Offshore Wind Power Limited

West of Orkney Windfarm Offshore EIA Report

Volume 1, Chapter 16 - Marine archaeology and cultural heritage

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West of Orkney Windfarm

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16 MARINE ARCHAEOLOGY AND CULTURAL HERITAGE

Chapter summary

This chapter of the Offshore EIA Report assesses the potential effects from the offshore Project on marine archaeology and cultural heritage receptors. This includes direct, indirect, whole Project assessment, cumulative, inter-related effects, inter-relationships and transboundary effects.

The initial desk study indicated that there were a number of post-medieval and 20th century wreck sites within the Option Agreement Area (OAA) and offshore Export Cable Corridor (ECC) areas. However, subsequent analysis of the geophysical survey results did not record any evidence of these wreck sites being present within these areas. Parts of one of the largest German minefields from the First World War, known as the Whiten Head Field, are in or very close to the offshore Project area with the potential for live mines to be present. A review of the site-specific survey data identified the potential for UXO, which will be confirmed through more targeted surveys pre construction.

A review of core samples from geotechnical investigations identified a single sample (Vibro Core 836-VC-ECC-SB-KP-36), located approximately 4 km from the Caithness coastline within the ECC area. The core contained a pocket of possible organic material that may contain microfossils that could provide palaeoenvironmental information on a now eroded former terrestrial land surface. However, subsequent analysis revealed that there was no organic material contained within the sample, and therefore there was no potential for it to provide palaeoenvironmental information on former prehistoric landscapes.

The following impacts were identified as requiring assessment:

- Construction and decommissioning:
  - Loss of or damage to known marine and intertidal historic environment assets;
  - Loss of or damage to unknown marine and intertidal historic environment assets; and
  - Loss of or damage to submerged prehistoric landscapes
- Operation and maintenance:
  - Loss of or damage to known marine historic environment assets;
  - Loss of or damage to unknown marine and intertidal historic environment assets;
  - Loss of or damage to submerged prehistoric landscapes; and
  - Long term changes to the setting of onshore historic environment assets that reduces their value.

The assessment has taken account of embedded mitigation measures for the assessment of potential effects including the preparation of a marine heritage Written Scheme of Investigation (WSI) and Protocol for Accidental Discoveries (PAD) to avoid or mitigate any accidental discoveries of archaeological interest.

No significant impacts relating to known or unknown marine and intertidal historic environment assets or submerged prehistoric landscapes have been identified during construction, operation and maintenance and decommissioning.

In terms of long-term changes to the setting of onshore historic environment assets that reduces their value, a selection of statutorily designated sites and areas were considered to act as proxies for the range of effects on all other designated sites within the offshore Project settings study area, which extends 60 km from the boundary of the OAA. Assets were chosen that were likely to have the most visibility of an impact from the presence of the turbines offshore, identified through consultation with Historic Environment Scotland (HES), and the County Archaeologists from Orkney Islands Council (OIC) and The Highland Council (THC). The setting of historic environment assets is defined by establishing how the surroundings contribute to the ways in which the historic structure is understood, appreciated and experienced. No significant impacts were identified through this assessment.

No significant impacts to any marine archaeology and cultural heritage receptors are predicted, either for the offshore Project or cumulatively with other plans or developments.

16.1 Introduction

This chapter of the Offshore Environmental Impact Assessment (EIA) Report presents the marine archaeology and cultural heritage receptors of relevance to the offshore Project and assesses the potential impacts from the construction, operation and maintenance and decommissioning of the offshore Project on these receptors. Where required, mitigation is proposed, and the residual impacts and their significance are assessed. Potential cumulative and transboundary impacts are also considered.

Table 16-1 below provides a list of all the supporting studies which relate to and should be read in conjunction with the marine archaeology and cultural heritage impact assessment. All supporting studies are appended to this Offshore EIA Report and issued on the accompanying Universal Serial Bus (USB).

Table 16-1 Supporting studies

DETAILS OF STUDY	LOCATIONS OF SUPPORTING STUDY
Marine Archaeology and Cultural Heritage Gazetteer of Sites	Offshore EIA Report, Supporting Study (SS) 14: Marine archaeology and cultural heritage gazetteer of sites.
Seascape Landscape Visual Impact Assessment (SLVIA) Visualisations	Offshore EIA Report, Supporting Study (SS) 20: Visualisations.
Marine Archaeology Onshore Setting Supporting Figures	Offshore EIA Report, Supporting Study (SS) 22: Marine Archaeology Onshore Setting Supporting Figures.

The impact assessment presented herein draws upon information presented within other impact assessments within this Offshore EIA Report, including chapter 18: Seascape, landscape and visual amenity - which assesses the impacts of the offshore Project on a range of visual receptors, including the historic environment, chapter 8: Marine physical and coastal processes - which assesses the impacts of physical processes on a range of receptors, including those (such as scouring) that might affect historic environment remains on the seabed, and chapter 19: Socio-economics which assesses impacts of the offshore Project on a range of receptors, including Properties in Care and the Heart of Neolithic Orkney (HONO) World Heritage Site (WHS) and promoted as heritage sites to visit.

Where information is used to inform the impact assessment, reference to the relevant Offshore EIA Report chapter is given. Equally, the marine archaeology and cultural heritage impact assessment also informs other impact assessments. This interaction between the impacts assessed within different topic-specific chapters on a receptor is defined as an 'inter-relationship'. The chapters and impacts related to the assessment of potential effects on marine archaeology and cultural heritage are provided in Table 16-2.

Table 16-2 Marine archaeology and cultural heritage inter-relationships

CHAPTER	IMPACT	DESCRIPTION
Marine physical and coastal processes (chapter 8, Offshore EIA Report)	Indirect impacts on marine archaeological assets on the seabed from changes to hydrodynamics.	Changes to hydrodynamics could lead to increased scour and abrasion which may indirectly result in loss or disturbance of marine archaeological assets on the seabed. Sediment disturbed during construction will be deposited throughout the offshore Project area. This deposition can have implications for marine archaeology and cultural heritage receptors. For instance, deposition can obscure features of archaeological importance. Change to seabed levels, sediment properties and suspended concentrations is assessed in chapter 8: Marine physical and coastal processes, section 8.6.1.1. Changes to marine processes can result in increased erosion of features which may protect marine archaeology and cultural heritage. Additionally, this could lead to the discovery of previously unidentified features of archaeological interest.
Seascape, Landscape and Visual Assessment (chapter 18, Offshore EIA Report)	Indirect impacts to Seascape, Landscape and Visual Amenity that are relevant to the setting of historic environment assets.	Indirect impacts from the development on views to and from historic environment assets, where views form part of their setting, could affect the value of the assets.
Socio-economics (chapter 19, Offshore EIA Report)	Indirect impacts to the setting of historic environment assets that are Properties in Care and the HONO WHS, and promoted as heritage sites to visit.	Indirect impacts from the development on the setting of historic environment assets that affects their heritage value could affect the recreation and tourism experience.

The following specialists have contributed to the assessment:

- Orkney Research Centre for Archaeology (ORCA) – desk-based assessment, baseline description, impact assessment and Offshore EIA Report; and
- SULA Diving – analysis and interpretation of the marine geophysical survey data for archaeological remains.

16.2 Legislation, policy and guidance

Over and above the legislation presented in chapter 3: Planning policy and legislative context, the following legislation, policy and guidance are relevant to the assessment of impacts from the offshore Project on marine archaeology and cultural heritage:

- Legislation:
  - International
    - The United Nations Convention of the Law of the Sea (UNCLOS);
    - Annex to the United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Protection of the Underwater Cultural Heritage 2001;
    - The European Convention on the Protection of the Archaeological Heritage (revised), known as the Valletta Convention;
  - National
    - The Protection of Military Remains Act 1986 (PoMRA);
    - The Marine (Scotland) Act 2010; and
    - The Ancient Monuments and Archaeological Areas Act 1979.
- Policy:
  - Scotland's National Marine Plan: A Single Framework for Managing Our Seas (Scottish Government, 2015):
    - GEN 6 Historic Environment: contains policies and advice concerning the marine historic environment, including the development and use of the marine environment should protect and, where appropriate, enhance assets in a manner proportionate to their significance;
    - Recommends that Historic Marine Planning Partnerships and licensing authorities should seek to identify significant historic environment resources at the earliest stages of the planning or development process and preserve them in situ wherever possible. Adverse impacts should be avoided, or, if not possible, minimised and mitigated. Where this is not possible licensing authorities should require developers to record and advance understanding of the significance of the heritage asset before it is lost, in a manner proportionate to that significance; and
    - GEN 7 Landscape/seascape contains policies that state development and use that affects World Heritage Sites should only be permitted where it will not adversely affect the integrity if its special qualities for which it has been designated; and any such adverse effects are clearly outweighed by social, environmental or economic benefits of national importance.
  - National Planning Framework 4 (Scottish Government, 2023):
    - Historic assets and places. To protect and enhance historic environment assets and places, and to enable positive change as a catalyst for the regeneration of places – Policy 7 (a - o).
  - Pilot Pentland Firth and Orkney Waters (PFOW) Marine Spatial Plan (Scottish Government, 2016):
    - General Policy 6: Historic Environment includes that development with potential to have an adverse effect on the significance of heritage assets will be expected to demonstrate that all reasonable measures will be taken to mitigate any loss of significance, and that any lost significance which cannot be mitigated is outweighed by social, economic, environmental, navigation or safety benefits.
  - Draft Orkney Marine Spatial Plan (Orkney Islands Council, 2022):
    - General Policy 8: The historic environment includes any physical evidence of human activity through time. Orkney is world renowned for the quality and quantity of its historic environment assets, both terrestrial and marine. This policy addresses impacts from development and/or activities on the historic environment.
  - The Historic Environment Policy Statement for Scotland (HEPS) (Historic Environment Scotland (HES), 2019a):
    - Includes policies that decisions affecting any part of the historic environment require understanding of its significance and consideration of avoiding or minimising detrimental impacts.
  - Historic Environment Scotland Designation Policy and Selection Guidance 2019 (HES, 2019b):
    - Stands alongside HEPS 2019 and outlines the principals and criteria that underpin the designation of Scottish Highly Protected Marine Areas.

  - Local Orkney Development Plan (Orkney Islands Council, 2017):
    - The Orkney Local Development Plan 2017 (referred to as "the Plan") sets out a vision and spatial strategy for the development of land in Orkney over the next ten to twenty years. The Plan contains the land use planning policies which Orkney Islands Council will use for determining applications. Policy 8 Historic Environment and Cultural Heritage seeks to protect the importance of these sites whilst recognising their place in the living landscape.
- Guidance:
  - Historic Environment Scotland Managing Change in the Historic Environment Guidance Series: Setting (revised 2020) (HES, 2016);
  - Orkney Islands Council Heart of Neolithic Orkney Supplementary Planning Guidance (2010);
  - The Chartered Institute for Archaeologists (CIfA) Codes, Standards and Guidance (various);
  - Maritime Cultural Heritage & Seabed Development: The Joint Nautical Archaeology Policy Committee (JNAPC) Code of Practice for Seabed Development (The Crown Estate, 2006);
  - Historic Environment Guidance for the Offshore Renewable Energy Sector (Wessex Archaeology, 2007);
  - Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy (COWRIE Ltd, 2008);
  - The Crown Estate (TCE) Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects and Offshore Renewables Projects Wessex Archaeology Ltd (TCE, 2021);
  - The Crown Estate Protocol for Archaeological Discoveries: Offshore Renewables Projects Wessex Archaeology Ltd (TCE, 2014);
  - English Heritage Ships and Boats: Prehistory to Present – Designation Selection Guide (Historic England, 2012); and
  - Wessex Archaeology Assessing Boats and Ships 1860-1913, 1914-1938 and 1939-1950 Archaeological Desk-Based Assessments in 3 Volumes (2011).

16.3 Scoping and consultation

Stakeholder consultation has been ongoing throughout the EIA and has played an important part in ensuring the scope of the baseline characterisation and impact assessment are appropriate with respect to the offshore Project and the requirements of the regulators and their advisors.

The Scoping Report, which covered the onshore and offshore Project, was submitted to Scottish Ministers (via Marine Scotland – Licensing Operations Team (MS-LOT)[1]), The Highland Council (THC) on 1st March 2022. MS-LOT circulated the Scoping Report to consultees[2] relevant to the offshore Project and a Scoping Opinion was received on 29th June 2022. Relevant comments from the Scoping Opinion and other consultation specific to marine archaeology and cultural heritage are provided in Table 16-4 below, which provides response on how these comments have been addressed within the Offshore EIA Report.

[1] MS-LOT have since been renamed Marine Directorate - Licensing Operations Team (MD-LOT).

[2] The Scoping Report was also submitted to the Orkney Islands Council (OIC), as the scoping exercise included consideration of power export to the Flotta Hydrogen Hub, however, this scope is not covered in the Offshore or Onshore EIA Reports and will be subject to separate Marine Licence and onshore planning applications.

Further consultation has been undertaken throughout the pre-application stage. Table 16-3 summarises the consultation activities carried out relevant to marine archaeology and cultural heritage.

Table 16-3 Consultation activities for marine archaeology and heritage

Consultee and Type of Consultation	Date	Summary
HES – meeting	10th November 2020	Offshore Wind Power Limited (OWPL) met with Historic Environment Scotland (HES) ahead of the ScotWind bid application. Pre-Application advice was provided to OWPL on the 26th November 2020.
MS-LOT	12th January 2021	It was noted by MS-LOT that the use of broadscale geophysical surveys may be useful to determine the presence of any wreck sites or other seabed remains.
Marine Archaeology and Cultural Heritage Consultee Meeting - meeting	19th July 2022	Agreements were reached on the study area (60 kilometre (km) buffer) and viewpoints for the assessment of impacts on the setting of onshore assets by the offshore array. Knowes of Trotty will be used to assess potential impact on the HONO WHS.
Marine Archaeology and Cultural Heritage Consultee Meeting - meeting	20th February 2023	Requests were made by HES, OIC and THC for photomontages to be prepared for the Category A Listed Building Hall of Clestrain and the Beinn Freiceadain Scheduled Monument.
Letter – additional visualisations	21st June 2023	Photomontages of Category A Listed Building Hall of Clestrain and the Beinn Freiceadain Scheduled Monument were circulated as requested in the February 2023 consultation meeting.
Letter – marine archaeological assessment	8th August 2023	Consultees previously requested the analysis of a single vibrocore sample that possibly contained organic material. The results of the analysis, concluding that no organic matter was present, was provided in the letter.

Table 16-4 Summary of consultation responses specific to marine archaeology and cultural heritage

Consultee	Comment	Response
Scottish Ministers (via MS-LOT)	The Scottish Ministers are broadly content with the Study Area as defined in Figure 2-39 in section 2.9 of the Scoping Report and that the baseline data gathered is appropriate for the assessment. The Scottish Ministers advise that the list of charted wrecks in Scapa Flow provided in Table 2-56 of the Scoping Report should be updated to include HMS Vanguard north of Flotta which is protected under the Protection of Military Remains Act 1986. Additionally, the Developer is advised to refer to the representation from THC to ensure that all designated sites are identified and considered with the EIA Report.	It is noted that the Study Area is acceptable. The offshore Export Cable Corridor (ECC) to the Flotta Hydrogen Hub are not part of this consent application and are not considered within this Offshore EIA Report. Consultation has been undertaken with THC and other stakeholders to ensure the assessment considers all designated sites required. Historic environment assets and their setting are described in section 16.4.4.2 and assessed in section 16.6.2.4.
Scottish Ministers (via MS-LOT)	In Table 2-60 of the Scoping Report the Developer summarises the potential impacts to marine archaeology and cultural heritage during different phases of the Proposed Development. The Scottish Ministers are broadly content with the impacts proposed to be scoped into the EIA Report.	Noted, the impacts that have been assessed are outlined in section 16.5.1. The offshore ECC to the Flotta Hydrogen Hub are not part of this consent application and are not considered within this Offshore EIA Report.
Scottish Ministers (via MS-LOT)	For completeness, the Developer should note that the HES representation confirms that the HES 2016 version of 'Managing Change in the Historic Environment' guidance, referenced in Table 2-61 of the Scoping Report, has been completely superseded and should not be referenced or relied upon as part of the assessment within the EIA Report.	Noted, only the HES, 2020 document has been used to inform the assessment.

Consultee	Comment	Response
HES	The relevant local authorities archaeological and cultural heritage advisors will also be able to offer advice on the scope of the cultural heritage assessment. This may include heritage assets not covered by our interests, such as unscheduled archaeology, and category B- and C-listed buildings. In this case, you should contact: THC Historic environment team OIC archaeology centre.	The Highland Council Historic Environment Team and County Archaeologist at Orkney Islands Council have been involved in all consultations on the marine archaeology and cultural heritage assessment.
HES	We note and welcome the intention in the scoping report to include long-term changes within the scope of the assessment. This should include impacts from the offshore wind turbines on the Outstanding Universal Value of the Heart of Neolithic Orkney world heritage site. I note that this is identified as an issue to be included in the assessment in table 2-58 of the offshore scoping report. I note that this is also identified as an issue to be considered in table 4-40 of the Orkney onshore scoping report. Clear cross-referencing may help within the EIAR, but it would also be helpful for the developer to clarify their thinking on this issue in future correspondence.	Assessment has been undertaken from Skara Brae and the Knowes of Trotty within the HONO WHS Sensitive Area (see 16.6.2.4). The ECC to the Flotta Hydrogen Hub are not part of this consent application and are not considered within this Offshore EIA Report.
HES	Finally, Table 2-61 indicates that not only will the 2020 setting guidance be referenced, but also the outdated 2016 setting guidance could be relied upon. Given that the 2016 guidance has been entirely superseded by the 2020 guidance, it carries no weight and should neither be referenced nor relied upon as part of the assessment. We also note that the developer has referred to Orkney Islands Council's 2010 supplementary planning guidance for the Heart of Neolithic Orkney world heritage site. Orkney Islands Council should clarify the guidance which applies in this case.	Historic Environment Scotland Managing Change in the Historic Environment Guidance Series: Setting (revised 2020) (HES, 2016), and the three-stage process outlined, has been used within the assessment. OIC Heart of Neolithic Orkney Supplementary Planning Guidance (OIC, 2010) has also been considered for the assessment.

Consultee	Comment	Response
HES	Guidance about national policy can be found in our 'Managing Change in the Historic Environment' series available online at www.historicenvironment.scot/advice-andsupport/planning-and-guidance/legislation-and-guidance/managing-change-in-thehistoric-environment-guidance-notes. Technical advice is available on our Technical Conservation website at https://conservation.historic-scotland.gov.uk/. We hope this is helpful. Please contact us if you have any questions about this response. The officer managing this case is Adele Shaw and they can be contacted.	Historic Environment Scotland Managing Change in the Historic Environment Guidance Series: Setting (revised 2020) (HES, 2016), and the three-stage process outlined, has been used within the assessment. HES has been contacted and participated in consultation meetings throughout the EIA process.
OIC	Table 2-61 Legislation and Guidance for the Marine Historic Environment Include Orkney Local Development Plan	Noted and this has been considered see section 16.2.
OIC	2.11.4 Baseline Environment Acknowledge and assess impacts on the setting of historic environment assets, particularly the components/setting of the World Heritage Site and coastal scheduled monuments. Make linkage here with Archaeology and Cultural Heritage section of the EIAR.	Acknowledged. Assessment of impact on setting are provided in section 16.6.2.4.
OIC	Refer to comment from OIC County Archaeologists provided to OIC Development Management.	For the Offshore EIA Report, OIC county archaeologist have been consulted with to assess setting impacts from Orkney cultural heritage assets as detailed in Table 16-4.
THC	The EIAR needs to identify all designated sites which may be affected by the development either directly or indirectly. This will require you to identify:	The key features of the historic environment which have been considered are:

Consultee	Comment	Response
	Submerged Paleolandscape Deposits, Archaeological Sites and Artefacts; the architectural heritage (Conservation Areas, Listed Buildings); the archaeological heritage (Scheduled Monuments, Historic Battlefields, offshore wrecks, vessels and structures); the landscape (including designations such as National Scenic Areas, Special Landscape Areas, Gardens and Designed Landscapes, and general setting of the development; and the inter-relationship between the above factors."	• Known wrecks; • Known losses with no known location (including vessels, submarines and aircraft); • Known wreckage and debris; • Marine paleoenvironmental deposits; • Submerged archaeological sites and artefacts; and • A range of onshore designated historic environment assets in Sutherland, Caithness and Orkney.
THC	We would expect any assessment to contain a full appreciation of the setting of these historic environment assets and the likely impact on their settings. It would be helpful if, where the assessment finds that significant impacts are likely, appropriate visualisations such as photomontage and wireframe views of the development in relation to the sites and their settings could be provided. Visualisations illustrating views both from the asset towards the proposed development and views towards the asset with the development in the background would be helpful.	The setting of historic environment assets and the likely impact on their setting are described in section 16.4.4.2 and assessed in section 16.6.2.4. Where significant effects have been identified, the visualisation has been included in chapter 20: Seascape, landscape and visual impact assessment.
THC	Historic Environment Scotland (HES) have responded to the consultation and agree with the proposed methodology and scope of assessment for heritage assets in their remit and the sites included in the assessment.	HES consultation response has been noted.

Consultee	Comment	Response
THC	There are a large number of heritage assets in the vicinity of the development, these need to be assessed. Our Historic Environment Team should be consulted further on the impact on heritage assets outwith the remit of HES.	THC have been consulted further during the Marine archaeology and cultural heritage consultee meetings (detailed in Table 16-4) as part of the EIA process.
THC	Acknowledge and assess impacts on the setting of historic environment assets, particularly the components/setting of the HONO World Heritage Site and coastal scheduled monuments.	This has been considered and included in the chapter. Historic environment assets and their setting are described in section 16.4.4.2 and assessed in section 16.6.2.4.

16.4 Baseline characterisation

This section outlines the current baseline for marine archaeology and cultural heritage in the offshore study area. A desk-based review of literature and available data sources (see Table 16-5) was undertaken, and the findings of this are presented below in order to provide an understanding of the offshore Project environment.

Marine geophysical surveys comprising Multibeam Echo Sounder (MBES), Side Scan Sonar (SSS) and magnetometer, along with a contact report and a sub bottom profile/core sample report were analysed, with the results of this presented below.

The key features of the historic environment which have been considered are:

- Known wrecks;
- Known losses with no known location (including vessels, submarines and aircraft);
- Known wreckage and debris;
- Marine paleoenvironmental deposits;
- Submerged archaeological sites and artefacts; and
- A range of onshore designated historic environment assets in Sutherland, Caithness and Orkney[3].

16.4.1 Study area

An overview of the study areas described below with locations of historic environment assets is shown on Figure 16-1 to Figure 16-5.

The marine archaeology and cultural heritage study area is defined as the offshore Project area, encompassing the area that will be directly impacted by the offshore infrastructure (including Wind Turbine Generators (WTGs) and associated foundations and substructures, the Offshore Substation Platforms (OSPs) and associated foundations and inter-connector cables, the inter-array cables and offshore export cables.

A separate study area for identifying potential impacts on the setting of designated historic environment assets has been defined, and this includes designated assets up to 60 km from the Option Agreement Area (OAA).

[3] A sample of designated historic environment assets were assessed to act as proxy sites for all designated historic environment assets within the study area (see 16.5.3 for explanation).

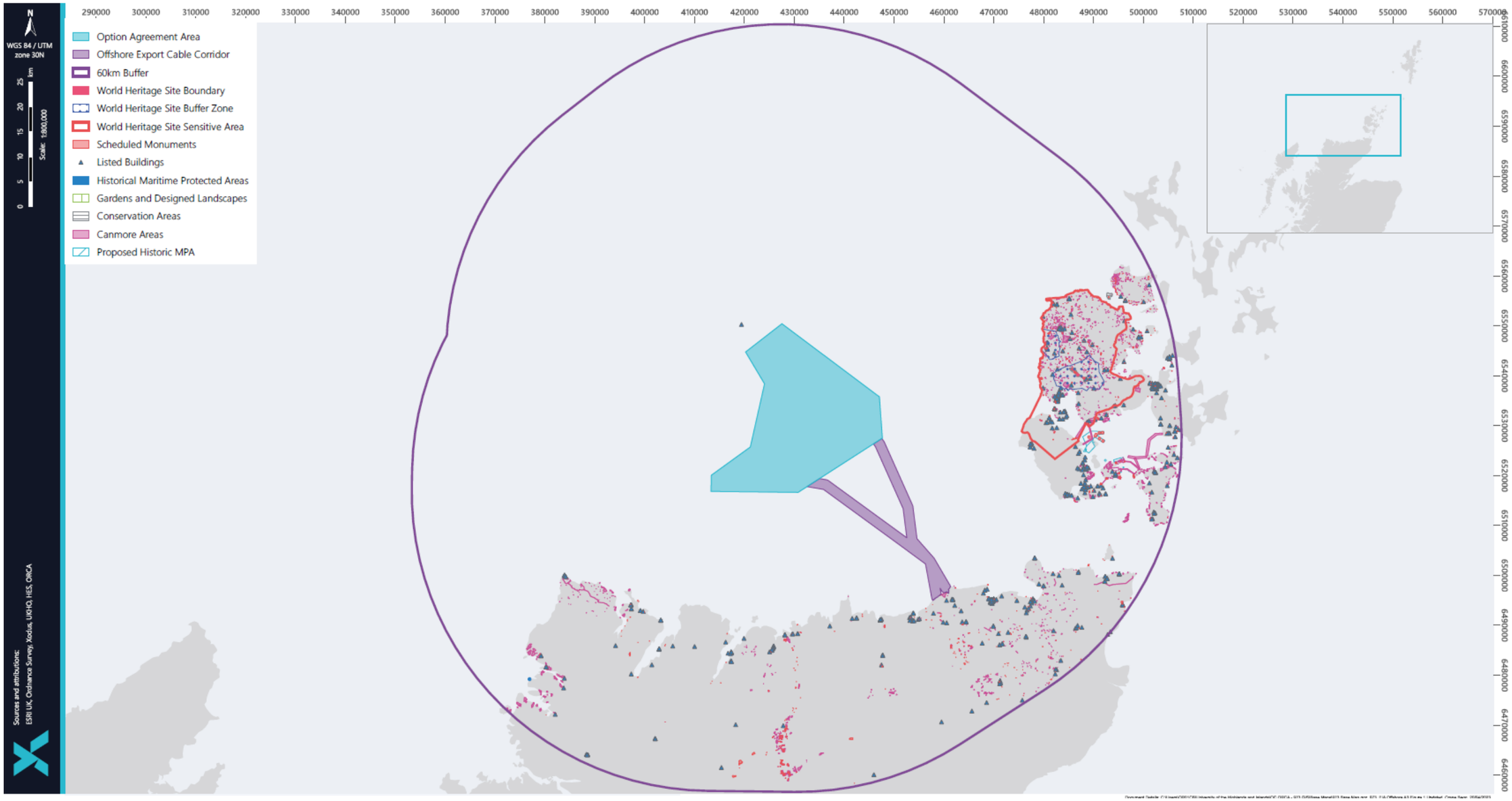

Figure 16-1 Overview of the offshore Project location and historic environment assets

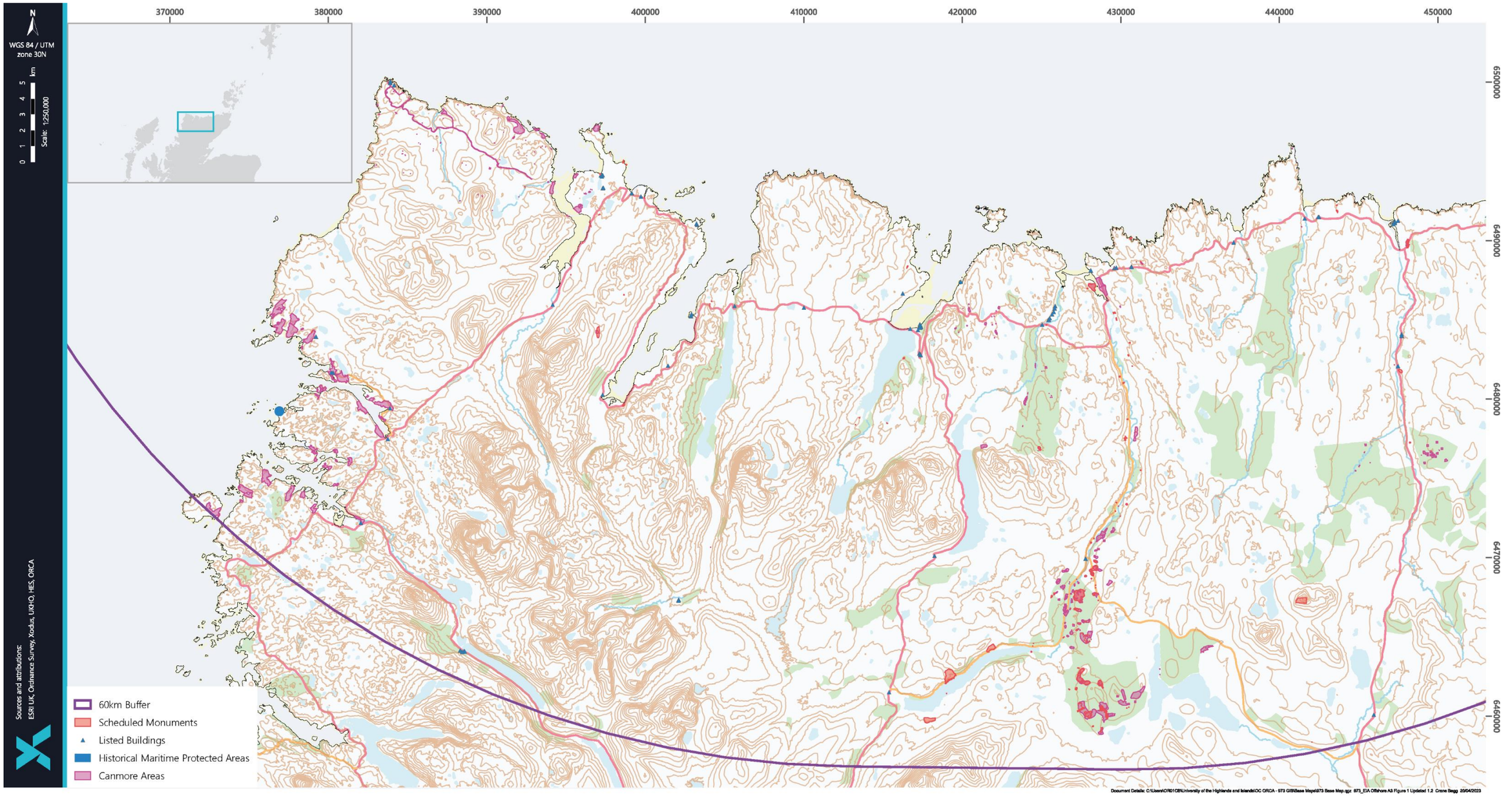

Figure 16-2 Overview of the historic environment assets within THC region (west)

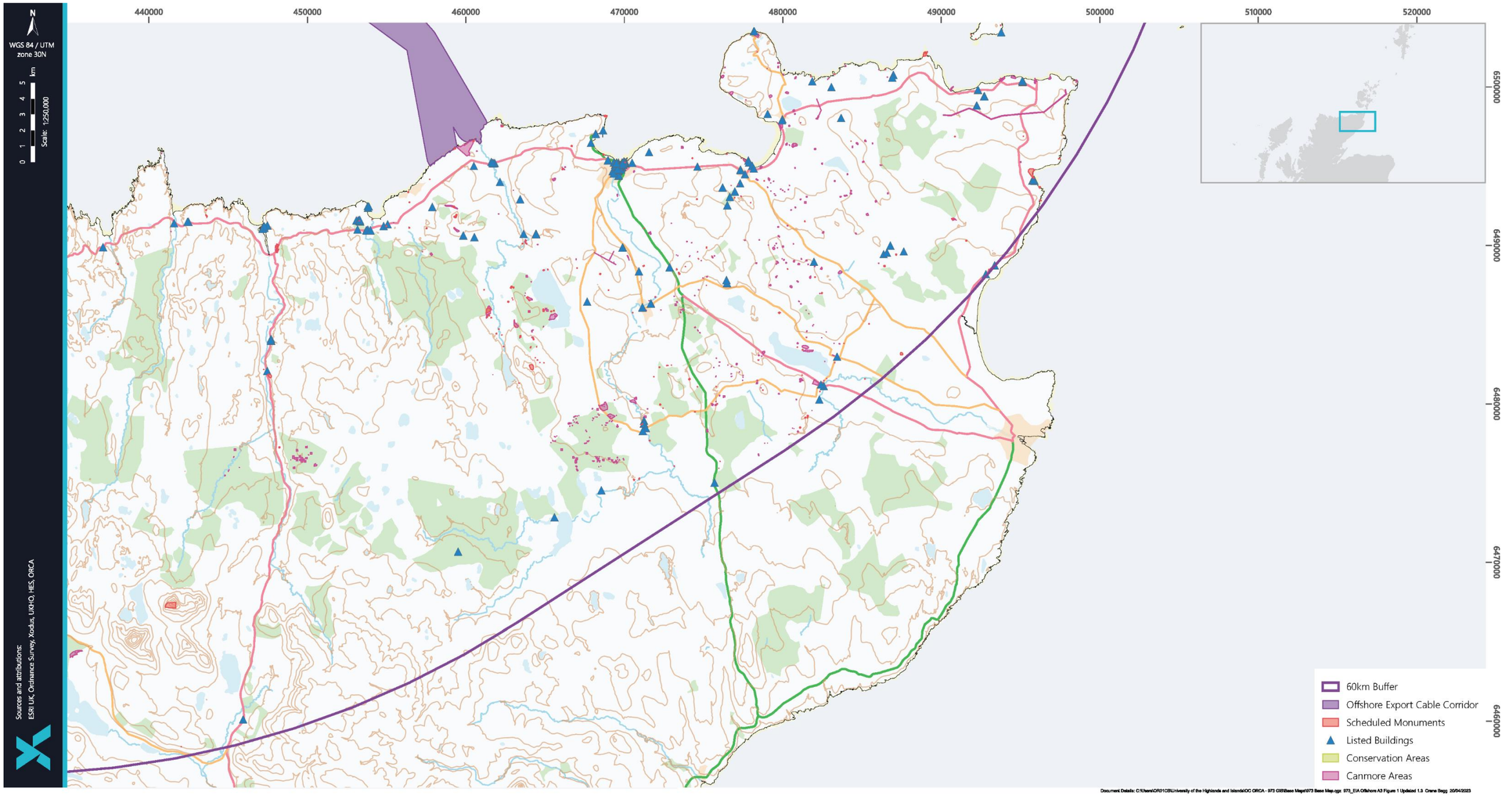

Figure 16-3 Overview of the historic environment assets within THC region (east)

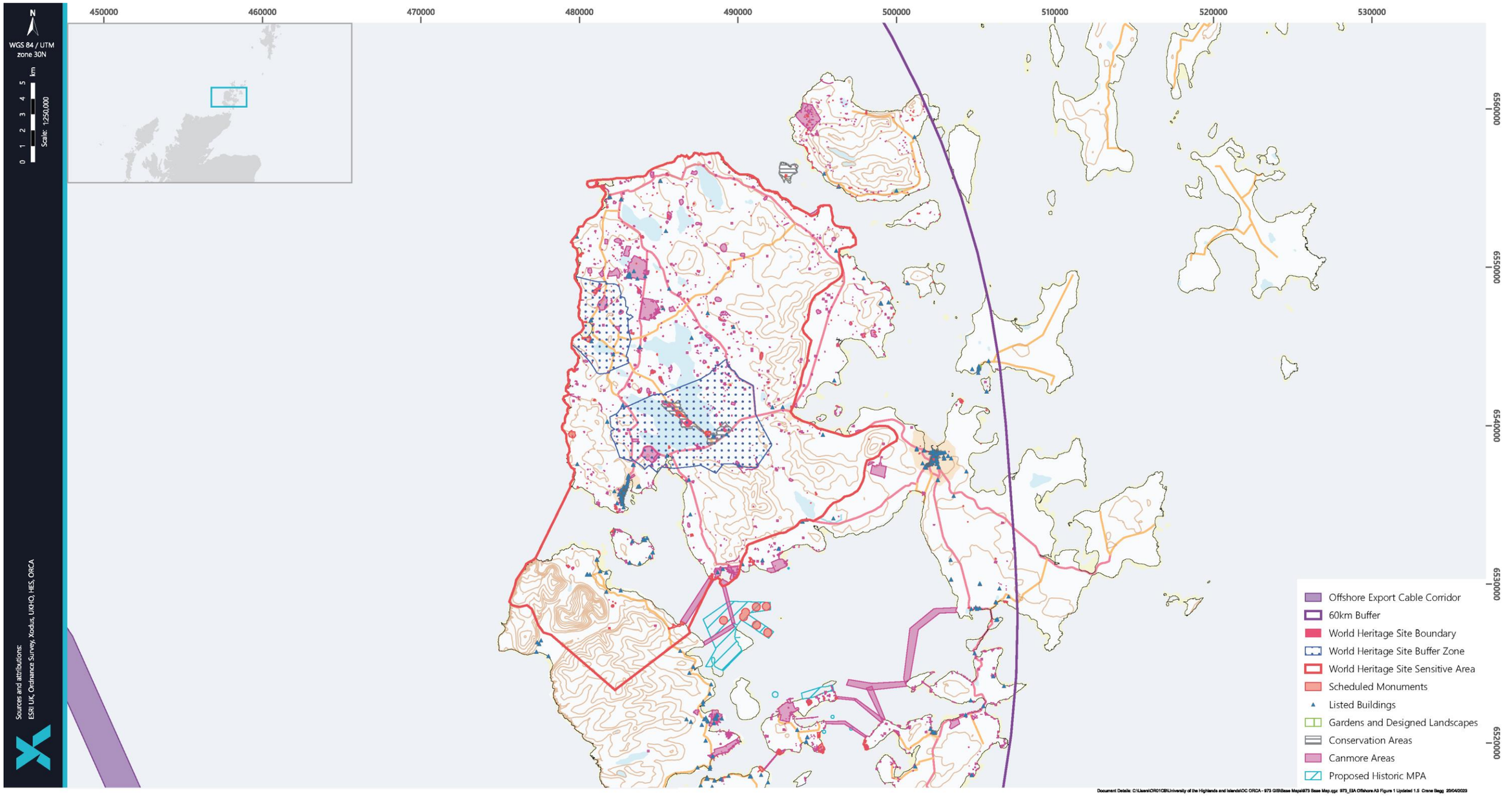

Figure 16-4 Overview of the historic environment assets within the OIC region (north)

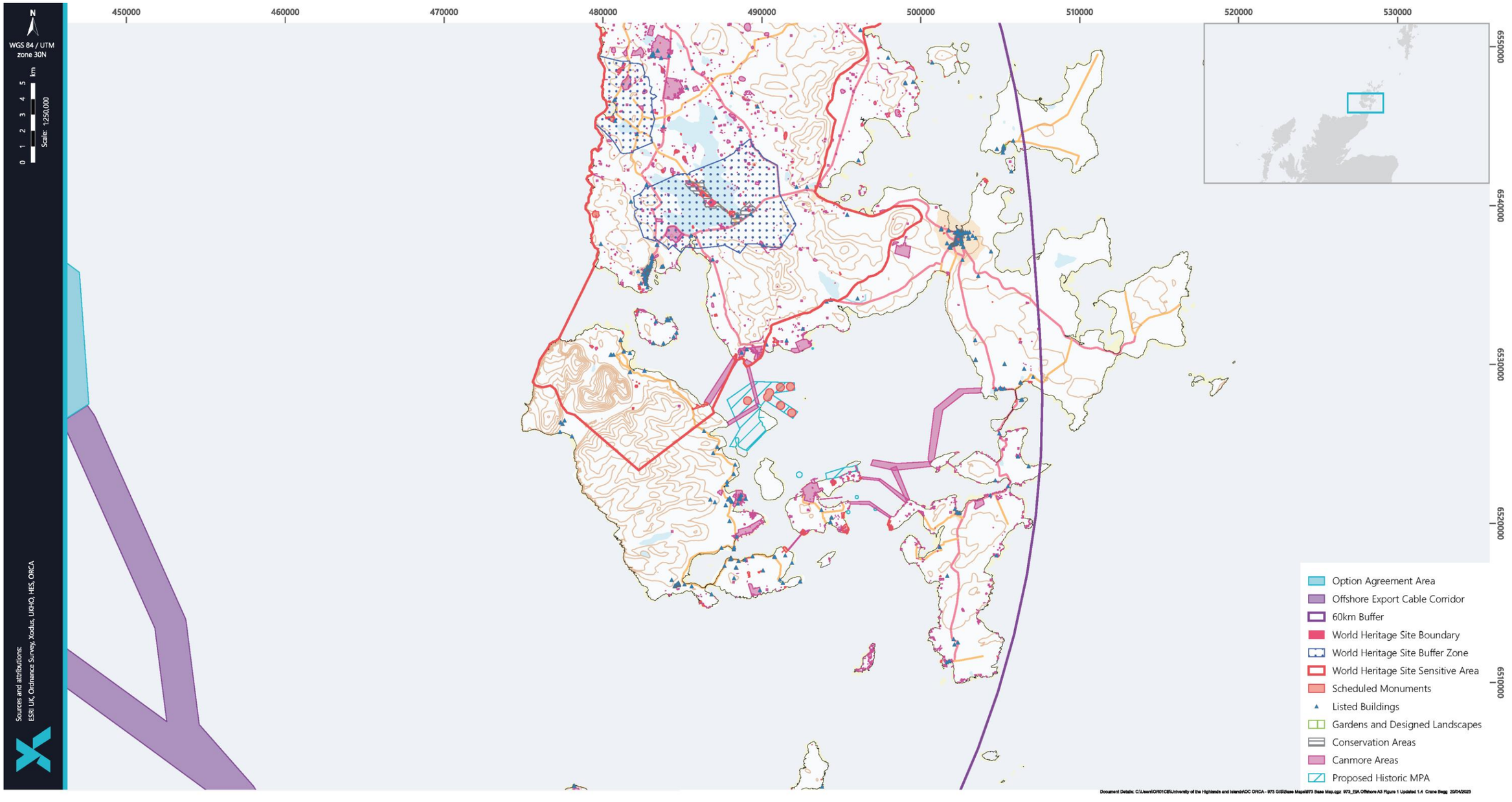

Figure 16-5 Overview of the historic environment assets within the OIC region (south)

16.4.2 Data sources

The existing data sets and literature with relevant coverage to the offshore Project, which have been used to inform the baseline characterisation for marine archaeology and cultural heritage, are outlined in Table 16-5.

Table 16-5 Summary of key datasets and reports

TITLE	SOURCE	YEAR[4]	AUTHOR
The National Record of the Historic Environment (NRHE) of Scotland	Canmore (https://canmore.org.uk)	2023	HES
	PastMap (http://pastmap.org.uk)	2023	HES
United Kingdom Hydrographic Office (UKHO) wreck register & nautical charts	https://www.admiralty.co.uk/digital-services/data-solutions/admiralty-marine-data-portal	2022 - 2023	UKHO
Statutory lists, registers and designated areas, including lists of Scheduled Monuments, Designated Wrecks and Historic Marine Protected Areas	The Historic Environment Scotland Data Portal https://portal.historicenvironment.scot	2023	HES
Off Scotland: a comprehensive record of maritime and aviation losses in Scottish waters	Edinburgh – C-Anne Publishing	1998	Whittaker I.G.
The Ship Wreck Index of Great Britain & Ireland Vol. 4 Scotland	London: Lloyd's Register of Shipping	1998	Larn, R & Larn, B
Shipwrecks of North Scotland	Edinburgh: Birlinn Ltd	2003	Baird, R.N.
Dive Scotland, Vol 2	London: Underwater World Publications	1985	Ridley, G
Dive Scotland, Vol 3	London: Underwater World Publications	1992	Ridley, G
Shipwrecks of Orkney & Shetland	Newton Abbot: David & Charles	1988	Ferguson, D

[4] *Where datasets are not dated, a date of last access has been provided.*

TITLE	SOURCE	YEAR[4]	AUTHOR
Ferguson/Heath Collection	Private collection, continuing to update Ferguson's database	2022	Ferguson, D & Heath, K
Wreck Site – European Union (EU)	http://www.wrecksite.eu	2022	WreckSite
The British Newspaper Archives	https://www.britishnewspaperarchive.co.uk/	2022	Briitsh Newspaper Archives
Lloyds Shipping Register	https://hec.lrfoundation.org.uk/archive-library/lloyds-register-of-ships-online/lloyds-register-of-ships-online	2022	Lloyds of London
Bi-monthly Minesweeping Reports	https://discovery.nationalarchives.gov.uk/details/r/C1825	2023	The National Archives
Lost in Waters Deep	https://lostinwatersdeep.co.uk/index.html	2022	Heath, K & Sadler, W
Aviation Research Group Orkney & Shetland	https://crashsiteorkney.com/index.html	2022	ARGOS
Jutland to Junkyard	Edinburgh: Birlinn Ltd	2003	George, S
The scope of Strategic Environmental Assessment of Continental Shelf Area SEA 4 in regard to prehistoric archaeological remains	https://assets.publishing.service.gov.uk/government	2003	Flemming, N.C
Submerged Landscapes of the European Continental Shelf	Chichester: John Wiley & Sons Ltd	2017	Flemming, N.C et al (eds)

16.4.3 Project site-specific surveys

A programme of marine geophysical surveys, comprising SSS, MBES and magnetometer were undertaken in 2022 (Ocean Infinity 2023a and 2023b). The survey data covered the OAA and offshore ECC. Shallow geotechnical data

has been collected for the offshore ECC (Ocean Infinity 2023c). No geotechnical site investigation data are currently available for the OAA[5].

16.4.4 Existing baseline

A review of literature and available data sources, augmented by consultation and marine geophysical and geotechnical surveys, has been undertaken to describe the current baseline environment for marine archaeology and cultural heritage.

16.4.4.1 OAA and offshore ECC

16.4.4.1.1 Historic minefields and ordnance

During both world wars, a large amount of ordnance, both offensive and defensive, was used in the seas around Orkney and the Pentland Firth. Some of these munitions still exist and are regularly found by divers and fishermen.

One of the largest German minefields of the First World War was laid to the north of mainland Scotland in January 1916. This was known to the British as the Whitten Head Field and had over 250 mines (Figure 16-6). By the end of April 1916, the Royal Navy had accounted for 70 of these mines and considered the minefield cleared. Parts of the Whitten Head Field are in, or very close to, the offshore Project area and there is a possibility that live mines could have drifted into it either as a result of minesweeping operations or mines having broken free of their moorings, and that some of the mines sunk during sweeping operations are still on the seabed. Mines associated with the Whitten Head Field have also been found ashore on Orkney and in the Pentland Firth. Site specific geophysical survey data were reviewed by 6Alpha Associates[6] alongside a desk top study (6Alpha, 2023). This assessment identified 222 potential Unexploded Ordnance (pUXO), including a number of contacts that could potentially be related to the Whitten Head Field. Further survey would be required to determine whether these contacts are indeed mines. 6Alpha assume 3-10% of potential pUXO may be expected to be confirmed UXO (cUXO) which equates to 6 to 22 UXO.

The only reported U-Boat mine-laying activity off the west coast of Orkney is off the Old Man of Hoy, with four mines laid by U-80 21st January 1917. The report in U-80's Kriegstagebücher (KTB – 'War Day Book') states the four mines were laid on high water slack 0.9 miles from land. On 1st March 1917, HMS Pheasant, an M class destroyer on patrol, struck one of these mines one mile off the Old Man of Hoy and sank (around 26 km to the east of the OAA) with the loss of the entire crew of 89 men. The Bi-Monthly minesweeping reports show that the area was subsequently swept for mines on 9th April 1917 and a further four mines in groups of two were found, indicating that there had been some further mine-laying. Two were a mile north-west of the Old Man of Hoy and the other two were 1.5 miles west of Old Man of Hoy (ADM 116-1516 Bi-monthly minesweeping reports). No further mines were reported after this.

[5] *As of 26th May 2023.*

[6] *Specialists in Unexploded Ordnance (UXO), Risk Management and Explosives Ordnance Disposal.*

Figure 16-6 The Whitten Head Minefield (Spindler, 1932)

16.4.4.1.2 Vessels

There are marine cultural heritage statutory designations within 60 km of the OAA, however none of these are located within the OAA or offshore ECC boundaries.

The potential exists for the discovery of vessels and aircraft that would be designated if found (see SS14: Marine archaeology and cultural heritage gazetteer of sites). These would include any aircraft lost while on military service (automatically protected under the terms of PoMRA and any vessels (including merchant vessels) that were lost during war actions with the death of crew onboard that could be deemed War Graves.

SS14: Marine archaeology and cultural heritage gazetteer of sites lists vessels and aircraft with verified locations (shown on Figure 16-7) and known losses that have no known location, but could be within the offshore Project study area, derived from the UKHO and Canmore databases.

16.4.4.1.3 Aircraft

A number of aircraft went missing without trace off the north coast of Scotland and off the west coast of Orkney in both world wars, especially the Second World War. The chances of finding one within the offshore Project area,

although not likely, cannot be discounted. See SS14: Marine archaeology and cultural heritage gazetteer of sites for known aircraft locations within the study area. Any aircraft lost on military service are automatically protected by PoMRA.

16.4.4.1.4 Submerged palaeolandscape deposits, archaeological sites and deposits

The offshore Project is located within Strategic Environmental Assessment 4 (SEA4) of the Strategic Environmental Assessment of the Continental Shelf. Flemming notes the potential for the survival of submerged landscapes and prehistoric sites in the study area is influenced by various physical factors, processes and topography with sheltered areas with lower seabed water movements, deep sediment deposits in rocky gullies and depressions and sea caves often providing conditions suitable for good site preservation (Flemming, 2003).

The results of Vibro Core sediment samples (shallow geotechnical data) collected for geotechnical site investigations within the offshore ECC area (see Figure 16-8) revealed a series of largely minerogenic deposits comprising of sands, clays, and gravels. These deposits hold little palaeoenvironmental potential for reconstructing former landscapes through proxies such as pollen analysis (Moore, Webb and Collinson, 1991).

It is noted in the offshore geotechnical site investigation (Ocean Infinity 2023c) that organic material is absent in the recovered Vibro Core sediment samples, and not interpreted at locations investigated along the survey routes. However, a very small pocket of possible organic material was identified within the top 20 cm of Vibro Core 836-VC-ECC-SB-KP-36 (see Figure 16-8), and observations made during sample assessment noted that it gave off a strong organic odour. The sample was subsequently assessed in Orkney by Associate Professor Scott Timpany, an environmental geoarchaeologist and expert in the palaeoenvironmental reconstruction of submerged landscapes, from the University of the Highlands and Islands Archaeology Institute. The assessment noted that there was no organic material contained within the sample, and therefore there was no potential for it to provide palaeoenvironmental information on former prehistoric landscapes.

Figure 16-7 Locations of known wreck sites[7] and contacts [8]

[7] *Known wrecks have been interpreted from the National Record of the Historic Environment (NRHE) of Scotland (Canmore) & UKHO wreck register & nautical charts.*

[8] *Contacts have been identified from the Project specific geophysical survey data.*

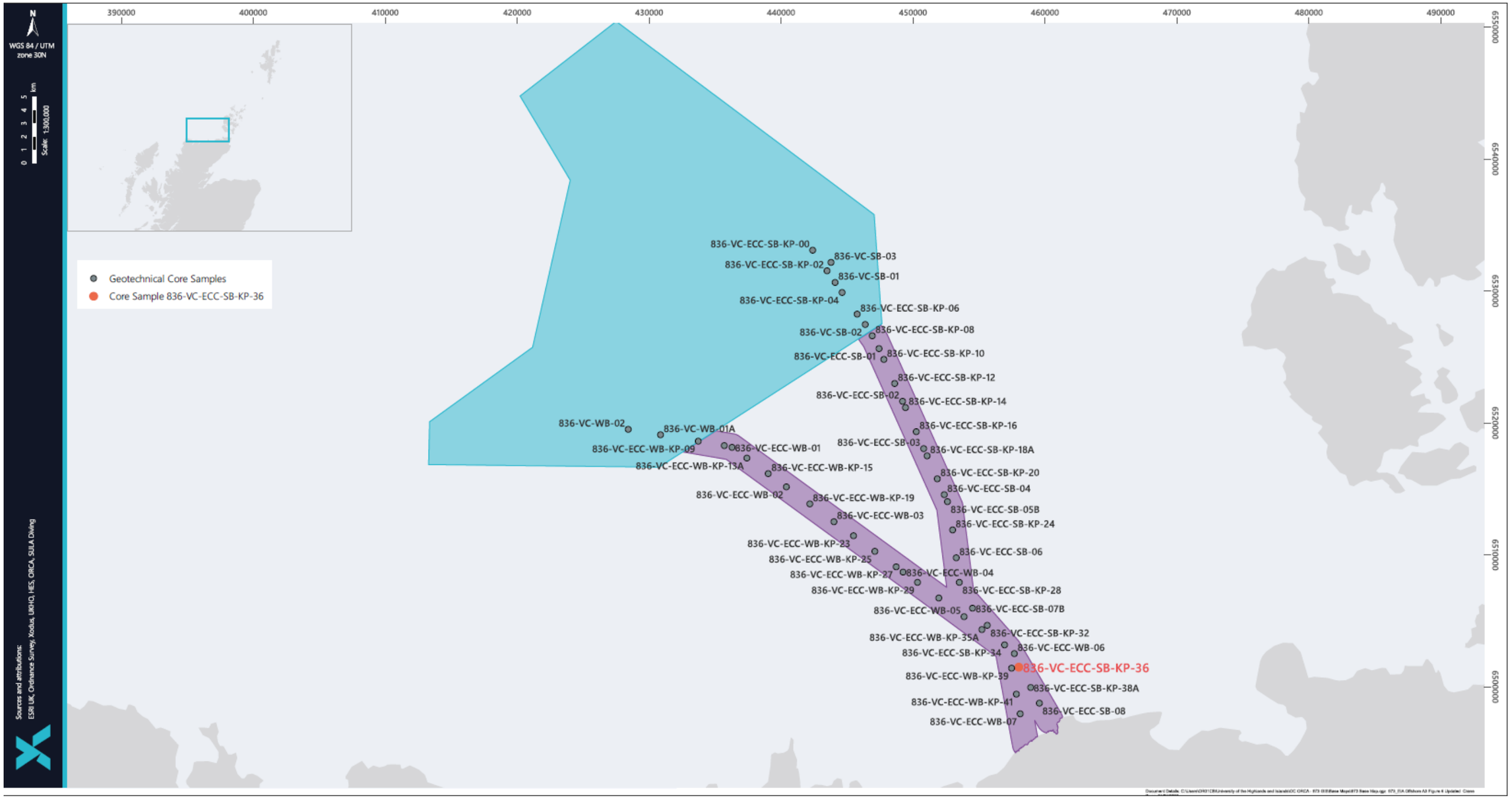

Figure 16-8 Locations of reconnaissance shallow geotechnical core samples

16.4.4.1.5 Geophysical Survey

Geophysical surveys were undertaken within the offshore Project area (Ocean Infinity 2023a; Ocean Infinity 2023b). The aim of the survey was to acquire data to evaluate the seabed and sub-seabed conditions, including potential associated hazards (geohazards or anthropogenic hazards), affecting the future installation of WTGs and subsea cables.

The survey results were analysed by SULA Diving, specialists in interpreting marine geophysical survey data for archaeological remains. For anthropogenic hazards the SSS, MBES and magnetometer results were analysed; as well as the geotechnical site investigation results (Ocean Infinity 2023c). The section below summarises the results of the analysis.

Side scan sonar

All contacts were digitised alongside MBES data to ensure that all contacts visible on the MBES data were also identified by the SSS. The shape of an SSS contact was the main parameter used to distinguish between debris (i.e. contacts likely to be anthropogenic objects) and boulders. Items of debris often show sharp edges and elongate/irregular shapes, while boulders usually appear as more rounded SSS contacts.

After SSS contacts had been finalised, correlation against magnetic anomalies was performed. Any SSS contacts that correlated with magnetic anomalies were marked as such in the contact list. In general, anthropogenic objects identified on the seabed were classified as debris. Some anthropogenic contacts were considered to represent active fishing as they were not imaged on adjacent lines acquired at different dates. Other items of fishing gear were presumed lost or abandoned and classified as debris if they were seen on more than two survey lines; were nonlinear or disordered; sat in a localised depression or scour; had an indistinct shape or occurred as isolated objects.

Three sets of SSS were provided for the OAA and offshore ECC areas, and image tiles were supplied in both high and low frequencies:

- High frequency SSS: The overall quality of the high frequency SSS was very good, with good coverage, post-processing and layback. From the images provided it was easy to discern small rocks and boulders, areas of sand, sand ripples and larger sand waves and patches of gravel or cobbles. Areas that had been recently trawled by scallop dredger were also seen. There were no obvious signs of wrecks, although some contacts could have been wires or ropes - these were identified as likely being related to lost or discarded fish gear or trawls; and
- Low frequency SSS: The overall quality of the low frequency SSS was not as good as the high frequency. Large boulders and larger rocks, sand ripples and sand waves could be discerned. There were no obvious signs of wrecks.

Multi beam echo sounder

Automated contact picking was performed on the survey areas. This process detected the presence of potential contacts by comparing the high-resolution bathymetry surface to the smoothed seabed in a Geographic Information System (GIS) software package.

Boulders and other features were highlighted in the resultant surface which was customised to balance the detection of contacts without introducing too many false positives. The dimensions of the contacts were calculated through analysis of a vectorised boulder map. Contacts with dimensions below the required threshold were stripped from the results and false positives caused by artefacts in the MBES surface were rejected manually in the GIS programme.

MBES files were supplied for the OAA and the offshore ECC at 50 centimetre (cm), with good coverage. This consisted of 40 tiles for the OAA and 20 tiles for the offshore ECC. Large boulders and larger rocks, sand ripples and sand waves could be discerned from the data. Debris noted from the high frequency SSS data could not be observed due to pixilation when zoomed in. No wrecks or debris were seen.

Magnetometer

All magnetic anomalies greater than 5 nanotesla (nT) peak-to-peak were identified, positioned and measured manually from the residual field in both grids and profiles. All magnetometer MAG anomalies were compared to all SSS contacts. If a magnetometer anomaly was within 3 metre (m) of any contact detected in SSS, it was deemed a correlation, assigned the same ID and flagged as "MAG hit". Several targets interpreted from SSS imagery presented strong correlation to magnetic anomalies and were interpreted as potential debris. The magnetic signature of these targets could be very similar to anthropogenic objects.

Magnetic anomalies forming a linear pattern such as fishing gear and wires were identified in the residual profiles or grids. Some anomalies were inferred to be of a geological nature.

The overall coverage of the OAA and offshore ECC areas was good with many anomalies recorded, most of which were identified as likely geology, such as glacial erratic rocks. Only one contact looked to potentially be related to a shipwreck (see SULA 36 on Figure 16-9 and Figure 16-10) but could also have been associated with discarded or lost fishing gear.

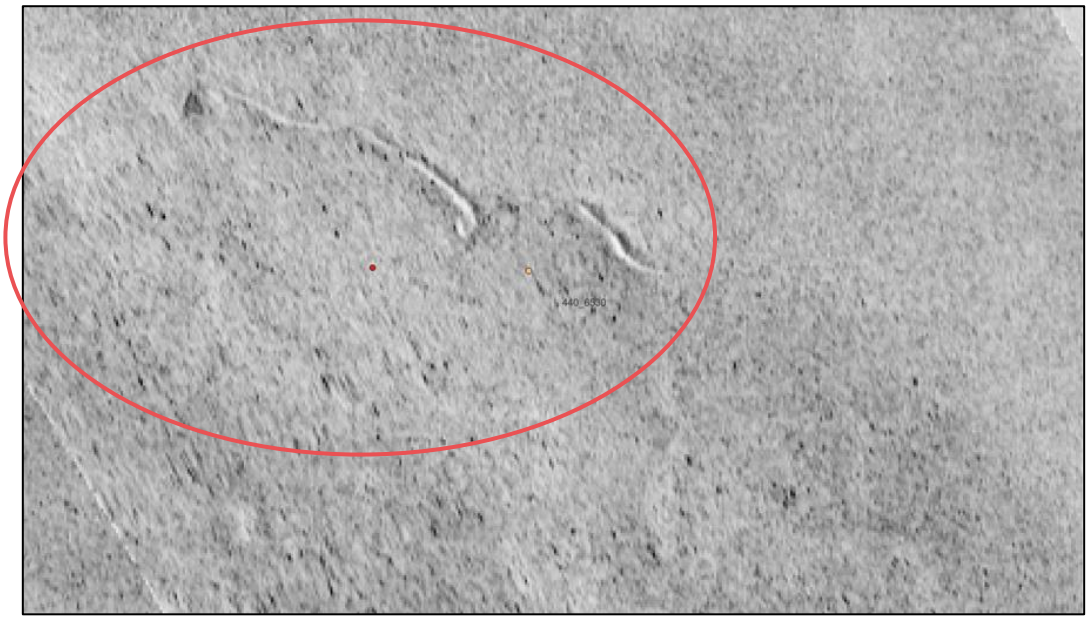

Figure 16-9 SULA 36 potential site (ringed) of interest from SSS high frequency survey

Some magnetometer readings appeared to indicate buried anomalies, so it was not possible to determine if these were geology or possible debris under the sand, although it was noted that these were relatively small and matched obvious boulders. Due to the size of these anomalies, and the fact that the reports of sinkings of vessels within the area were large steel vessels, it was concluded that they were likely to be geological.

Contact reports

Two files with images and contact reports were supplied for OAA and offshore ECC.

- OAA: images were cross referenced with high frequency SSS data, which showed contacts were likely rocks and boulders. Creels with other possible discarded fishing gear, ropes or wires could be seen, examples are provided below in Figure 16-10; and
- Offshore ECC: images were cross referenced with high frequency SSS data, which showed contacts were likely rocks and boulders. Creels with other possible discarded fishing gear, ropes or wire could be seen.

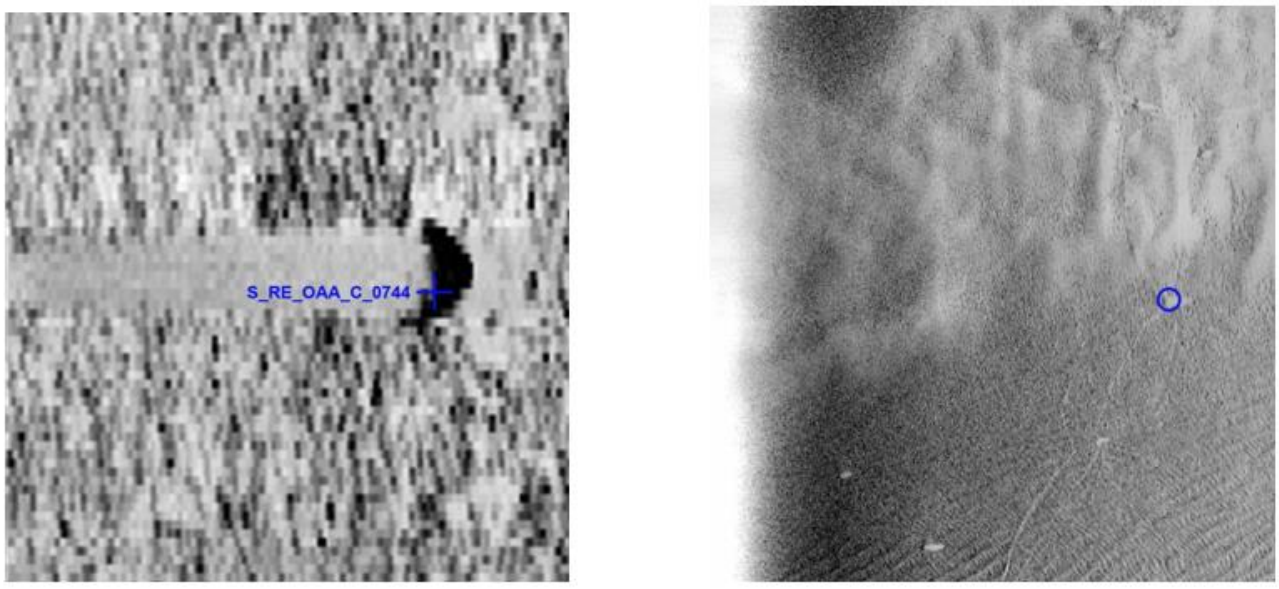

Figure 16-10 Pixilated probable boulder (left) Line of creels (right)

16.4.4.2 Historic environment assets and their setting

The landscape of Caithness tends to be low, open, rolling farmland in the more cultivated northeast of the county, turning into moorland and the extensive low bog of the Flow Country, to the south and west. The landscape affords open distant views with isolated hills, which form focal landmarks. There are extensive dark conifer plantations across parts of the area. The land rises to south and west to the wilder higher ground of north Sutherland, with its long south-north oriented straths and settlements nowadays mostly concentrated along the coast. The coast comprises high cliffs, sandy bays with dune systems and low rocky shelf shorelines (Stanton, 1998).

The landscape of Orkney has a predominantly low and gentle relief, the smooth contours of which are emphasised by the scarcity of trees and woodland cover. This landscape, though windswept, supports large areas of productive

pastures and some arable farming. The landform is generally lower than 270 m, except on Hoy, the second largest island, where hills reach 480 m above sea level. These are characterised by heather moorland cover which contrasts with the pastoral greens of the lower ground. Hoy also shows the most northerly evidence of corries, u-shaped valleys and other glacial erosion in the United Kingdom (UK). This produces a stark contrast to the smoother, lower islands.

There are 737 Scheduled Monuments, 83 A category Listed Buildings (LBs), 703 B category LBs and 608 C category LBs, one Garden and Designed Landscapes (GDL) and one WHS within the marine archaeology and cultural heritage study area to the south and east of the OAA (see Figure 16-1). There are many more non-designated sites identified in the online Canmore, Pastmap, THC and OIC Historic Environment Record (HER) databases within the marine archaeology and cultural heritage study area.

In order to undertake a reasonable and proportionate assessment, as agreed by stakeholders in their scoping responses (see Table 16-4), a selection of statutorily designated sites and areas have been considered below that act as proxies for the range of effects on all other designated and undesignated sites. The sites chosen and described below are likely to have the most visibility of and impact from the OAA (tested by reviewing the Zone of Theoretical Visibility (ZTV) (see chapter 18: Seascape, landscape and visual assessment) and were selected as cultural heritage viewpoints. The location of these viewpoints is shown on Figure 16-11, Figure 16-12 and Figure 16-13. The rest of the designated sites are summarised in table form in SS14: Marine archaeology and cultural heritage gazetteer of sites.

16.4.5 Future baseline

The future baseline will be broadly comparable to the existing baseline described in section 16.4.4 above. Sea level rise and increased extreme weather events associated with climate change may result in the erosion and gradual destruction of coastal archaeological sites that are located close to sea level (as detailed in SS1: Climate and carbon assessment).

16.4.6 Summary and key issues

A summary of the key sensitive receptors identified from the baseline characterisation study that form the focus of the impact assessment are outlined below.

Table 16-6 Summary and key issues for marine archaeology and cultural heritage

SUMMARY AND KEY ISSUES	OFFSHORE PROJECT AREA
	Onshore 'setting impact' receptors
	Long term changes to the setting of onshore historic environment assets within the 60 km study area that reduces their value, including: • HONO WHS; • Coastal Scheduled Monuments and Listed Buildings in Caithness and Orkney; and • The Hall of Clestrain Category A Listed Building that has principal views west to Hoy Sound and beyond.

OAA and offshore ECC
Marine geophysical surveys have not identified the presence of known or potential archaeological remains.

16.4.7 Data limitations and uncertainties

The assessment of marine geophysical survey results by specialists has concluded that there are likely no archaeological remains associated with wreck sites or other archaeological remains within the OAA or the offshore ECC areas. The survey data have been supplemented by a robust and up to date dataset of known wreck sites and archaeological remains, which has allowed a focus on locations of archaeological potential. The potential does remain however for archaeological remains to be present buried under the seabed, and embedded mitigation will be in place to deal with any unexpected discoveries (see Section 16.5.4, Table 16-12).

16.5 Impact assessment methodology

16.5.1 Impacts requiring assessment

The impacts identified as requiring consideration for marine archaeology and cultural heritage are listed in Table 16-7. Information on the nature of impact (i.e. direct or indirect) is also described.

This assessment covers all potential impacts identified through the scoping process, as well as any further potential impacts that have been highlighted as the EIA has progressed. It should be noted that impacts are not necessarily relevant to all stages of the offshore Project development.

Table 16-7 below indicates all of the potential direct and indirect impacts assessed with regards to marine archaeology and cultural heritage and indicates the offshore Project stages to which they relate. Cumulative impacts are discussed in section 16.7.

Table 16-7 Impacts requiring assessment for marine archaeology and cultural heritage

POTENTIAL IMPACT	NATURE OF IMPACT
Construction (including pre-construction) and decommissioning	
Loss of or damage to known marine historic environment assets	Direct
Loss of or damage to unknown marine historic environment assets	Direct
Loss of or damage to submerged prehistoric landscapes	Direct

POTENTIAL IMPACT	NATURE OF IMPACT
Operation and maintenance	
Loss of or damage to known marine historic environment assets	Direct
Loss of or damage to unknown marine historic environment assets	Direct
Loss of or damage to submerged prehistoric landscapes	Direct
Long term changes to the setting of onshore historic environment assets that reduces their value	Indirect
Decommissioning*	
**** In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the offshore Project considered analogous with, or likely less than, those of the construction stage. Where this is not the case, decommissioning impacts have been listed separately and have been assessed in section 16.6.3.***	

16.5.2 Impacts scoped out of the assessment

No impacts have been scoped out of the assessment.

16.5.3 Assessment methodology

An assessment of potential impacts is provided separately for the construction and decommissioning (including pre-construction), operation and maintenance stages.

The assessment for marine archaeology and cultural heritage is undertaken following the principles set out in chapter 7: EIA methodology.

Topic specific criteria have been developed for the value, sensitivity and vulnerability of historic environment receptors as outlined in Table 16-8 and Table 16-10. Marine geophysical survey anomalies were reviewed by specialists from SULA Diving to identify if there were any anthropogenic features, which would then be incorporated into the same value and impact criteria.

The sensitivity or value[9] of the receptor is combined with the magnitude of impact, supported by professional judgement to arrive at a consequence for each impact under consideration. Topic-specific sensitivity and magnitude criteria are described in Table 16-8 and Table 16-10. Example criteria for assessing magnitude of impact on the setting of onshore historic environment receptors are presented in Table 16-9. The consequence and significance of effect is then determined using the matrix provided in chapter 7: EIA methodology.

The example criteria presented in the tables below are used to inform the assessment, but the tables and matrices are tools and not mechanical systems. Professional judgement is required to input into the assessment, which may result in heritage values and significance of effect being moved higher or lower than the matrix result. This may also result in a significant material effect that does not reduce the integrity or heritage value of the receptor being identified as potentially acceptable by the statutory authorities. This reasoning is stated in the individual assessment wherever this is the case.

"*Setting can often be integral to a historic asset's cultural significance…..'Setting' is the way the surroundings of a historic asset or place contribute to how it is understood, appreciated and experienced. Monuments, buildings, gardens and settlements were almost always placed and orientated deliberately, normally with reference to the surrounding topography, resources, landscape and other structures. Over time, these relationships change, although aspects of earlier settings can be retained*." (*Managing Change in the Historic Environment: Setting*. HES 2020). To assess setting impacts, a ZTV was established for the offshore Project. A 60 km radius around the boundary of the OAA was established to identify any designated cultural heritage assets from which the development will be partially or fully visible (Figure 16-1). There were many designated cultural heritage assets within the 60 km radius that were not within the ZTV and, after initial consideration in case they could be affected, were not considered further within the assessment.

Due to the total number of sites, as agreed in the methodology sent to stakeholders, this Offshore EIA Report assesses a selection of designated historic environment assets that potentially have the most visibility of, and impact from, the OAA to act as proxy for all the others. Wirelines and visualisations have been developed that showed the worst case scenario for selected designated assets (see SS19: Visualisations). Viewpoints were chosen for assessment where there were designated onshore historic environment assets present within the viewpoint envelope. Where no designated onshore historic environment assets were within the viewpoint envelope the viewpoint was not used for assessment. The assessment of impacts on setting differs from that used within the SLVIA assessment and hence conclusions between the chapters can vary.

[9] *For this assessment, the word 'value' is used in relation to assets throughout to avoid confusion with the importance of setting and sensitivity to change criteria. Sensitivity to change is used in relation to the setting assessment.*

Table 16-8 Value criteria

VALUE OF RECEPTOR	DEFINITION
High	• WHS; • Scheduled Monuments and sites proposed for scheduling; • Category A Listed Buildings; • Inventoried Gardens and Designed Landscapes; • Interconnected groups of Category B Listed Buildings; • Outstanding Conservation Areas; • Historic Battlefields; • Historic Marine Protected Areas and Designated Wrecks; • Aircraft lost on military service; and • Designated and undesignated wrecks, archaeological sites, areas and buildings of international and national importance due to association, rarity, intrinsic value, loss of life and/or retaining archaeological, structural, architectural, decorative or other physical remains to the extent that it makes a significance contribution to our understanding or appreciation of the past.
Medium	• Category B and Category C Listed Buildings; • Historic burial grounds; • Protected heritage landscapes; • Conservation Areas; and • Undesignated wrecks, archaeological sites, areas and buildings of equivalent regional importance due to association, rarity, intrinsic value, loss of life and/or retaining archaeological, structural, architectural, decorative or other physical remains to the extent that it makes a significance contribution to our understanding or appreciation of the past.
Low	• Cultural heritage assets the physical remains of which contribute little to our understanding or appreciation of the past; • Cultural heritage assets of local value or interest for education or cultural appreciation; • Undesignated archaeological sites, areas, buildings, wrecks and cargos of equivalent local importance (identified in the HER) due to limited intrinsic, contextual or associative characteristics, or that are still common; and • Unlisted historic buildings and settlements with local characteristics.
Negligible	• Sites of former archaeological features, lifted or salvaged wrecks; • Unlisted buildings of little historic or architectural interest; • Sites or features the physical remains of which make a negligible contribution to our understanding or appreciation of the past; • Single findspots; and • Sites of little or no known heritage importance.

Table 16-9 Criteria for importance of setting and sensitivity to change

SENSITIVITY TO CHANGE	IMPORTANCE OF SETTING
High	A setting that makes a crucial contribution to the understanding and/or appreciation of the siting and/or historical / archaeological / architectural context of a receptor. Examples of this include: dominant topographic locations; surroundings that include highly related monuments in extremely close association; surroundings that are believed not to have changed from those when the receptor was created.
Medium	A setting that makes a positive contribution to the understanding and/or appreciation of the siting and/or historical / archaeological / architectural context of a receptor. Examples of this include: surroundings that complement the siting and appearance of a receptor, such as the presence of a feature of the rural past within a more recent farming landscape containing little or no urban or industrial development.
Low	A setting that makes little positive contribution to the understanding and/or appreciation of the siting and/or historical / archaeological / architectural context of a receptor. Examples of this include: surroundings that only partially complement the siting and appearance of a receptor, such as the presence of a feature of the rural past within a partly urbanized or industrialized landscape.
Negligible	A setting that does not contribute positively to the understanding and/or appreciation of the siting and/or historical / archaeological / architectural context of a receptor. Examples of this include: immediate surroundings, such as commercial coniferous woodland or an industrial development, that are not relevant to the understanding of the context of the receptor.

Table 16-10 Magnitude criteria

MAGNITUDE OF IMPACT	DIRECT IMPACTS: MARINE	INDIRECT IMPACTS: MARINE
High	Works would result in the complete loss of an asset, or the loss of an area, features or evidence fundamental to the historic character and integrity of the site, which would result in the complete loss of physical integrity.	The removal of, or a fundamental and irreversible change to, the relationship between a marine heritage asset or environment and a historically relevant seabed context. Major change that removes or prevents appreciation of characteristics key to a heritage asset, or permanent change to or removal of surroundings of a less sensitive asset or seabed context. A noticeable change to a key relationship between a marine heritage asset or environment and a highly sensitive, valued or

MAGNITUDE OF IMPACT	DIRECT IMPACTS: MARINE	INDIRECT IMPACTS: MARINE
		historically relevant seabed context over a wide area or an intensive change to a less sensitive or valued asset or seabed context over a limited area.
Medium	Works would result in the loss of an important part of the site or some important features and evidence, but not areas or features fundamental to its historic character and integrity. The integrity of the site would be affected, but key physical relationships would not be lost.	Noticeable change to a non-key relationship between a marine heritage asset or environment and a historically relevant seabed context. A heritage asset and setting that is tolerant of moderate levels of change. Small changes to the relationship between a heritage asset and a historically relevant seabed context over a wide area or noticeable change over a limited area.
Low	Works would not affect the main features of the site. The historic integrity of the site would not be significantly affected.	Minor changes to the relationship between a heritage asset or environment and a historically relevant seabed context over a wide area or minor changes over a limited area. A heritage asset and setting that is considered tolerant of change.
Negligible	Works would be confined to a relatively small, peripheral and/or unimportant part of the site. The integrity of the site, or the quality of the surviving evidence would not be affected.	Changes to a historically relevant seabed context that cannot be discerned or perceived in relation to the heritage asset or environment.
Unknown	Ground breaking works over features that have not been fully interpreted would reduce the chance of interpretation in the future. In the event of significant features this would constitute impact of high magnitude; for sites of lesser significance it is less problematical. Nevertheless, it remains an issue where features have not been or could not be interpreted, in which case a precautionary approach to assessment will be taken.	Changes to a seabed context, where it is uncertain how these contribute to our understanding of the site because the feature or asset itself could not or has not been understood or interpreted.
Positive	An enhancement to the baseline condition of the asset.	An enhancement to the seabed context of a heritage asset or environment. An enhancement to preservation conditions of a heritage asset or environment.

Table 16-11 Example criteria for assessing magnitude of impact on the setting of onshore designated historic environment receptors

MAGNITUDE OF IMPACT	SETTING IMPACT
High	The removal of, or a fundamental and irreversible change to, the relationship between a heritage asset and its relevant setting and the integrity of the setting. Major change that removes or prevents appreciation, understanding or experience of a heritage asset and its key characteristics, or permanent change to or removal of surroundings of a less sensitive asset. A noticeable change to a key relationship between a heritage asset and a highly sensitive, valued or historically relevant setting over a wide area or an intensive change to a less sensitive or valued asset or setting over a limited area.
Medium	Noticeable change to a non-key relationship between a heritage asset and its relevant setting, but the integrity of setting is adequately retained. A heritage asset and setting that is tolerant of moderate levels of change. Small changes to the relationship between a heritage asset and its setting over a wide area or noticeable change over a limited area.
Low	Minor changes to the relationship between a heritage asset and its setting over a wide area or minor changes over a limited area, with no adverse effect on the integrity of the setting. A heritage asset and setting that is considered tolerant of change.
Negligible	Changes to that cannot be discerned or perceived in relation to the heritage asset or environment.
Unknown	Changes to a setting, where it is uncertain how these contribute to our understanding, appreciation or experience of the site because the feature or asset itself could not or has not been understood or interpreted.
Positive	Changes to a setting that improves the relationship with the heritage asset.

16.5.4 Embedded mitigation

As described in chapter 7: EIA methodology, certain measures have been adopted as part of the offshore Project development process in order to reduce the potential for impacts to the environment, as presented in Table 16-12. These have been accounted for in the assessment presented below. The requirement for additional mitigation measures (secondary mitigation) will be dependent on the significance of the effects on marine archaeology and cultural heritage receptors.

Table 16-12 Embedded mitigation

MITIGATION MEASURE	FORM (PRIMARY OR TERTIARY	DESCRIPTION	HOW MITIGATION WILL BE SECURED
Embedded mitigation			
Written Scheme of Investigation (WSI) and Protocol for Accidental Discoveries (PAD)	Tertiary	The preparation of a marine heritage WSI and PAD to avoid or mitigate any impacts on accidental discoveries of archaeological interest.	Production of a WSI and PAD will be a requirement of the Section 36 Consent and/or Marine Licence condition. Details will be included in the WSI and PAD included within the Environmental Management Plan (EMP). An outline EMP is provided as part of the offshore application in the Offshore EIA Report, Outline Plan (OP) 1: Outline environmental management plan.
Review of further geophysical surveys by marine archaeologist	Tertiary	Further marine geophysical surveys that are undertaken as part of the offshore Project will be analysed by a marine archaeologist with specialist knowledge of geophysical survey.	Secured via the WSI and PAD, required under Section 36 Consent and/or Marine Licence conditions. Details on the review of geophysical surveys form part of the WSI. Details will be included in the WSI and PAD included within the EMP. An outline EMP is provided as part of the offshore application OP1: Outline environmental management plan.
Assessment of geotechnical cores	Tertiary	Cores collected during geotechnical surveys of the OAA will be assessed by environmental and geoarchaeological specialists, as appropriate.	Secured via the WSI and PAD, required under Section 36 Consent and/or Marine Licence conditions. Details will be included in the WSI and PAD included within the EMP. An outline EMP is provided as part of the offshore application in OP1: Outline environmental management plan.
Consideration of marine archaeology features for final layout	Primary	Where anthropogenic geophysical anomalies are identified in any subsequent marine geophysical survey, seabed preparation, device locations, cable routing and installation activities will avoid these by a minimum of 30 m. The final offshore Project layout will be presented within the Development	Secured via the WSI and PAD, required under Section 36 Consent and/or Marine Licence conditions. Details will be included in the WSI and PAD included within the EMP. An outline EMP is provided as part of the offshore application in OP1: Outline environmental management plan.

MITIGATION MEASURE	FORM (PRIMARY OR TERTIARY	DESCRIPTION	HOW MITIGATION WILL BE SECURED
		Specification and Layout Plan (DSLP) and Cable Plan (CaP).	
Cable protection	Primary	Suitable implementation and monitoring of cable protection (via burial or external protection). Cables will be buried as the first choice of protection. External cable protection will be used where adequate burial cannot be achieved and this will be minimised as far as is practicable. This will be informed by a Cable Burial Risk Assessment (CBRA), undertaken post-consent following results of the geotechnical survey.	Final cable design will be informed by the CBRA and detailed within the CaP, required under Section 36 Consent and/or Marine Licence conditions.
Decommissioning programme	Tertiary	The development of, and adherence to, a Decommissioning Programme, approved by Scottish Ministers prior to construction and updated throughout the Project lifespan.	The production and approval of a Decommissioning Programme will be required under Section 105 of the Energy Act 2004 (as amended).

16.5.5 Worst case scenario

As detailed in chapter 7: EIA methodology, this assessment considers the worst case scenario for the offshore Project parameters which are predicted to result in the greatest environmental impact, known as the 'worst case scenario'. The worst case scenario represents, for any given receptor and potential impact, the design option (or combination of options) that would result in the greatest potential for change. Given that the worst case scenario is based on the design option (or combination of options) that represents the greatest potential for change, it the development of any alternative options within the design parameters will give rise to no worse effects than assessed in this impact assessment. Table 16-13 presents the worst case scenario for potential impacts on marine archaeology and cultural heritage during construction, operation and maintenance, and decommissioning.

The final design of the offshore Project will be confirmed through detailed engineering design studies that will be undertaken post-consent. In relation to the setting assessment, it is not possible to confirm the final layout of the WTGs within the OAA, which will depend on final Project design, WTG choice, ground conditions and environmental considerations at the time of construction. At this stage of the offshore Project, to ensure it is future proofed, the maximum number of the largest WTGs have been assessed. The WTGs have been weighted along the perimeter of the OAA using the smallest WTG spacing (associated with the WTG parameters). This represents the maximum effect in terms of the proximity, scale, spread, density and prominence of the WTGs from receptors around the coastline. The number of WTGs, regardless of size, is considered to be up to a maximum of 125. Therefore, the utilisation of a smaller WTG size does not increase the number of WTGs beyond this number. This approach has been informed by and is consistent with that implemented for chapter 18: Seascape, landscape and visual assessment.

Table 16-13 Worst case scenario specific to marine archaeology and cultural heritage receptor impact assessment

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Construction and decommissioning		
Loss of or damage to known marine and intertidal historic environment assets through construction activities **Loss of or damage to unknown marine and intertidal historic environment assets through construction activities** **Loss of or damage to submerged prehistoric landscapes through construction activities**	Up to 69.12 km² of disturbance and loss associated with: • Seabed preparation: – UXO clearance requiring detonation of up to 22 targets over 22 days; – Disturbance over 30.4 km² from boulder clearance across the offshore Project, including for the WTG and OSPs, and along the full length of all cables (at a width of 30 m per cable) (this area will also encompass the disturbance from pre-lay grapnel run along the entire length of all cables at a width of 2 m per cable); – Maximum bedform[10] clearance along the inter-array and interconnector cables at a width of 150 m (inter-array cables = 3.4 km², interconnector cables = 2.9 km²), and bedform clearance along the offshore export cables at a width of 1,000 m (area = 19.2 km²); and – Maximum bedform clearance required for WTG and OSP suction bucket foundation installation over 0.22 km². • Offshore export cables: – Seabed disturbance associates with installation of up to five offshore cable circuits with a total length of 320 km and a worst case seabed disturbance width of 50 m = 16 km². • Inter-array cables: – Seabed disturbance associated with installation of up to 140 inter-array cables, with a total length of 500 km and a worst case seabed disturbance width of 50 m = 25 km².	Largest spatial area and duration of seabed disturbance and loss during construction. The total area of seabed disturbance or loss for the cables has been calculated based on the 50 m widths of seabed disturbance associated with cable burial / installation in addition to areas of bedform clearance. Any seabed disturbance associated with the boulder clearance and pre-lay grapnel run would be located within these areas. It has been assumed that up to two jack-up events will be required per WTG and per OSP.

[10] *Bedforms include sandwave bedforms, bedform fields comprising of sand and gravel, megaripples and rippled scour depressions which are present in different areas across the offshore Project area (see chapter 8: Marine physical and coastal processes for further information).*

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
	• Interconnector cables: – Seabed disturbance associated with installation of up to six interconnector cables with a total length of 150 km and a worst case seabed disturbance width of 50 m = 7.5 km^2. • Landfall: – Maximum of six Horizontal Directional Drilling (HDD) exit pits (five plus one spare), each of an area of 300 m^2 (totalling 1,800 m^2 (0.0018 km^2)), at a water depth of approximately 10 - 40 m below Lowest Astronomical Tide (LAT) (approximately at a minimum of 100 m offshore from 0 mLAT). • Jack-up vessels on site for 125 WTGs and five OSPs, each with a seabed footprint of 270 m^2 x six jack-up legs = 0.42 km^2; • Anchoring vessel seabed disturbance = 0.03 km^2; • Maximum seabed footprint for ancillary equipment, including mooring systems for Heavy Lift Vessels (HLVs) = 0.00003 km^2; and • Intermittent disturbance over the four-year construction period, with seabed preparation activities such as UXO clearance in the year prior.	
Operation and maintenance		
Loss of or damage to known marine historic environment assets **Loss of or damage to unknown marine historic environment assets**	• Maintenance activities including: – Annual routine inspections of WTG foundations, with repairs on an ad hoc basis; – Annual routine inspections of the inter-array cables, interconnector cables, and offshore export cables initially; and – Following routine inspections, the requirement of geophysical surveys, inter-array cable repair, inter-array cable reburial.	Conservative assumptions have been made to estimate the scour protection and cable protection requirements for the offshore Project, as detailed in chapter 5: Project description and chapter 8: Marine physical and coastal processes, section 8.5.5.5.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Loss of or damage to submerged prehistoric landscapes		
Long term changes to the setting of designated onshore historic environment assets that reduces their value	• Operational life of up to 30 years; • Presence of: – A maximum of 125 WTGs with a maximum tip height of 359.52 m; – Up to five High Voltage Alternating Current (HVAC) OSPs; – WTG lighting to meet aviation and navigation requirements; and – Up to 19 vessels present at one time for operation and maintenance activities.	The maximum number of WTGs and OSPs built out across the OAA is considered to represent the greatest spatial extent of any visual impact from onshore designated cultural heritage assets during the operation and maintenance stage.
Decommissioning*		
***In the absence of detailed information regarding decommissioning works, the implications for marine archaeology and cultural heritage are considered analogous to or likely less than those of the construction stage. Therefore, the worst case parameters defined for the construction stage also apply to decommissioning. The decommissioning approach is set out in chapter 5: Project description.**		

16.6 Assessment of potential effects

16.6.1 Potential effects during construction (including pre-construction) and decommissioning

During the construction stage (including pre-construction) seabed preparation activities (e.g., bedform clearance, boulder clearance and pre-lay grapnel runs), foundation installation (e.g. jack-up vessel placement) and cable installation activities (e.g. trenching, laying, burial and protection) may result in the loss of or damage to known and unknown historic environment assets, and to submerged prehistoric landscapes.

Additionally, sediment disturbed during construction will be deposited throughout the offshore Project area. This deposition can have implications for marine archaeology and cultural heritage receptors. For instance, deposition can obscure features of archaeological interest.

16.6.1.1 Loss of or damage to known marine historic environment assets

A review of Canmore identified the conjectured locations of ten wrecks within or immediately adjacent to the OAA; these wrecks are identified in SS14: Marine archaeology and cultural heritage gazetteer of sites and shown on Figure 16-1. The risk of loss or damage to these wrecks has been reduced because of the marine geophysical surveys conducted and reviewed, which did not encounter evidence of any of the identified wrecks on the seabed. It is never possible to eliminate this risk entirely because smaller artefacts/wreckage of stone, non-ferrous materials such as aluminium and wood might not be picked up by such surveys.

The value of such items could vary anywhere from negligible to high, however due to the surveys conducted to reduce the risk and the localised construction/installation activities, the likelihood of impact is considered low. Embedded mitigation that will require an appropriately qualified marine archaeologist to assess any additional pre-construction geophysical survey data, and the preparation of a WSI and implementation of a PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest means that the magnitude of direct impact is negligible.

Evaluation of significance

Taking the negligible to high value and the negligible magnitude of impact, the consequence of effect is negligible and not significant in EIA terms.

Value	Magnitude of impact	Consequence
Negligible to high	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

16.6.1.2 Loss of or damage to unknown marine historic environment assets

The risk of unknown marine and intertidal historic environment assets being in the OAA and offshore ECC has been reduced because of the marine geophysical surveys conducted and reviewed. It is never possible to eliminate the risk entirely, because smaller artefacts / wreckage of stone, non-ferrous materials such as aluminium and wood might not be picked up by such surveys.

The value of such items could vary anywhere from **negligible to high**, however due to the surveys conducted to reduce the risk and the localised construction/installation activities, the likelihood of impact is considered low. The embedded mitigation of the preparation of a WSI and implementation of a PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest means that the magnitude of direct impact is **negligible.**

Evaluation of significance

Taking the negligible to high value and the negligible magnitude of impact, the consequence of effect is **negligible** and **not significant** in EIA terms.

Value	Magnitude of impact	Consequence
Negligible to high	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

16.6.1.3 Loss of or damage to submerged prehistoric landscapes

A single location of possible palaeoenvironmental interest has been identified 4 km north of the Caithness coast (core sample 836-VC-ECC-SB-KP-36, see Figure 16-8) within the offshore ECC area. The sample was subsequently assessed in Orkney by Associate Professor Scott Timpany, an environmental geoarchaeologist and expert in the palaeoenvironmental reconstruction of submerged landscapes, from the University of the Highlands and Islands Archaeology Institute. The assessment noted that there was no organic material contained within the sample, and therefore there was no potential for it to provide palaeoenvironmental information on former prehistoric landscapes. While this is a single location, the sub-bottom profile data and the other core samples comprise slice snapshots rather than 100% coverage, so it is not possible to eliminate the risk of similar remains being present within the OAA and offshore ECC boundaries.

Submerged prehistoric and palaeoenvironmental deposits are generally considered to have **medium** or **high** value.

The surveys conducted and the localised construction/installation activities compared to the potential extent of such deposits means that the likelihood of impact is considered low. The embedded mitigation of the preparation of a WSI and implementation of a PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest means that the magnitude of direct impact is **negligible**.

Evaluation of significance

Taking the medium to high value and the negligible magnitude of impact, the consequence of effect is **negligible** and **not significant** in EIA terms.

Value	Magnitude of impact	Consequence
Medium to high	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

16.6.2 Potential effects during operation and maintenance

16.6.2.1 Loss of or damage to known marine historic environment assets

During operation and maintenance any activities that affect the seabed have the potential to result in loss of / damage to known marine historic environment assets. Changes to marine processes brought about by the introduction of offshore export cable(s) and inter-array cables, anchors, mooring lines, clump weights and scour protection itself, as well as any cable re-burial works, or remedial cable protection works have the potential to result in the loss of / damage to known marine historic environment assets lying on the seabed.

Desk-based review of Canmore identified the conjectured locations of ten wrecks within, or immediately adjacent to, the offshore Project Area and the offshore ECC, these wrecks are identified in SS14: Marine archaeology and cultural heritage gazetteer of sites and shown on Figure 16-1 and Figure 16-3. The risk of loss or damage to these wrecks has been reduced because of the marine geophysical surveys conducted and reviewed, which did not encounter evidence of any of the identified wrecks on the seabed. It is never possible to eliminate this risk entirely because smaller artefacts/wreckage of stone, non-ferrous materials such as aluminium and wood might not be picked up by such surveys.

The value of such items could vary anywhere from **negligible** to **high**; however, due to the surveys conducted to reduce the risk and the localised maintenance activities, the likelihood of impact is considered low. The embedded mitigation of the preparation of a marine WSI and implementation of a PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest during maintenance operations means that the magnitude of direct impact is **negligible**.

Evaluation of significance

Taking the negligible to high value and the negligible magnitude of impact, the consequence of effect is **negligible** and **not significant** in EIA terms.

Value	Magnitude of impact	Consequence
Negligible to high	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

16.6.2.2 Loss of damage to unknown marine historic environment assets

During operation and maintenance any activities that affect the seabed have the potential to result in loss of / damage to known marine historic environment assets. Changes to marine processes brought about by the introduction of offshore export cable(s) and inter-array cables, anchors, mooring lines, clump weights and scour protection itself, as well as any cable re-burial works, or remedial cable protection works have the potential to result in the loss of / damage to known marine historic environment assets lying on the seabed.

Desk-based review of Canmore identified the conjectured locations of ten wrecks within, or immediately adjacent to the offshore Project. The risk of loss or damage to these wrecks has been reduced because of the marine geophysical surveys conducted and reviewed, which did not encounter evidence of any of the identified wrecks on the seabed. It is never possible to eliminate this risk entirely because smaller artefacts/wreckage of stone, non-ferrous materials such as aluminium and wood might not be picked up by such surveys.

The value of such items could vary anywhere from **negligible** to **high**, however due to the surveys conducted to reduce the risk and the localised maintenance activities, the likelihood of impact is considered low. The embedded mitigation of the preparation of a marine WSI and implementation of a PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest during maintenance operations means that the magnitude of direct impact is **negligible**.

Evaluation of significance

Taking the negligible to high value and the negligible magnitude of impact, the consequence of effect is **negligible** and **not significant** in EIA terms.

Value	Magnitude of impact	Consequence
Negligible to high	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

16.6.2.3 Loss of or damage to submerged prehistoric landscapes

Any aspects of the offshore infrastructure on the seabed, including fixed foundations, potential scouring from offshore export cables, inter-array cables, clump weights and scour protection itself have the potential to result in the damage/loss of submerged prehistoric landscape deposits or features, if any are present. Maintenance vessel anchoring systems that impact the seabed, potential jack-up vessels for major maintenance and other infrastructure in ways that disturb the seabed also have the potential to result in the damage/loss of any such features. Although the likelihood of impact is low, effects are considered to be permanent (see chapter 8: Marine physical and coastal processes for details relating to the worst case scenario for operation and maintenance activities).

Submerged prehistoric and palaeoenvironmental deposits are generally considered to have **medium** to **high** value. As mentioned in section 16.6.1.3, a single location of possible palaeoenvironmental interest was identified 4 km north

of the Caithness shore (core sample 836-VC-ECC-SB-KP-36, see Figure 16-8) within the offshore ECC area. However, following assessment, no organic material was contained within the sample, and therefore there was no potential for it to provide palaeoenvironmental information on former prehistoric landscapes. While this was a single location, the sub-bottom profile data and the other core samples comprise slice snapshots rather than 100% coverage, so it is not possible to eliminate the risk of similar remains being present. The surveys conducted and the localised maintenance activities compared to the potential extent of such deposits means that the likelihood of impact is considered low.

The embedded mitigation of the preparation of a marine WSI and implementation of a PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest during maintenance operations means that the magnitude of direct impact is **negligible**.

Evaluation of significance

Taking the medium to high value and the negligible magnitude of impact, the consequence of effect is **negligible** and **not significant** in EIA terms.

Value	Magnitude of impact	Consequence
Medium to high	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

16.6.2.4 Long term changes to the setting of onshore historic environment assets that reduces their value

There is a possibility that the presence of WTGs offshore could have long-term effects on the setting of an onshore historic environment asset, impacting the way in which the asset is understood, appreciated and experienced, and thus the significance / importance of the historic asset.

A selection of statutorily designated sites and areas have been considered to act as proxies for the range of effects on all other designated sites, as detailed below. The sites and areas chosen are likely to have the most visibility of and impact from the OAA, identified through consultation with HES, OIC and THC, along with analysis of the offshore Project ZTV and associated viewpoints photomontages and wirelines that are presented in chapter 18: Seascape, landscape and visual assessment. The setting of historic environment assets is defined by establishing how the surroundings contribute to the ways in which the historic structure is understood, appreciated and experienced. Viewpoint and wireline locations relevant to the marine archaeology and cultural heritage assessment are shown on Figure 16-11, Figure 16-12 and Figure 16-13, and listed in Table 16-14 with cross-references to chapter 18: Seascape Landscape Impact Assessment (SLVIA), SS20: SLVIA Visualisations where the figures are provided.

Table 16-14 Viewpoint and wireline locations relevant to the marine archaeology and cultural heritage assessment

VIEWPOINT / WIRELINE REF	VIEWPOINT / WIRELINE FIGURE NO.	VIEWPOINT / WIRELINE LOCATION
1	18.VP1a-e (SS20: SLVIA Visualisations)	Faraid Head
7	18.VP7a-d (SS20: SLVIA Visualisations)	Melvich Beach
9	18.VP9a-e (SS20: SLVIA Visualisations)	A836, Reay Kirk, Sandside Bay
10	18.VP10.a-e (SS20: SLVIA Visualisations)	Crosskirk, St Mary's Chapel
11	18.VP11a-f (SS20: SLVIA Visualisations)	Ben Griam Beg Hillfort
13	18.VP13a-e (SS20: SLVIA Visualisations)	Dunnet Head
14	18.VP14a-d (SS20: SLVIA Visualisations)	Castle of Mey LB & GDL
15	18.VP15a-e (SS20: SLVIA Visualisations)	St John's Point
16	18.VP16a-f (SS20: SLVIA Visualisations)	Beinn Freiceadain Hillfort
17	18.VP17a-e (SS20: SLVIA Visualisations)	Kyle of Tongue – A838 Causeway
18	18.VP18a-e (SS20: SLVIA Visualisations)	A836 between Thurso and Castletown
19	18.VP19a-e (SS20: SLVIA Visualisations)	A836 Dounreay
21	18.VP21a-e (SS20: SLVIA Visualisations)	Rackwick Bay at Bothy Beach
24	18.VP24a-e (SS20: SLVIA Visualisations)	Warebeth – on Warebeth Road to beach
25	18.VP25a-e (SS20: SLVIA Visualisations)	Yesnaby – Brough of Bigging
26	18.VP26a-e (SS20: SLVIA Visualisations)	Bay of Skaill
27	18.VP27a-e (SS20: SLVIA Visualisations)	Marwick Head Kitchener Memorial

VIEWPOINT / WIRELINE REF	VIEWPOINT / WIRELINE FIGURE NO.	VIEWPOINT / WIRELINE LOCATION
28	18.VP28a-e (SS20: SLVIA Visualisations)	Earl's Palace, Birsay
A	Figure 1 (SS22: Marine Archaeology Onshore Setting Supporting Figures)	Borve Castle
B	Figure 2 (SS22: Marine Archaeology Onshore Setting Supporting Figures)	Cnoc Freiceadain long cairns
E	Figure 5 (SS22: Marine Archaeology Onshore Setting Supporting Figures)	Brough of Birsay carpark
F	Figure 6 (SS22: Marine Archaeology Onshore Setting Supporting Figures)	Knowes of Trotty / WHS West Mainland Sensitive Area
G	Figure 7 (SS22: Marine Archaeology Onshore Setting Supporting Figures)	Skara Brae – at the east side of the settlement
H	Figure 8 (SS22: Marine Archaeology Onshore Setting Supporting Figures)	Skara Brae – at gate on north side of visitor centre
I	Figure 9 (SS22: Marine Archaeology Onshore Setting Supporting Figures) Figure 18.30a-d (SS20: SLVIA Visualisations)	Hall of Clestrain

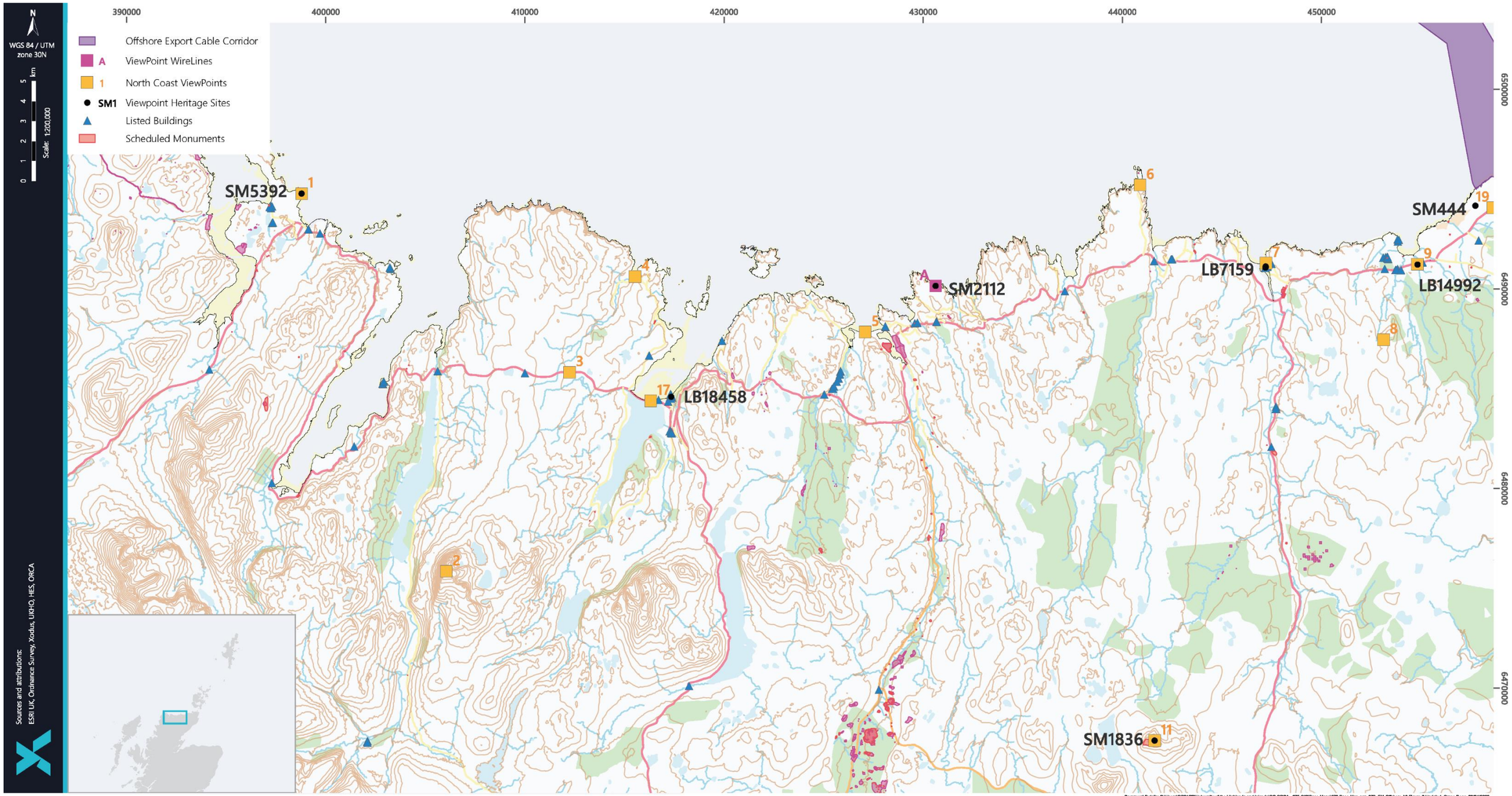

Figure 16-11 Viewpoints within THC (west)

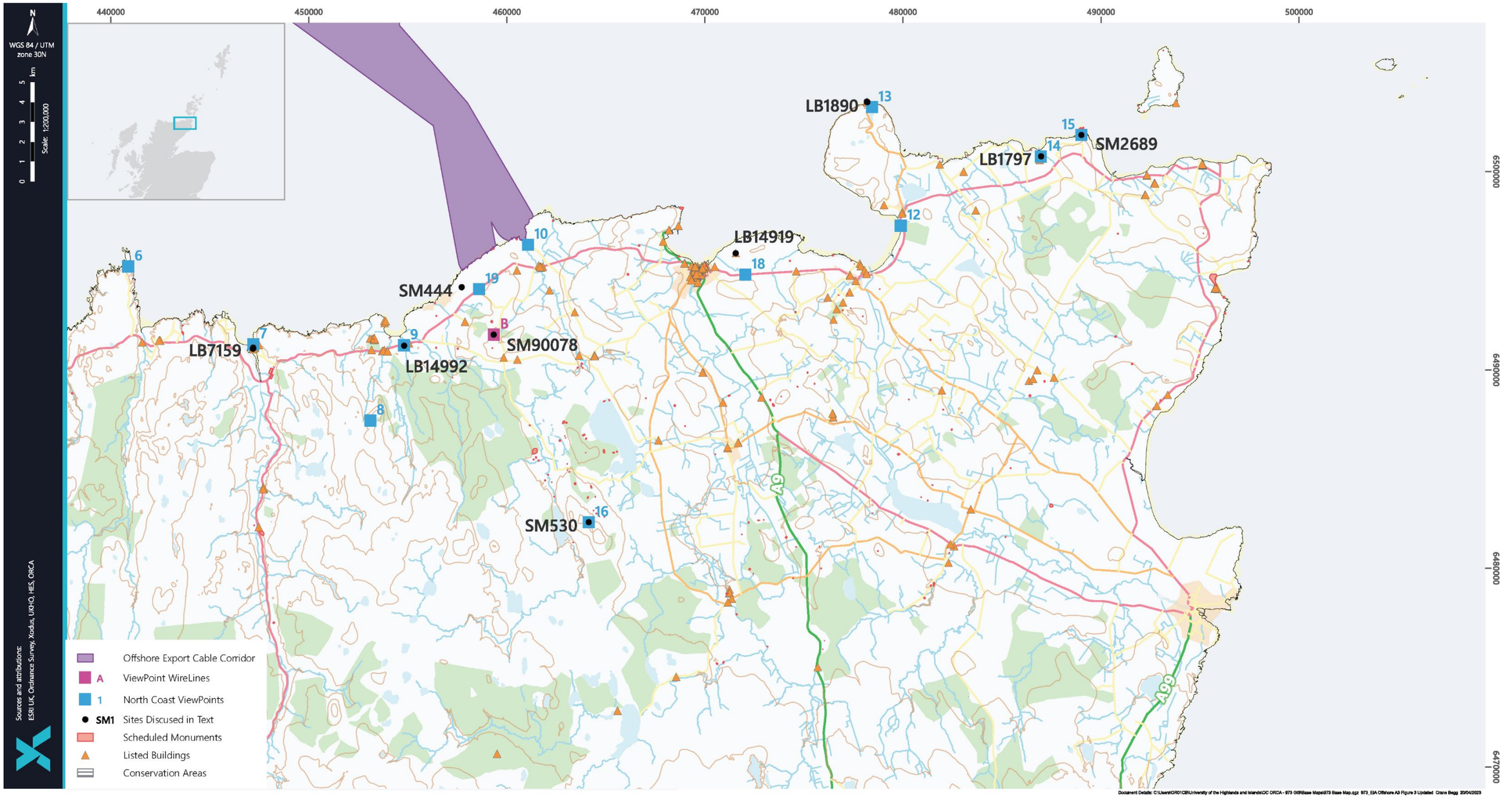

Figure 16-12 Viewpoints within THC (east)

16.6.2.4.1 THC

Onshore designated historic environment assets within THC area (Caithness and Sutherland) are discussed below. THC viewpoint locations are shown in Figure 16-11 and Figure 16-12.

Viewpoint 1: Faraid Head - North of Durness Seanachaisteal promontory fort (Scheduled Monument SM5303) and monastery (Scheduled Monument SM5392)

Seanachaisteal promontory fort and monastery (see Figure 16-11) are located on a precipitous coastal promontory and are related to two distinct periods of occupation. The promontory fort is prehistoric, likely Iron Age, in date and includes a defended hillfort and promontory fort. The monastery consists of a settlement, likely a pre-Norse monastery on a rocky headland. While both monuments are likely not contemporary, they retain a close visual relationship.

Both monuments have a high heritage value and a high contribution of setting, with a high sensitivity to change in terms of key views to the east, north-east and north.

Viewpoint 1 shows that the south-western section of the OAA would be visible breaking the horizon at sea from both monuments. The change would not affect key views between the promontory fort and monastery, nor would it affect visual relationships between contemporary monuments in any other direction. With the OAA being located out at sea, some 27 km distant, the land-based context of the monuments and their sense of place is not affected.

The noticeable change to the view north-eastwards does not disrupt key relationships between the monuments and their relevant settings, forming a negligible magnitude of impact on setting.

Evaluation of significance

The sensitivity of Faraid Head - North of Durness Seanachaisteal promontory fort (Scheduled Monument SM5303) and monastery (Scheduled Monument SM5392) is assessed as high. Combined with the negligible magnitude of impact, the resulting consequence of effect on setting would be negligible and not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

Viewpoint 7: Melvich Beach – Big House LB (Listed Building LB7159)

There is a complex of eight listed buildings at Melvich Bay, all of which are associated with Big House Lodge and its ancillary buildings (Figure 16-11). Big House is sited on a spit of level land projecting into the Halladale River by which it is enclosed on three sides. Screened and protected from the open sea at the north by a high mounded dune, the general impression is that of an 18th-century complex, though subsequent alterations to Big House Lodge (the suffix Lodge was added in 1984) give it, at first glance, a 19th-century appearance. The principal buildings are Big House

Lodge, The Barracks, the walled garden with its garden pavilion and the icehouse. At the rear of Big House Lodge is a low irregular 2-storey, L-plan range of service buildings, which with The Barracks, are incorporated in the walls enclosing house and garden. The main house and The Barracks, facing south up the Halladale River, are sheltered at the east by rising ground and overlooked on the west by the township of Melvich strung out along the A836 road (Beaton, 2019).

The Big House complex has a **high** heritage value and a high contribution of setting, with a **high** sensitivity to change in terms of key views to the east, south and west, with views to the north being screened by dunes.

The photomontage shows that the south-western section of the OAA would be visible breaking the horizon from Melvich Beach at a distance of 30 km, however as views north from Big House are screened by dunes the OAA would not be visible from the Big House buildings.

The noticeable change to the view north-eastwards does not disrupt key relationships between the Big House buildings and contemporary buildings in the immediate environs, or their relevant settings, forming a **negligible** magnitude of impact on setting.

Evaluation of significance

The sensitivity of Melvich Beach – Big House LB (Listed Building LB7159) is assessed as high. Combined with the negligible magnitude of impact, the resulting consequence of effect on setting would be **negligible** and **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

Viewpoint 9: A836, Reay Kirk, Sandside Bay – Reay Kirk (Listed Building LB14992)

Reay Parish Church (Figure 16-11) has a **high** heritage value and a medium contribution of setting, the Category A Listed church therefore has a **high** sensitivity to change. It also stands as proxy for the other Listed Buildings in Reay village and the Scheduled Medieval burial ground and cross slab of Reay old parish church (Scheduled Monument (SM) 615).

The Category A Listed Building was constructed in 1739 on a T-plan with a bell tower at the eastern end. Later additions were added in 1909 and a Gothic window in 1933. The entrance to the church is on the south facing side with four windows, one window on the north elevation, a large Gothic window on the western elevation and an entrance on the eastern bell tower.

As the entrance and windows of the church are located on the southern elevation of the building it is an indication that the exterior was meant to be viewed from the south looking north. From inside the building the views have been outwards to the landscape further south.

The church sits largely in isolation, with no immediate neighbouring buildings in any direction. It is located in a setting that makes a positive contribution to the understanding, appreciation and siting of the church as well as its historical and architectural context, a medium contribution of setting. As the church has a high heritage value and a medium contribution of setting, it has a high sensitivity to change.

The photomontage indicates that the OAA would be visible at a distance of 35 km but this would be a minor change in this wider landscape and seascape therefore has an impact of low magnitude.

Evaluation of significance

The sensitivity of A836, Reay Kirk, Sandside Bay – Reay Kirk (Listed Building LB14992) is assessed as high, and the magnitude of impact is assessed as low. At this distance the effect is of minor consequence. Despite the sensitivity of the church's setting, this change would not affect the integrity of the setting, the site's understanding, appreciation or integrity, sense of place or heritage value. The negligible consequence of effect is not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Negligible

Impact significance - NOT SIGNIFICANT

Viewpoint 10: Crosskirk - St Mary's Chapel and Broch (Scheduled Monument SM90086)

The remains of the chapel of St Mary (possibly dating from the 12th century and later used as two burial enclosures) lies east to west within a square burial ground, together with the adjacent remains of a broch and outer defensive works (see Figure 16-12). The broch is located to the north of the burial ground and succeeded a promontory fort on the site. The broch was partly excavated between 1966 and 1972. The site is also an HES Property In Care (PIC 318), and promoted as a site to visit.

The chapel is located close to the shore on the south-west side of Crosskirk Bay adjacent to modern farmland. It is dominated to the south-west by Forss Business and Energy Park 250 m away, with the six-WTG Forss windfarm. Its location, on a lower coastal slope means it would have been quite inconspicuous in the wider landscape. The key views from the site would have been out to sea but the broch, an imposing tower, would have had a good level of intervisibility in the wide flat landscape including to the broch sites at Green Tullochs (SM554) 1.3 km to the south-west, where a chambered cairn is also part of that scheduling and Tulloch of Lybster (undesignated) 650 m to the south.

The six-WTG Forss Wind Farm and the Forss Technology and Business Park 250 m to the south-west dominate Crosskirk. This has not affected the high heritage value of the chapel. The high heritage value and low contribution of setting results in a low sensitivity to change.

The photomontage shows that the entirety of the OAA would be visible 33 km out to sea but is a minor change to views from the site to the north-west and would not alter the appreciation of the coastal location, the intervisibility with other sites or any other key relationships between the site and its setting. This is a low magnitude of impact.

Evaluation of significance

Taking the low sensitivity of Crosskirk - St Mary's Chapel and Broch (Scheduled Monument SM90086) and the low magnitude of impact, the resulting consequence of effect is **negligible** by matrix definition, and is thus **not significant** in EIA terms. The change does not affect the integrity of the setting, or prevent the appreciation, understanding or experience of the site.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Negligible

Impact significance - NOT SIGNIFICANT

Viewpoint 11: Ben Griam Beg hillfort (Scheduled Monument SM1836)

Ben Griam Beg hillfort (see Figure 16-12) has extensive 360-degree views over the low-lying open landscape below and to Ben Griam Mor to the south-west. The site occupies a topographically prominent position on the summit of a distinctive, steep-sided hill in a predominantly open lower landscape of bog and moorland (high contribution of setting).

The **high** heritage value and high contribution of setting, results in a **high** sensitivity to obvious changes that do not blend into the distant vistas.

The wireframe (VP11) indicates that the OAA would be visible at a distance of 50 km and would be a very minor change in this wider landscape and therefore has an impact of **low** magnitude.

Evaluation of significance

The sensitivity of Ben Griam Beg hillfort (Scheduled Monument SM1836) is assessed as high. Combined with the low magnitude of impact, at this distance the effect is of minor consequence. Despite the sensitivity of the hillfort's setting, this change would not affect the integrity of the setting, the site's understanding, appreciation or integrity, sense of place or heritage value. The **minor** consequence of effect is **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance - NOT SIGNIFICANT

Viewpoint 13: Dunnet Head – Dunnet Head Lighthouse and keepers' houses (Listed Building LB1890)

Dunnet Head Lighthouse was built by Robert Stevenson in 1831. It is a short circular tower of white-painted tooled ashlar with corbelled parapet with lattice cast-iron balustrade and circular domed lattice-pane light. There are white-

painted flat-roofed single storey keepers' houses attached. The complex is enclosed by a coped rubble wall and a pair of square tooled ashlar gate piers with simple square caps.

The Category B listed lighthouse and associated keepers' houses occupy a highly prominent location on the cliffs of Dunnet Head (see Figure 16-12). The key sightlines are to and from the Pentland Firth, while the views inland across Caithness with its farming landscape and windfarms are not essential to the understanding of the site but do add to the experience.

The medium heritage value and high contribution of setting, results in a high sensitivity to change, according to definition. However, lighthouses can be considered as assets that are tolerant of change over a distance because of their function. Therefore, the buildings can be considered as having a low sensitivity to change at a landscape / seascape level.

The photomontage provided shows that the entirety of OAA would be visible out to sea more than 40 km distant. The addition of the OAA would be a minor change to Dunnet Head's wider setting, not altering the experience and appreciation of the lighthouse, its location or understanding of its function, and does not affect the integrity of the setting. This is a low magnitude of impact.

Evaluation of significance

Taking the low sensitivity of Dunnet Head – Dunnet Head Lighthouse and keepers' houses (Listed Building LB1890) and the low magnitude of impact, the consequence of effect on setting is negligible and thus not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Negligible

Impact significance - NOT SIGNIFICANT

Viewpoint 14: Castle of Mey (Listed Building LB1797 & Garden and Designed Landscape GDL00096)

The Castle of Mey and its associated Garden and Designed Landscape (GDL) lies on the flat coastal plain of Caithness and is exposed to the harsh climate and winds which blow off the Pentland Firth. The surrounding landscape is predominantly pastureland and there are few trees. Key views are gained west to Dunnet Head, and across the Pentland Firth to Orkney. The Castle and its woodlands are significant from the A836 and other minor roads between it and the coast, particularly from the east. The flat nature of the surrounding landscape limits views of the policies which are enclosed within the woodlands to the south and the policy walls to the north.

The high heritage value and high contribution of setting, results in a high sensitivity to obvious changes that do not blend into the key views.

The photomontage indicates that the OAA would be visible at 48 km distant but is a minor change in this wider landscape/seascape and therefore has an impact of low magnitude.

At this distance the effect is of minor consequence. Despite the sensitivity of the Castle and GDL's setting, this change would not affect the integrity of the setting, the site's understanding, key views, appreciation or integrity, sense of place or heritage value.

Evaluation of significance

The sensitivity of Castle of Mey (Listed Building LB1797 & Garden and Designed Landscape GDL00096) is high. The magnitude of impact is low, resulting in a **minor** significance of effect that is **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance - NOT SIGNIFICANT

Viewpoint 15: St John's Point - Fort and site of St John's Chapel (Scheduled Monument SM2689)

The fort consists of a mutilated earth-and-stone rampart built between two geos and cutting off the fairly level promontory of St John's Point. No structures are visible within the rampart but against its rear is a well-constructed rectangular building, locally said to be the site of John's Chapel. The site has extensive 180-degree views across the Pentland Firth and over to Dunnet Head. The surrounding landscape is predominantly pasture and there are few trees.

The **high** heritage value and high contribution of setting, results in a **high** sensitivity to obvious changes that do not blend into the key views.

The photomontage (VP15) indicates that the OAA would be visible in view to the north-west looking towards Dunnet Head at a distance of 49 km but is a minor change in this wider landscape/seascape and therefore has an impact of **low** magnitude.

At this distance the effect is of minor consequence since it does not significantly impact the heritage value of the monument, or the understanding, appreciation or experience of it, and adequately retains the integrity of the setting.

Evaluation of significance

The sensitivity of St John's Point - Fort and site of St John's Chapel (Scheduled Monument SM2689) is assessed as high. The magnitude of impact is low, resulting in a **minor** consequence of effect, that is therefore **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance - NOT SIGNIFICANT

Viewpoint 16: Beinn Freiceadain hillfort (Scheduled Monument SM530)

Beinn Freiceadain rises to a height of 238 m Ordnance Datum (OD) from the surrounding flat moorland. Together with the slightly higher twin summit of Ben Dorrery it is one of the highest hills in the north of Caithness and a notable landmark. A chambered cairn is situated within the fort which crowns the summit, on ground which slopes down from the east and west. The monument has extensive 360-degree views over the low-lying open landscape below and towards the Pentland Firth, including the existing Limekiln offshore windfarm.

The high heritage value and high contribution of setting, results in a high sensitivity to obvious changes that do not blend into the distant vistas.

The wireframe (VP16) indicates that the OAA would be visible at a distance of 46 km but is a minor change in this wider landscape and therefore has an impact of low magnitude.

Evaluation of significance

The sensitivity of Beinn Freiceadain hillfort (Scheduled Monument SM530) is assessed as high and the magnitude of impact is assessed as low. At this distance the effect is of minor consequence and professional judgement indicates that the resulting significance of effect is minor since the effect does not significantly impact the heritage value of the monument, or the understanding, appreciation or experience of it, and adequately retains the integrity of the setting. The minor consequence of effect is therefore not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance - NOT SIGNIFICANT

Viewpoint 17: Kyle of Tongue, A838 causeway – Tongue House (Category A Listed Building LB18458)

Tongue House dates to between 1678 and 1750, and a three-storey, four-bay crowstepped block facing east/west, with two-storey wings to the northwest. The principal elevation is north-west facing with view across the Kyle of Tongue towards Talmine. The house and associated buildings sites are walled and are surrounded by woodland that screens immediate views.

Tongue House has a high heritage value and a high contribution of setting, with a high sensitivity to change in terms of key views to the north and north-west.

The photomontage (VP17) indicates that the OAA would not be visible in views to the north-west, with the tips of WTGs being glimpsed behind the Rabbit Islands at a distance of 32km, an almost imperceptible change in the wider landscape and therefore has an impact of negligible magnitude.

At this distance, and with the Rabbit Islands located in front of the OAA, the change to the view north-west does not disrupt key views from the house, or the relationships between it and associated buildings, or with the settlement of Tongue itself.

Evaluation of significance

The sensitivity of Kyle of Tongue, A838 causeway – Tongue House (Category A Listed Building LB18458) is assessed as high, and the magnitude of impact is assessed as negligible. Professional judgement indicates that the resulting consequence of effect is **negligible** and therefore **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

Viewpoint 18: A836 between Thurso and Castletown – Harold's Tower Mausoleum (Category B Listed Building LB14919)

Dating to the 1790s, the building is a hexagonal mausoleum that was erected by Sir John Sinclair of Ulbster and Thurso to commemorate Earl Harold buried near the site after being killed in battle in 1190.

The mausoleum is a prominent landmark, located on the high ground to the east of Thurso, and has commanding views over the Pentland Firth. It is situated within open pastureland, within a wider landscape of enclosed agricultural land.

The **medium** heritage value and medium contribution of setting, results in a **medium** sensitivity to obvious changes.

The photomontage (VP18) indicates that the OAA would be visible in views to the north-west, with the WTGs being evident at a distance of 41 km but is a minor change in this wider landscape and therefore has an impact of **low** magnitude. The OAA would not disrupt key views north from the mausoleum, or its setting.

Evaluation of significance

The sensitivity of A836 between Thurso and Castletown – Harold's Tower Mausoleum (Category B Listed Building LB14919) is assessed as medium, and the magnitude of impact assessed as low. Professional judgement indicates that the resulting significance of effect is **minor** and therefore **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

Viewpoint 19: A836 Dounreay - Cnoc-na-h'Uiseig chambered cairn (Scheduled Monument SM444)

The chambered cairn has been altered physically and visually by the construction and operation of the Dounreay Nuclear Research Establishment Site. The research establishment dominates the setting of the monument to the west, and the surrounding landscape has been much altered with onshore WTGs and the A836. Setting does therefore not contribute towards the site's overall significance to a great deal.

The monument has a high heritage value and a low contribution of setting, with a low sensitivity to change.

The photomontage indicates that the OAA would be visible at a distance of 34 km from the monument, and this is a minor change in this wider landscape/seascape and therefore has an impact of low magnitude.

Evaluation of significance

The sensitivity of A836 Dounreay - Cnoc-na-h'Uiseig chambered cairn (Scheduled Monument SM444) is assessed as low, and the magnitude of impact assessed as low. Professional judgement indicates that at this distance the effect is of negligible consequence since the effect does not significantly impact the heritage value of the cairn, or the understanding, appreciation or experience of it, is therefore not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Low	Low	Negligible

Impact significance - NOT SIGNIFICANT

Wireline A: Borve Castle (Scheduled Monument SM2112)

The remains of Borve Castle occupy a precipitous promontory on the coast to the northeast of Farr and are likely medieval in date. The defences comprise a roughly square keep commanding the neck on the landward side, where a ditch has also been cut across the promontory, while a second ditch controls access from the lower seaward end on the east-northeast; numerous scoops and footings of buildings can be seen within its interior.

Borve Castle has a high heritage value and high contribution of setting, resulting in a high sensitivity to obvious changes.

Wireline A indicates that the OAA would be visible at a distance of 26 km to the north of Borve Castle. This is a minor change in its setting palace and therefore has an impact of low magnitude.

Evaluation of significance

The sensitivity of Borve Castle (Scheduled Monument SM2112) is assessed as high, and the magnitude of impact is assessed as low. Professional judgement indicates that at this distance the effect is of **minor** consequence and therefore **not significant** in EIA terms, as it does not significantly impact the heritage value of the castle and the appreciation or experience of the monument and retains the integrity of its setting.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance - NOT SIGNIFICANT

Wireline B: Cnoc Freiceadain long cairns (Scheduled Monument SM90078)

The setting of the two long cairns on an elevated topographical position (see Figure 16-12) allows for 360-degree views of the surrounding landscape and makes them a prominent feature on the skyline. Key views from the burial mounds would have been to other funerary sites or settlement sites in the surrounding area, such as the Hill of Shebster chambered cairn, c. 750 m to the south and Creag Breac Mhor to the north. The cairns are located within an area of prehistoric activity that is also within a more recent farming landscape with the extensive windfarm (21 WTGs) of Baillie Hill / Stemster Hill located 0.7 to 2.4 km to the east, pylons running nearby and the Dounreay Site at the coast (a low contribution of setting eastwards due to Baillie Hill and a medium contribution of setting in terms of prominence).

As the Cnoc Freiceadain long cairns have a **high** heritage value and a medium contribution of setting, it has a **medium** sensitivity to change.

Wireline B shows that the entirety of the OAA would be visible breaking the horizon at sea. Key views from the long cairns to the prehistoric monuments of Creag Bhreac Mhor 0.75 km to the north and north-west will have this change in the background, but the change does not disrupt the relationship between them. A similar effect is likely from the Hill of Shebster cairn to Cnoc Freiceadain. The change would not affect the key relationships of the site with monuments in any other direction. With the OAA being out at sea, the land-based context of the site and its sense of place is not affected.

This noticeable change to the view northwards does not disrupt key relationships between the heritage asset and its relevant setting, forming a **low** magnitude of impact on setting.

Evaluation of significance

The sensitivity of Cnoc Freiceadain long cairns (Scheduled Monument SM90078) is assessed as medium, and the magnitude of impact is assessed as low. Professional judgement indicates that the resulting consequence of effect is **minor** since the effect does not significantly impact upon the heritage value of the receptors, or the understanding, appreciation or experience of the assets, and adequately retains the integrity of the setting, and is therefore **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

16.6.2.4.2 Orkney Islands Council

Onshore designated historic environment assets within the Orkney Island Council area are discussed below. Orkney Islands viewpoints are shown in Figure 16-13.

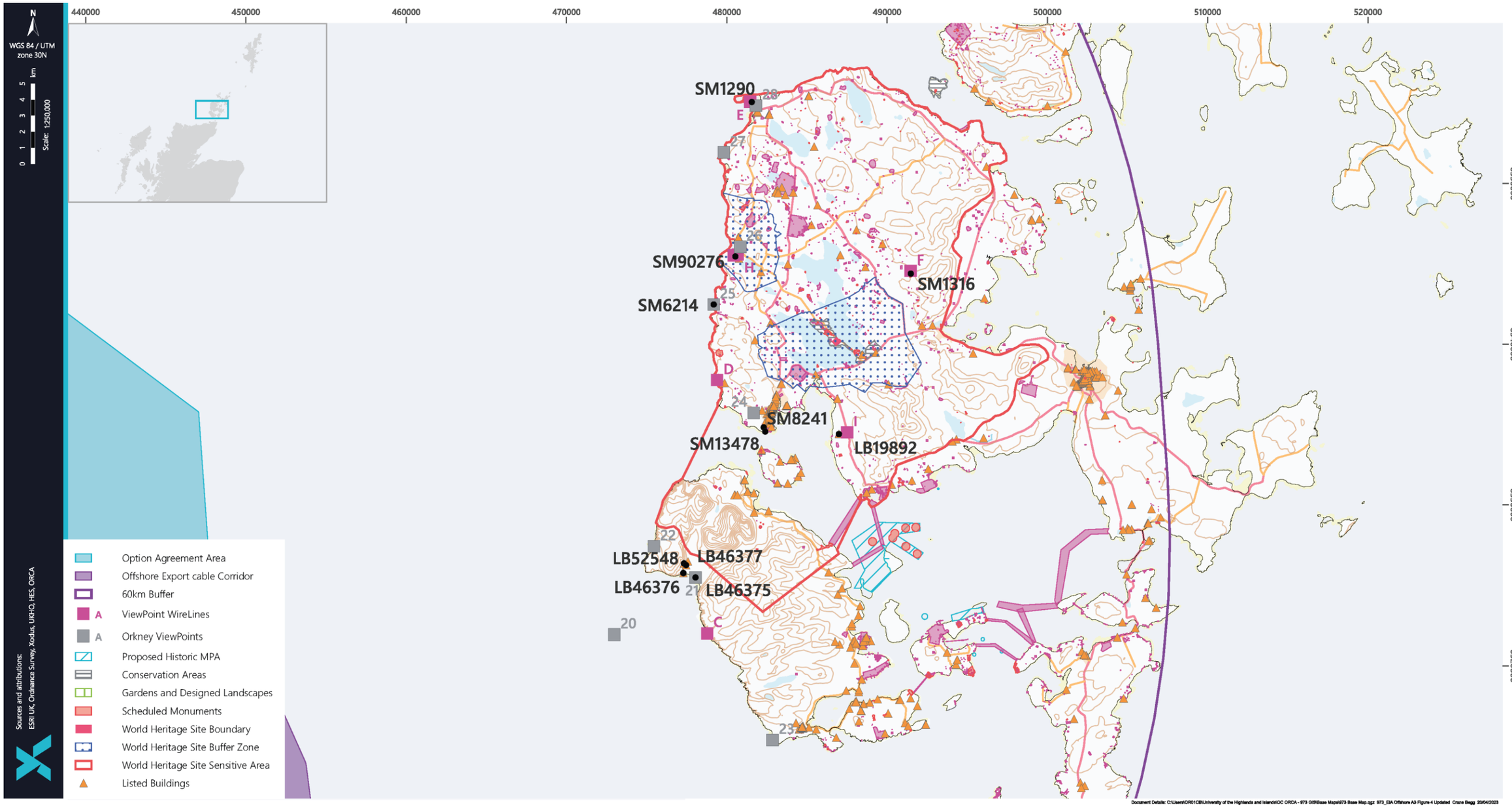

Figure 16-13 Viewpoints within the Orkney Islands Council area

Viewpoint 21: Rackwick Bay at Bothy Beach - listed buildings at Rackwick (Listed Buildings LB46375, LB46376, LB46377, LB52547 and LB52548)

Rackwick Bay is located approximately 30 km to the east of the proposed development. Rackwick is a farming and fishing settlement on the largely uninhabited west coast of Hoy. There are five listed buildings at Rackwick Bay, all of which form a complex of contemporary 18th and 19th century crofting buildings comprising: Muckle House Crofthouse (Category B, LB46376), Burnmouth Bothy (Category A, LB46375), The Mount (Category B, LB46377), Crow's Nest (Craa Nest) Museum including crofthouse, barn, circular kiln and net store (Category A LB, LB52548) and a pair of threshing barns to the west of Glen (Category C, LB52547).

There is a clear functional, historical and visual inter-relationship between the buildings, and their setting within their wider surroundings and landscape, including views down over the wide arc of Rackwick Bay. They are all prominent buildings in the Rackwick Bay landscape, and collectively, they show traditional vernacular methods of construction and therefore contribute to the built heritage and historic character of Rackwick.

As a complex of listed buildings these have a high heritage value, and high contribution of setting, resulting a high sensitivity to obvious changes.

The photomontage (VP21) indicates that the OAA would be visible at a distance of 30 km from Rackwick, and this is a minor change in this wider landscape/seascape and therefore has an impact of low magnitude.

Evaluation of significance

The sensitivity of Rackwick Bay at Bothy Beach - listed buildings at Rackwick (Listed Buildings LB46375, LB46376, LB46377, LB52547 and LB52548) is assessed as high and the magnitude of impact is assessed as low. Professional judgement indicates that at this distance the effect is of minor consequence since the effect does not significantly impact the heritage value of the buildings, or the understanding of their functional, historical and visual inter-relationships, or the appreciation or experience of them, and adequately retains the integrity of their setting and character and is therefore not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance - NOT SIGNIFICANT

Viewpoint 24: Warebeth, on Warebeth Road to beach - Ness Battery gun emplacements 300 m SSE of Stromness (Scheduled Monument SM13478) and Ness Battery, coast defence battery (Scheduled Monument SM8241)

Within this viewpoint location there are two scheduled monuments that have been considered. Both these monuments relate to the use of the area for the defence of Scapa Flow during the First and Second World Wars. Both assets are located approximately 35 km to the east of the OAA.

At the beginning of the First World War the western approaches to Stromness and Scapa Flow through Hoy Sound were unprotected, leading to the construction and operation of the defences (SM13478) which were replaced with a larger complex of defences and accommodation in the Second World War (SM8241).

Ness Battery (SM13478)

The Ness Battery gun emplacement (SM13478) was built in 1915 and was in use until 1918, comprising three concrete gun emplacements and two magazines. It is situated close to the coast, now within a golf course, at around 10 m above OD with good views across Hoy Sound to the south and southwest.

The monument retains its field characteristics to a marked degree. The three-gun emplacements and two magazines survive virtually intact, except for the guns. Its significance is further enhanced by the potential to compare this battery with numerous other contemporary defences in this area.

Ness Battery, coast defence battery (SM8241)

The monument comprises the remains of a Second World War coastal battery replacing the battery from the First World War (SM13478). The battery was built in 1938 and was operational before the outbreak of the war. Its specific role was that of close defence of the western approach to Scapa Flow. A camp was situated immediately next to it. It is situated around 500 m to the north of the First World War battery and retains open views across Hoy Sound and retains a visual and physical relationship with the surviving coastal defences.

Assessment of significance

As a complex of First and Second World War coastal defences the batteries have a high heritage value, and high contribution of setting, resulting a high sensitivity to obvious changes. The photomontage (VP24) indicates that the OAA would be visible at a distance of 35 km to the west of the monuments, and this is a minor change in this wider landscape/seascape and therefore has an impact of low magnitude.

Evaluation of significance

The sensitivity of Warebeth, on Warebeth Road to beach - Ness Battery gun emplacements 300 m SSE of Stromness (Scheduled Monument SM13478) and Ness Battery, coast defence battery (Scheduled Monument SM8241) is assessed as high and the magnitude of impact is assessed as low. Professional judgement indicates that at this distance the effect is of minor consequence since the effect does not significantly impact the heritage value of the buildings, or the understanding of their functional, historical and visual inter-relationships, or the appreciation or experience of them, and completely retains the integrity of their setting and character including inter-visibility with other coastal defences and views over the western approach to Scapa Flow across Hoy Sound and is therefore not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance - NOT SIGNIFICANT

Viewpoint 25: Yesnaby, Brough of Bigging (Scheduled Monument SM6214)

The Brough of Bigging is a fort occupying a promontory and was in use probably between around 1100 BC and AD 800. This monument has good potential to enhance our understanding of the organisation and social and economic activities of the later prehistoric people who built and used it. Although damaged by stone-robbing and some erosion at the cliff-edge, substantial remains of the fort's defensive works survive across the narrow neck of the promontory, together with associated structures, including, possibly, evidence for a guardhouse, and for two roundhouses on the promontory. The enclosed area retains high potential for the presence of buried archaeological deposits relating to the prehistoric and later use of the fort. There is also significant potential to compare this site with the nearby and probably roughly contemporary broch at Borwick close by, and with other promontory forts locally and nationally to enhance our understanding of the development and functions of different types of broadly contemporary, defensive sites within the landscape.

The monument is a highly visible coastal landmark today, and it preserves a range of archaeological features in their original and dramatic landscape context, testifying to use of the site probably over many centuries.

The monument has a high heritage value, and high contribution of setting, resulting a high sensitivity to obvious changes.

The photomontage indicates that the OAA would be visible at a distance of 30 km to the west of the monuments, and this is a minor change in this wider landscape/seascape and therefore has an impact of low magnitude.

Evaluation of significance

The sensitivity of Yesnaby, Brough of Bigging (Scheduled Monument SM6214) is assessed as high and the magnitude of impact is assessed as low. Professional judgement indicates that at this distance the effect is of minor consequence since the effect does not significantly impact the heritage value of the monument, or the understanding of its relationship with the archaeological remains within the promontory fort, or with contemporary monuments such as the broch at Borwick, or the appreciation or experience of the monument, and retains the integrity of its setting and is therefore not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance – NOT SIGNIFICANT

Viewpoint 26: Bay of Skaill – HONO WHS Bay of Skaill, near toilet block; Skara Brae, at the east side of the settlement (Wireline G) and Skara Brae, at gate on north side of the settlement (Wireline H)

The OAA is located around 30 km to the west of Orkney, which is world famous for its Neolithic archaeology, and which is home to the HONO WHS. The HONO WHS comprises six individual component sites, each of which are a scheduled monument, including the settlement of Skara Brae.

The Statement of Outstanding Universal Value set out in the HONO WHS Management Plan, as submitted to the World Heritage Committee for approval in 2008 states that: *The relationships between the wider physical landscape are critical to understanding the monuments and the intentions of their builders; and hence form part of the Outstanding Universal Value of the World Heritage Site.* (HES, 2014)

Taking the above into account, consideration of the contribution setting makes to the HONO WHS Statement of Outstanding Universal Value, forms a key part of the assessment into long term changes to the setting of designated onshore historic environment assets that reduces their value.

Skara Brae is located on the very edge of the Bay of Skaill, protected by modern coastal defences. When it was built, the village was situated over 1 km from the sea's edge, and through the lifetime of the settlement the sea advanced towards it and this, coupled with other environmental, economic and social factors seems to have led to its eventual abandonment. The remains of the village survive within the dunes, and due to this they are not visually prominent within the surrounding landscape, and during opening hours the many visitors and guides are the most visible feature.

Views to and from Skara Brae are restricted to its immediate environs, with the horseshoe of hills surrounding the Bay closing off the majority of views into and out of the monument. Likewise, views to Skara Brae (or more accurately the piece of land in which the monument is situated given the fact that it has virtually no visual prominence when viewed from a distance) in the modern landscape are restricted from the east, however, views can be gained from the south and north shores of the Bay of Skaill.

The landscape around Skara Brae is enclosed by the ridgelines typical of Orkney coasts, where softer rocks have created sandy bays. Small in scale, and closely confined, the Bay of Skaill is defined at its outer limit by high cliffs and within the bay by ridges and hills. It is rounded and smooth in a regular horseshoe-shape. The sheltered, enclosed, small-scale and low-lying landscape cradled by low green slopes and overlooked by steadings and cottages on the higher ground, is dominated by Skaill House and the farm buildings. However, closer to the shore the character is more maritime and provides the unique and distinctive setting of Skara Brae, with its calm stillness and deep sense of history and place in juxtaposition with the activities on the sea and the beach and the ceaseless lapping of waves in the bay (Tyldesley and Associates, 2001).

Key elements of Skara Brae's setting include:

- The well-defined ridgelines and higher ground that defines the edges of the visual envelope around the site;
- The working pastoral of the landscape around the site;
- The sensory experience of the site and in particular its relationship with the sea; and
- The small number of visual links to other archaeological monuments in the wider landscape.

Skara Brae has a high (very high) heritage value being a key element of the HONO WHS, and high contribution of setting, resulting in a high sensitivity to obvious changes, particularly the key elements of its setting outlined above.

The photomontage (VP26) indicates that the OAA would be visible at a distance of 35 km to the east of the Bay of Skaill, and Wirelines G and H taken at two points close to the settlement of Skara Brae show that the OAA would not be visible at these locations. This is a very minor change in this wider landscape/seascape and therefore has an impact of negligible magnitude.

Evaluation of significance

The sensitivity of Bay of Skaill – HONO WHS Bay of Skaill, near toilet block; Skara Brae, at the east side of the settlement (Wireline G) and Skara Brae, at gate on north side of the settlement is assessed as high and the magnitude of impact is assessed as negligible. At this distance, and with topography intervening between Skara Brae and the OAA there will be no views of the WTGs. The effect is therefore of negligible consequence and therefore not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

Wireline F: Knowes of Trotty/HONO WHS West Mainland Sensitive Area

The Knowes of Trotty is a group of Bronze Age burial mounds, located within the HONO WHS Sensitive Area. There are twelve large mounds and several smaller ones in a band of land running north-south along the limit of present-day agricultural cultivation. It is of national importance as one of the finest groups of Bronze Age (perhaps Early Bronze Age) burial mounds in Scotland, and it has proven archaeological potential, and has further potential through excavation and analysis to provide important information about prehistoric burial practices and material culture.

The Knowes of Trotty is located within an open area of land, with relatively few modern intrusions, and while it does not have a direct visual relationship with the HONO WHS to the west, excavations have revealed Neolithic structural remains which were seemingly reused by the barrow builders which suggests a possible cultural/ancestral connection with it. Views to the west are across to the mountains of Hoy and the low ridgelines to the west of the WHS. The views are shadowed by the low-lying plateau to the south-west of the barrows.

As the monument has a high heritage value and a high contribution of setting, it has a high sensitivity to change.Wireline F shows that the OAA would only be very slightly visible breaking the horizon at sea in the far distance, some 56 km to the west. This would hardly constitute a change to the existing view westwards and would not disrupt key relationships between the Knowes of Trotty and its relevant setting, including the HONO WHS, forming a negligible magnitude of impact on setting.

Evaluation of significance

The sensitivity of the Knowes of Trotty/HONO WHS West Mainland Sensitive Area is assessed as high and the magnitude of impact is assessed as negligible. The resulting consequence of effect on setting would be negligible, which is not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

Viewpoint 27: Marwick Head Kitchener Memorial (Category C Listed Building LB6182)

The Kitchener Memorial was erected in 1926 to commemorate Earl Kitchener and the crew of His / Her Majesty's Ship (HMS) Hampshire that sank off Marwick Head on 5th June 1916. It is an imposing tower that is highly visible across the north-west of the Mainland, and from the memorial there are commanding 360-degree views across the landscape and seascape.

The Kitchener Memorial has a **medium** heritage value and high contribution of setting, resulting in a **high** sensitivity to obvious changes.

The memorial is a highly visible coastal landmark, and the photomontage indicates that the OAA would be visible at a distance of 36 km to the west of the memorial, and this is a minor change in the wider landscape/seascape and therefore has an impact of **low** magnitude.

Evaluation of significance

The sensitivity of Marwick Head Kitchener Memorial (Category C Listed Building LB6182) is assessed as high and the magnitude of impact is assessed as low. At this distance the effect is of **minor** consequence and professional judgement indicates that the resulting significance of effect is **minor** and therefore **not significant** in EIA terms, as it does not significantly impact the heritage value of the memorial, retaining a visual relationship with the sea, including views out to the west and to the resting place of HMS Hampshire 3.5 km to the west.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance - NOT SIGNIFICANT

Viewpoint 28: Earl's Palace Birsay (Scheduled Monument SM90033)

Construction of the Palace probably began in 1569 and was largely complete by 1574. It was used by the Earls of Morton in the 1650s, and by the early 1700s had lost its roof and fallen into decay. Today it is in a ruinous state, with the eastern and southern ranges barely surviving above first-floor level.

The palace is of national importance as the palatial residence of a powerful noble of royal blood, Robert Stewart, the illegitimate son of James V. The planning of the palace, considered in relation to surviving documentation, offers insights into the layout and functioning of such a building. The buried archaeological remains have the potential to contribute further details, besides adding to our knowledge of the material culture of the period. The historical importance of the building is enhanced by its role in the rebellion of the younger Robert Stewart (son of Patrick) in May 1614.

The palace is located at the northern edge of Birsay, bounded to the immediate north and west by the A966. Views towards the west and south-west are dominated by adjacent residential and ecclesiastical buildings, with views to the north-west, north, east and south being relatively open and uninterrupted.

The Earl's Palace has a high heritage value and medium contribution of setting, resulting in a medium sensitivity to obvious changes. The Palace derives some significance from its setting in that it retains a relationship with the historic core of Birsay.

The photomontage (VP27) indicates that the OAA would be visible at a distance of 39 km to the south-west of Birsay, however from the Earl's Palace itself it would not be visible. This is a negligible change in the setting of the palace and therefore has an impact of negligible magnitude.

Evaluation of significance

The sensitivity of Earl's Palace Birsay (Scheduled Monument SM90033) is assessed as medium and the magnitude of impact is assessed as negligible. The effect is of negligible consequence and therefore not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

Wireline E: Brough of Birsay carpark - Point of Buckquoy, four mounds (Scheduled Monument SM1290)

The location allows for 360-degree views of the surrounding landscape, with the immediate setting being dominated by the modern cark park and interpretation boards. The monument comprises four mounds dating probably to the late Iron Age (Pictish) and Norse period (between around 500 and 1200 AD), or possibly earlier. The four mounds vary in size and form, but they are all turf-covered with exposed stone visible in places. The monument is situated on the flat promontory known as the Point of Buckquoy. The monument is of national importance because of its inherent potential to make a significant addition to our understanding of the past, in particular of Pictish and Norse settlement, society, agriculture and economy. Given the size of the surviving mounds, the visible stone content (including walling), and the wealth of archaeological remains discovered during excavations in the near vicinity, especially along the Brough Road, these mounds are highly likely to contain very important structural remains and archaeological deposits.

As the monument has a high heritage value and a medium contribution of setting, it has a medium sensitivity to change.

Wireline E shows that the entirety of the OAA would be visible breaking the horizon at sea in the distance, some 40 km to the west. This change to the view westwards does not disrupt key relationships between the heritage asset and its relevant setting, forming a low magnitude of impact on setting.

Evaluation of significance

The sensitivity of Brough of Birsay carpark - Point of Buckquoy, four mounds (Scheduled Monument SM1290) is assessed as medium and the magnitude of impact is assessed as low. Professional judgement indicates that the resulting consequence of effect is **minor** since the effect does not significantly impact upon the heritage value of the receptors, or the understanding, appreciation or experience of the assets, and adequately retains the integrity of the setting, and is therefore **not significant** in EIA terms.

Sensitivity	Magnitude of impact	Consequence
Medium	Low	Minor

Impact significance - NOT SIGNIFICANT

Wireline I (and Figure 18.30a-d[11]): Hall of Clestrain, top of access track (Category A Listed Building LB19892)

The Hall of Clestrain is an 18th century villa in its original designed landscape setting. It is largely single-phase of c1750 and ceased being a family residence in the mid-20th century. The house straddles the old Stromness to Orphir road and is aligned with it, with the principal elevation facing south. It is on three floors with an attic and is almost square in plan with three bays to each elevation. An outbuilding to the northwest was formerly matched by another on the northeast as a pair of flanking pavilions. The principal rooms were located on the first floor with bedrooms above and service rooms below. To the southeast there is a large walled garden which contains a circular ornamental pond, now considerably overgrown. A number of agricultural buildings of low quality are located alongside the walled garden.

Apart from its architectural significance, the hall is highly significant as the birthplace of John Rae, the Arctic explorer (1813-1893). Rae grew up at the house and learned to sail, shoot and fish in the area around it. He went on to become a doctor with the Hudson's Bay Company and mapped large parts of the north coast of Canada, largely on foot. He also discovered the last navigable link in what became the route for Roald Amundsen to sail through the North West Passage in 1903-1906.

The hall stands within a rectilinear arrangement of even sized fields which are characteristic of some parts of the Orkney landscape. These landscapes might be associated with particular estates or a particular approach in land management. The 'squaring' or rectilinear division is significant surviving evidence, but the landscape did not necessarily look the same way in the mid-18th century when the hall was built.

The setting of Hall of Clestrain possibly has not changed significantly since its first construction in 1750. It is possible that the north-south axis which is part of its aesthetic predates the 'squaring' of the landscape around into fields. The

[11] *Figure 18.30a-d is presented in SS20: SLVIA Visualisations.*

relationship between the house and the shore will be similar to the original relationship although the position of the public road has changed.

The principal views from the hall are from the first-floor windows to the south, west and north. In the views to the west there is an important view to Stromness and Hoy, and when viewed from the hall, Stromness would have been an obvious place of trade and prosperity, and it is possible that the best views being to the west influenced the positioning of the principal rooms in the house; the drawing and dining rooms. It would also have influenced the positioning of the subsidiary buildings which are aligned with the north corners of Hall of Clestrain possibly to avoid blocking these views. Additionally, John Rae would have been aware of these views and the relationship of the gap between Hoy and Stromness being a gateway to Canada for the Hudson's Bay Company. (Simpson & Brown, 2020).

As the monument has a high heritage value and a high contribution of setting, and therefore a high sensitivity to change.

The photomontage indicates that the OAA would be visible from the principal view from the western first-floor window of the hall, albeit at a distance of 40 km which would mean it would only likely be visually prominent on the clearest of days. When visible, the OAA would be seem to fill the open space between Graemsay and Stromness on Hoy Sound, and this could be considered to interrupt the 'gateway to Canada' as likely understood by John Rae. Given the distance and the fact that the OAA would only be visually prominent on the clearest of days it would have an impact of low magnitude.

Evaluation of significance

The sensitivity of Hall of Clestrain, top of access track (Category A Listed Building LB19892) is high and the magnitude of impact is assessed as low. The visibility of the OAA would not significantly impact on the heritage value of the Hall, or the understanding, appreciation of experience of it, as well as adequately retaining the integrity of its setting, and it would have an impact of minor consequence, and is therefore not significant in EIA terms.

Sensitivity	Magnitude of impact	Consequence
High	Low	Minor

Impact significance – NOT SIGNIFICANT

16.6.3 Potential effects during decommissioning

In the absence of detailed information regarding decommissioning works, the impacts during the decommissioning of the offshore Project are considered analogous with, or likely less than, those of the construction stage.

The removal of WTGs would remove any effects on the setting of heritage assets identified above.

16.6.4 Summary of potential effects

A summary of the outcomes of the assessment of potential effects from the construction, operation and maintenance and decommissioning of the offshore Project is provided in Table 16-15.

No significant effects on marine archaeology and cultural heritage receptors were identified. Therefore, mitigation measures in addition to the embedded mitigation measures listed in section 16.5.4 are not considered necessary.

Table 16-15 Summary of potential effects

POTENTIAL EFFECT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[12]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning						
Loss of or damage to known marine historic environment assets	Known marine and intertidal historic environment assets	Negligible to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Loss of or damage to known marine historic environment assets	Unknown marine and intertidal historic environment assets	Negligible to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Loss of or damage to submerged prehistoric landscapes	Submerged prehistoric landscapes	Medium to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Operation and maintenance						

[12] *Sensitivity to change relates to the assessment of impacts on the setting of receptors.*

POTENTIAL EFFECT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[12]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Loss of or damage to known marine historic environment assets	Known marine and intertidal historic environment assets	Negligible to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Loss of or damage to known marine historic environment assets	Unknown marine and intertidal historic environment assets	Negligible to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Loss of or damage to submerged prehistoric landscapes	Submerged prehistoric landscapes	Medium to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP1: Faraid Head - Seanachaisteal promontory fort (SM5303) and monastery (SM5392)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP7: Melvich Beach - Big House (LB7159)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[12]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP9: A836, Reay Kirk, Sandside Bay - Reay Kirk (LB14992)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP10: Crosskirk, St Mary's Chapel and broch, Scheduled Monument (SM90086)	Low	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP11: Ben Griam Beg hillfort (SM1836)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP13: Dunnet Head - Dunnet Head Lighthouse and keepers' cottages (LB1890)	Low	Low	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[12]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP14: Castle of Mey (LB1797) (GDL00096)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP15: St John's Point - Fort and site of St John's Chapel (CM2689)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP16: Bein Freiceadain hillfort (SM530)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP17: Kyle of Tongue, A838 Causeway - Tongue House (LB18458)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[12]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP18: A836 between Thurso and Castletown - Harold's Tower Mausoleum (LB14919)	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP19: A836 Dounreay - Cnoc-na-h'Uiseig chambered cairn (SM444)	Low	Low	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	Wireline A: Borve Castle (SM2112)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	Wireline B: Cnoc Freiceadain long cairns (SM90078)	Medium	Low	Minor (no significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[12]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP21: Rackwick Bay at Bothy Beach – listed buildings (LB46376, LB46275, LB46377, LB52548 & LB52547)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP24: Warebeth, on Warebeth Road to beach – Ness battery gun emplacements (SM13478) and Ness battery coast defence battery (SM8241)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP25: Yesnaby, Brough of Bigging (SM6214)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP26: Wirelines G & H: Bay of Skaill – Skara Brae (SM90246), HONO WHS	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[12]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Long term changes to the setting of onshore historic environment assets that reduces their value	Wireline F: Knowes of Trotty / HONO WHS sensitive area	High	Negligible	Negligible (Not significant)	None required above embedded mitigation measures.	Negligible (Not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP27: Marwick Head, Kitchener Memorial (LB6182)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	VP28: Earl's Palace Birsay (SM90033)	Medium	Negligible	Negligible (Not significant)	None required above embedded mitigation measures.	Negligible (Not significant)
Long term changes to the setting of onshore historic environment assets that reduces their value	Wireline E: Brough of Birsay carpark - Point of Buckquoy, four mounds (SM1290)	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[12]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Long term changes to the setting of onshore historic environment assets that reduces their value	Wireline I (and Figure 18.30a-d): Hall of Clestrain (LB19892)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

16.7 Assessment of cumulative effects

16.7.1 Introduction

Potential impacts from the offshore Project have the potential to interact with those from other developments, plans and activities, resulting in cumulative impacts on marine archaeology and cultural heritage receptors. The general approach to the cumulative effects assessment is described in chapter 7: EIA methodology and further detail is provided below.

The list of relevant developments for inclusion within the cumulative effects assessment is outlined in Table 16-16. This has been informed by a screening exercise, undertaken to identify relevant developments for consideration within the cumulative effects assessments for each EIA topic, based on defined Zones of Influence (ZoI).

The consideration of which developments could result in potential cumulative effects on marine archaeology and cultural heritage is based on the results of this impact assessment, with the expert judgement of ORCA and developments identified by statutory consultees, including HES, THC and OIC.

Other developments within the marine archaeology and cultural heritage study area were considered to have the potential to result in cumulative impacts for cultural heritage receptors due to impacts on setting.

Table 16-16 List of developments considered for the marine archaeology and cultural heritage cumulative impact assessment

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE TO OAA (KM)	DISTANCE TO OFFSHORE ECC (KM)	STATUS	CONFIDENCE[13]
Caithness (Armadale)	Onshore Wind	Armadale Wind Farm	29	149.9	Pre-application	Low
Caithness (Hollandmey)	Onshore Wind	Hollandmey Energy Development	50	149.9	Pre-application	Low
Orkney (Mainland)	Onshore Wind	Costa Head Wind Farm	45	33.5	Consented	High

[13] *Confidence ratings have been applied to each cumulative development where: 'Low' = pre-application or application, 'Medium' = consented and 'High' = under construction or operational.*

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE TO OAA (KM)	DISTANCE TO OFFSHORE ECC (KM)	STATUS	CONFIDENCE[13]
Sutherland (Bettyhill)	Onshore Wind	Bettyhill	30	119	Operational	High
Caithness	Onshore Wind	Ackron Farm	33	35.4	Operational	High
Caithness	Onshore Wind	Forss I & II	33	78	Operational	High
Sutherland	Onshore Wind	Strathy North	33	110	Operational	High
Caithness	Onshore Wind	Balmore Farm	34	1	Operational	High
Caithness	Onshore Wind	Baillie	37	110	Operational	High
Caithness	Onshore Wind	Limekiln	38	7	Under construction	High
Caithness (Thurso)	Onshore Wind	Thurso WWTW	39	10	Operational	High
Orkney (Hoy)	Onshore Wind	Ore Brae, Hoy	41	34	Operational	High
Caithness	Onshore Wind	Moss of Geise	42	9	Operational	High
Caithness	Onshore Wind	Weydale Farm	43	12	Operational	High
Orkney (Mainland)	Onshore Wind	Holodykes	44	47	Operational	High
Caithness (Dunnet)	Onshore Wind	Taigh na Muir	45	22	Operational	High
Orkney (Flotta)	Onshore Wind	West Hill, Flotta	46	39	Operational	High
Caithness	Onshore Wind	Thurdisoft Farm	46	18	Operational	High
Orkney (Mainland)	Onshore Wind	Burgar Hill	47	51	Operational	High

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE TO OAA (KM)	DISTANCE TO OFFSHORE ECC (KM)	STATUS	CONFIDENCE[13]
Caithness	Onshore Wind	Lochend	50	25	Operational	High
Orkney (Mainland)	Onshore Wind	Hammars Hill	50	52	Operational	High
Orkney (Mainland)	Onshore Wind	Rennibister	50	50	Operational	High
Caithness (Lyth)	Onshore Wind	Burnside Lyth	54	25	Operational	High
Orkney (Mainland)	Onshore Wind	Crowness Business Park	54	54	Operational	High
Caithness (Mybster)	Onshore Wind	Achlachan	55	22	Operational	High
Caithness (Stoupster)	Onshore Wind	Stroupster	55	30	Operational	High
Caithness (Halkirk)	Onshore Wind	Causeymire	56	23	Operational	High
Caithness (Lathertonwheel)	Onshore Wind	Berridale	56	48	Operational	High
Caithness (Spittal)	Onshore Wind	Halsary	57	24	Operational	High
Caithness, (South of Thurso)	Onshore Wind	Bad a Cheo	57	24	Operational	High
Orkney (Rousay)	Onshore Wind	Kingarly Hill	57	30	Operational	High
Orkney (Burray)	Onshore Wind	Northfield, Burray	58	53	Operational	High
Caithness (Lybster)	Onshore Wind	Hill of Lybster	34	1	Consented	Medium

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE TO OAA (KM)	DISTANCE TO OFFSHORE ECC (KM)	STATUS	CONFIDENCE[13]
Caithness (Thusater)	Onshore Wind	Thusater Farm	36	4	Consented	Medium
Caithness (Strathy)	Onshore Wind	Strathy Wood	35	21	Consented	Medium
Caithness (Strathy)	Onshore Wind	Strathy South	37	35	Consented	Medium
Caithness (Limekiln)	Onshore Wind	Limekiln Extension	38	7	Consented	Medium
Orkney (Hoy)	Onshore Wind	Hoy Community	39	32	Consented	Medium
Caithness (Thurso)	Onshore Wind	Cnoc na Gaoithe	44	15	Consented	Medium
Orkney (Mainland)	Onshore Wind	Akla	45	44	Consented	Medium
Orkney (Mainland)	Onshore Wind	Hammars Hill Extension	49	52	Consented	Medium
Orkney (Mainland)	Onshore Wind	Quanterness	52	51	Consented	Medium
Caithness (Wick)	Onshore Wind	Thura Mains	52	23	Consented	Medium
Caithness (Slickly)	Onshore Wind	Slickly	56	29	Consented	Medium
Caithness (Mybster)	Onshore Wind	Achlachan II	56	22	Consented	Medium
Orkney (South Ronaldsay)	Onshore Wind	Hesta Head	57	45	Consented	Medium
Caithness (Wick)	Onshore Wind	Cogle Moss	58	28	Consented	Medium

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE TO OAA (KM)	DISTANCE TO OFFSHORE ECC (KM)	STATUS	CONFIDENCE[13]
Caithness (Latheron)	Onshore Wind	Tacher	60	27	Consented	Medium
Caithness (Dounreay)	Onshore Wind	Forss III	33	0	Application	Low
Sutherland (Kirkton)	Onshore Wind	Kirkton	34	14	Application	Low
Caithness (Thurso)	Onshore Wind	Cairnmore Hill	36	4	Application	Low
Orkney (Mainland)	Onshore Wind	Nisthill	44	48	Application	Low
Caithness (Thurso)	Onshore Wind	East of Whitemoss	45	14	Application	Low
Caithness (Tormsdale)	Onshore Wind	Tormsdale	56	22	Application	Low
Orkney	Offshore Wind Farm	West of Orkney Windfarm – transmission connection to the Flotta Hydrogen Hub	0	0	Pre-application	Low
Pentland Firth	Offshore Wind Farm	Pentland Floating Offshore Wind Farm (PFOWF)[14]	7	23	Consented	Medium

[14] Pentland Floating Offshore Wind Farm (PFOWF) will incorporate the currently consented Pentland Floating Offshore Wind Demonstrator turbine, and hence PFOWF only has been considered. The PFOWF Section 36 Consent and Marine Licence was granted for 10 years. However, the cumulative effects assessment has been based on the Project Design Envelope, as specified within the EIA, and therefore, an operational life of up to 30 years for the PFOWF has been considered. Since consent was granted in June 2023, PFOWF have submitted a Screening Report to MD-LOT with the intention to request a variation to the Section 36 Consent. This variation will incorporate refinements to the Project Design Envelope and to extend the operational life to 25 years.

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE TO OAA (KM)	DISTANCE TO OFFSHORE ECC (KM)	STATUS	CONFIDENCE[13]
Pentland Firth (Caithness to Mainland Orkney)	Power transmission cable	Scottish Hydro Electric Transmission Limited (SHET-L) Caithness to Orkney HVAC Link	22	0	Consented	Medium

The methodology for direct and indirect cumulative effects on marine archaeology and cultural heritage is the same process as outlined in section 16.5, identifying if there may be a greater magnitude of impact and consequence derived from the combination of the overall impact of a series of developments. In terms of assessing cumulative impacts on the setting of onshore historic environment assets, cumulative impacts are derived from the combination of the overall impact of a series of developments or from the combination of different environmental impacts.

Due to the large number of designated onshore heritage assets within 60 km of the OAA, this Offshore EIA Report assesses a selection of appropriate designated assets to act as proxy for all the others in line with the approach taken in the impact assessment, and where potential cumulative impacts have been identified through professional judgement as being possible. Where there is no or very far visibility of current, proposed, consented or applied for developments from a designated historic environment asset then no cumulative impact assessment has been undertaken.

A cumulative impact on setting may result from different developments within a single view, or as seen when looking from different directions from a single viewpoint, or the sequential viewing of multiple developments when moving through the setting of one or more asset. The significance of cumulative effects has been assessed based on the sensitivity of the asset and its setting and the magnitude of impacts expected to occur within the setting. The magnitude of impact is based on:

- The scale of change to the setting;
- Proximity of the OAA to other wind farm developments;
- Whether the developments integrate or contrast within the existing landscape; and
- Whether the OAA appears as an extension to another development or introduces a new aspect of the view.

The magnitude of cumulative impact on the setting of a historic environment asset is assessed using the criteria set out in Table 16-17.

Table 16-17 Criteria to assess the magnitude of cumulative impact on the setting of a historic environment asset

MAGNITUDE OF IMPACT	CRITERIA
High	Offshore Project would be visually prominent and visible along with other prominent wind farm developments within the setting / landscape. Offshore Project severs last or key link between asset and original setting, and removes integrity of setting. Proposed WTGs and additional WTGs visible in multiple directions creating a feeling of being surrounded, removing Sense of Place.
Medium	Offshore Project would add to the successive or simultaneous visibility of other wind farm developments making wind farm developments seem larger and more spread out within the landscape setting. Offshore Project interrupts but does not sever links between asset and setting, retaining the integrity of setting. WTGs would be visible in two directions with the offshore Project in one of these views.
Low	Offshore Project will not add to the successive visibility with other wind farm developments. Offshore Project does not interrupt links between asset and setting, with no effect on the integrity of setting. WTGs would be visible in only one direction with the offshore Project in this view.
Negligible	Offshore Project is the only one in the setting, thus no Cumulative Effect (although there may still be significant direct or indirect effects).
Unknown	Changes to a setting, where it is uncertain how these contribute to our understanding, appreciation or experience of the site because the feature or asset itself could not or has not been understood or interpreted.
Positive	Changes to a setting that improves the relationship with the heritage asset.

The following impacts have been taken forward for the cumulative assessment:

- Construction and decommissioning:
  - Loss of or damage to unknown marine and intertidal historic environment assets; and
  - Loss of or damage to submerged prehistoric landscapes.
- Operation and maintenance:
  - Loss of or damage to unknown marine and intertidal historic environment assets;
  - Loss of or damage to submerged prehistoric landscapes; and
  - Long-term changes to the setting of designated onshore historic environment assets that reduces their value.

16.7.2 Cumulative construction effects

16.7.2.1 Loss of or damage to unknown marine historic environment assets

As there will be no overlapping development, this cumulative effect has been scoped out for the OAA. The offshore ECC has been scoped in due to the proximity of the proposed SHET-L Caithness to Orkney HVAC Link at Sandside Bay approximately 8 km to the south-west of the offshore ECC's landfall location.

The risk of unknown marine and intertidal historic environment assets being present has been much reduced because of the marine geophysical surveys conducted and reviewed. It is never possible to eliminate the risk entirely because smaller artefacts / wreckage of stone, non-ferrous metals such as aluminium and wood might not be picked up by such surveys.

The historic importance of such items could vary anywhere from negligible to high. However, due to the surveys conducted to reduce the risk and the localised construction / installation activities, the likelihood of cumulative impact is considered low. The embedded mitigation of the implementation of a WSI and PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest means that the magnitude of direct cumulative impact is negligible. Therefore, the consequence of effect is negligible and the resulting significance of effect is not significant.

16.7.2.2 Loss of or damage to submerged prehistoric landscapes

As there will be no overlapping development, this cumulative effect has been scoped out for the OAA. The offshore ECC has been scoped in due to the proximity of the proposed SHET-L Caithness to Orkney HVAC Link.

Submerged prehistoric and paleoenvironmental deposits are generally considered to have medium or high heritage value or sensitivity. However, no submerged paleoenvironmental deposits have been identified from review of the marine geophysical survey data, and none is known from other studies.

Because sub-bottom profile data comprises slice snapshots rather than 100% coverage, it is not possible to eliminate the risk. However, due to the surveys conducted to reduce the risk and the localised construction / installation activities compared to potential extent of such deposits, the likelihood of cumulative impact is considered low. The embedded mitigation of the implementation of a WSI and PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest means that the magnitude of direct cumulative impact is negligible.

Therefore, the consequence of effect is negligible and the resulting significance of effect is not significant.

16.7.3 Cumulative operation and maintenance effects

16.7.3.1 Loss of or damage to unknown marine and intertidal historic environment assets

As there will be no overlapping development, this cumulative effect has been scoped out for the OAA. The offshore ECC has been scoped in due to the proximity of the proposed SHET-L Caithness to Orkney HVAC Link.

The risk of unknown marine and intertidal historic environment assets being present has been much reduced because of the marine geophysical surveys conducted and reviewed. It is not possible to eliminate the risk, because smaller artefacts / wreckage of stone, non-ferrous metals such as aluminium and wood might not be picked up by such surveys. The historic importance of such items could vary anywhere from negligible to high.

During operation and maintenance any activities that impact the seabed have the potential to result in the damage / loss of unknown cultural material lying on the seabed. Potential scouring from cables on the seabed, scour protection, any cable re-burial works, or remedial cable protection works have the potential to result in the cumulative damage / loss of cultural material lying on the seabed.

However, due to the marine geophysical survey conducted to reduce the risk (which did not identify any marine assets within the study area), the likelihood of cumulative impacts during operation and maintenance is considered Negligible. The embedded mitigation of the implementation of a WSI and PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest means that the magnitude of direct cumulative impact is negligible.

Therefore, the consequence of cumulative effect is negligible and the resulting significance of effect is not significant.

16.7.3.2 Loss of or damage to submerged prehistoric landscapes

As there will be no overlapping development, this cumulative effect has been scoped out for the OAA. The offshore ECC has been scoped in due to the proximity (located approximately 5km to the south-west of the offshore ECC landfall location) of the proposed SHET-L Caithness to Orkney HVAC Link.

Submerged prehistoric and paleoenvironmental deposits are generally considered to have medium or high heritage value or sensitivity. However, no submerged paleoenvironmental deposits have been identified within the offshore Project area from review of the sub-bottom profile marine geophysical survey data, and none is known from other studies.

Because sub-bottom profile data comprises slice snapshots rather than 100% coverage, it is not possible to eliminate the risk. However, due to the surveys conducted to reduce the risk and the localised operation and maintenance activities compared to potential extent of such deposits. The embedded mitigation of the implementation of a WSI and PAD to avoid or mitigate accidental impacts and manage any accidental discoveries of archaeological interest means that the magnitude of direct cumulative impact is negligible.

Therefore, the consequence of effect is negligible and the resulting significance of effect is not significant.

16.7.3.3 Long-term changes to the setting of designated onshore historic environment assets that reduces their value

The potential for medium or long-term cumulative changes by the offshore Project and other windfarms to adversely impact on the setting of onshore historic environment assets, reducing their heritage value by significantly affecting the way the asset is understood, appreciated and experienced is assessed below.

Potential cumulative impacts on the setting of onshore historic environment assets includes the PFOWF located approximately 6 km off Dounreay, the existing Hammars Hill and Burgar Hill wind farms in Orkney's West Mainland, the recently approved Hoy and Quanterness Community Windfarm developments, and the existing and proposed windfarms across Caithness and Sutherland as outlined in Table 16-16 above.

In order to keep the size of assessment reasonable and proportionate, a selection of statutorily designated historic environment assets have been considered, which can act as proxy for the range of effects on all other designated and undesignated historic environment assets. Wirelines and visualisations have been developed that showed the worst case scenario for selected designated assets (see SS20: Visualisations and SS22 Marine Archaeology Onshore Setting Supporting Figures). The selected designated assets are all located within THC region as some are located within an area of higher concentrations of planned and operational developments, are at an elevation that affords them extensive views across the land and / or they are located under 40 km from the OAA thus increasing their sensitivity to cumulative visual impacts. None of the Orkney designated assets were considered to be sensitive to these potential cumulative visual impacts and were therefore not assessed.

16.7.3.3.1 Seanachaisteal promontory fort and monastery, Scheduled Monument (SM5392), Figure 16-11

Seanachaisteal promontory fort and monastery have a high heritage value and a high contribution of setting, with a high sensitivity to change in terms of key views to the east, north-east and north.

The OAA is visible some 27 km out to sea, with the Forss I & II, Forss III, Cairnmore Hill, Hill of Lybster and Thusater Farm wind farm sites being potentially visible on a very clear day from over 60 km to the north-east of the asset. Therefore, there is a negligible magnitude, of negligible consequence.

With the cumulative effect not impacting the integrity of the setting, the heritage value of the sites, or the understanding, appreciation or experience of them, and is therefore not significant.

16.7.3.3.2 Reay Kirk, Listed Building (LB14992), Figure 16-12

Reay Parish Church stands as proxy for the other Listed Buildings in Reay village and the Scheduled Medieval burial ground and cross slab of Reay old parish church (SM 615).

The church sits largely in isolation, with no immediate neighbouring buildings in any direction. It is located in a setting that makes a positive contribution to the understanding, appreciation and siting of the church as well as its historical and architectural context, a medium contribution of setting. As the church has a high heritage value and a medium contribution of setting, it has a high sensitivity to change.

The photomontage provided indicates that the OAA would be visible at a distance of 35 km, and this would be a minor change in this wider landscape and therefore has an impact of low magnitude. The proposed PFOWF would be visible from the burial ground and the approach to the church along the main road, although the other buildings of the village and many mature trees would screen this and other wind farms in the vicinity to a great extent.

The effect would not change the current relationship of the church with the other heritage assets in the village, which is a minor consequence of effect. The resulting significance of cumulative effect is minor since the effect does not significantly impact on the heritage value of the church and other heritage assets, or the understanding, appreciation or experience of these, and adequately retains the integrity of the setting, and is therefore not significant.

16.7.3.3.3 Forss/Crosskirk – St Mary's Chapel and broch, Scheduled Monument (SM90086), Figure 16-12

The coastal location of these sites indicates that views to and from the Pentland Firth are key, as is intervisibility with other similar sites such as the broch site at Green Tullochs (SM554) 1.3 km along the coast to the south-west, where a chambered cairn is also part of that scheduling and Tulloch of Lybster broch (undesignated) 650 m to the south.

The seven-WTG PFOWF and the six-WTG Forss Wind Farm, as well as the Forss Technology and Business Park 250 m to the south-west dominates Crosskirk. This has not affected the high heritage value of the chapel. The high heritage value and low contribution of setting results in a medium sensitivity to change.

The photomontage shows that the entirety of the OAA would be visible out to sea, and its addition 33 km away would be a noticeable change to views from the site to the north-west, extending the horizontal spread of WTGs round to the north-west. This does not alter appreciation of the chapel and broch's coastal location, intervisibility with other sites or any other key relationships between the chapel and broch themselves and their setting.

This is a low magnitude of cumulative impact with a minor consequence of cumulative effect on setting by matrix definition. The cumulative change does not affect the integrity of the setting, or prevent the appreciation, understanding or experience of the assets and is thus not significant.

16.7.3.3.4 Ben Griam Beg hillfort, Scheduled Monument (SM1836), Figure 16-12

The site has extensive 360-degree views over the low-lying open landscape below and to Ben Griam Mor to the south-west. The site occupies a topographically prominent position on the summit of a distinctive, steep-sided hill in a predominantly open lower landscape of bog and moorland (high contribution of setting). The high heritage value and high contribution of setting, results in a high sensitivity to obvious changes that do not blend into the distant vistas.

The photomontage indicates that the OAA would be visible at a distance of 50 km, adding to the wind farms in the 180-degree view to the north (the three Strathy wind farms, Ackron, Drum Hollistan, Forss, Limekiln, Baillie Hill, Stroupster and PFOWF).

This is a minor cumulative change in this wider landscape and therefore has a cumulative impact of low magnitude. At this distance the effect is of minor consequence. Despite the sensitivity of the hillfort's setting, this cumulative change would not affect the integrity of the hillfort's setting, the site's understanding, appreciation or experience, sense of place or heritage value, resulting in an effect that is not significant.

16.7.3.3.5 Dunnet Head Lighthouse and keepers' cottages, Listed Building (LB1890), Figure 16-12

The site occupies a highly prominent location on the cliffs of Dunnet Head. The key sightlines are to and from the Pentland Firth, whilst the views inland across Caithness with its farming landscape and windfarms are not essential to the understanding of the site but do add to the experience. The medium heritage value and high contribution of setting, results in a high sensitivity to change, according to definition. However, lighthouses can be considered as assets that are tolerant of change over a distance because of their function. Therefore, the buildings can be considered as having a low sensitivity to change at a landscape / seascape level.

The photomontage provided shows that the entirety of OAA would be visible out to sea more than 39 km distant. The addition of the OAA to the other wind farms in the background, including the PFOWF; Hoy Community; Ora Brae, Hoy; Quanterness; West Hill, Flotta; Northfield, Burray; Berriedale and Hesta Head would extend the horizontal spread of WTGs.

This presents a medium magnitude of cumulative impact with a minor consequence of effect on setting that is thus not significant. Such a cumulative change is to Dunnet Head's wider setting, not altering the integrity of the setting, the experience and appreciation of the lighthouse, its location or understanding of its function.

16.7.3.3.6 Beinn Freiceadain hillfort, Scheduled Monument (SM530), Figure 16-12

The hillfort has extensive 360-degree views over the low-lying open landscape below and towards the Pentland Firth, including the existing Limekiln, Baillie, Forss I&II, Causeymore, Achlachan, Halsary, Bad a Cheo and Balmore Farm windfarms. The high heritage value and high contribution of setting, results in a high sensitivity to obvious changes that do not blend into the distant vistas.

The addition of the OAA would add to the windfarms outlined above in the 180-degree view to the north, effectively filling in the gap between the Limekiln and Baillie windfarms, forming a near continuous line of WTGs from this aspect; however this would be at 47 km distant from Beinn Freiceadain and the OAA would only be seen on the horizon on the clearest of days, and would therefore not be a dominant feature on the horizon.

This presents a low magnitude of cumulative impact with a minor consequence of effect on setting that is thus not significant. Such a cumulative change is to Beinn Freiceadain's wider setting, not altering the integrity of the monument's setting, the experience and appreciation of the hillfort, its location or understanding of its function.

16.7.3.3.7 A836 Dounreay Cnoc-na-h'Uiseig chambered cairn, Scheduled Monument (SM444), Figure 16-12

The chambered cairn has been altered physically and visually by the construction and operation of the Dounreay Nuclear Research Establishment Site. The research establishment dominates the setting of the monument to the west, and the surrounding landscape has been much altered with onshore WTGs and the A836. Setting does therefore not contribute towards the site's overall significance to a great deal.

The monument has a high heritage value and a low contribution of setting, with a low sensitivity to change.

The OAA would be visible behind the PFOWF in views to the north (roughly 25 km behind), and this would reinforce the visual presence of WTGs in this location.

This presents a medium magnitude of cumulative impact with a minor consequence of effect on setting that is thus not significant. Such a cumulative change is to the cairn's wider setting which is already dominated by the Dounreay Nuclear Research Establishment, HMS Vulcan and other modern development, not altering the integrity of the cairn's setting, the experience and appreciation of it, its location or understanding of its function.

16.7.3.3.8 Impact on the setting of remaining designated assets within the setting study area

The remaining heritage assets, the majority within Orkney, are either screened from other developments, or located over 40 km away from them, so they have not been considered for cumulative impact assessment.

It can be seen from the above assessment of chosen sites, that there are no cumulative impacts of high magnitude on setting that result in a total removal of or fundamental and irreversible change to, the relationship between a heritage asset and its relevant setting.

16.7.4 Cumulative decommissioning effects

The decommissioning process will essentially be a reversal of the construction process and while there will be disturbance as infrastructure is removed, this should not be worse than or expand the footprint of disturbance of that during construction.

The removal of WTGs would reverse any setting impacts. Therefore, no adverse cumulative effects on the setting of onshore heritage assets during decommissioning have been identified.

16.7.5 Summary of cumulative effects

A summary of the outcomes of the assessment of cumulative effects for the construction, operation and maintenance and decommissioning stages of the offshore Project is provided in Table 16.

Table 16-18 Summary of assessment of cumulative effects

POTENTIAL IMPACT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[15]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning						
Loss of or damage to unknown marine historic environment assets	Unknown marine and intertidal historic environment assets	Negligible to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Loss of or damage to submerged prehistoric landscapes	Submerged prehistoric landscapes	Medium to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Operation and maintenance						
Loss of or damage to unknown marine historic environment assets	Unknown marine and intertidal historic environment assets	Negligible to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

[15] *Sensitivity to change relates to the assessment of impacts on the setting of receptors.*

POTENTIAL IMPACT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[15]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Loss of or damage to submerged prehistoric landscapes	Submerged prehistoric landscapes	Medium to High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Long-term changes to the setting of designated onshore historic environment assets that reduces their value	Seanachaisteal promontory fort and monastery, Scheduled Monument (SM5392)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Long-term changes to the setting of designated onshore historic environment assets that reduces their value	Reay Kirk, Listed Building (LB14992)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long-term changes to the setting of designated onshore historic environment assets that reduces their value	Forss/Crosskirk – St Mary's Chapel and broch, Scheduled Monument (SM90086)	Medium	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

POTENTIAL IMPACT	RECEPTOR	VALUE / SENSITIVITY TO CHANGE OF RECEPTOR[15]	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Long-term changes to the setting of designated onshore historic environment assets that reduces their value	Ben Griam Beg hillfort, Scheduled Monument (SM1836)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long-term changes to the setting of designated onshore historic environment assets that reduces their value	Dunnet Head Lighthouse and keepers' cottages, Listed Building (LB1890)	Low	Medium	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long-term changes to the setting of designated onshore historic environment assets that reduces their value	Beinn Freiceadain hillfort, Scheduled Monument (SM530)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Long-term changes to the setting of designated onshore historic environment assets that reduces their value	A836 Dounreay Cnoc-na-h'Uiseig chambered cairn, Scheduled Monument (SM444)	Low	Medium	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

16.8 Inter-related effects

Inter-related effects are the potential effects of multiple impacts, affecting one receptor or a group of receptors. Inter-related effects include interactions between the impacts of the different stages of the offshore Project (i.e. interaction of impacts across construction, operation and maintenance and decommissioning), as well as the interaction between impacts on a receptor within an offshore Project stage. The potential inter-related effects for marine archaeology and cultural heritage receptors are described below.

This chapter has assessed all impacts that are relevant to marine archaeology and cultural heritage receptors during construction, operation and maintenance, and decommissioning stages of the offshore Project. Loss or damage to known and unknown marine historic environmental assets and submerged prehistoric landscapes, could occur during all offshore Project stage. There will be limited potential for interaction between impacts on the same receptor across the different offshore Project stages. Any receptors identified during construction, will be considered during subsequent stages, with appropriate mitigation as described in place.

The assessment has also considered the potential for inter-related effects in relation to marine archaeology and cultural heritage, and no additional inter-related effects have been identified.

16.9 Whole Project assessment

The onshore Project is summarised in chapter 5: Project description and a summary of the effects of the onshore Project is provided in chapter 21: Onshore EIA summary. These onshore aspects of the Project have been considered in relation to the impacts assessed in section 16.5.1. There is no overlap between the onshore Project and the impacts on marine archaeology and cultural heritage receptors assessed in section 16.6. From a setting perspective, there are no potential effects on onshore setting associated with the presence of the onshore substation and the offshore Project on the basis that due to the distance of the substation from the coast (approximately 18 km from the landfall area and approximately 12 km from nearest coastal location) there are no locations where it is possible to see both the offshore Project and the substation at the same time. Therefore, there is no potential for the onshore Project to exacerbate any of the effects assessed within this chapter.

16.10 Transboundary effects

Transboundary effects arise when impacts from a development within one European Economic Area (EEA) state's territory affects the environment of another EEA state(s).

There is no potential for transboundary impacts upon marine archaeology and cultural heritage receptors due to construction, operation and maintenance and decommissioning of the offshore Project. The potential impacts are localised and will not affect other EEA states. Therefore, transboundary effects for marine archaeology and cultural heritage receptors do not need to be considered further.

16.11 Summary of mitigation and monitoring

The offshore Project embedded mitigation measures proposed address most identified impacts, including the requirement to provide a marine WSI and PAD.

No secondary mitigation measures are currently proposed, over and above the embedded mitigation measures proposed in section 16.5.4, as no adverse significant impacts are predicted.

Any monitoring requirements during construction will be detailed in the marine WSI and PAD that is part of the embedded mitigation and will be agreed post-consent. An outline WSI and PAD is provided within OP1: Outline environmental management plan.

16.12 References

6Alpha (2023). Technical Note: UXO Assessment and Estimates. Document Number: WO1-OWC-GEO-GS-TN-0001. 21st February 2023.

Aviation Research Group Orkney & Shetland (ARGOS) (2022). Crash Site Orkney – ARGOS. Available online at: https://crashsiteorkney.com/index.html [Accessed 12/09/2023].

Baird, R.N. (2003). Shipwrecks of North Scotland. Edinburgh: Birlinn Ltd.

Beaton, E (2019). Bighouse and Strath Halladale, Sutherland. Scottish Society for Northern Studies. Available online at: https://www.ssns.org.uk/wp-content/uploads/2019/10/07_Beaton_Strathnaver_2000_-pp_143-172.pdf [Accessed 14/04/2023].

British Newspaper Archive (2022). The British Newspaper Archives. Available online at: https://www.britishnewspaperarchive.co.uk/ [Accessed 12/09/2023].

COWRIE (2008). Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy. Commissioned by COWRIE Ltd (project reference CIARCH-11-2006). Project contractors: Oxford Archaeology with George Lambrick Archaeology and Heritage. Available online at: https://biofund.org.mz/wp-content/uploads/2018/11/F1349.Cowrie-Ciarch-Web.pdf [Accessed 12/09/2023].

Ferguson, D (1988). Ferguson, D.M. (1988). Shipwrecks of Orkney, Shetland and the Pentland Firth. David and Charles, Newton Abbot.

Flemming, N. (2003). Archaeology of the Continental Shelf: Marine Resources, Submerged Landscapes and Underwater Archaeology, *Quaternary Science Reviews*, 27 (23-24), pp. 2153-2165. Available online at: https://www.researchgate.net/publication/222923558_Archaeology_of_the_Continental_Shelf_Marine_Resources_Submerged_Landscapes_and_Underwater_Archaeology [Accessed 11/09/2023].

Flemming, Nicholas C.; Harff, Jan; Moura, Delminda; Burgess, Anthony; Bailey, Geoffrey N., eds. (2017). Submerged landscapes of the European continental shelf: Quaternary paleoenvironments. Chichester, John Wiley & Sons, 533pp.

George, S. (2003). Jutland to Junkyard. Birlinn, Edinburgh.

Heath, K & Sadler, W. (2022). Lost in Waters Deep. Available online at: https://lostinwatersdeep.co.uk/index.html [Accessed 12/09/2023].

Historic England (2012). English Heritage Ships and Boats: Prehistory to Present – Designation Selection Guide. Available online at: https://historicengland.org.uk/images-books/publications/dsg-ships-boats/heag143-ships-and-boats-prehistory-to-present-sg/ [Accessed 12/09/2023].

Historic Environment Scotland (HES) (2014). Heart of Neolithic Orkney World Heritage Site Management Plan 2014 – 2019. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=c96546cf-ff4d-409e-9f96-a5c900a4f5f2 [Accessed 11/09/2023].

HES (2016). Managing Change in the Historic Environment Guidance Series: Setting. Revised 2020. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=80b7c0a0-584b-4625-b1fd-a60b009c2549 [Accessed 12/09/2023].

HES (2019a). The Historic Environment Policy Statement for Scotland (HEPS). Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=1bcfa7b1-28fb-4d4b-b1e6-aa2500f942e7 [Accessed 12/09/2023].

HES (2019b). Designation Policy and Selection Guidance. Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=8d8bbaeb-ce5a-46c1-a558-aa2500ff7d3b [Accessed 12/09/2023].

HES (2023a). The National Record of the Historic Environment Scotland: Canmore. Available online at: https://canmore.org.uk [Accessed 12/09/2023].

HES (2023b). The National Record of the Historic Environment Scotland: PastMap. Available online at: http://pastmap.org.uk [Accessed 12/09/2023].

HES (2023c). The Historic Environment Scotland Data Portal. Available online at: https://portal.historicenvironment.scot/ [Accessed 12/09/2023].

Larn, R. and Larn, B. (1998). Shipwreck Index of the British Isles: Vol 4 Scotland. Lloyds Register of Shipping, London.

Lloyds of London (2022). Lloyds Shipping Register. Available online at: https://hec.lrfoundation.org.uk/archive-library/lloyds-register-of-ships-online/lloyds-register-of-ships-online [Accessed 12/09/2023].

Moore, P.D., Webb, P.D., and Collinson, M.E. (1991) Pollen Analysis, Second edition. Oxford: Blackwell Scientific Publications.

Ocean Infinity (2023a). Offshore Geophysical Site Investigation West of Orkney Windfarm: Volume 1 – OAA Results Report. Document No. 103836-TOT-OI-SUR-REP-OOAREP.

Ocean Infinity (2023b). Offshore Geophysical Site Investigation West of Orkney Windfarm: Volume 1 – ECC Results Report. Document No. 103836-TOT-OI-SUR-REP-ECCWHBCREP.

Ocean Infinity (2023c). Offshore Geotechnical Site Investigation West of Orkney Windfarm: Volume 1 – Shallow Geotechnical Report Document No. 104549-TOT-OI-SUR-REP-SHGEOTER.

Orkney Islands Council (OIC) (2010). Orkney Islands Council Heart of Neolithic Orkney Supplementary Planning Guidance. Available online at: https://www.orkney.gov.uk/Files/Planning/Development-and-Marine-Planning/The_Heart_of_Neolithic_Orkney_World_Heritage_Site_SG.pdf [Accessed 12/09/2023].

OIC (2017). Orkney Local Development Plan. Available online at: https://www.orkney.gov.uk/Service-Directory/O/Orkney-Local-Development-Plan.htm [Accessed 12/09/2023].

OIC (2022). Orkney Islands Regional Marine Plan: Consultation Draft. Available online at: https://www.orkney.gov.uk/Service-Directory/D/orkney-islands-regional-marine-plan.htm [Accessed 12/09/2023].

Ridley, G. (1985). Dive North West Scotland: the diver guide to Scotland Vol. II. Underwater World Publications, London.

Ridley, G. (1992). Dive Scotland: Vol III. Underwater World Publications, London.

Scottish Government (2015). Scotland's National Marine Plan. March 2015. Scottish Government, Edinburgh.

Scottish Government (2016). Pilot Pentland Firth and Orkney Waters Marine Spatial Plan. March 2016. Scottish Government, Edinburgh.

Scottish Government (2023). National Planning Framework 4. February 2023. Scottish Government, Edinburgh.

Simpson & Brown (2020). Hall of Clestrain Conservation Plan. Available online at: https://www.johnraesociety.com/wp-content/uploads/2021/06/Hall-of-Clestrain-Conservation-Plan-Final.pdf. [Accessed 06/02/2023].

Spindler, A. (1932). Der Handelskrieg mit U-Booten. Verlag Mittler & Sohn, Berlin.

Stanton, C (1998). Caithness and Sutherland landscape character assessment. Available online at: https://www.nature.scot/doc/landscape-character-assessment-caithness-and-sutherland-landscape-evolution-and-influences [Accessed 11/09/2023].

The Crown Estate (TCE) (2016). Maritime Cultural Heritage & Seabed Development: Joint Nautical Archaeology Policy Committee (JNAPC) Code of Practice for Seabed Development. Available online at: https://www.historicenvironment.scot/media/2374/jnapc_brochure_may_2006.pdf [Accessed 12/09/2023].

TCE (2014). Protocol for Archaeological Discoveries: Offshore Renewables Projects. Published by Wessex Archaeology, Salisbury, on behalf of The Crown Estate. Available online at: https://www.thecrownestate.co.uk/media/1782/ei-protocol-for-archaeological-discoveries-offshore-renewables-projects.pdf [Accessed 12/09/2023].

TCE (2021). Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects and Offshore Renewables Projects. Wessex Archaeology Ltd, July 2021. Available online at: https://www.thecrownestate.co.uk/media/3917/guide-to-archaeological-requirements-for-offshore-wind.pdf [Accessed 12/09/2023].

The National Archives (2023). Admiralty Record Office Cases ADM 116-1516 Bi-monthly minesweeping reports. Available online at: https://discovery.nationalarchives.gov.uk/details/r/C1825 [Accessed 06/02/2023].

David Tyldesley and Associates (2001). Landscape Studies of the Heart of Neolithic Orkney World Heritage Site. Scottish Natural Heritage Commissioned Report No. F00LA01A. Available: https://www.nature.scot/sites/default/files/2017-07/Publication%202000%20-%20SNH%20Commissioned%20Report%20F00LA01A%20-%20Landscape%20Studies%20of%20the%20Heart%20of%20Neolithic%20Orkney%20World%20Heritage%20Site.pdf [Accessed 12/09/2023].

United Kingdom Hydrographic Office (UKHO) (2023). Wreck register & nautical charts. Available online at: https://www.admiralty.co.uk/digital-services/data-solutions/admiralty-marine-data-portal [Accessed 11/09/2023].

Wessex Archaeology Ltd. (2007). Historic Environment Guidance for the Offshore Renewable Energy Sector. Commissioned by COWRIE Ltd (project reference ARCH-11-05). Available online at: https://www.wessexarch.co.uk/sites/default/files/field_file/COWRIE_2007_Wessex_%20-%20archaeo_%20guidance_Final_1-2-07.pdf [Accessed 12/09/2023].

Wessex Archaeology (2011). Assessing Boats and Ships 1860-1913, 1914-1938 and 1939-1950 Archaeological Desk-Based Assessments in 3 Volumes. Available online at: https://www.wessexarch.co.uk/our-work/assessing-boats-and-ships [Accessed 12/09/2023].

Whittaker, I.G. (1998). Off Scotland: a comprehensive record of maritime and aviation losses in Scottish waters. C-ANNE Publishing, Eyemouth.

WreckSite (2022). Wreck Database. Available online at: https://www.wrecksite.eu/ [Accessed 12/09/2023].

16.13 Abbreviations

ABBREVIATIONS	DEFINITION
AD	Anno Domini
BC	Before Christ
CaP	Cable Plan
CBRA	Cable Burial Risk Assessment
CIfA	Chartered Institute for Archaeologists
cm	Centimetre
cUXO	Confirmed UXO
DSLP	Development Specification and Layout Plan
ECC	Export Cable Corridor
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EU	European Union
GDL	Garden and Designed Landscape
GIS	Geographic Information System
HDD	Horizontal Directional Drilling
HEPS	The Historic Environment Policy Statement for Scotland 2019
HER	Historic Environment Record

ABBREVIATIONS	DEFINITION
HES	Historic Environment Scotland
HLV	Heavy Lift Vessel
HMS	His (or Her) Majesty's Ship
HONO	Heart of Neolithic Orkney
HONO WHS	Heart of Neolithic Orkney World Heritage Site
HVAC	High Voltage Alternating Current
JNAPC	The Joint Nautical Archaeology Policy Committee
km	Kilometre
LAT	Lowest Astronomical Tide
LB	Listed Building
m	Metre
MAG	Magnetometer
MBES	Multi Beam Echo Sounder
MD-LOT	Marine Directorate – Licensing Operations Team
MS-LOT	Marine Scotland – Licensing Operations Team
NRHE	National Record of the Historic Environment of Scotland
nT	Nanotesla
OAA	Option Agreement Area
OD	Ordnance Datum

ABBREVIATIONS	DEFINITION
OIC	Orkney Islands Council
OP	Outline Plan
ORCA	Orkney Research Centre for Archaeology
OSP	Offshore Substation Platform
OWPL	Offshore Wind Power Limited
PAD	Protocol for Accidental Discoveries
PFOW	Pilot Pentland Firth and Orkney Waters
PFOWF	Pentland Floating Offshore Wind Farm
PoMRA	The Protection of Military Remains Act 1986
pUXO	Potential UXO
SEA4	Strategic Environmental Assessment 4
SHET-L	Scottish Hydro Electric Transmission Limited
SLVIA	Seascape Landscape Visual Impact Assessment
SM	Scheduled Monument
SS	Supporting Study
SSS	Side Scan Sonar
TCE	The Crown Estate
THC	The Highland Council
UK	United Kingdom

ABBREVIATIONS	DEFINITION
UKHO	United Kingdom Hydrographic Office
UNCLOS	United Nations Convention of the Law of the Sea
UNESCO	United Nations Educational, Scientific and Cultural Organization
USB	Universal Serial Bus
UXO	Unexploded Ordnance
WTG	Wind Turbine Generator
WSI	Written Scheme of Investigation
ZOI	Zones of Influence
ZTV	Zone of Theoretical Visibility

16.14 Glossary

TERM	DEFINITION
Multibeam Echosounder (MBES)	Multi-beam echosounder can also deliver high resolution side-scan like images. MBES forms multiple acoustic beams across track at reception using digital beamforming techniques
Side Scan Sonar (SSS)	Side scan sonar is used to create images of the seafloor. An acoustic beam is transmitted to either side of the side scan sonar survey track. As the acoustic beam travels outward from the side scan sonar, the seabed and other obstructions reflect portions of the sound energy back in the direction of the side scan sonar. The travel time and amplitude of these reflections are analysed to create the seafloor images. During post processing, the targets lateral dimensions, height and geographic coordinates can be calculated. The high-resolution images are capable of imaging objects as small as several inches in size.
Magnetometer	A magnetometer is a scientific instrument used to measure magnetic field strength. Under the sea, magnetometers detect variations in the total magnetic field of the underlying seafloor. Usually, the increased magnetization is caused by the presence of ferrous (unoxidized) iron on the seafloor, whether from a shipwrecked boat made of steel or a volcanic rock containing grains of magnetite, a highly magnetic mineral.