the Area of Project Physical Work, Eni Development Area and MASA is therefore relatively high, and is borne out by some of the recorded maritime sites, discussed below.

11.7.4.4 Known and recorded maritime and coastal archaeology

Assessment of geophysical data and desk-based sources has demonstrated the presence of maritime remains within the Area of Project Physical Work, Eni Development Area and MASA. The assessment has found evidence of wrecks and possible wreck sites, other maritime remains (ranging from debris, mounds potentially indicating wreck sites, remains of tower bases which are thought to represent the remains of anti-aircraft forts dumped after World War II (WWII), to modern infrastructure and unidentified obstructions), terrestrial and coastal features with evidence of wartime activity, navigational aids, documentary records demonstrating the loss of vessels within the area, and geological features. Of particular note, are the presence of:

- five sites indicating wreck remains within Area of Project Physical Work;
- fifty-one sites indicating wreck remains within the Eni Development Area;
- two sites representing possible tower bases which are thought to represent the remains of anti-aircraft forts dumped after WWII within the Eni Development Area;

- thirty one sites indicating wreck remains within the wider Study Area. The latter includes the position of a Protected Wreck (the *Resurgam*), the designated circle for which extends to within the Area of Project Physical Work and Eni Development Area;
- other remains including mounds (which could indicate wreck sites), debris, fouls of unknown origin, and other unidentified obstructions are also present within the Area of Physical Project Work and Eni Development Area; and
- magnetic anomalies of potential archaeological significance, including anomalies of high and medium potential (volume 3, appendix N). The origin of the anomalies is unknown, but they have potential to be of archaeological significance.

The majority of the wrecks are undated, but where dates are they demonstrate a focus on 19th and 20th century craft, which is also borne out by the documented losses within the area. All maritime and coastal remains are summarised within Table 11.8 and volume 3, appendix N.

The assessment has also found potential for other remains, including wartime coastal features and navigational aids. Pillboxes are present within the MASA around the Landfall site, though beyond both the Eni Development Area and Area of Physical Project Work. There are no known remains within the Eni Development Area and Area of Physical Project Work at the landfall site. The closest are low potential geophysical anomalies identified just offshore of the landfall location, seaward of the point where the Eni Development Area and Area of Physical Project Work widen.

The key known maritime remains are therefore those which occur below the low water mark, and include the wrecks and potential wreck sites enumerated above.

11.7.5 Aviation remains

There are no known aircraft crash sites within the Area of Project Physical Work, Eni Development Area or MASA. However, the assessment has identified potential for aircraft crash sites to occur, in particular associated with the use of Talacre Warren (which lies 1.5 km to the east of the landfall site) as a WWII Spitfire training camp. This potential is further demonstrated by records of nine documented losses of aircraft within the MASA and Eni Development Area, of which around half are Spitfires. While aircraft crashes tend to result in disarticulated remains, there is potential for remains of aircraft within the Area of Project Physical Work, Eni Development Area or MASA.

11.7.6 Historic seascape character

The assessment identified a variety of characteristics within the Eni Development Area and Area of Project Physical Work. These can be summarised as:

- modern installations and activities such as hydrocarbon wells, pipelines, submarine cables, aggregate extraction, spoil and waste dumping;
- a range of fishing methods used in the modern period;
- navigation routes, both modern and post medieval;
- wrecks and maritime debris (in some cases undated); and
- seabed types and characteristics including shoals and flats and fine sediment plains.

11.7.7 Data limitations

The key limitation to the assessment is the lack of full coverage geophysical data for the area, including within the Area of Project Physical Work and Eni Development Area. The current data coverage is discussed in detail in volume 3, appendix N, and the supporting archaeological assessment of geophysical survey data (MSDS Marine, 2023). This limitation has been recognised in this assessment and fed into the recommendations for further work or mitigation.

11.8 Key parameters for assessment

11.8.1 Maximum design scenario

11.8.1.1 Overview

Volume 1, chapter 3 contains a full description of the Proposed Development Description. In summary, the Proposed Development will include the following construction activities:

- installation of a new Douglas Carbon Capture and Storage (CCS) platform using up to eight pile driven legs;
- installation of new topsides on the Hamilton Main, Hamilton North, and Lennox wellhead platforms and associated use of jack-up barges and vessel anchoring;
- repurposing of the existing subsea natural gas pipelines;
- development of the Hamilton Main, Hamilton North and Lennox reservoirs for CO_2 storage through the drilling and re-completion of injection wells by side-tracking existing production wells. This will involve re-drilling the wells (within the existing footprints of former wells) and installing CO_2-resistant tubulars and cement;
- drilling of two new monitoring wells, one at Hamilton North (well ten at Hamilton North, 110/13/HN_M2_1) and one at Hamilton Main (Well nine at Hamilton North, 110/13/HM_M2_1);
- other monitoring and sentinel wells will be created through use of existing wells, with need for fibre optics to be confirmed;
- installation of new pipelines connecting the new Douglas CCS and the existing subsea natural gas pipelines. This will require insertion of a small section of pipeline, laid on the seabed, to tie the new Douglas CCS platform to the existing pipelines;
- installation of new submarine power cables connecting the Douglas Platform with the onshore terminal, and connecting the Douglas Platform with the Hamilton Main, Hamilton North and Lennox Platforms. In general these cables will follow existing pipelines at an offset of 100 m, though micrositing around heritage assets and Unexploded Ordnance (UXO) where required;
- installation of concrete mattresses and cable protection at crossings and in areas where cable burial is not possible; and
- potential wet storage of cables close to platforms.

In addition to the installation of new infrastructure, or the repurposing of existing infrastructure, impacts will arise from the anchoring or positioning of vessels or jack-ups. Additionally, an offshore accommodation flotel will be stationed adjacent to the New Douglas CCS platform during construction, commissioning, and start-up activities (in the operation and maintenance phase) with associated anchoring impacts.

Sand wave clearance will also be necessary in some areas, for pipeline installation potentially in the areas south of the Douglas Platform, and West Hoyle Bank. This will be undertaken with a mass flow excavator, or a jet sled. Sand waves are approximately 2 m and 3 m in height, and a corridor approximately 10 m in width would be created through them. If the West Hoyle Bank route is not chosen the alternative route passes further east through a tidal channel. If this option is chosen some pre-lay dredging would be required to allow for a self-beaching Cable Lay Vessel (CLV) to ground itself at low tide on a 'flat' area of sandbank. The area to be dredged in this scenario would be approximately 180 m length, 60 m wide and between 1 and 2 m below LAT.

The landfall connection will be made using Horizontal Directional Drilling (HDD). HDD will be used to pass under the Talacre dunes and exit seaward of the MHWS point, within the beach area.

The maximum design scenarios identified in Table 11.9 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected

from the Project Design Envelope (PDE) provided in volume 1, chapter 3. Effects of a greater adverse significance are not predicted to arise should any other design scenario, based on details within the PDE (e.g. different infrastructure layout), to that assessed here be taken forward in the final design scheme.

Operation and maintenance activities will take place for the 25 anticipated years of the project. The activities will include monitoring, for example for any unexpected leaks, additionally cable repair, pipeline maintenance, and associated surveys will also take place using supply and standby vessels. Well interventions will be undertaken from a jack-up barge.

Decommissioning will include removal of all installations and injection facilities, as well as other equipment, infrastructure and materials.

11.8.1.2 Areas of work

Two primary areas have been defined for the purposes of this application. These include:

- the Area of Project Physical Work; and
- the Eni Development Area.

A third area, termed the wider MASA, will undergo no direct impacts associated with the development. The Area of Project Physical Work will be the focus for all construction activities. The installation of new wells, cables and the Douglas Platform will all be within this area, as will associated seabed preparation activities including sand wave clearance and dredging, as well as boulder clearance. Existing platforms to be repurposed also fall within this area. While the installation of new infrastructure and the conversion of existing platform infrastructure will fall within this zone, associated impacts including from jack up barges and anchoring of vessels may occur within the wider Eni Development Area. As such, taking a precautionary approach, mitigation will be applied across both of these areas, ensuring appropriate and proportionate protection for the marine historic environment.

Table 11.9: Maximum Design Scenario

Potential impact	Maximum Design Scenario	Justification
Sediment disturbance and deposition leading to indirect impacts on marine archaeology receptors (the exposure or burial of receptors).	The potential changes to sedimentation have been Modelled in volume 3, appendix H, which identified seabed preparation, the drilling of monitoring wells, and the laying of cables to be the principal construction elements which have a bearing on sediment transport and sedimentation. *Construction Phase:* **Site preparation** • Sand wave clearance in two potential locations, south of the existing Douglas Platform and West Hoyle Bank area, with average heights of c.3 m and lengths of c.100 m and c.15 m respectively. Excavation of a 10 m wide corridor will be necessary. • Tidal channel preparation: If the West Hoyle Bank route is not chosen the alternative route passes further east through a tidal channel. If this option is chosen some pre-lay dredging would be required to allow for a self-beaching Cable Lay Vessel (CLV) to ground itself at low tide on a 'flat' area of sandbank. The area to be dredged in this scenario would be approximately 180 m length, 60 m wide and between 1 m and 2 m below Lowest Astronomical Tide (LAT). • Boulder clearance. **Platform installation** • Installation of new platform at Douglas using up to eight pile driven legs. Each pile will be approximately 1.5 m in diameter and 40.25 m in total length, with a penetration depth of around 22 m. • Installation of new topsides on the Hamilton Main, Hamilton North, and Lennox wellhead platforms (there will be no additional seabed impacts for this work, beyond use of jack up barges) **Well drilling and modifications** • Drilling of two new monitoring wells at Hamilton North (Well ten) and Hamilton Main (Well nine). The wells with both extend through the entire Quaternary sequence and into the bedrock. Jack ups to be used during drilling. • Existing well holes will be reused for carbon injection or used as sentinel wells. The wells will be prepared for CO_2 storage through the drilling and re-completion of injection wells by side-tracking existing production wells, and with well casings removed and CO_2 -resistant tubulars concrete lining being inserted. Side-tracking will be within the bedrock	The following activities have the potential to cause sediment disturbance and deposition leading to indirect impacts on marine archaeology receptors, through burial or erosion. *Construction phase:* **Site preparation** Sand wave clearance south of the Douglas Oil Platform (OP) and in the West Hoyle Bank Area are set to be undertaken across two sections where sand waves are present. To enable the laying of cables, a c.10 m wide corridor will be excavated using a mass flow excavator/jet sled, which will suspend sediment at the seafloor. South of the Douglas OP, suspended sediment is expected to be concentrated within 200 m of the seabed release (peak value of c.1,400 mg/l), though with finer sediment distributed further afield (up to 12 km away with maximum concentrations of <100 mg/l) volume 3, appendix H). Sedimentation is anticipated to occur within 8 km of the work, though with maximum values of <50 mm within 10 m of the point of excavation. At West Hoyle Bank in order to allow the laying of the cable directly across the feature, a dredged channel will be necessary. During clearance activities material will be side cast along the c.1,000 m length of channel and backfilled after cable installation. The trench width is expected to be c.21 m in width and c.7 m in depth. Maximum plume extents are expected to be within 25 km, to the south east, though the majority of the material is expected to fall adjacent to the dredged channel. Maximum suspended sediment values are modelled at 3,000-10,000 mg/l, however in most areas fall below 30 mg/l, and concentrations are generally <10 mg/l in the Eni Development Area. Sedimentation will be at its maximum values of c.5 m adjacent to the dredged channel, though may occur at negligible levels c. 8 km into the Dee Estuary. Boulder clearance activities will result in minimal increases in suspended sediment concentrations and have therefore not been considered in the assessment. **Platform installation** Piling for the new platform (Douglas) may cause some suspended sediment however the method chosen (driven piles) are not likely to result in significant suspended sediment.

Potential impact	Maximum Design Scenario	Justification
	and all works within the Quaternary sediment and on the seabed would be within the area of existing impacts. **Cable installation and pipeline works** • Installation of new fibre optic cables from the Point of Ayr (PoA) to Douglas OP. Two cables will be laid c. 30 m apart, each cable laid in an installation zone of c. 15 m in width for each cable. Cables will be primarily installed using a plough (not exceeding 15 m in impact width). The maximum depth is set at 3 m. Any cable protection will fall within this zone of impacts. • Installation of new inter-oil platform cables (Douglas – Hamilton; Douglas – Hamilton North; Douglas – Lennox). Two cables will be laid c. 30 m apart, each cable laid in an installation zone of c. 15 m in width for each cable. Cables will be primarily installed using a plough (not exceeding 15 m in impact width). The maximum depth is set at 3 m. Any cable protection will fall within this zone of impacts. A dynamic-positioning vessel is the preferred option for installation thus there will be no additional anchoring impacts. • Installation of new pipeline from the Douglas CCS to the existing subsea natural gas pipelines. • Potential wet storage of cables. • Existing pipelines will be utilised for CO_2 transmission. • Installation of concrete mattresses and cable protection at crossings and in areas where cable burial is not possible. **Vessel use** • Use of jack ups and vessel anchoring during construction, in addition to other vessels including a flotel. *Operation and maintenance:* • Project lifespan of c. 25 years. • Maintenance of platforms and infrastructure including removal of marine growth, replacement of anodes and painting or modifications to J tubes and ancillary structures. Associated impacts from vessel anchoring and potential jack up use. • Survey and repair events for cables and pipeline maintenance, and cable reburial • Well interventions • Jack up use and vessel anchoring during Operation and Maintenance (O&M) activities	**Well drilling and modifications** Drilling of new wells may lead to the discharge of sediments. The new wells will require drilling of two sections the first of which is a 26" opening in which the 20" conductor will be encased, and the second a deeper cutting to penetrate bedrock (Mercia Mudstones Group). The first section will clear c.30.48 m of sand and silt and the drilling of c.84.43 m of coarser sediment, expected to be Quaternary sediment. Suspended sediment is expected, with plumes at Hamilton Main and Hamilton North extending potentially 8 km from the drill sites, though the greatest sedimentation is seen within 50 m of the drill sites. At Hamilton Main, maximum concentrations across the plume can rise to a peak of c.360 mg/l, however maximum concentrations are generally are limited to <20 mg/l, reducing rapidly away from discharge location. Sedimentation is expected within 50 m of the drill sites, where values of up to c. 70 mm are anticipated, though generally sedimentation under 0.03 mm is expected further afield, within the range of the tidal ellipse. At Hamilton North maximum suspended sediment concentrations are limited to 500 mg/l in the direct vicinity of the drill site and are generally less than 5 mg/l across the rest of the plume (reaching up to 8 m from the drill site). The maximum sedimentation values are expected to be c. 100 mm within c. 50 m of the drill site. **Cable installation** Point of Ayr (PoA) to Douglas: Installation of this cable may result in suspended sediment up to 15 km from the cable installation, expected to be at c. <1 mg/l. Maximum suspended sediment concentrations are expected along the cable route itself, generally at <10,000 mg/l, increasing over the shallow West Hoyle Bank to 300,000 mg/l, peaking at c.640,000 mg/l. However, maximum sedimentation occurs within c.30 m of the cable route, limited to <300 mm of deposited material. Douglas to Lennox: Maximum suspended sediment concentrations occur within c.50 m the trenching route, with high mean values of <1,000 mg/l. The plume may extend over 15 km from the trenching route, though with suspended sediment at near background values. Maximum sedimentation is anticipated within 50 m of the cable route, with deposition limited to <50 cm (peak of c.32 cm). **Vessel use** Vessel use is not expected to cause significant changes to sedimentation. *Operation and Maintenance*

Potential impact	Maximum Design Scenario	Justification
	• Decommissioning: • Post-closure phase is anticipated to be c. 20 years in duration • Potential removal of infrastructure may cause impacts though these are likely to be within the footprint of existing impacts. • Jack up use and vessel anchoring during decommissioning, including use of cargo barges, anchor handling vessels and other support vessels.	The primary impact on sedimentation is likely to be from cable replacement, following the modelled case set out above for cable installation. Alteration of sediment transport regimes leading to potential erosion or burial of archaeological sites are considered below. *Decommissioning* The changes to sedimentation associated with decommissioning have not been modelled. However, changes to sediment transport and deposition are likely when removing infrastructure where this infrastructure has a seabed interaction.
Direct damage to marine archaeology receptors (e.g. wrecks, debris, submerged prehistoric receptors (palaeolandscapes and associated archaeological receptors)	*Construction Phase:* **Site preparation** • Sand wave clearance in two potential locations, south of the existing Douglas Platforms, with average heights of c.3 m and lengths of c.100 m and c.15 m respectively. Excavation of a 10 m wide corridor will be necessary. • Tidal channel preparation: If the West Hoyle Bank route is not chosen the alternative route passes further east through a tidal channel. If this option is chosen some pre-lay dredging would be required to allow for a self-beaching CLV to ground itself at low tide on a 'flat' area of sandbank. The area to be dredged in this scenario would be approximately 180 m length, 60 m wide and between 1 m and 2 m below LAT. • Boulder clearance. **Platform installation** • Installation of new platform at Douglas using up to eight pile driven legs. Each pile will be approximately 1.5 m in diameter and 40.25 m in total length, with a penetration depth of around 22 m. **Well drilling and modifications** • Installation of new monitoring wells at Hamilton North (Well ten) and Hamilton Main (Well nine). The wells with both extend through the entire Quaternary sequence and into the bedrock. Jack ups to be used during drilling. **Cable installation** Installation of new fibre optic cables from the PoA to Douglas OP. Two cables will be laid c. 30 m apart, each cable laid in an installation zone of c. 15 m in width for each cable. Cables will be primarily installed using a	Impacts including site preparation, platform installation, well drilling and modifications, cable laying and associated vessel use all have the potential to cause direct damage to archaeological remains on and within the seabed. These include known and potential maritime and coastal remains; potential submerged prehistoric landscapes and sites; and potential aviation remains. Maximum design parameters for operation, maintenance and decommissioning are not known but will be lower than for installation. Cable repair, remediation and reburial, well interventions and all associated vessel and jack up activities may cause impacts. Removal of infrastructure may cause impacts though these are likely to be largely within the footprint of existing impacts.

Potential impact	Maximum Design Scenario	Justification
	plough (not exceeding 15 m in impact width). Any cable protection will fall within this zone of impacts. Installation of new inter-oil platform cables (Douglas – Hamilton; Douglas – Hamilton North; Douglas – Lennox). Two cables will be laid c. 30 m apart, each cable laid in an installation zone of c. 15 m in width for each cable. Cables will be primarily installed using a plough (not exceeding 15 m in impact width). Any cable protection will fall within this zone of impacts. A dynamic-positioning vessel is the preferred option for installation thus there will be no additional anchoring impacts. Potential wet storage of cables. **Vessel use** • Use of jack ups and vessel anchoring during construction, in addition to other vessels including a flotel. *Operation and maintenance:* • Project lifespan of c. 25 years. • Maintenance of platforms and infrastructure including removal of marine growth, replacement of anodes and painting or modifications to J tubes and ancillary structures. Associated impacts from vessel anchoring and potential jack up use. • Survey and repair events for cables and pipeline maintenance, and cable reburial • Well interventions • Jack up use and vessel anchoring during O&M activities *Decommissioning:* • Post-closure phase is anticipated to be c. 20 years in duration • Potential removal of infrastructure may cause impacts though these are likely to be within the footprint of existing impacts. • Jack up use and vessel anchoring during decommissioning, including use of cargo barges, anchor handling vessels and other support vessels.	
Direct damage to coastal/intertidal archaeological remains through cable installation at the landfall site	*Construction* • Cable laying from the PoA to Douglas OP will involve cables making landfall around the Talacre dune system. The two cables will pass under the dunes (landward of MHWS) and will punch out within the intertidal zone. Horizontal Directional Drilling (HDD) will be used in construction, with the exit pits located just seaward of the MHWS mark. Associated impacts from vessels or beach vehicles may also be incurred.	Impacts to potential coastal and intertidal remains may be incurred during cable installation and associated activities in the intertidal zone.

Potential impact	Maximum Design Scenario	Justification
Alteration of sediment transport regimes leading to potential erosion or burial of archaeological sites	• Use of jack up barges during construction, operation and decommissioning may cause localised scour. *Operation and maintenance phase* • Installation of new platform at Douglas using up to eight pile driven legs. Each pile will be approximately 1.5 m in diameter and 40.25 m in total length, with a penetration depth of around 22 m. • Cables and associated cable crossings: the PoA to Douglas cables would require up to 16 crossings (eight per cable), with a width of c. 5 m and total length of 1,600 m along each cable route; and up to 10 crossings on two of the inter OP cables, with a width of c. 5 m at each area of cable protection and total length of 1,600 m per cable.	Alteration of sediment transport regimes are likely to happen primarily following construction, during the operation and maintenance phase. The Douglas OP installation and areas of cable protection provide the largest obstruction to flow in the water column (other platforms are already constructed and will be reused). Additional changes may be felt through use of jack up barges during all phases of the development. The changes have the potential to lead to indirect impacts on marine archaeology receptors, through burial or erosion.
Change of use has the potential to affect the Historic Seascape Character	• Change of use from an oil and gas field to a carbon capture and storage development.	Change of use has the potential to affect the Historic Seascape Character

11.8.2 Impacts scoped out of the assessment

On the basis of the baseline environment and the description of development outlined in volume 1, chapter 3, no impacts are proposed to be scoped out of the assessment for marine archaeology.

11.9 Methodology for assessment of effects

The marine archaeology impact assessment has followed the methodology set out in volume 1, chapter 5.

11.9.1 Impact assessment criteria

The criteria for determining the significance of effects is a two-stage process that 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 1, chapter 5.

Table 11.10: Definition of Terms Relating To The Magnitude Of An Impact

Magnitude of impact	Definition
High	Total loss of, or major alteration to, key elements/features of the baseline (pre-development) conditions such that post development character/composition/attributes will be fundamentally changed and may be lost from the site altogether.
Medium	Loss of, or alteration to, more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the 'no change' situation.
No change	No change from baseline conditions.

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; and
- value – a measure of the receptor's importance, rarity and worth.

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.

Based on HE's Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment (English Heritage, 2008) and Conservation Principles for the Sustainable Management of the Historic Environment in Wales (Cadw, 2011) 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.

HE's Ships and Boats: Prehistory to Present – Selection Guide (Historic England, 2017) sets a criteria of value to shipwrecks specifically that is 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 11.11, below.

Table 11.11: Definition of Terms Relating To The Value (And Therefore Sensitivity) Of The Receptor

Value	Definition
Very High	Singular or excellent example and/or significant 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 Protection of Wrecks Act 1973, Ancient Monuments and Archaeological Areas Act 1979 or Protection of Military Remains Act 1986 with an international dimension or 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 the Protection of Wrecks Act 1973, Ancient Monuments and Archaeological Areas Act 1979 or Protection of Military Remains Act 1986 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 following the Historic England Selection Guide (Historic England, 2017). 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 following the Historic England Selection Guide (Historic England, 2017). 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.

Value	Definition
	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 following the Historic England Selection Guide (Historic England, 2017). 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 11.12. Where a range of significance of effect is presented 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 2020 EIA Regulations and 2017 EIA regulations.

Table 11.12: Matrix Used For The Assessment Of The Significance Of 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 or Substantial
	Very High	Minor	Moderate or Major	Major or Substantial	Substantial

11.10 Embedded mitigation

For the purposes of the EIA process, the term ‘measures adopted as part of the project’ is used to include the following measures (adapted from IEMA, 2016):

- Measures included as part of the project design. These include modifications to the location or design envelope of the Project which are integrated into the application for consent. These measures are secured through the consent itself through the description of the development and the parameters secured in the consent for development and/or marine licences (referred to as primary mitigation in IEMA, 2016).
- Measures required to meet legislative requirements, or actions that are standard practice used to manage commonly occurring environmental effects and are secured through the consent for development and/or the conditions of the marine licences (referred to as tertiary mitigation in IEMA, 2016).

A number of measures (primary and tertiary) have been adopted as part of the Project to reduce the potential for impacts on marine archaeology. These are outlined in Table 11.13 below. As there is a secured commitment to implementing these measures for the Project, they have been considered in the assessment presented in section 11.11 (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). The measures adopted as part of the Project are captured in the Outline WSI and PAD submitted with the application.

Table 11.13: Measures Adopted As Part Of The Project

Measures adopted as part of the project	Justification	How the measure will be secured
Primary measures: Measures included as part of the project design		
The identification and implementation of AEZs around those sites identified as having high and medium archaeological potential (Table 11.14). Further details provided in the Outline WSI. Final cable routing, well drilling and platform construction to avoid any known archaeological constraints identified in pre-construction site investigation surveys through micro siting.	To avoid direct impacts on sites of identified archaeological significance.	Proposed to be secured through a condition in the marine licence(s).
The identification and implementation of Temporary Archaeological Exclusion Zones (TAEZs) based on all available information including the stated positional accuracy, the recorded size of the target and the potential archaeological significance around those records for wrecks, obstructions, debris and other sites of archaeological potential outside of the survey data coverage but within the Project boundary. TAEZs are recommended in Table 11.15. Further details provided in the Outline WSI.	To avoid impacts on sites of archaeological importance.	Proposed to be secured through a condition in the marine licence(s).
Archaeological input into specifications for, and archaeological analysis of, any further pre-construction geophysical and geotechnical surveys. Further details provided in the Outline WSI.	To identify any sites of archaeological importance that may require further investigation, avoidance or engagement with the archaeological curators. To offset the impacts of the Project on sediments of geoarchaeological/ palaeoenvironmental importance and enhance knowledge of the offshore marine archaeological resource.	Proposed to be secured through a condition in the marine licence(s).
Project archaeologists to be consulted in the preparation of any pre-construction Remotely Operated Vehicle (ROV)/diver surveys and, if appropriate, in monitoring/checking of data. Further details provided in the Outline WSI.	To identify any sites of archaeological importance that may require further investigation, avoidance or engagement with the archaeological curators.	Proposed to be secured through a condition in the marine licence(s).
Operational awareness of the location of those archaeological anomalies identified as having a low potential. Reporting through the agreed protocol (PAD) will be undertaken should material of potential archaeological	To identify any sites of archaeological importance that may require further investigation, avoidance or engagement with the archaeological curators.	Proposed to be secured through a condition in the marine licence(s).

Measures adopted as part of the project	Justification	How the measure will be secured
interest be encountered. Further details provided in the Outline WSI.		
Implementation of a protocol for recording finds of archaeological interest, following the guidance for the Protocol for Archaeological Discoveries (PAD).	To identify any currently unknown sites of archaeological importance that may require further investigation, avoidance or engagement with the archaeological curators.	Proposed to be secured through a condition in the marine licence(s).
Archaeologists to be consulted in the preparation of pre-construction cable route clearance or other pre-construction operations and, if appropriate, to carry out archaeological monitoring of such work. Further details provided in the Outline WSI.	To record archaeological remains that may be affected by pre-construction clearance operation.	Proposed to be secured through a condition in the marine licence(s).
Mitigation of unavoidable direct impacts on known sites of archaeological significance: Options include i) preservation by record; ii) stabilisation; iii) detailed analysis and safeguarding of otherwise comparable sites elsewhere. Further details provided in the Outline WSI.	To offset the effects of disturbance/destruction of irreplaceable archaeological remains.	Proposed to be secured through a condition in the marine licence(s).
Tertiary measures: Measures required to meet legislative requirements, or adopted standard industry practice		
Commitment to implementation of the Offshore WSI which is submitted with this application, prior to any post-consent works within the Eni Development Area and Area of Physical Project Works.	The Outline WSI is submitted alongside the application and contains a method statement for pre-construction surveys and details of monitoring requirements. The PAD will ensure the protection and, if necessary, recording of previously unknown sites/objects of archaeological significance affected by the development.	Proposed to be secured through a condition in the marine licence(s).

11.10.1 Archaeological exclusion zones

Best practice favours the preservation *in situ* of archaeological remains, therefore the ideal preferred mitigation for archaeological remains is avoidance (COWRIE, 2007). For the Project, AEZs have been proposed that prohibit development-related activities within their extents, which vary depending upon the nature of the site. The final development layout will take into account these preliminary zones, which may evolve or be removed (with the agreement of Cadw and HE) as the Project progresses, subject to layout designs and additional subsequent surveys that may be required.

All AEZs agreed with the archaeological curators, through the Offshore WSI, will be marked on the Design Plan. If impacts cannot be avoided, measures to reduce, remedy or offset disturbance will be agreed.

In view of their potential archaeological significance, AEZs (either in the form of individual AEZs or clusters) will be placed around the nine locations which include the Protected Wreck of the *Resurgam*, and Scheduled wreck of the *Lelia*, both of which have statutory designated areas, included here as AEZs. The others represent high and medium potential anomalies identified by the geophysical data assessment. These anomalies have been recommended AEZs based on the size of the anomaly, the extents of any debris, the potential significance of the anomaly, the potential impact of the development and the seabed dynamics within the area.

Dependant of the form of the anomaly, AEZs have either been recommended as a radius from the centre point of the anomaly or as a distance from the extents. Particularly in the case of shipwrecks, which tend to be longer in length than width, the use of a circle provides unequal protection around the extents. This not only impacts the protection afforded but does not present proportional mitigation.

The proposed AEZs are listed in Table 11.14 and shown in Figure 11.1 to Figure 11.3. Scope is allowed for their amendment in light of further evidence and with the involvement of consultees. Currently, planned cable routes bisect a number of Archaeological Exclusion Zones. There is therefore a commitment to either investigate AEZs and refine the extents of AEZs where appropriate; and/or to re-route around these AEZs and to collect and assess data from the wider area to do so (ensuring that impacts do not take place before archaeological assessment of full-coverage geophysical data has been conducted, including on any deviations to the cable routes necessary to avoid AEZs). This work will take place prior to any seabed impacts in the area, and there will be no impacts to finalised AEZs during construction, operation, maintenance and decommissioning activities. Further details of AEZs and archaeological monitoring are provided in the Outline WSI and PAD.

The designated wreck of the *Resurgam* and the statutory protected area (Statutory Instrument 1996 No. 1741), have been included within this section. Whilst the wreck lies outside of the Eni Development Area and the Area of Project Physical Work the statutory protected area extends into these areas. To note, the designated area is not centred on the location of the wreck as provided by UKHO (detailed in Table 11.14), the location of the designated area is presented in Figure 11.1. Likewise, the scheduled wreck of the *Lelia* has also been included. Both the wreck and the designated circle lie within the Study Area, but due to proximity to the Eni Development Area the site has been included here to ensure awareness.

Table 11.14: Archaeological Exclusion Zones

MSDS_ID	Geophysical ID	Description	Easting (ED50 UTM30N)	Northing (ED50 UTM30N)	AEZ (m)	Type
E_001		*Resurgam*. Protected Wreck. Submarine	463157.66	5916617.67	300	Radius (not centred)
E_002		*Lelia*. Scheduled. Paddle Steamer	474625.65	5926786.95	50	Radius
E_005	CCS23_052	Wreck	475696.8	5914362.7	75	Extents

MSDS_ID	Geophysical ID	Description	Easting (ED50 UTM30N)	Northing (ED50 UTM30N)	AEZ (m)	Type
E_006	CCS23_020	Potential wreck	461786.6	5933019.5	75	Extents
E_010	CCS23_054	Mound	472907.1	5915455.1	25	Extents
E_095	CCS23_092	Debris	461580.3	5928986.4	25	Extents
E_096	CCS23_094	Debris	476748.4	5914455.3	15	Radius
E_097	CCS23_095	Debris	476667.2	5914598.3	15	Radius
E_098	CCS23_104	Debris	476023.9	5937756.2	50	Extents

11.10.2 Temporary archaeological exclusion zones

Sixty-seven TAEZs have been recommended within the Eni Development Area and Area of Physical Project Work. TAEZs are recommended where an anomaly is not visible in the geophysical dataset but is known to exist based on information from other datasets (e.g. UKHO data), where the position cannot be determined with enough accuracy for refined exclusion zones, or where the extents are not fully known. They are often larger than AEZs but are identified as temporary as they are highly likely to be altered following higher resolution or full coverage data assessment, or investigation with an ROV, however, they will remain in place until alterations have been formally agreed.

TAEZs have been assigned where remains are thought to be of medium, high or uncertain archaeological potential. All wreck remains which lie within the Area of Physical Project Work and Eni Development Area, listed in Table 11.8, have been recommended either AEZs or TAEZs. Other maritime remains including wreck sites or potential wreck sites, wreckage, the two potential WWII anti-aircraft towers, and unidentified fouls, obstructions, debris and magnetic anomalies have been recommended for TAEZs where they are considered to be of potential high or medium archaeological significance or where the significance is as yet unknown. Those remains which have not been recommended for protection by a TAEZ have been excluded following assessment which has determined their low archaeological potential. This is the case for maritime remains including chain cable or rope, collapsed oil platforms, likely infrastructure, fishing gear, concrete mattresses and other similar remains. Other remains which have not been recommended for protection by a TAEZ have been excluded where assessment has determined an unlikelihood of remains being present at the given location (e.g. fisherman's fastenings and unidentified obstructions connected with records of fisherman's fastenings, unidentified non-submarine contacts, and spoil ground, the extents of which are unknown). All terrestrial assets (see summary in Table 11.8) lie beyond the Area of Physical Project Work and Eni Development Area, and are therefore not recommended AEZs. Likewise documentary records are not recommended for TAEZs due to the low likelihood of physical remains at the given locations. In summary, the assessment has determined the following groupings of remains, and has made the following recommendations:

Remains identified as of high archaeological potential, which have been recommended TAEZs:

- Wrecks, wreckage and wreck remains.

Remains identified as of medium archaeological potential within the geophysical assessment, which have been recommended TAEZs:

- debris;
- mounds; and
- two potential WWII anti-aircraft towers.

Unidentified remains with uncertain archaeological interest, which have been recommended TAEZs. These include:

- fouls;
- obstructions; and
- magnetic anomalies of high and medium archaeological potential.

Remains identified as of low archaeological potential within the geophysical assessment or by the desk-based assessment which have not been recommended AEZs/TAEZs:

- debris and potential debris;
- beacons (discarded navigation beacons);
- geophysical anomalies (debris and origin unknown);
- unknown anomalies;
- seabed disturbance; and
- linear features.

Modern elements with no archaeological interest which have not been recommended AEZs/TAEZs. These include:

- anchor, chain and cable and chain, cable or rope;
- collapsed platforms;
- platforms;
- possible oil rig leg;
- debris (likely infrastructure);
- fishing gear; and
- concrete mattresses.

Remains where the extents or positions are unknown or questionable which have not been recommended AEZs/TAEZs:

- unidentified obstructions and fisherman's fasteners;
- obstruction classed as a Non – Submarine Contact (NSC); and
- spoil ground.

The above bullet points account for all remains within the Eni Development Area and Eni Area of Physical Project work, detailed in Table 11.8.

The size of the TAEZs takes into consideration the proximity of available survey data, the potential to represent material of archaeological significance, the perceived accuracy of the position, and other anomalies that may be present within the surrounding area. Anomalies and their recommended exclusion zones are detailed in Table 11.15 and the distribution presented in Figure 11.1, with detailed distributions in Figure 11.4 to Figure 11.8.

Table 11.15: Temporary Archaeological Exclusion Zones

MSDS TR ID	Geophysical ID	Type	Easting (ED50 UTM30N)	Northing (ED50 UTM30N)	AEZ (m)	AEZ Type
E_013		Wreck	461936.409	5930419.47	150	Radius
E_016		Wreck	465945.894	5930704.11	150	Radius

MSDS TR ID	Geophysical ID	Type	Easting (ED50 UTM30N)	Northing (ED50 UTM30N)	AEZ (m)	AEZ Type
E_017		Wreck	464004.008	5930992.88	150	Radius
E_018		Wreck	462622.612	5930132.13	150	Radius
E_019		Wreck	464944.288	5931135.99	150	Radius
E_020		Wreck	465748.985	5928944.17	150	Radius
E_021		Wreck	463219.551	5931000.8	150	Radius
E_022		Wreck	463335.604	5930295.26	150	Radius
E_023		Wreck	464473.676	5930268	150	Radius
E_025		Wreck	479313.151	5938753.4	150	Radius
E_026		Wreck	475854.121	5942736.87	150	Radius
E_027		Wreck	471718.371	5941023.76	150	Radius
E_030		Wreck	466862.893	5930172.27	150	Radius
E_031		Wreck	464452.733	5934664.68	150	Radius
E_032		Wreck	474292.184	5942705.61	150	Radius
E_033		Wreck	473631.371	5942010.22	150	Radius
E_034		Wreck	473171.832	5942226.08	150	Radius
E_035		Wreck	473101.251	5941451.39	150	Radius
E_036		Wreck	473268.123	5942491.94	150	Radius
E_037		Wreck	467864.906	5939373.83	150	Radius
E_038		Wreck	468907.256	5938563.4	150	Radius
E_040		Wreck	470529.796	5939325.49	150	Radius
E_043		Wreck	487647.245	5944174.28	150	Radius
E_044		Wreck	491021.934	5939923.43	150	Radius
E_045		Wreck	465747.155	5931230.86	150	Radius
E_048		Wreck	474120.979	5942040.87	150	Radius
E_052		Wreck	490156.377	5937636.74	150	Radius
E_054		Wreck	465936.149	5926795.95	50	Radius
E_058		Wreck	473841.365	5933249.41	150	Radius
E_059		Wreck	473159.973	5945159.62	150	Radius
E_060		Wreck (probable)	464763.209	5930562.51	50	Radius
E_061		Wreck or ballast mound	480201.187	5946851.51	50	Radius
E_062		Wreck or debris	464336.382	5929649.71	50	Radius
E_063		Wreck or debris	473072.826	5941685.19	50	Radius
E_065		Wreck or beacon	473179.159	5940423.67	50	Radius
E_066		Wreck or beacon	473009.024	5941134.83	50	Radius
E_070		Possible wreck	475487.923	5914655.71	50	Radius
E_071		Possible wreck	476423.397	5914374.67	50	Radius
E_077		Wreck or wreckage (possible)	473394.939	5941332.89	50	Radius
E_078		Wreckage	473064.822	5942019.01	50	Radius
E_079		Wreckage	473389.805	5942176.62	50	Radius
E_080		Wreckage	473345.743	5942182.43	50	Radius
E_081		Wreckage	470165.918	5939914.9	50	Radius

MSDS TR ID	Geophysical ID	Type	Easting (ED50 UTM30N)	Northing (ED50 UTM30N)	AEZ (m)	AEZ Type
E_082		Wreckage	473371.504	5941477.66	50	Radius
E_083		Wreckage	473320.944	5942089.94	50	Radius
E_084		Wreckage	474352.147	5942547.71	50	Radius
E_085		Wreckage	473458.147	5941397.43	50	Radius
E_086		Wreckage	473598.255	5939846.47	50	Radius
E_087		Wreckage	474751.24	5938506.9	50	Radius
E_088		Wreckage	474431.873	5942248.7	50	Radius
E_089		Wreckage	473195.497	5941352.57	50	Radius
E_090		Wreckage	473230.141	5941433.96	50	Radius
E_091		Possible wreckage	473391.011	5941223.52	50	Radius
E_093		Debris	473446.026	5941399.36	50	Radius
E_094		Debris	474424.38	5942693.77	50	Radius
E_179		Tower	468297.634	5940854.15	50	Radius
E_180		Tower	473671.771	5938796.54	50	Radius
E_188		Obstruction	480525.477	5938531.93	25	Radius
E_194		Foul	473550.442	5939581.58	25	Radius
E_195		Foul	473170.608	5939698.7	25	Radius
E_421	CCS23_M206	Magnetic anomaly	475824.1	5914015.1	25	Radius
E_422	CCS23_M220	Magnetic anomaly	473906.2	5915305.7	25	Radius
E_423	CCS23_M221	Magnetic anomaly	468331.6	5916557.8	25	Radius
E_424	CCS23_M235/237	Magnetic anomaly	473810.2	5915328.8	50	Radius
E_425	CCS23_M268	Magnetic anomaly	461729.3	5928916.4	25	Radius
E_426	CCS23_M199	Magnetic anomaly	476341.72	5914668.39	25	Radius
E_427	CCS23_M215	Magnetic anomaly	476634.56	5914622.8	50	Radius

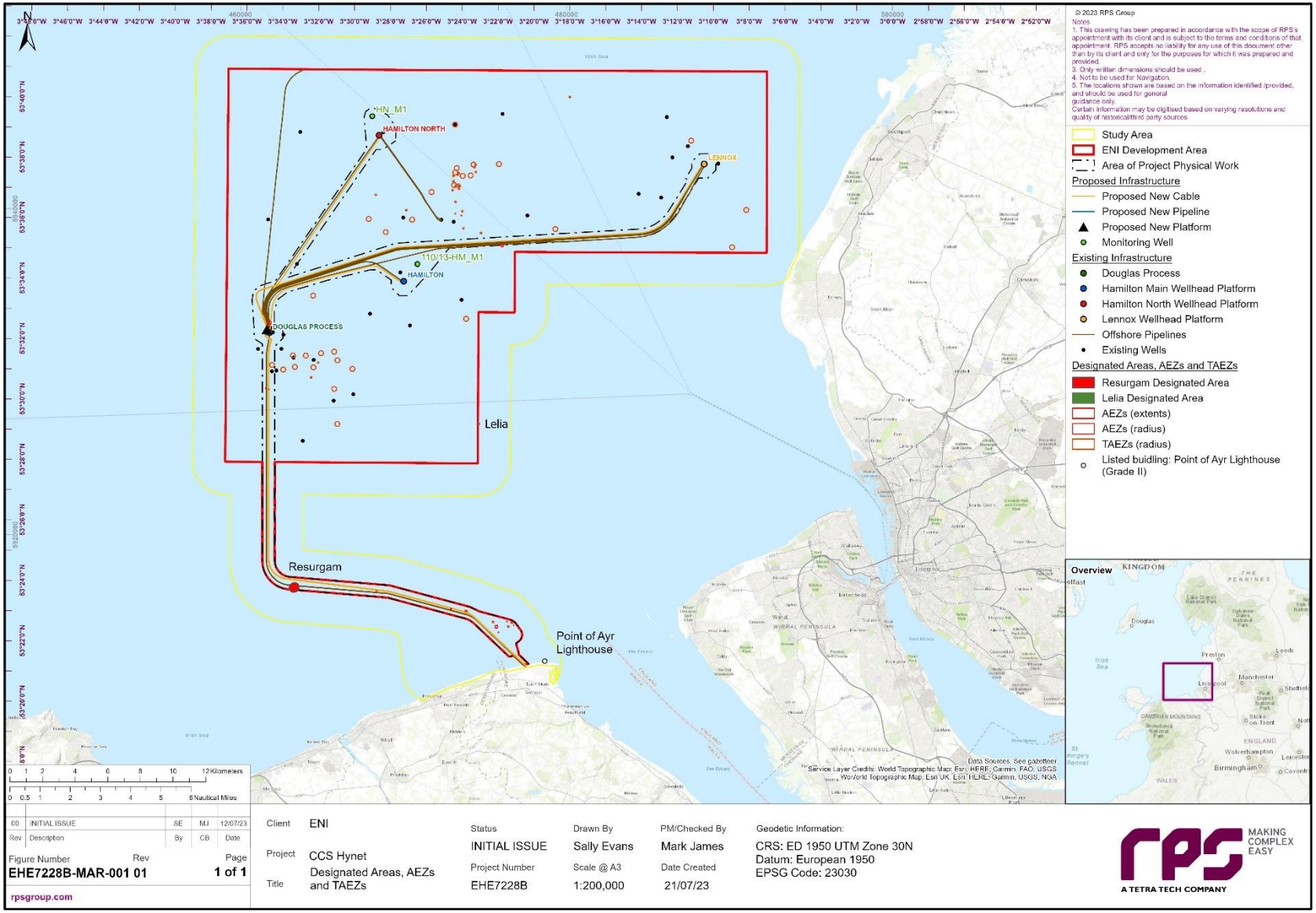


Figure 11.1: Distribution Of All Designated Areas, AEZs And TAEZs

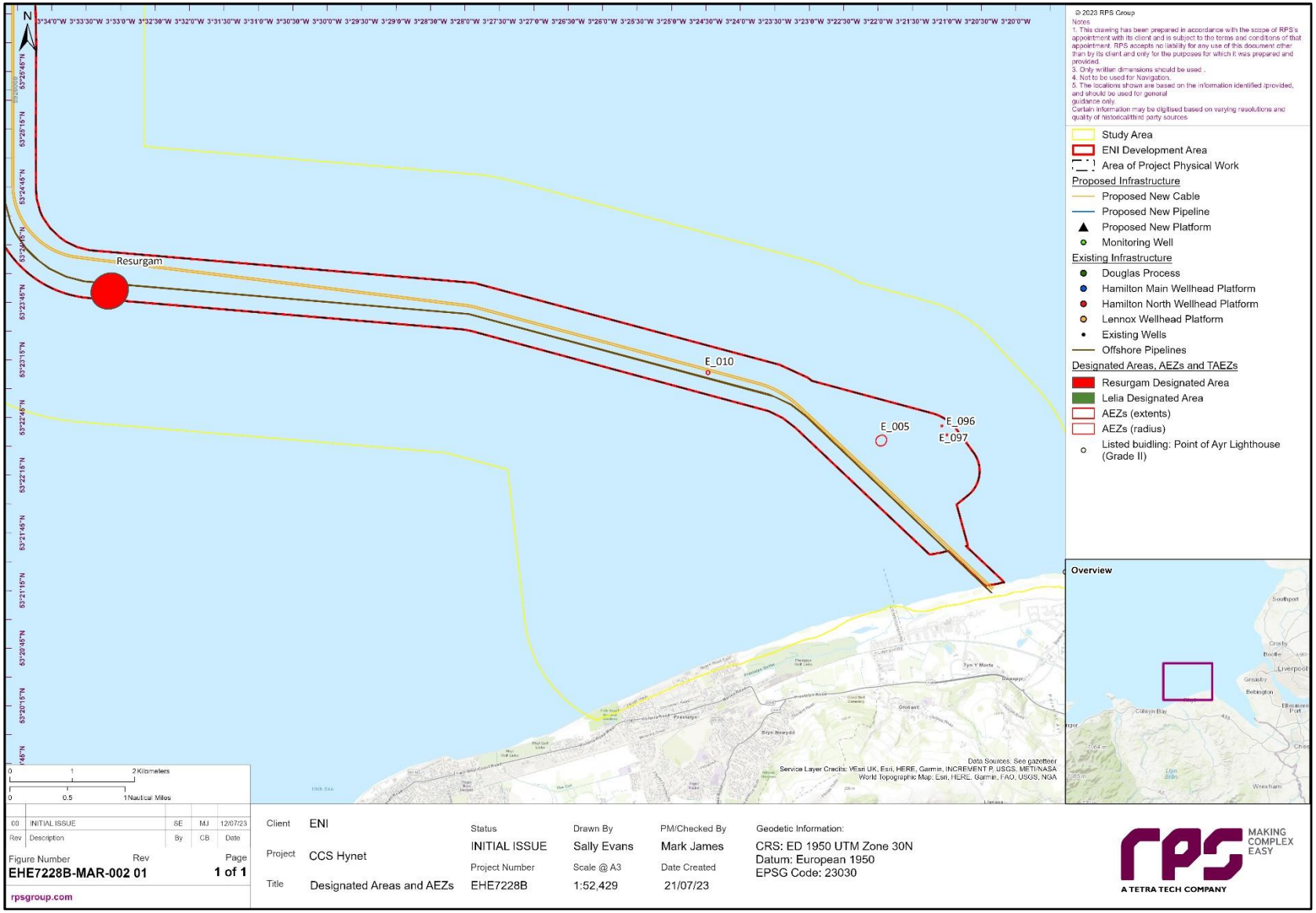


Figure 11.2: Distribution Of All Designated Areas And AEZs (south)

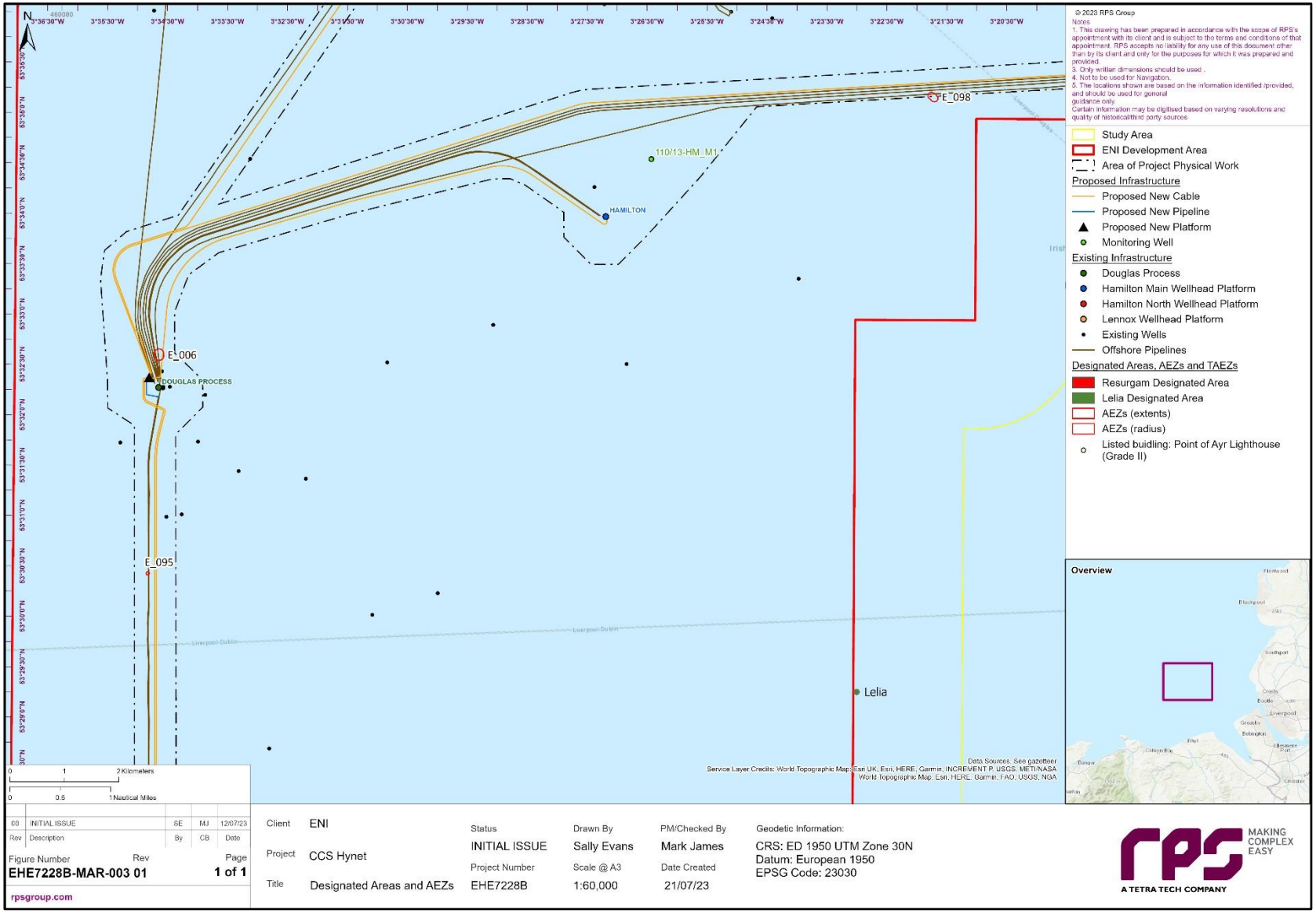


Figure 11.3: Distribution Of All Designated Areas And AEZs (north)

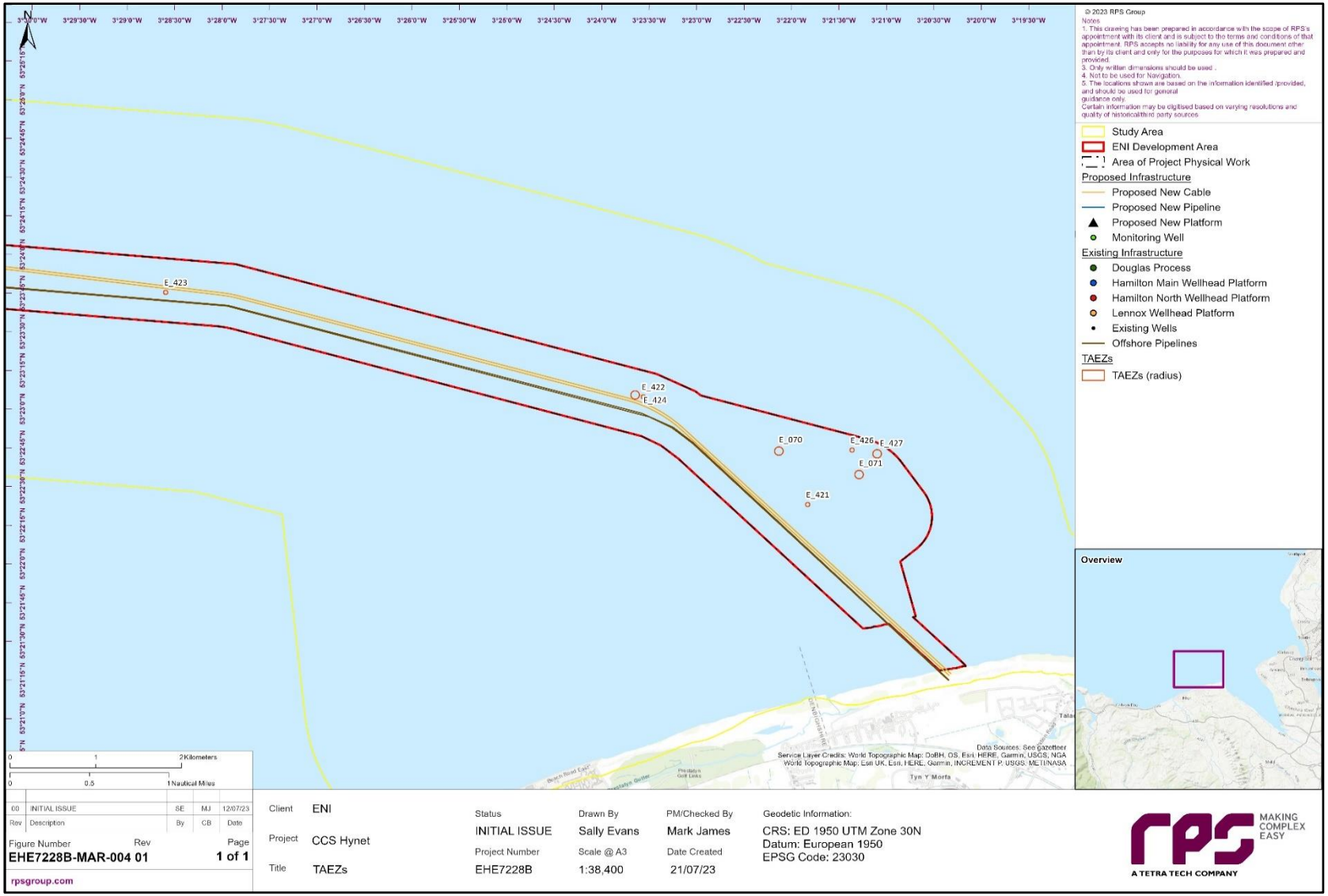


Figure 11.4: Distribution Of TAEZs (Southern Cable Route And Landfall)

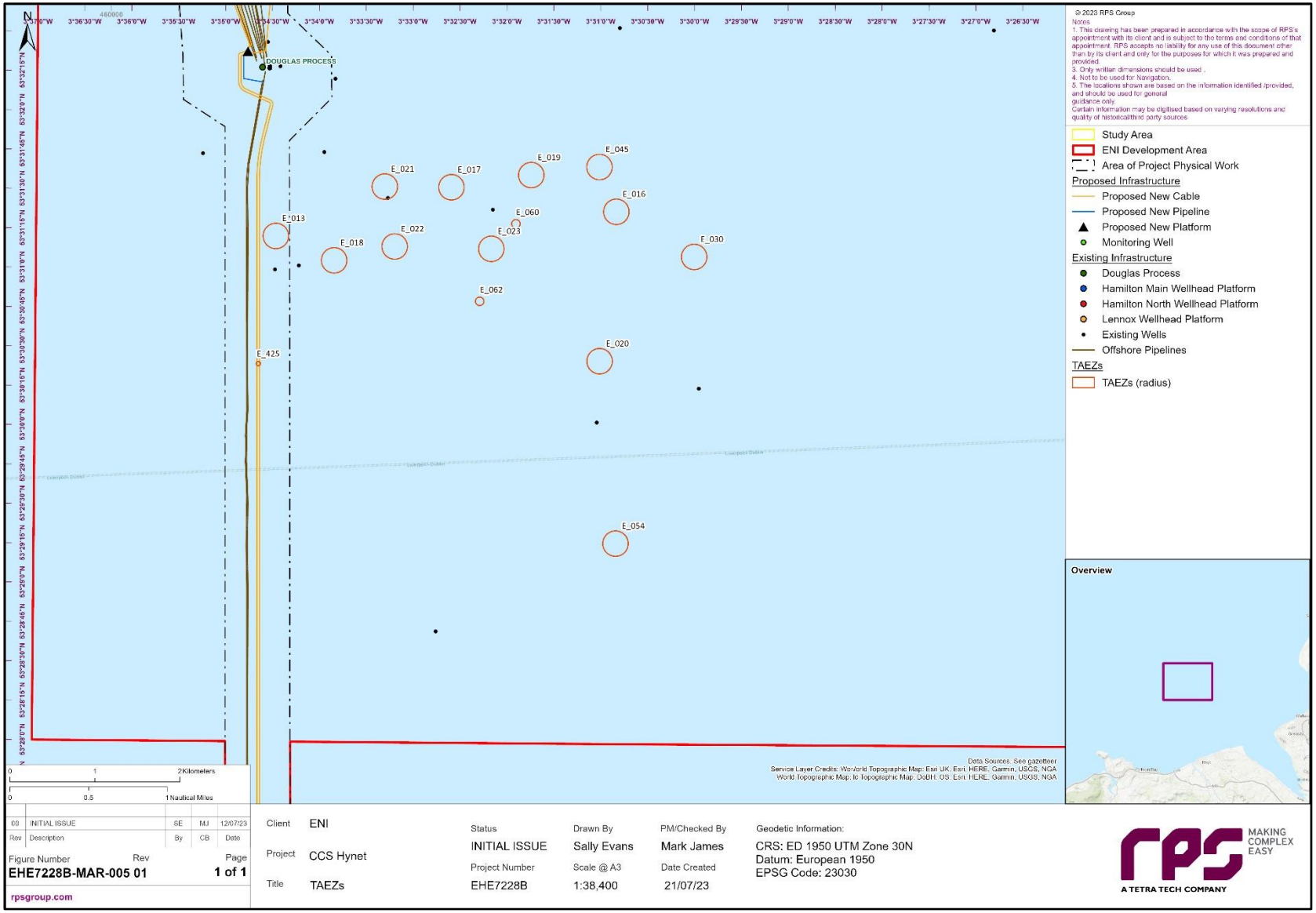


Figure 11.5: Distribution Of TAEZs (South Of Douglas Platform)

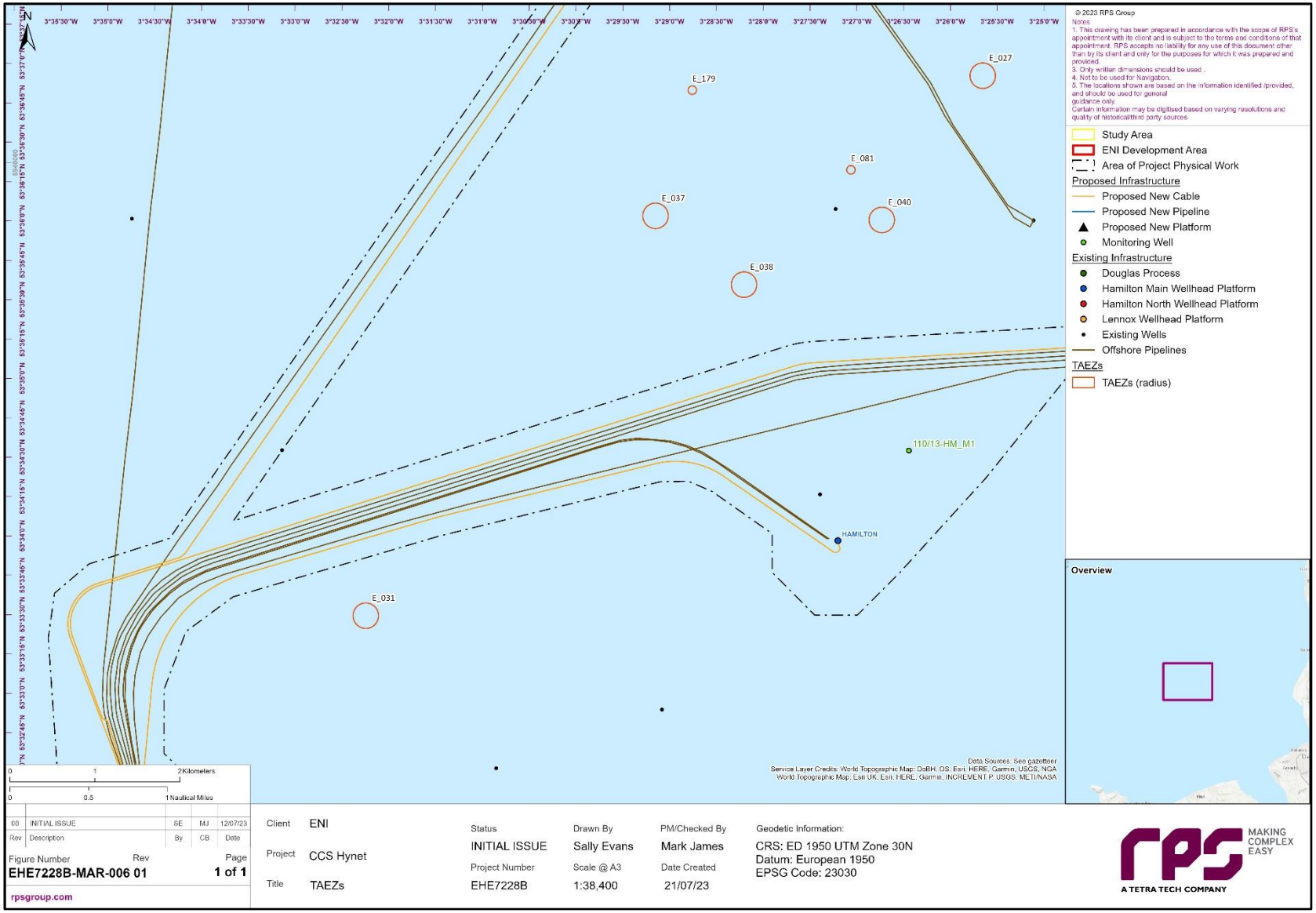


Figure 11.6: Distribution Of TAEZs (North Of Douglas Platform)

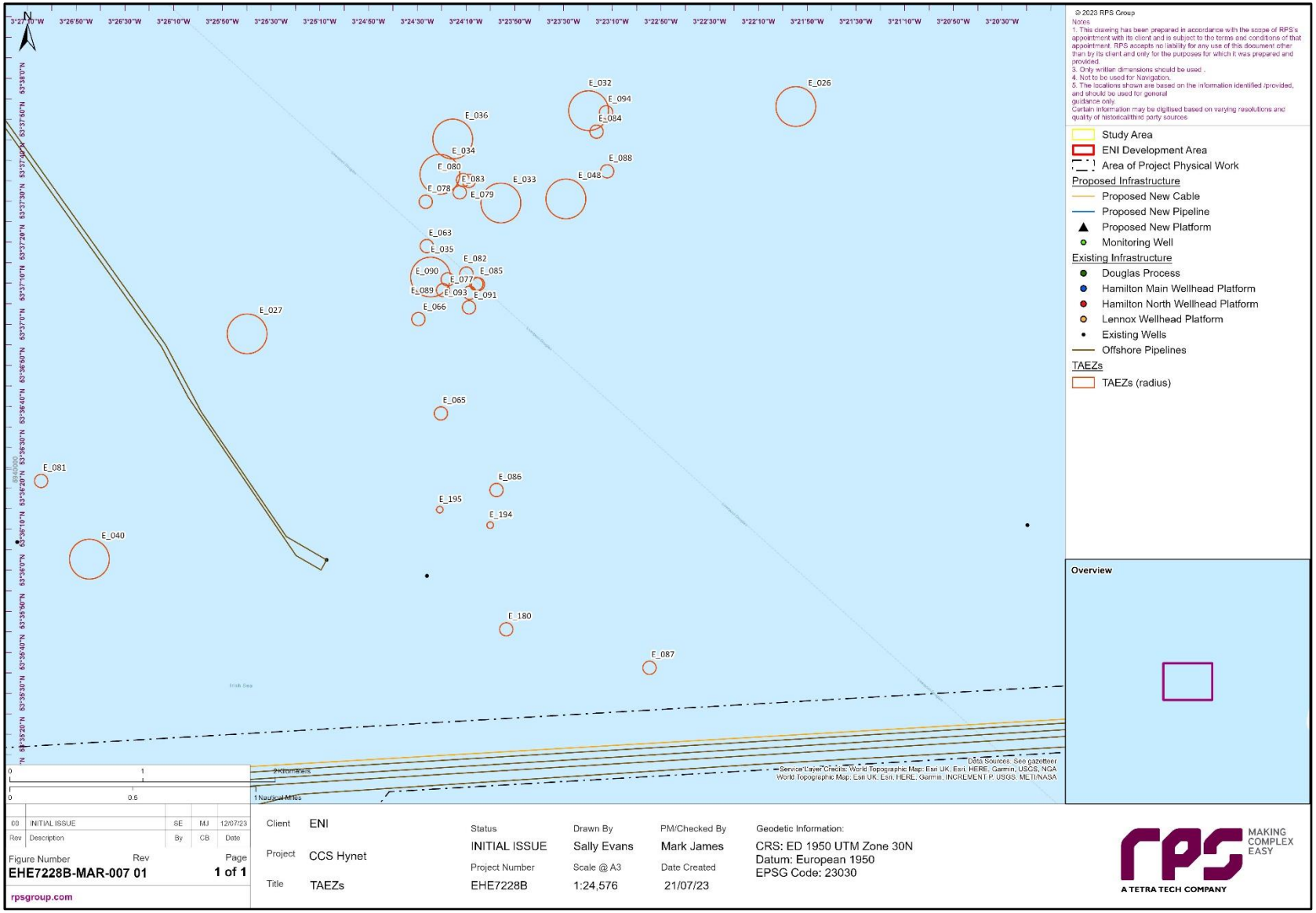


Figure 11.7: Distribution Of TAEZs (Between Hamilton Platforms)

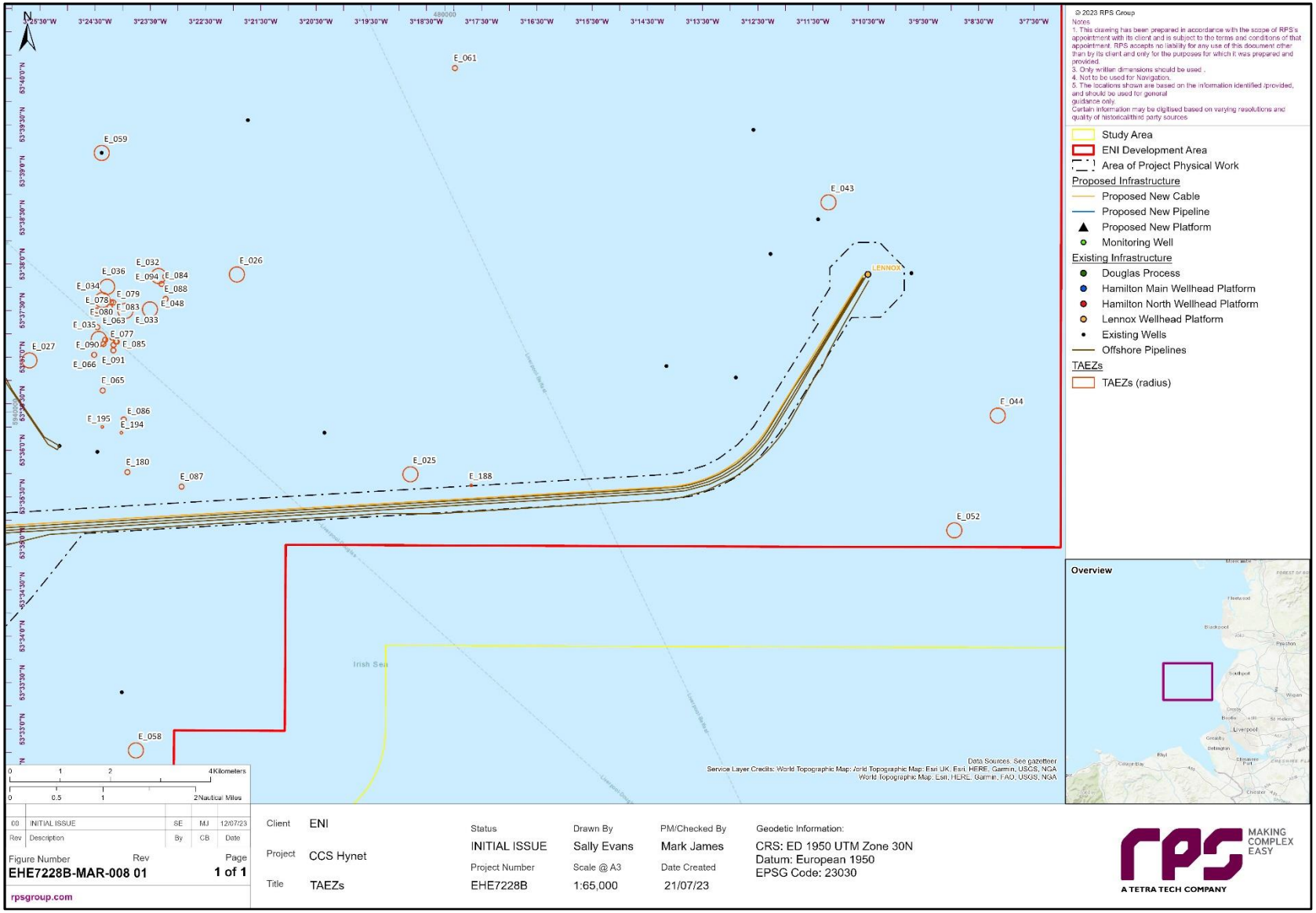


Figure 11.8: Distribution Of TAEZs (Eastern Area To Lennox Platform)

11.10.3 Preservation by record

Where preservation *in situ* is not practicable, disturbance of archaeological sites or material will be offset by appropriate and satisfactory measures, also known as 'preservation by record'. In these circumstances, the effects of the Project will be offset by carrying out excavation and recording prior to the impact occurring (COWRIE, 2007.

It is likely that previously unknown wrecks, archaeological sites or material may only be encountered during the course of the construction, maintenance and/or decommissioning of the Project. Procedures will therefore be put in place to allow for such eventualities.

A protocol for reporting finds of archaeological interest will be followed, in line with The Offshore Renewables PAD (The Crown Estate, 2014). This will involve the reporting of archaeological discoveries made during the lifetime of the Project. This protocol covers the reporting and investigating of unexpected archaeological discoveries encountered during construction, operations and maintenance and decommissioning activities, informed by the guidance of a marine archaeologist specialised in working with PADs for offshore wind farm projects. This protocol further makes provision for the implementation of TAEZs around areas of possible archaeological interest, for prompt archaeological advice and, if necessary, for archaeological inspection of important features prior to further construction, maintenance or decommissioning activities in the vicinity. It complies with the Merchant Shipping Act 1995, including notification to the Receiver of Wrecks, in accordance with the Code of Practice for Seabed Developers (Joint Nautical Archaeology Policy Committee (JNAPC), 2006). The PAD will be submitted as part of the Outline WSI at application.

11.11 Assessment of significance

The impacts of the construction, operations and maintenance, and decommissioning phases of the Project have been assessed on marine archaeology. The potential impacts arising from the construction, operations and maintenance and decommissioning phases of the Project are listed in Table 11.9 along with the maximum design scenario 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.

11.11.1 Sediment disturbance and deposition leading to indirect impacts on known archaeological receptors

The construction, operations and maintenance and decommissioning of the Project may lead to sediment disturbance and deposition leading to indirect impacts on marine archaeology receptors. The maximum design scenario is represented by sand wave clearance and dredging, platform installation, well drilling and modifications and cable installation and is summarised in Table 11.9.

The disturbance of sediment/seabed deposits can result in the exposure of known marine archaeology receptors (i.e. wreck sites) and the exposure of as yet unknown wreck sites and associated materials. Such activities can also result in the burial of known receptors.

11.11.1.1 Construction, operation, maintenance and decommissioning phase

Magnitude of impact

The potential changes to sedimentation have been modelled in volume 3, appendix H, which identified seabed preparation, the drilling of monitoring wells, and the laying of cables to be the principal construction elements which have a bearing on sediment transport and sedimentation. Full details of the construction activities which will result in sediment disturbance and deposition are provided in Table 11.9.

These construction activities will disturb the seabed, resulting in sediment being released into the water column and subsequently redeposited. Impacts of sediment disturbance and deposition have the potential to expose

previously unrecorded marine archaeology receptors, and also to bury or partially bury known marine archaeology receptors, resulting in the potential for direct impacts on marine archaeology assets located on or within the seabed.

The changes to sediment transport and deposition are set out in detail within volume 3, appendix H and are summarised in Table 11.9, and below. The physical processes studies found that during site preparation activities ahead of cable installation, including sand wave clearance in two potential locations, south of Douglas OP, and at West Hoyle Bank, sediment transport and sedimentation would be altered from the baseline. Modelling demonstrated that suspended sediment for the former would be at its maximum levels within 200 m of the seabed release with a peak value of c.1,400 mg/l at the point of mobilisation. Finer sediments would be carried further within the tidal ellipse, with maximum concentrations of <100 mg/l. These plumes may extent c. 12 km west to east. All sedimentation would occur within 8 km of the work, with maximum deposition limited to <50 mm within 10 m of the point of excavation.

At West Hoyle Bank, dredging through a channel to allow cable installation was modelled. This showed that suspended sediment would have a maximum plume of 25 km, reaching southeast to the mouth of the River Dee. Maximum suspended sediment values were modelled at 3,000-10,000 mg/l however in most areas fall below 30 mg/l, and concentrations are generally <10 mg/l in the Eni Development Area. Sedimentation may occur at maximum values of c.5 m adjacent to the dredged channel with average sedimentation values outside of the dredge path generally limited to <50 mm, and <10 mm. Sedimentation may occur at negligible levels c. 8 km into the Dee Estuary.

If the West Hoyle Bank route is not chosen the alternative route passes further east through a tidal channel. If this option is chosen some pre-lay dredging would still be required to allow for a self-beaching CLV to ground itself at low tide on a ‘flat’ area of sandbank. The area to be dredged in this scenario would be approximately 180 m length, 60 m wide and between 1 m and 2 m below LAT. This is likely to cause suspended sediment and sedimentation, though the values have not been modelled.

Drilling operations for the insertion of two new monitoring wells at Hamilton Main and Hamilton North will also result in suspended sediment and sedimentation. The new wells will require drilling of two sections the first of which is a 26” opening in which the 20” conductor will be encased, and the second a deeper cutting to penetrate bedrock (Mercia Mudstones Group). The first section will clear c.30.48 m of sand and silt and the drilling of c.84.43 m of coarser sediment, expected to be Quaternary sediment. Suspended sediment is expected, with plumes at Hamilton Main and Hamilton North extending potentially 8 km from the drill sites. At Hamilton Main, maximum concentrations across the plume can rise in excess of 300 mg/l to a peak of c.360 mg/l, however maximum concentrations are generally are limited to <20 mg/l, reducing rapidly away from the drill site discharge location. Sedimentation is expected within 50 m of the drill sites, where values of up to c. 70 mm are anticipated, though generally sedimentation under 0.03 mm is expected further afield, within the range of the tidal ellipse. At Hamilton North maximum suspended sediment concentrations are limited to 500 mg/l in the direct vicinity of the drill site and are generally less than 5 mg/l across the rest of the plume (reaching up to 8 m from the drill site). The maximum sedimentation values are expected to be c. 100 mm within c. 50 m of the drill site, with much lower values settling within the plume area as at Hamilton Main.

Cable laying activities would also lead to suspended sediment and sedimentation. The effects of these installations on sediment transport and sedimentation have been modelled, assuming cables are trenched (the maximum design scenario). Modelling was undertaken for two representative routes: The PoA to Douglas route, and the Douglas OP to Lennox route. Other cable route installations are anticipated to have a similar effect. The PoA to Douglas cable is expected to result in sediment up to 15 km from the cable installation, however, sment transport within the wider area (15 km from the cable route) is expected to be at c. <1 mg/l. Maximum suspended sediment concentrations are expected along the cable route itself, generally at <10,000 mg/l, increasing over the shallow West Hoyle Bank to 300,000 mg/l, peaking at c.640,000 mg/l. Maximum sedimentation occurs within c.30 m of the cable route, and is limited to <300 mm of deposited material, with the deepest sedimentation close to the cable route. Physical processes for the Douglas OP to Lennox cable have also been modelled, finding that maximum suspended sediment concentrations occur within c.50 m the trenching route, with high mean values of <1,000 mg/l. The plume may extend over 15 km from the trenching

route, though with suspended sediment at near background values. Maximum sedimentation is anticipated within 50 m of the cable route, with deposition limited to <50 cm (peak of c.32 cm).

The primary impact on sedimentation during the operation and maintenance phase is likely to be from cable replacement, following the modelled case set out above for cable installation. Alteration of sediment transport regimes leading to potential erosion or burial of archaeological sites are considered below.

The changes to sedimentation associated with decommissioning have not been modelled. However, changes to sediment transport and deposition are likely when removing infrastructure where this infrastructure has a seabed interaction.

Additional changes to sedimentation may come from other activities including vessel anchoring and use of jack up barges, in addition to other works summarised in Table 11.9. While these other works may mobilise small amounts of sediment, the primary elements which are considered to have a bearing on sediment transport and deposition have been detailed above (seabed preparation, the drilling of monitoring wells, and the laying of cables).

Following the works suspended sediments would return to baseline levels, within a couple of days. Thus the changes would be temporary.

Sediment disturbance and deposition has the potential to impact archaeological sites. While changes in sediment transport and sedimentation have been noted, modelling indicates an increase in sediment suggesting coverage rather than exposure of archaeological sites, which may afford protection to sites in many cases. Thus, while this increase in sedimentation may affect known archaeological receptors, including those within AEZs and TAEZs, the increases may afford protection to the sites. Embedded mitigation measures also set out procedures in the case of exposure of sites. The principal mitigation measure is implementation of a protocol for reporting finds of archaeological interest, ensuring the recording, assessment and investigation or protection of new sites where warranted.

The indirect impacts on marine archaeology receptors during the construction, operations and maintenance and decommissioning of the Project is predicted to be of local spatial extent, short term duration (though impacts from sediment deposition may be longer term), intermittent and medium reversibility. It is predicted that the impact will affect marine archaeology indirectly and may result in a benefit to sites, through additional burial, though this is likely to be limited in extent. Exposure of sites is mitigated through use of the protocol for reporting finds of archaeological interest. Overall, and with embedded mitigation in place, the magnitude is considered to be **low.**

Sensitivity of the receptor

Palaeolandscape and submerged prehistoric remains

Assessment has led to the identification of three main Quaternary units within the Site, representing the environmental shift from glacially and proglacially dominated conditions of the Devensian (represented by Unit III and II), to later potentially pre-transgressional environments (possibly represented by Units II and I), followed by the modern active marine environment which characterises the Site today (Unit I). Units III and II hold low archaeological potential in general, though material may survive on the surface of the unit where later subaerial exposure may have occurred and where later erosion has not removed such evidence. Unit I may hold both palaeoenvironmental and archaeological potential, however, subsequent marine transgression has eroded the upper parts of this deposit, potentially affecting preservation of any prehistoric sites. Potential for redeposited remains has also been identified.

Palaeolandscape and palaeoenvironmental remains do not tend to warrant designation in most cases and are not considered highly significant in general They may, however, be capable of contributing to our understanding of palaeolandscapes following the Last Glacial Maximum. Such deposits could hold evidential value within their palaeoenvironmental remains, sea level data and dating evidence, which is considered a priority by research frameworks including People and the Sea (Ransley *et al*., 2013). The deposits may therefore be capable of addressing priorities within these agendas, and therefore may be considered to hold

a moderate level of value. In contrast, submerged prehistoric sites are rare and, depending on the level of survival and nature of the remains, may be of up to high value. However, no such sites or palaeoenvironmental remains are known within the Eni Development Area or Area of Project Physical Work.

New sites may be exposed through erosion. Burial may also affect any sites which are currently already buried. Any such items would be unable to adapt to, tolerate, or recover from the impact where erosion to take place. The sensitivity of the receptors are therefore considered to be high.

Maritime and coastal remains

Potential for remains of wreck sites and other maritime and coastal remains has been defined as increasing during the post-medieval and modern periods, in association with increased trade, transport, wartime activity and changes in vessel construction. The assessment has also found evidence of other maritime remains ranging from debris, mounds potentially indicating wreck sites, remains of tower bases which are thought to represent the remains of anti-aircraft forts dumped after WWII, to other unidentified geophysical anomalies. The assessment has also found potential for other remains, including wartime coastal features and navigational aids (see Table 11.8 for a summary).

Wrecks

The value of a wreck, site or find, is case specific, dependent upon age, historical importance and rarity, and under the right conditions, wrecks can be of high value. These items are unable to adapt to, tolerate, or recover from the impact, except in the case of burial. The sensitivity of the receptors are therefore considered to be high.

Other maritime remains

Other maritime remains are discussed above. The majority are of low archaeological potential (see summary in Section 11.7), however, debris and mounds which may represent wreck-related remains have also been identified, and could be of up to medium archaeological value. Likewise, two potential WWII anti-aircraft towers have also been identified. These may hold evidential and historical value, though limited as they are not thought to be *in situ* (the records indicate dumped remains), and therefore a medium value is considered appropriate. Other remains including fouls and obstructions have an unknown value, and a range of magnetic anomalies with high and medium values are recorded.

Given the recorded maritime history of the area there is potential for other remains which may also be of up to high value. These items are unable to adapt to, tolerate, or recover from the impact, except in the case of burial. The sensitivity of the receptors are therefore considered to be medium to high.

Aviation remains

The assessment also found potential for remains of aviation crash sites, in particular for Spitfires and other wartime crash sites, though none are currently recorded within the Eni Development Area of Area of Project Physical Work. Such sites can be of high value, with certain aircraft automatically designated under the Protection of Military Remains Act. As with wrecks these remains are unable to adapt to, tolerate, or recover from the impact, except in the case of burial. The sensitivity of the receptors are therefore considered to be high.

Significance of the effect

The measures adopted as part of the Project outlined in Table 11.13 include measures to ensure that any newly exposed archaeological assets are recorded. These measures include implementation of a protocol for reporting finds of archaeological interest, ensuring identification, recording and mitigation for new sites where appropriate.

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptors is considered to be medium to high. Based on professional judgement, the effect will, therefore, be of **minor** significance, which is not significant in EIA terms. Additionally, the effects may benefit the receptors through additional burial.

11.11.2 Direct damage to known archaeological receptors

The seabed activities to facilitate the construction, operations and maintenance and decommissioning of the Project have the potential to impact both maritime archaeology receptors and submerged prehistoric receptors within the Eni Development Area and Area of Physical Project Work.

11.11.2.1 Construction, operation, maintenance and decommissioning phase

Magnitude of impact

Direct impacts to the seabed during construction will include sand wave clearance at two potential locations (south of Douglas OP and at West Hoyle Bank), leading to clearance of sand waves with average heights of c.3 m and lengths of c.100 m and c.15 m respectively at the two locations. Excavation of a 10 m wide corridor will be necessary at each location, in preparation for cable installation. Additionally, if the West Hoyle Bank route is not chosen the alternative route passes further east through a tidal channel. If this option is chosen some pre-lay dredging would be required to allow for a self-beaching CLV to ground itself at low tide on a 'flat' area of sandbank. The area to be dredged in this scenario would be approximately 180 m length, 60 m wide and between 1 and 2 m below LAT. Construction will also involve installation of a new platform at Douglas using up to eight pile driven legs. Each pile will be approximately 1.5 m in diameter and 40.25 m in total length, with a penetration depth of around 22 m. Additionally, two new wells will be drilled, to maximum depths of 3,000 and 3,200 m respectively, and new cables will be inserted. The cables from the PoA to Douglas OP will include two cables laid c. 30 m apart, each cable laid in an installation zone of c. 15 m in width. Cables running between oil platforms will also be inserted, again with two cables laid c. 30 m apart, each cable laid in an installation zone of c. 15 m in width. All cables will be primarily installed using a plough (not exceeding 15 m in impact width). In addition to the construction of new infrastructure, direct seabed impacts will occur through use of jack up vessels and anchoring of other vessels. These activities are likely to be focused around the new infrastructure, all within the Area of Project Physical Work, but may also extend into the Eni Development Area. Anchoring and jack up impacts may also be felt in areas where existing infrastructure is to be modified for use under the Project, including the existing oil platforms and wells. Other impacts may arise from the wet storage of cables and boulder clearance.

The maximum design parameters for operation, maintenance and decommissioning are not known but will be lower than for installation. Cable repair, remediation and reburial may cause impacts, as may well interventions and all associated vessel and jack up activities. Removal of infrastructure during decommissioning may also cause impacts though these are likely to be largely within the footprint of existing impacts.

These activities have the potential to directly and permanently impact upon marine archaeology receptors on the seabed, including maritime remains, and those that lie concealed below the covering sands including potential submerged prehistoric landscapes. These activities also have the potential to expose previously unrecorded marine archaeology receptors. However, embedded mitigation has already been applied to avoid and mitigate impacts. The relevant embedded mitigation includes:

- Establishment of AEZs and TAEZs around wrecks, and archaeological remains of potential high and medium significance, including potential wrecks, wreckage, debris, mounds, potential remains of WWII aircraft towers, obstructions and fouls. Full details of the AEZs and TAEZs is included in section 11.10.1.. No installation activities or other activities which would impact the seabed (including vessel anchoring etc) will take place within these zones, unless permitted by Cadw and HE. Modifications to AEZs based on new or additional data will also be agreed with Cadw and HE prior to any impacts on the seabed. Currently, planned cable routes bisect a number of AEZs. There is therefore a commitment to either investigate AEZs and refine the extents of AEZs where appropriate; and/or to re-route around these AEZs and to collect and assess data from the wider area to do so (ensuring that impacts do not take place before archaeological assessment of full-coverage geophysical data has been conducted, including on any deviations to the cable routes necessary to avoid AEZs). This work will take place prior to any seabed impacts in the area, and there will be no impacts to finalised AEZs during construction, operation, maintenance and decommissioning activities.

- Archaeological input into specifications for, and archaeological analysis of, any further pre-construction geophysical and geotechnical surveys:
  - From the geotechnical perspective, geoarchaeological assessment will accompany planned geotechnical works. This will follow a staged process, and accepted guidance. Further details will be set out within the Outline WSI. Survey specific method statements will be appended to the WSI and approved by HE prior to the commencment of any site investigation.This will be the mechanism for ensuring impacts to the submerged prehistoric landscape are understood and mitigated.
  - From the geophysical perspective, there will be input into and review of geophysical survey data by an experienced marine archaeological geophysicist. New data will be collected ensuring full coverage of the Area of Project Physical Work prior to any seabed impacts. This includes collection and review of any data where micrositing of cables leads to re-routing through areas in which there is no data coverage. Additionally, due to re-routing around the designated area associated with the Protected Wreck *Resurgam*, the planned cable routes currently pass through an area in which full coverage data has not yet been assessed. This data is in collection and will be assessed prior to any seabed impacts.
- Implementation of a protocol for recording finds of archaeological interest, following the guidance for the PAD. This will ensure identification and appropriate protection or investigation of sites of archaeological importance which are currently unknown.

With the embedded mitigation in place, the magnitude of impact, which will be of local spatial extent, long term (permanent) duration and with no reversibility, is considered to be low.

Sensitivity of receptors

The value of the receptors including known wrecks and other maritime remains, potential palaeolandscape remains and submerged prehistoric sites, and potential aviation crash sites, has been discussed in detail above (see section 11.11.1). The marine archaeology receptors are deemed to be of high vulnerability to direct damage, low recoverability and of varying value, up to high value. The sensitivity of the receptors is therefore considered to be up to high.

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. Based on professional judgement and following implementation of embedded mitigation, it is considered that the effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

11.11.3 Direct damage to coastal/intertidal archaeological remains through cable installation at the landfall site

Magnitude of impact

Cable laying from the PoA to Douglas OP will involve cables making landfall around the Talacre dune system. The two cables will pass under the dunes (landward of MHWS) and will punch out within the intertidal zone. HDD will be used in construction, with the exit pits located just seaward of the MHWS mark. These activities, and associated cable laying across the intertidal zone, have the potential to impact remains which lie between the low and high water marks. Associated impacts from vessels or beach vehicles may also be incurred.

Neither of the new cables will cross or impact upon any known archaeological sites within this zone. However, evidence of wartime activity in the form of pillboxes has been identified along this section of the coast, with the nearest recorded pillbox located c. 150 m from the proposed cable routes, within the MASA (volume 3, appendix N). Potential for associated wartime remains is present within the intertidal zone.

Additionally, potential for crashed aircraft has also been identified. This is particularly due to the use of Talacre Warren as a Spitfire training camp, with a number of Spitfires and other wartime military aircraft lost within the area. While no aircraft crash sites are currently recorded within the Eni Development Area or Area of Project Physical Works there is potential for such remains to be encountered.

The intertidal zone has currently not been surveyed using geophysical equipment. In line with the commitment to provide and review full coverage data prior to impacts occurring this should also take place within the intertidal zone. Archaeological assessment of this data will allow for a closer characterisation of potential and known sites within the intertidal zone, and mitigation should be recommended following these surveys and assessments, where required. This should seek to protect, or investigate, any newly identified sites, as appropriate according to the significance of the sites. Additionally, the embedded mitigation measure which indicates that archaeologists will be consulted in the preparation of pre-construction cable route clearance or other pre-construction operations and, if appropriate, to carry out archaeological monitoring of such work will also come into play, should sufficient potential be identified following the pre-construction surveys. This mitigation is presented within the Outline WSI.

The potential for unrecorded remains will also be mitigated through implementation of a protocol for reporting finds of archaeological interest. This PAD should be in place across the entire scheme, including during any intertidal works. Should any material be encountered the opportunity to protect or investigate the material will be afforded, in line with the protocol. Further details are set out within the Outline WSI.

Overall, the impact from intertidal cable laying is predicted to be localised in its spatial extent, though with any impacts permanent and irreversible. Following embedded mitigation, the magnitude of the impact is considered to be low.

Sensitivity of receptors

The value of coastal archaeological features including pillboxes and other wartime remains can be up to high: Scheduled and Listed examples exist within the UK, though designation does not occur in all cases and is specific to the historical, evidential, communal, and aesthetic value of each heritage asset. Nevertheless, heritage assets of this type can be up to high value. The value of aircraft has been discussed above, and potential for high value has been determined.

Neither type of asset has the ability to recover from direct physical impacts, and they are considered to be of high vulnerability to the impacts. Sensitivity is therefore considered to be high (though no such receptors are currently recorded within the Eni Development Area or Area of Project Physical Work).

Significance of effect

Overall, the magnitude of the impact is deemed to be low and the sensitivity of the potential receptors is considered to be high. Based on professional judgement and following implementation of embedded mitigation, it is considered that the effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

11.11.4 Alteration of sediment transport regimes

The presence of infrastructure on the seabed can obstruct flow in the water column and lead to localised changes in the sediment transport regimes. This has the potential to impact on marine archaeology within the Study Area and the immediate vicinity.

11.11.4.1 Construction, operation, maintenance and decommissioning phase

Magnitude of impact

The primary impacts associated with the alteration of sediment transport regimes will occur during the operation and maintenance phases. They include impacts which follow on from the construction of the new

platform at Douglas using up to eight pile driven legs, and from the installation of cables and associated cable crossings. The PoA to Douglas cables would require up to 16 crossings (eight per cable), with a width of c. 5 m and total length of 1,600 m along each cable route; and up to ten crossings on two of the inter OP cables, with a width of c. 5 m at each area of cable protection and total length of 1,600 m per cable. The Douglas OP installation and areas of cable protection provide the largest obstruction to flow in the water column (other platforms are already constructed and will be reused). Additional changes may occur through use of jack up barges during all phases of the development. The changes to sediment transport regimes have the potential to bury known archaeological sites and to expose others and previously unknown sites.

The extent of the effects of the alteration to sediment transport regimes have not been modelled, but are not anticipated to be extensive. They are anticipated to be localised and focused around the infrastructure described above.

The impacts may lead to the exposure of new sites. The embedded mitigation includes implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate.

The impact is predicted to be of local spatial extent, long term duration, continuous though with some reversibility (if sites are buried rather than eroded). It is predicted that the impact will affect the receptor indirectly. Following embedded mitigation, the magnitude is therefore considered to be negligible.

Sensitivity of the receptors

The primary potential impacts from this alteration would be to maritime archaeological remains, which are vulnerable to exposure or burial. The sensitivity of maritime and coastal remains has been discussed above. They have been found to be of varying value (up to high). These items are unable to adapt to, tolerate, or recover from the impact, except in the case of burial, and receptor sensitivity is therefore considered to be up to high.

Significance of effect

Overall, the magnitude of the impact is deemed to be negligible, and the sensitivity of the receptor is considered to be medium. Based on professional judgement it is considered that the effect will, therefore, be of **minor** significance, which is not significant in EIA terms. Additionally, while impacts from erosion would be adverse, burial may lead to a positive effect.

11.11.5 Change of use: effects on historic seascape character

The proposed development would involve the insertion of new infrastructure. The effects on the Historic Seascape Character (HSC) are therefore assessed.

11.11.5.1 Construction, operation, maintenance and decommissioning phase

Magnitude of impact

The development will primarily reuse existing infrastructure, and will add a new platform at Douglas OP, and new cables. These developments are in line with the character and location of the existing infrastructure, with the cables and platform situated within a few hundred meters of existing infrastructure. Likewise, operations and maintenance activities are likely to be in line with those which have characterised the area in its previous use as an oil and gas field. Decommissioning may lead to removal of some infrastructure, though again this is likely to be in line with previous conditions.

The assessment identified a variety of characteristics within the Eni Development Area and Area of Project Physical Work. These can be summarised as:

- modern installations and activities such as hydrocarbon wells, pipelines, submarine cables, aggregate extraction, spoil and waste dumping;

- a range of fishing methods used in the modern period;
- navigation routes, both modern and post medieval;
- wrecks and maritime debris (in some cases undated); and
- seabed types and characteristics including shoals and flats and fine sediment plains.

Overall, the proposed development would be in line with the modern installations already present within the area, though would form a new type of development (CCS). While the development type would be new it would not pose a significant change to the character of the area. Other activities including fishing, navigation and seabed character would remain substantially unchanged in terms of the character of the area. Potential impacts to wrecks have been mitigated through implementation of AEZs and thus no change to the character of these assets is anticipated. Therefore overall, it is considered that there would be no change to the HSC of the area. Further assessment is therefore not required.

11.12 Cumulative impact assessment

11.12.1 Methodology

The Cumulative Effects Assessment (CEA) takes into account the impact associated with the Project together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise. 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 marine archaeology CEA methodology has followed the methodology set out in volume 1, chapter 5. As part of the assessment, all projects and plans considered alongside the Proposed Development have been allocated into ‘tiers’ reflecting their current stage within the planning and development process, these are listed below.

Tier 1:

- Hilbre Swash Area 393;
- Burbo Bank Extension Offshore Wind Farm (OWF): Dredge disposal site and cable repair and remediation;
- Gwynt y Mor OWF, removal of met mast;
- Awel y Môr OWF;
- Prestatyn Coastal Defence; and
- MaresConnect Interconnector.

This tiered approach is adopted to provide a clear assessment of the Project alongside other projects, plans and activities. The specific projects, plans and activities scoped into the CEA, are outline in Table 11.16. They include projects with a temporal and geographic overlap with the Eni Development Area, Area of Physical Project Work or Study Area.

11.12.1.1 Maximum design scenario

The maximum design scenarios identified in Table 11.9 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the PDE provided in volume 2, chapter 14 as well as the information available on other projects and plans, in order to inform a ‘maximum design scenario’. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the PDE, to that assessed here, be taken forward in the final design scheme.

Table 11.16: List Of Other Projects, Plans And Activities Considered Within The CEA

Project/ Plan	Status	Distance from Eni Development Area (km)	Description of project/plan	Licence start date	Licence end date	Overlap with Eni Project
Burbo Bank Extension OWF: Dredge disposal site	Open	0.5	Burbo Bank Extension Offshore Wind Farm (OWF): Dredge disposal site	Unknown	Unknown	Temporal (overlap with Eni HyNet construction and operation)
Burbo Bank Extension OWF: cable repair and remediation	Consented/Licensed	0.0	Burbo Bank Extension OWF: cable repair and remediation	20/07/2017	01/09/2027	Temporal (overlap with Eni HyNet construction)
Hilbre Swash Area 393	Unknown	0.0	Hilbre Swash Area 393	01/01/2014	01/01/2030	Temporal (overlap with Eni HyNet construction and operation)
Gwynt y Mor OWF, removal of met mast	Unknown	0.0	Gwynt y Mor OWF, removal of met mast	21/11/2022	30/11/2027	Temporal (overlap with Eni HyNet construction)
Awel y Môr OWF	Submitted	1.1	Awel y Môr OWF	01/01/2030	01/01/2055	Temporal (overlap with Eni HyNet construction and operation)
Prestatyn Coastal Defence	Consented/Licensed	2.0	Prestatyn Coastal Defence	31/07/2021	31/05/2025	Temporal (overlap with Eni HyNet construction)
MaresConnect Interconnector	Permitted	0.0	MaresConnect Interconnector	Unknown	Unknown	Temporal (overlap with Eni HyNet construction and operation)

Table 11.17: Maximum Design Scenario Considered For The Assessment Of Potential Cumulative Effects On Marine Archaeology

Potential cumulative effect	Phase			Maximum Design Scenario	Justification
	C	O	D		
Direct damage to marine archaeology receptors (e.g. wrecks, debris, submerged prehistoric receptors (palaeolandscapes and associated archaeological receptors)	Y	Y	Y	Maximum design scenario as described for the Project (Table 11.9) assessed cumulatively with the following other projects/plans: • Burbo Bank Extension OWF: Dredge disposal site and cable repair and remediation; • Hilbre Swash Area 393; • Gwynt y Mor OWF removal of met mast; • Awel y Môr OWF; • Prestatyn Coastal Defence; and • MaresConnect Interconnector.	Maximum potential for culminative effects of direct damage to marine archaeology receptors.
Direct damage to coastal/ intertidal archaeological remains through cable installation at the landfall site	Y			There is no overlap between the landfall site and other developments and therefore no cumulative impacts are anticipated.	There is no overlap between the landfall site and other developments and therefore no cumulative impacts are anticipated. This element has therefore been scoped out of the CEA.
Sediment disturbance and deposition leading to indirect impacts on marine archaeology receptors (the exposure or burial of receptors).	Y	Y	Y	Maximum design scenario as described for the Project (Table 11.9) assessed cumulatively with the following other projects/plans: • Burbo Bank Extension OWF: Dredge disposal site and cable repair and remediation; • Hilbre Swash Area 393; • Gwynt y Mor OWF, removal of met mast; • Awel y Môr OWF; and • MaresConnect Interconnector.	Maximum potential for culminative effects of sediment disturbance and deposition leading to indirect effects on marine archaeology receptors.
Alteration of sediment transport regimes leading to potential erosion or burial of archaeological sites	Y	Y	Y	Maximum design scenario as described for the Project (Table 11.9) assessed cumulatively with the following other projects/plans: • Burbo Bank Extension OWF: Dredge disposal site and cable repair and remediation; • Hilbre Swash Area 393; • Gwynt y Mor OWF removal of met mast; • Awel y Môr OWF; • Prestatyn Coastal Defence; and • MaresConnect Interconnector.	Maximum potential for culminative effects of alteration of transport regimes to have indirect impacts on marine archaeology receptors.

11.12.2 Cumulative effects assessment

A description of the significance of cumulative effects upon marine archaeology receptors arising from each identified impact is given below.

11.12.2.1 Direct damage to maritime archaeology receptors (e.g. wrecks, debris, submerged prehistoric receptors (palaeolandscapes and associated archaeological receptors)

The Project, together with the projects and plans identified in Table 11.16, may result in direct damage to marine archaeology receptors. Other projects and plans screened into the assessment include:

- Aggregate extraction:
  - Hilbre Swash Area 393;
- Offshore Wind Farms:
  - Burbo Bank Extension OWF: Dredge disposal site and cable repair and remediation
  - Gwynt y Mor OWF, removal of met mast;
  - Awel y Môr OWF.
- Coastal Defences:
  - Prestatyn Coastal Defence.
- Interconnectors:
  - MaresConnect Interconnector.

Construction, operation, maintenance and decommissioning phases

Magnitude of impact

Where known, the status of the projects identified for inclusion of the CEA have been detailed in Table 11.16. The details indicate the following:

- Submitted:
  - The application for Awel y Môr OWF has been submitted, and it is possible therefore that construction, operation, maintenance and decommissioning phases will overlap with those of the HyNet Carbon Dioxide Transportation and Storage Project. In addition to temporal overlaps, the OWF also shares spatial overlaps with the Project. Impacts associated with this OWF are likely to include site preparation activities, construction of turbines using piled foundations, cable installation and installation of associated infrastructure. Operation and maintenance activities for OWFs typically includes scope for cable repair, replacement and remediation, in addition to cleaning and maintaining turbines and bases. Decommissioning may result in the removal of infrastructure.
- Permitted:
  - The MaresConnect Interconnector project has been permitted, and it is possible therefore that construction, operation, maintenance and decommissioning phases will overlap with those of the HyNet Carbon Dioxide Transportation and Storage Project. Impacts including site preparation works and cable installation has the potential to lead to a cumulative impact on marine archaeology receptors;
  - The cable repair and remediation for the Burbo Extension OWF Project has been permitted. It is possible therefore that these activities (considered under the operation and maintenance phase of the project) will overlap with those of the HyNet Carbon Dioxide Transportation and Storage

Project. Additionally, the Burbo Extension OWF export cable route also crosses the proposed Project cable route, indicating the potential for overlapping activities. The cable repair and remediation activities have the potential to lead to a cumulative impact on marine archaeology receptors; and

  - The Prestatyn Coastal Defence project has been permitted, and it is possible therefore that construction, operation and maintenance phases of this project will overlap with those of the HyNet Carbon Dioxide Transportation and Storage Project. The preferred option for this development involves insertion of an earth embankment to protect the area of Prestatyn (around the golf course boundaries). This may result in works in the intertidal zone including site preparation activities and construction of the embankment, which have the potential to lead to a cumulative impact on marine archaeology receptors.

- Unknown: The status of the following projects is unknown, however, all have the potential to overlap with the Project, both temporally and spatially.
  - Burbo Bank Extension OWF Disposal Site;
  - Hilbre Swash Area 393; and
  - Gwynt y Mor OWF: Removal of met mast.

These activities have the potential to cumulatively, directly and permanently impact upon marine archaeology receptors on the seabed, including maritime remains, and those that lie concealed below the covering sands including potential submerged prehistoric landscapes. Direct impacts to receptors are most likely where there are overlapping spatial components of the projects (see Table 11.16). These activities also have the potential to expose previously unrecorded marine archaeology receptors. However, embedded mitigation has already been applied to avoid and mitigate impacts:

- As described in sections 11.10.1 AEZs and TAEZs will be established for any identified maritime archaeological receptors of high and medium significance, including all wrecks and potential wrecks, in addition to other remains. Additionally, where known, the AEZs implemented for other projects which are currently active have been applied to this Project. This is the case for example for MSDS_ E_054, which is an unnamed wreck falling within the boundaries of the Eni Development Area and Aggregate Area 393 (see volume 3, appendix N). The probability for direct damage to occur in association with the Project is therefore low.
- There will also be input into specifications for, and archaeological analysis of, any further pre-construction geophysical and geotechnical surveys. From the geotechnical perspective, geoarchaeological assessment will accompany planned geotechnical works. This will follow a staged process and accepted guidance. This is the mechanism for ensuring impacts to the submerged prehistoric landscape are understood and mitigated. From the geophysical perspective, there will be input into and review of geophysical survey data by an experienced marine archaeological geophysicist. New data will be collected ensuring full coverage of the Area of Project Physical Work prior to any seabed impacts. This includes collection and review of any data where micrositing of cables leads to re-routing through areas in which there is no data coverage. Additionally, due to re-routing around the designated area associated with the Protected Wreck *Resurgam*, the planned cable routes currently pass through an area in which full coverage data has not yet been assessed. This data is in collection and will be assessed prior to any seabed impacts. Further details will be set out within the Outline WSI.
- Unknown archaeological sites may also be impacted, however, following additional review of full coverage geophysical data and any additional mitigation following that review (e.g. implementation of new AEZs), and implementation of a protocol for reporting finds of archaeological interest (set out within the Outline WSI), the probability of impacting unknown sites is low.

The cumulative effect is predicted to be of local spatial extent, long term duration, and be irreversible. It is predicted that the impact will affect the receptor directly. However, followng the mitigation implemented for the Project, the magnitude is considered to be low.

Sensitivity of receptor

The sensitivity of the receptors including known wrecks and other maritime remains, potential palaeolandscape remains and submerged prehistoric sites, has been discussed in detail above (see section 11.11.1). The marine archaeology receptors are deemed to be of high vulnerability, low recoverability and of varying value, up to high value. The sensitivity of the receptors is therefore considered to be up to high.

Significance of effect

The measures adopted as part of the Project outlined in section 11.10 include measures to ensure avoidance of an archaeological receptors; mitigate impacts to the palaeolandscape through geoarchaeological analysis, and set out workflows that ensure any newly exposed archaeological assets are identified, recorded and protected or investigated as necessary.

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

11.12.2.2 Sediment disturbance and deposition leading to indirect impacts on known archaeological receptors

Potential indirect effects upon marine archaeology receptors from sediment disturbance have been outlined in relation to the Project. Other projects and plans screened into the assessment include:

- Aggregate extraction:
  - Hilbre Swash Area 393;
- Offshore Wind Farms:
  - Burbo Bank Extension OWF: Dredge disposal site and cable repair and remediation;
  - Awel y Môr OWF.
- Interconnectors:
  - MaresConnect Interconnector.

Construction, operation, maintenance and decommissioning phases

Magnitude of impact

Where known, the status of the projects identified for inclusion of the CEA have been detailed in Table 11.16, along with project details. The effects on sediment disturbance vary between development types, and stages.

Offshore wind farms in construction may cause sediment disturbance through site preparations and cable installation. Those which have already been constructed and are in operations and maintenance phases may cause sediment disturbance through cable repair and replacement. Likewise, interconnectors (the MaresConnect Interconnector) have the potential to cause similar impacts, through site preparation and cable installation. Vessel anchoring and jack up use associated with the developments also has the potential to increase sediment disturbance. Decommissioning may also cause disturbance through the removal of infrastructure such as cables or turbines. Aggregate extraction is associated with dredging activities which cause sediment plumes and redeposition of sediment. These developments therefore have the potential to increase sediment disturbance and deposition leading to a culminative indirect impact on marine archaeology receptors.

As described for the Project, sediment disturbance and deposition has the potential to impact archaeological sites. As described in section 11.10, an Outline WSI and PAD accompanies this application, to inform the construction, operation, maintenance and decommissioning works and to facilitate the recording and reporting of any archaeological material discovered as a result of increased sediment disturbance which may lead to the exposure of new sites.

The cumulative effect is predicted to be of local spatial extent, short term duration (though impacts from sediment deposition may be longer term), intermittent and medium reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

The sensitivity of the receptors including known wrecks and other maritime remains, potential palaeolandscape remains and submerged prehistoric sites, has been discussed in detail above (see section 11.11.1). The marine archaeology receptors are vulnerable sites that can be exposed further by disturbance activities. They have low recoverability and are of varying value, up to high value. The sensitivity of the receptors is therefore considered to be up to high.

Significance of effect

The measures adopted as part of the Project outlined in section 11.10 include measures to ensure that any newly exposed archaeological assets are recorded.

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

11.12.2.3 Alteration of sediment transport regimes

The Project, together with the projects and plans identified in Table 11.16 may result in alteration of transport regimes. During the operations and maintenance phase the presence of infrastructure may alter the sediment transport and sediment transport pathways leading to changes in the Project area. Other projects and plans screened into the assessment include:

- Aggregate extraction:
  - Hilbre Swash Area 393;
- Offshore Wind Farms:
  - Burbo Bank Extension OWF: Dredge disposal site and cable repair and remediation;
  - Awel y Môr OWF.
- Interconnectors:
  - MaresConnect Interconnector.

Operation and maintenance phases

Magnitude of impact

The operations and maintenance phase of the Project may coincide with the operations and maintenance phases of OWFs in the area, and those due for construction. Impacts from alterations to sediment transport regimes may arise from changes around the turbines, offshore export cables and protection, and cable repair or reburial activities (also likely for the MaresConnect Interconnector), any associated vessel anchor deployments or jack up use. Dredging operations may also take place, altering sediment transport regimes through the mobilisation of sediment into the water column while dredging activities take place.

The assessment set out in section 11.11.4 found that the impacts from the project would result in a negligible magnitude of impact, following embedded mitigation which includes implementation for reporting finds of

archaeological interest for the identification, recording and mitigation for new sites where appropriate (should new sites be exposed by erosion). Impacts from the other developments assessed in this CEA are likely to be of a similar scale: with local spatial extent, long term duration, continuous though with some reversibility (if sites are buried rather than eroded). The impacts to receptors would be direct. Overall, the magnitude is considered to be low.

Sensitivity of receptor

The sensitivity of the receptors including known wrecks and other maritime remains, potential palaeolandscape remains and submerged prehistoric sites, has been discussed in detail above (see section 11.11.1). The marine archaeology receptors are vulnerable sites that can be exposed further by disturbance activities. They have low recoverability and are of varying value, up to high value. The sensitivity of the receptors is therefore considered to be up to high.

Significance of effect

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

11.12.3 Transboundary effects

A screening of transboundary impacts has been carried out and has identified that there was no potential for significant transboundary effects with regard to marine archaeology from the Project upon the interests of other states.

11.13 Conclusion

Information on marine archaeology within the Area of Project Physical Work, Eni Development Area and Study Area was collected through desktop review, site surveys and consultation.

Overall, it is concluded that there will be no significant effects arising from the Project during the construction, operations and maintenance or decommissioning phases. Table 11.18 presents a summary of the potential impacts, measures adopted as part of the project and residual effects in respect to marine archaeology. The impacts assessed include: sediment disturbance and deposition leading to indirect impacts on marine archaeology receptors; direct damage to marine archaeology receptors (e.g. wrecks, debris, submerged prehistoric receptors (palaeolandscapes and associated archaeological receptors); direct damage to coastal/intertidal archaeological remains through cable installation at the landfall site; alteration of sediment transport regimes; and change of use: effects on HSC.

The assessment also found that there will be no significant cumulative effects from the Project alongside other projects/plans. Table 11.19 presents a summary of the potential cumulative impacts, mitigation measures and residual effects. The cumulative impacts assessed include: sediment disturbance and deposition leading to indirect impacts on marine archaeology receptors; direct damage to marine archaeology receptors (e.g. wrecks, debris, submerged prehistoric receptors (palaeolandscapes and associated archaeological receptors); and alteration of sediment transport regimes.

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

Table 11.18: Summary Of Potential Environmental Effects, Mitigation And Monitoring

Potential effect	Phase			Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Direct damage to marine archaeology receptors (e.g. wrecks, debris, submerged prehistoric receptors (palaeolandscapes and associated archaeological receptors)	Y	Y	Y	Establishment of AEZs and TAEZs; Additional data reviews and revised recommendations for AEZs; Re-routing and micrositing; Archaeological input into and assessment of geophysical and geotechnical investigations; Implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate.	C: Low O: Low D: Low	C: High O: High D: High	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A
Direct damage to coastal/intertidal archaeological remains through cable installation at the landfall site	Y			Additional data reviews to ensure archaeological assessment of full coverage geophysical data and revised recommendations for AEZs; Archaeologists will be consulted in the preparation of pre-construction cable route clearance or other pre-construction clearance operation and, if appropriate, to carry out archaeological monitoring of such work; Implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate.	C: Low O: Low D: Low	C: High O: High D: High	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A
Sediment disturbance and deposition leading to indirect impacts on marine archaeology	Y	Y	Y	Implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate. Known sites of significance are protected by AEZs and TAEZs.	C: Low O: Low D: Low	C: High O: High D: High	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A

Potential effect	Phase			Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
receptors (the exposure or burial of receptors).										
Alteration of sediment transport regimes leading to potential erosion or burial of archaeological sites		Y		Implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate.	O: Negligible	O: High	O: Minor Adverse	N/A	O: Minor Adverse	N/A
Change of use: effects on Historic Seascape Character				No change identified.	No change.	-	-		-	

*C= Construction, O= Operation and Maintenance, D= Decommissioning

Table 11.19: Summary Of Potential Cumulative Environmental Effects, Mitigation And Monitoring

Potential cumulative effect	Phase			Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Direct damage to marine archaeology receptors (e.g. wrecks, debris, submerged prehistoric receptors (palaeolandscapes and associated archaeological receptors)	Y	Y	Y	Establishment of AEZs and TAESz; Additional data reviews and revised recommendations for AEZs; Re-routing and micrositing; Archaeological input into and assessment of geophysical and geotechnical investigations; Implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate.	C: Low O: Low D: Low	C: High O: High D: High	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A
Direct damage to coastal/intertidal archaeological remains through cable installation at the landfall site	Y			Additional data reviews to ensure archaeological assessment of full coverage geophysical data and revised recommendations for AEZs; Archaeologists will be consulted in the preparation of pre-construction cable route clearance or other pre-construction clearance operation and, if appropriate, to carry out archaeological monitoring of such work; Implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate.	C: Low O: Low D: Low	C: High O: High D: High	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A
Sediment disturbance and deposition leading to indirect impacts on marine	Y	Y	Y	Implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate.	C: Low O: Low D: Low	C: High O: High D: High	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A	C: Minor Adverse O: Minor Adverse D: Minor Adverse	N/A

Potential cumulative effect	Phase			Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
archaeology receptors (the exposure or burial of receptors).										
Alteration of sediment transport regimes leading to potential erosion or burial of archaeological sites		Y		Implementation of a protocol for reporting finds of archaeological interest for the identification, recording and mitigation for new sites where appropriate.	O: Negligible	O: High	O: Minor Adverse	N/A	O: Minor Adverse	N/A

11.14 References

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