



LLYR

LLYR FLOATING OFFSHORE WIND PROJECT

Llŷr 1 Floating Offshore Wind Farm

Environmental Statement

**Volume 6: Appendix 24B – Archaeological review of marine
geophysical and landfall survey data**

August 2024

Prepared by: Llŷr Floating Wind Ltd



FLOVENTIS
ENERGY



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Marine geophysical survey data were collected for an earlier iteration of the Offshore Development Area. Consequently, there are currently significant gaps in the geophysical survey coverage for the revised route, which includes alterations to the proposed route of the offshore export cable corridor (OfECC) as it approaches Freshwater West. The report presented here focuses solely upon the original route of the proposed Project. Further surveys are required to assess the revised OfECC; it is anticipated that, in consultation with the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW), these will be undertaken post-consent. These will require archaeological assessment, following the methodologies outlined in this document.

This will result in a revised Archaeological assessment of marine geophysical and landfall survey data, which will be submitted to the RCAHMW for their review and comment. This assessment will then be incorporated into the project-specific marine archaeological written scheme of investigation, which will detail mitigation strategies for identified assets and anomalies. No installation works that disturb the seabed will be undertaken prior to the satisfactory completion of those assessments.



Summary

Coracle Archaeology was commissioned by Llŷr Floating Wind Limited to undertake marine archaeological environmental assessments, including this archaeological assessment of marine geophysical and landfall survey data, for the Llŷr Floating Offshore Wind Project. This is a test and demonstration wind farm development, located in Welsh waters in the Celtic Sea. The array area will include up to 10 floating wind turbine generators, with an operational life of 30 years. These will be located c. 33 km offshore, in water depths averaging 60-70 m; the Offshore Development Area reaches landfall at Freshwater West, on the Pembrokeshire Coast.

Marine geophysical surveys were conducted within the Offshore Development Area, encompassing both the Array Area and the Offshore Export Cable Corridor, by N-SEA. This included the collection of multibeam echosounder, sidescan sonar, magnetometer and sub-bottom profiler data. It should be noted that these surveys were conducted within an earlier iteration of the proposed OfECC, the nearshore parts of which are now redundant. Following this OfECC revision, additional geophysical surveys will be required which will undergo archaeological assessment. It is anticipated that this will be done post-consent.

The archaeological assessment of the supplied data has identified 29 geophysical anomalies with archaeological potential within the original Offshore Development Area. Of these five are considered to be of high archaeological potential, including four positively identified wreck sites, and 12 of medium. Archaeological exclusion zones have been proposed for each of the anomalies assessed as being of high or medium archaeological potential; these are areas in which all activities that disturb the seabed are prohibited. Twenty-five of the identified anomalies are located beyond the revised Offshore Development Area; where necessary, this is highlighted in the report.

Assessment of the available sub-bottom profiler data has revealed thick Quaternary deposits distributed across the Array Area and southern sectors of the Offshore Export Cable Corridor. These consist primarily of late glacial Devensian deposits. Closer to the shore, mobile sediments sit above the underlying geology. Many of these features are likely to consist of till clays, sands and gravels, with boulders also observed within some of the Array Area fills.

Non-intrusive surveys at the proposed landfall location at Freshwater West comprised geophysical, walkover and hand-held metal detector surveys. One linear anomaly was identified in both the geophysical and metal detector survey data; this is believed to be a relict Ministry of Defence listening cable and therefore has no archaeological significance. No new sites or features of archaeological potential were identified during the surveys at the landfall location.



Acronyms and abbreviations

Acronym / Abbreviation	Definition	Acronym / Abbreviation	Definition
AEZ	Archaeological exclusion zone	MW	Megawatt
CA	Coracle Archaeology	nm	Nautical miles
CIfA	Chartered Institute for Archaeologists	nT	nanoTesla
COARS	Coastal and offshore archaeological research services	NMRW	National Monument Record of Wales
DBA	Desk-based assessment	NPRN	National primary reference number
EM	Electro-magnetic	OfECC	Offshore Export Cable Corridor
EPSPG	European Petroleum Survey Group	OSL	Optically-stimulated luminescence
GIS	Geographic Information System	RCAHMMW	Royal Commission on the Ancient and Historical Monuments of Wales
Ft	Feet	ROV	Remotely operated vehicle
GPS	Global Positioning System	SBP	Sub-bottom profiler
grt	Gross registered tonnage	SSS	Sidescan sonar
HER	Historic Environment Record	UKHO	United Kingdom Hydrographic Office
Hz	Hertz	UHRS	Ultra high resolution seismic
LAT	Lowest astronomical tide	USBL	Ultra short baseline
LGM	Last glacial maximum	UTM	Universal Transverse Mercator
MHWS	Mean high water springs	VORF	Vertical offshore reference frames
MBES	Multibeam echosounder	WGS	World Geodetic System
MHWM	Mean high water mark	WSA	Wider study area
MoD	Ministry of Defence	WTG	Wind turbine generator
mS/m	milliSiemens / metre		



Glossary of project terms

Term	Definition
The Applicant	The developer of the Project, Llŷr Floating Wind Limited
Array	All wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the Array Area, as defined, when considered collectively, excluding the offshore export cable(s).
Array Area	The area within which the wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure will be located
Floventis Energy	A joint venture company between Cierco Ltd and SBM Offshore Ltd of which Llŷr Floating Wind Limited is a wholly owned subsidiary.
Landfall	The location where the offshore export cable(s) from the Array Area, as defined, are brought onshore and connected to the onshore export cables (as defined) via the transition joint bays (TJB).
Llŷr 1	The proposed Project, for which the Applicant is applying for Section 36 and Marine Licence consents. Including all offshore and onshore infrastructure and activities, and all project phases.
Marine Licence	A licence required under the Marine and Coastal Access Act 2009 for marine works which is administered by Natural Resources Wales (NRW) Marine Licensing Team (MLT) on behalf of the Welsh Ministers.
Offshore Development Area	The footprint of the offshore infrastructure and associated temporary works, comprised of the Array Area and the Offshore Export Cable Corridor, as defined, that forms the offshore boundary for the S36 Consent and Marine Licence application
Offshore Export Cable	The cable(s) that transmit electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OfECC)	The area within which the offshore export cable circuit(s) will be located, from the Array Area to the Landfall.
Onshore Development Area	The footprint of the onshore infrastructure and associated temporary works, comprised of the Onshore Export Cable Corridor and the Onshore Substation, as defined, and including new access routes and visibility splays, that forms the onshore boundary for the planning application.
Onshore Export Cable(s)	The cable(s) that transmit electricity from the landfall to the onshore substation
Onshore Export Cable Corridor (OnECC)	The area within which the onshore export cable circuit(s) will be located.
proposed Project	All aspects of the Llŷr 1 development
Onshore Substation	Located within the Onshore Development Area, converts high voltage generated electricity into low voltage electricity that can be used for the grid and domestic consumption.
Section 36 consent	Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works.



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24-B ARCHAEOLOGICAL REVIEW OF MARINE GEOPHYSICAL AND LANDFALL SURVEY DATA

24.1 Introduction

24.1.1. Outline

1. Coracle Archaeology (CA) was commissioned by Llŷr Floating Wind Limited in March 2023 to undertake marine archaeological environmental assessments, including landfall surveys and an archaeological review of marine geophysical survey data, for the Llŷr 1 Floating Offshore Wind Project (henceforth 'the proposed Project'). This consists of a test and demonstration offshore wind farm development, located in Welsh waters in the Celtic Sea. The Array Area will consist of up to ten floating wind turbine generators (WTGs) with an operational life of 30 years. This report includes an archaeological assessment of marine geophysical survey data collected within the Offshore Development Area, and landfall surveys conducted on the foreshore and intertidal zone at Freshwater West, Pembrokeshire. The proposed Project above mean high water springs (MHWS) is beyond the remit of this report.
2. Marine geophysical survey data was collected by N-SEA between September and December 2022 and assessed for Coracle Archaeology by our colleagues at Coastal and Offshore Archaeological Research Services (COARS), University of Southampton. The archaeological assessment of supplied data assessed the entire Array Area and a geophysical survey corridor, located within the original iteration of the Offshore Export Cable Corridor (OfECC; Figure 24B-1).
3. The results were then compared with the marine archaeological desk-based assessment (DBA; Coracle Archaeology 2023a), which highlighted known sites and heritage assets located within the Offshore Development Area. This includes both the Array Area and the OfECC. It also assessed a wider study area (WSA), extending a further 1 km around the Array Area and 500 m around the OfECC as it funnels towards the Pembrokeshire coast. Following OfECC revisions in January 2024, parts of the original surveyed area no longer form part of the consent application. Additional geophysical surveys will be undertaken along the nearshore section of the revised OfECC; these additional surveys will require marine archaeological assessment.
4. The landfall surveys assessed two potential offshore export cable landfall locations, one situated in the centre of the beach at Freshwater West (southern option) and the other located to the north, in the area known as Gravel Bay (northern option; Figure 24B-2). The latter has now been adopted as the preferred option. The southern survey area assessed an area 300 m wide (150 m either side of the proposed OfECC centreline), from mean high water into the intertidal zone. The northern survey area was constrained by the presence of rocks and cliff walls at its northern extent.
5. Landfall surveys included the collection of geophysical, metal detection and walkover survey datasets. All surveys were undertaken by Coracle Archaeology in May 2023; terrestrial geophysical survey data were processed and assessed by our colleagues at both Headland Archaeology and TigerGeo.

24.2 Aims and Objectives

6. The aims of these assessments are:
 - To identify anomalies and areas of archaeological potential within the Offshore Development Area, including at the landfall location; and
 - To assess the archaeological and palaeo-environmental potential of the sub-surface sediments.



7. These aims will be achieved through the following objectives:

- Detection of anomalies through the examination of multibeam echosounder (MBES) sidescan sonar (SSS) and magnetometer data to locate and characterise features with possible archaeological potential within the Offshore Development Area;
- Detection of sites and features of archaeological potential at the ofecc landfall through walkover survey and the assessment of electro-magnetic conductivity and metal detector survey data; and
- Assessment of sub-bottom profiler (SBP) and MBES data to establish the archaeological and / or palaeo-environmental potential of the sub-surface sediments.

Figure 24B-2 Landfall survey areas at Freshwater West



24.3 Geophysical Survey and Data Acquisition

24.3.1. Landfall Surveys

8. Landfall surveys were conducted in May 2023 at Freshwater West, Pembrokeshire. The surveys were conducted on the foreshore and intertidal zone, from MHWS to low water on the most favourable spring tides, thus ensuring as much continuity as possible with the marine geophysical survey datasets. These are tides just after a new or full moon, when the difference between high and low water is at its greatest.
9. The surveys were conducted at two potential offshore export cable landfall locations on the beach at Freshwater West, encompassing both a southern and a northern landfall option (**Figure 24B-2**); the latter has now been selected as the preferred option. A 300 m survey grid was established at the southern option, extending 150 m either side of the potential offshore export cable centreline. This was subsequently subdivided into 5m transects, using a Global Positioning System (GPS) with an accuracy of ≤ 0.5 m. The surveys, comprising electro-magnetic conductivity, hand-held metal detector and walkover surveys, were conducted along these transects, parallel to the retreating waterline. The northern survey area extended from 150m to the south of the proposed offshore export cable centreline; it was constrained by the presence of rocks and cliff walls at the northern extent (**Figure 24B-3**). The longest transect in the northern survey area was c. 250 m, the shortest c. 100 m. The majority of transects measured between c. 180 m and c. 200 m.



Figure 24B-3 Geophysical survey in progress at Freshwater West

10. The landfall geophysical survey was undertaken using a Geophex GEM-2 multi-frequency broadband electro-magnetic (EM) instrument to perform a terrain electrical conductivity survey (**Figure 24B-3**). The GEM-2 instrument is a non-intrusive frequency-domain electrical conductivity measuring device that records the spatial variations of apparent ground conductivity of the earth in units of milliSiemens / metre (mS / m). The 'siemen' is the international unit of measurement for volume electrical conductance and is the equivalent to an ampere / volt.
11. A Minelab X-Terra 705 instrument was used to conduct the metal detector surveys. The metal detector was set to detect all metal, with the sensitivity adjusted to compensate for the high



salt content of the beach sand. Any find locations identified during the walkover surveys were recorded using a hand-held GPS; features of archaeological potential were recorded with digital photography, using a Google Pixel 7 Pro.

24.3.2. *Marine geophysical survey*

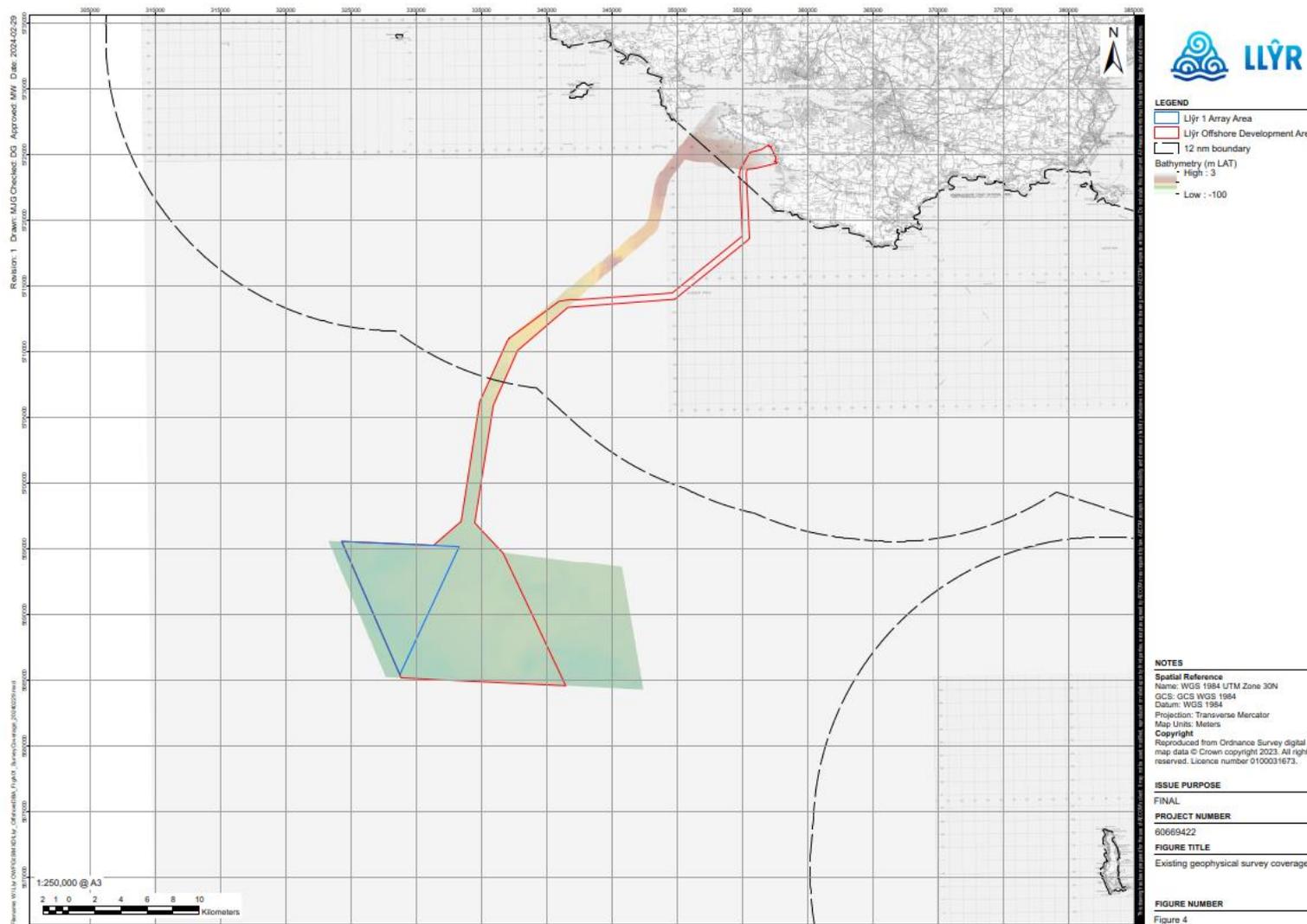
- 12.** Marine geophysical surveys were undertaken by N-SEA between September and December 2022, using the survey vessels *Braveheart Spirit* (offshore) and *Coastal Observer* (inshore, within the Milford Haven port limits). The surveys covered the entirety of the Array Area and a corridor within the previous iteration of the OfECC. This corridor varies in width from 900 m-2.1 km; no geophysical survey data was collected for a c. 6 km x 750 m stretch of the previous iteration of the Offshore Development Area, to the south of Freshwater West. As highlighted, additional geophysical survey is required for sections of the revised OfECC located beyond the original survey area (

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13. **Figure 24B-4).** Any additional marine geophysical surveys will require archaeological assessment, following the methodologies outlined in this report.
 14. Bathymetric data for the offshore survey area was acquired from the Braveheart Spirit using a Kongsberg EM2040-04, with backscatter data collected using an R2Sonic 2024. Sound velocity (SV) probes were used to perform regular sound velocity casts, with one cast every 24 hours. SSS was undertaken using a Klein MA-X VIEW 600, and SBP data was collected using an Edgetech 2050-DSS. Magnetometer survey was undertaken using a Geometrics G882 caesium vapour magnetometer. Positioning data was acquired using a Starpack Omnistar (XP2 PPP), with sub-sea positioning of towed sensors accomplished using the HiPAP 501 ultra-short baseline (USBL) system. The transducer was used in conjunction with a Kongsberg C-Node MiniS and Maxi.
 15. Bathymetry and backscatter were acquired within the Milford Haven port limits on the Coastal Observer using a Norbit B41 Winghead MBES. SSS data were acquired using an Edgetech 4125, and SBP data using a Geo-pulse 5430A. The magnetometer survey was undertaken using a Geometrics G882 caesium vapour magnetometer, with onboard positioning provided by an Applanix PosMV Wavemaster 2. Sub-sea positioning of towed sensors was accomplished using a Sonardyne Mini Ranger 2 USBL system, in conjunction with the Sonardyne WSM 6+ x2. Full details of survey specification and methodology can be found in N-Sea (2023).

24.4 Geodetic and Projection Parameters and Vertical Datum

16. Survey positions were recorded in the geodetic datum WGS84, with projection in the Universal Transverse Mercator (UTM) Zone 30 North. The vertical reference level is lowest astronomical tide (LAT), with MBES elevation corrected using vertical offshore frames (VORF). Predicted tides were extracted from Total Tide, a tidal prediction program issued by the United Kingdom Hydrographic Office (UKHO; N-Sea 2023).

Figure 24B-4 Marine geophysical survey coverage



24.5 Methodology

24.5.1. Landfall Survey Method

Geophysics

17. Electrical conductivity surveys were undertaken using a Geophex GEM-2 multi-frequency EM instrument. The GEM-2 detects differences in deposits, principally variations in thickness between deposits with different conductivities, which can produce spatial variations in conductivity readings. The system provides two measurements:
 - Quadrature (apparent conductivity); and
 - In-phase data (metallic response).
18. The GEM-2 can acquire data over multiple frequencies, which is equivalent to measuring the earth response from multiple depths (depending on the earth medium targeted). Five frequencies were utilised and subsequently analysed at Freshwater West (1525 Hertz (Hz), 2825 Hz, 5275 Hz, 9825 Hz and 18325 Hz).
19. The primary focus of the survey was to identify buried metal objects that might relate to heritage assets. In addition, variations in silting patterns in the foreshore area were successfully mapped where possible. These variations may occur in areas where timber structures have influenced the deposition of sediments and could therefore be used to identify the presence of wood, potentially indicative of wreck material or other wooden structures buried in the sand.
20. Similarly, as ground conductivity is influenced by soil moisture content, an electromagnetic conductivity survey can be used to differentiate between areas of solid sub-strata and sand. This enables some analysis of the former physical topography of the survey area, by identifying former channels or basins in the sub-strata. Identification of these features might help to define areas of archaeological potential in the survey area.
21. The data were digitally recorded and periodically downloaded to a field computer for quality assurance and preliminary interpretation. At the conclusion of the survey the Geophex GEM-2 data were interpreted and mapped using Terrasurveyor V3.0.32.4 software, a surface mapping software that enables topographic data to be contoured and presented in a manner that enables the interpretation of sub-surface features.
22. The illustrations of the landfall geophysical survey data in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different frequencies. The landfall geophysical survey and report were completed in accordance with relevant best practice guidance documents (Gaffney *et al.* 2002; David *et al.* 2008; Bonsall *et al.* 2014; Schmidt *et al.* 2015).

Metal-Detector and Walkover Surveys

23. The purpose of metal-detector and walkover surveys is to identify known and potential sites and features of archaeological interest at the potential landfall locations that may be impacted by the proposed Project. Any significant impacts will then be limited through the adoption of appropriate mitigation measures. Archaeological potential is evaluated through the assessment of the nature and density of known sites in the vicinity of the proposed Project.
24. All identified features and detected find spots were recorded photographically with a brief description, if required. Numeric values displayed on the metal-detector were also recorded; these have the potential to identify the type of metal detected, with higher values more likely to be indicative of non-ferrous metals (Minelab 2017:11). Locations were recorded using a hand-held GPS and plotted into ArcGIS. As the surveys were non-intrusive, no find spots were



excavated.

24.5.2. Marine Geophysical Assessment Method

25. Geophysical assessment was undertaken utilising the programmes Coda Octopus Survey Engine 4.3 and ArcGIS 10.8. SSS and SBP data were analysed using the former, with the positions of surface and sub-surface anomalies exported in shapefiles and uploaded into ArcGIS alongside processed magnetometer data collected during the marine geophysical survey campaign, following the guidelines of Plets *et al.* (2013). MBES data were provided at a gridded resolution of 0.25 m. This was supplemented by additional bathymetry data from the UKHO Civil Hydrography Programme (survey HI328), which was used to assess both the survey area and areas immediately adjacent. These data were collected in 2011 and gridded at 2-4 m resolution.
26. The assessed data exceeded minimum requirements, with SSS data meeting 200 percent coverage across the entire survey area and the bathymetry survey exceeding International Hydrographic Organisation (IHO) Special Order 1 specifications (processed to a 0.25 m resolution; Plets *et al.* 2013). The data were therefore of sufficient quality to permit detailed archaeological assessment of geophysical anomalies identified within the survey area.
27. The geophysical datasets were assessed for anomalies with archaeological potential, with selection based on the presence of multiple lines of evidence (confirming datasets). Anomalies were defined based on their potential to be of archaeological interest, and have been classified using the following criteria:
 - **High potential** - typically identified by multiple geophysical datasets and can be positively identified as being an archaeological site (e.g. Wreck) or of archaeological interest;
 - **Medium potential** - typically identified by multiple geophysical datasets, and strongly suggestive of the presence of anthropogenic feature(s) which may be of archaeological interest, but cannot be classified or identified visually (e.g. Cannot be positively identified as a wreck);
 - **Low potential** - usually identified by a single geophysical dataset (typically magnetics and / or sss) that suggest a possible anthropogenic feature that may have archaeological significance and that differs in character from those identified as having no potential; or
 - **No potential** - geological features such as boulders or known (and often mapped) anthropogenic features such as cables, anchorages etc.
28. Any known and located historic assets and geophysical anomalies identified as being of high or medium archaeological potential within the survey area will be protected through the imposition of an archaeological exclusion zone (AEZ) around each asset that may be impacted by the proposed Project. These are areas imposed for the in-situ protection of cultural heritage assets, in which any works that disturb the seabed are strictly prohibited. It is nevertheless possible to work over them, or sail through them.
29. The suggested extent of each AEZ is the radius of a circle centred on the given location and based on the available geophysical data for each anomaly, including the lateral distribution of visible features, extent and direction of scour, and the likelihood for debris to have spread away from the site (the debris field). They have been designed to encompass all debris / structure visible on the seabed, with an added dimension to protect adequately both potentially buried remains and the potential for mobile debris associated with the direction (and extent) of the scour.
30. AEZs have been defined following professional recommendations (Dix 2008) and have been



converted into circular AEZs with a defined centre point to encapsulate the required exclusion zone. The extent of the suggested circular AEZ is therefore sufficiently large to encompass the area that would be defined by a polygon, following the procedures outlined in Dix (2008).

31. The use of a centre point and set radius has been deemed the most robust method when attempting to incorporate AEZs into different vessel navigation systems. This reduces the risk of accidental incursions into AEZs during site works, and possible impacts on the potential asset within. In accordance with clauses 5.1.1 and 5.2.1 of the Model Clauses (which advocates preservation in situ with the aid of AEZs; The Crown Estate & Wessex Archaeology 2021), the extent of the AEZ is based not only on the perceived archaeological potential of the asset, but also on its extent, if known.

24.6 Results

24.6.1. *Metal-Detecting and Walkover Surveys*

32. Freshwater West is a long, low, flat, predominantly sandy beach. It is enclosed at its northern and southern extents by low cliffs and rock outcrops, with a low bank of shingles and pebbles located around the mean high water mark in the east (**Figure 24B-5—Figure 24B-6**). The latter gives way to a complex, relatively high dune sequence. The beach is publicly accessible from car parks located beyond the dunes to the north and south. It is noteworthy that the beach has been used as a location for numerous film shoots, most recently as the location of Dobby the Elf's shell house in Harry Potter and the Deathly Hallows Part I. The location has become a site of pilgrimage for fans of the Harry Potter franchise, with a cairn 'marking' Dobby's 'grave' erected at the southern end of the beach. The site was entered into the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) National Monuments Records of Wales (NMRW) in 2022 (National Primary Reference Number [NPRN] 704008). The cairn is located beyond the survey area, and the WSA.



Figure 24B-5 The beach at Freshwater West, looking south



Figure 24B-6 Shingle bank around the mean high water mark, looking south

33. Cultural heritage assets identified in the DBA were given a unique Coracle Archaeology (CA) number for ease of reference (see Coracle Archaeology 2023a). Several assets are recorded in the DBA for the survey areas on Freshwater West (Figure 24B-7), including one wreck site (CA2) and an exposure of peat indicative of a submerged forest (CA9). The Willemoes of Thuro (CA2) was a wooden schooner of 186 gross registered tonnage (grt), built at Svenburg in 1911 (NPRN 273193). The vessel ran ashore at Freshwater West in December 1924 while on passage from Caernarfon to Erquy, with the loss of one life. It is routinely exposed by winter storms and was previously known as the ‘upside-down wreck’ (NPRN 420445).
34. During the storms of December 2013 / 2014, 15.5 m x 3.4 m of the vessel was exposed, including a length of keel, outer planking fastened with iron pins and both main and filling frames (Figure 24B-8). An additional piece of timber and concretions were reported c. 20 m to the south of the wreck. The wreck is located within the survey area of the southern landfall option, though no remains of the wreck were visible on the surface at the time of the survey in May 2023, presumably as a result of elevated levels of mobile beach sand. An AEZ of 50 m has nevertheless been assigned (Table 24B-1).

Table 24B-1 Archaeological exclusion zones at Freshwater West

CA number	Easting UTM 30N	Northing UTM 30N	Description	Archaeological potential	Proposed AEZ radius
2	357165	5725301	Willemoes of Thuro	High	50 m

Figure 24B-7 Cultural heritage assets located within the landfall survey areas





Figure 24B-8 The Willemoes of Thuro (or 'upside-down wreck') when it was exposed during the storms of February 2014 (www.pemcoastphotos.com/_photo_12563415.html)

35. One cultural heritage asset is also recorded at Gravel Bay, within the survey area of the northern landfall option. In March 2020, an area of submerged forest was identified (**CA9**), consisting of an undulating peat surface with abundant pools and occasional tree remains (**Figure 24B-9**), extending over an area of c. 100 x 30 m and centred on SN 8806 0047 (WGS84 UTM 30N 357116 5725573). These peats are not recorded in the NMRW or Historic Environment Record (HER) datasets (see Coracle Archaeology 2023a).



Figure 24B-9 Gravel Bay peats, exposed in March 2020 (picture from brian-mountainman.blogspot)

36. Leach (1913) recorded small sharp flakes and chips from the sandy downwash on the side of Gravel Bay in the early 20th century; these were mapped by Wainwright (1963) alongside a



series of lithic scatters located along the cliff line. Leach also reports flint flakes and implements, indistinguishable from those found at the 'clipping floor' sites, obtained near shell-heaps and shell-strewn spaces, although the location of these sites is unclear (see Coracle Archaeology 2023a). No trace of these deposits were visible at the time of the survey, and no lithic artefacts were noted.

37. One maritime named location is recorded within the southern survey area at Freshwater West (**CA17**; Error! Reference source not found.). These locations serve to highlight the archaeological potential of an area, based on the number of reported maritime losses recorded in the vicinity. These losses have been assigned a spatial coordinate temporarily by the RCAHMW, which represents the centre of the generalised area in which the loss was recorded, pending additional information becoming available. The location should not therefore be seen as indicative of the presence or absence of physical remains. In total, 14 wrecks and one aircraft are recorded at this location (**CA18-33**; Coracle Archaeology 2023a); no trace of these wrecks was visible in the survey data, and they will not be considered further here.
38. Four other findspots are recorded on the beach at Freshwater West, including flint flakes (**CA41**), a red deer metapodial (**CA42**) an arrowhead and chert pebble (**CA43**) and an early medieval leaden tablet (**CA44**). No similar finds were recorded during the surveys, and no new archaeological sites or features with archaeological potential were noted.
39. The relatively low number of metal-detections in both survey areas on the beach may be indicative of both its frequent use by the public and the presence of teams of volunteer beachcombers, committed to keeping the beach clean. In addition, the wide exposed nature of the beach means that metallic objects are perhaps more likely to be swept offshore and redeposited. Readings do, however, become denser in both survey areas towards the mean high water mark (**Figure 24B-9**). These areas are associated with the start of the low pebble and shingle bank, and may be indicative of casual losses, driven ashore by the tide.
40. A linear feature may be visible in the southern survey area c. 35 m from the proposed export cable landfall, though the readings are too sparse (c. 20 m apart) to discount the possibility that the alignment is little more than coincidence (**Figure 24B-10**). Of more certainty is the presence of a linear feature in the northern survey area; this is likely to represent the line of a cable, tentatively identified as a relict Ministry of Defence (MoD) listening cable (see below).
41. Two substantial metallic objects were also recorded in the walkover and metal-detector surveys, both found amongst the rocks at Gravel Bay in the northern survey area. One of these (**Figure 24B-11**) may be the disarmed remains of a Second World War mine or bomb. The other (**Figure 24B-12**) would appear to be a boat mooring, a common beach find. Neither are considered to be in situ, and neither are considered to be of archaeological significance.

Figure 24B-10 Results of the metal detector survey at Freshwater West





Figure 24B-11 An unidentified dummy / decoy mine



Figure 24B-12 A boat mooring on the beach

24.6.2. Landfall Geophysics

42. Both the northern and southern survey areas showed similar patterns of conductivity and magnetic susceptibility (Figure 24B-13 to Figure 24B-17). Lower conductivity readings were recorded towards MHWS at the eastern extent of both survey areas, indicative of the drier sand components of the beach and shingle deposits. Conductivity readings generally increase in intensity westwards towards mean low water, with waterlogged beach deposits visible in the higher conductivity readings of the northern survey area. It is possible that the edge of the higher readings of conductivity and magnetic susceptibility visible in this area relate to the submerged forest deposits previously recorded at Gravel Bay (CA9), though this cannot be confirmed from the geophysical data alone. In the southern survey area, the sand is not magnetically uniform at depth, with lobe-shaped quadrature variations. This too may be indicative of the presence of submerged forest deposits beneath the mobile beach sands.
43. A linear anomaly running approximately south-west / north-east is also visible in the northern survey area (Figure 24B-13 to Figure 24B-17) it is noteworthy that this was also recorded in geophysical surveys undertaken for the Greenlink Interconnector Cable (see Cotswold Archaeology 2019), where it was identified as a relict MoD listening cable.
44. Towards the southern end of the surveyed area, trends or channels of alternating high / low conductivity and magnetic susceptibility were recorded running south-west / north-east. These are likely to be geological in origin, though an archaeological origin cannot be discounted entirely. No areas of high conductivity or magnetic susceptibility anomalies were identified in proximity to the recorded location of the Willemoes of Thuro (CA2).

24.6.3. Marine

45. Marine geophysical survey data was supplied and assessed for the entire Array Area and for the majority of the Offshore Development Area as it funnels towards the Pembrokeshire Coast. Survey within the OfECC was restricted to a 900 m-2.1 km survey corridor; no



46. geophysical survey data was collected for a c. 6 km x 750 m stretch of the OfECC, to the south of Freshwater West.
47. This report assesses the previous iteration of the Offshore Development Area; OfECC revisions undertaken in January 2024 have altered the nearshore sections of the Offshore Development Area as it approaches Freshwater West. At the time of writing, no survey data is available for this part of the revised OfECC (**Volume 5: Figure 24B-4**). Archaeological assessment of additional geophysical survey data will be required to ensure the archaeological potential of the entirety of the Offshore Development Area has been fully assessed.

Figure 24B-13 Results of the geophysical survey at Freshwater West: inphase at 1525 Hz

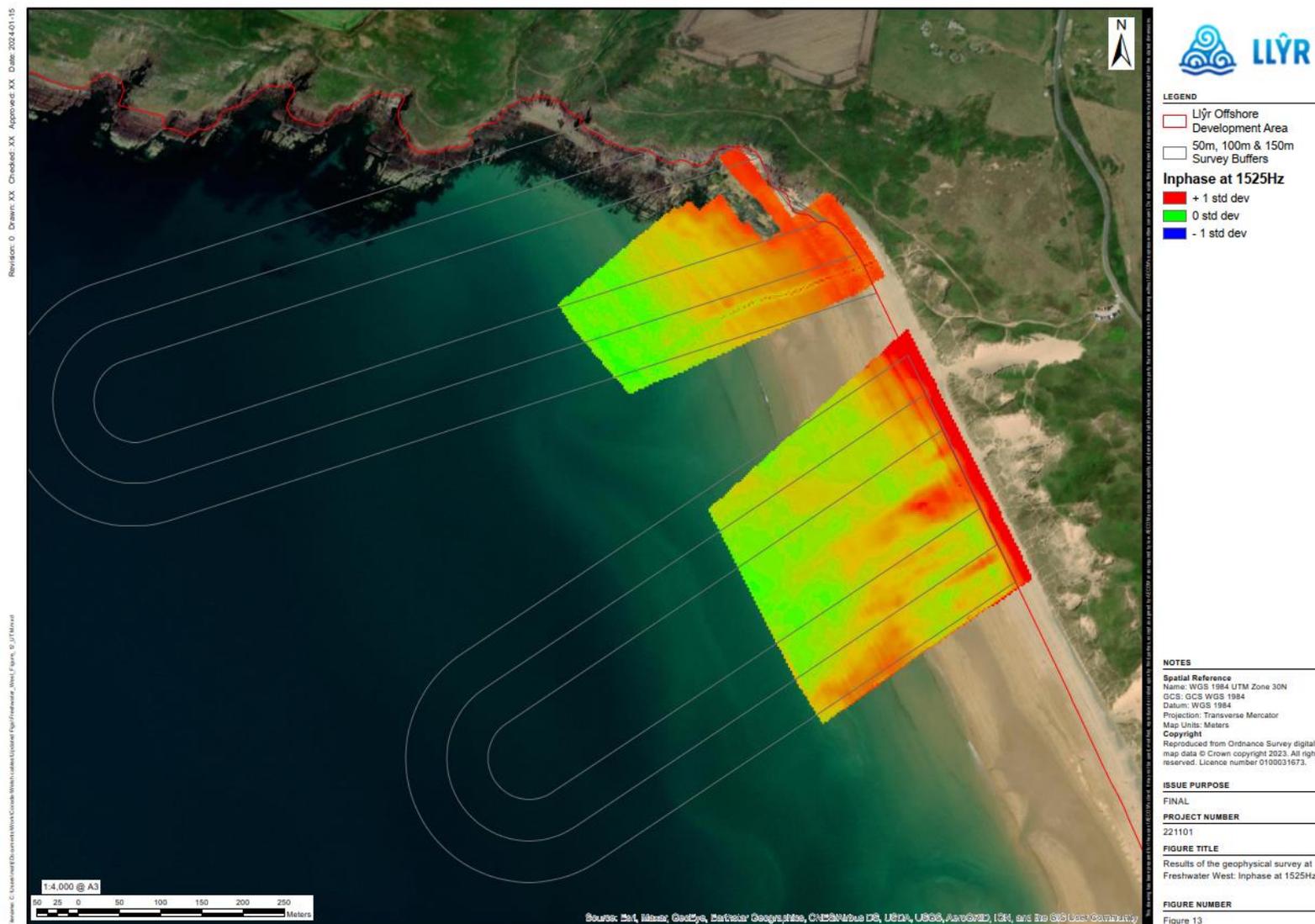




Figure 24B-14 Results of the geophysical survey at Freshwater West: inphase at 9825 Hz

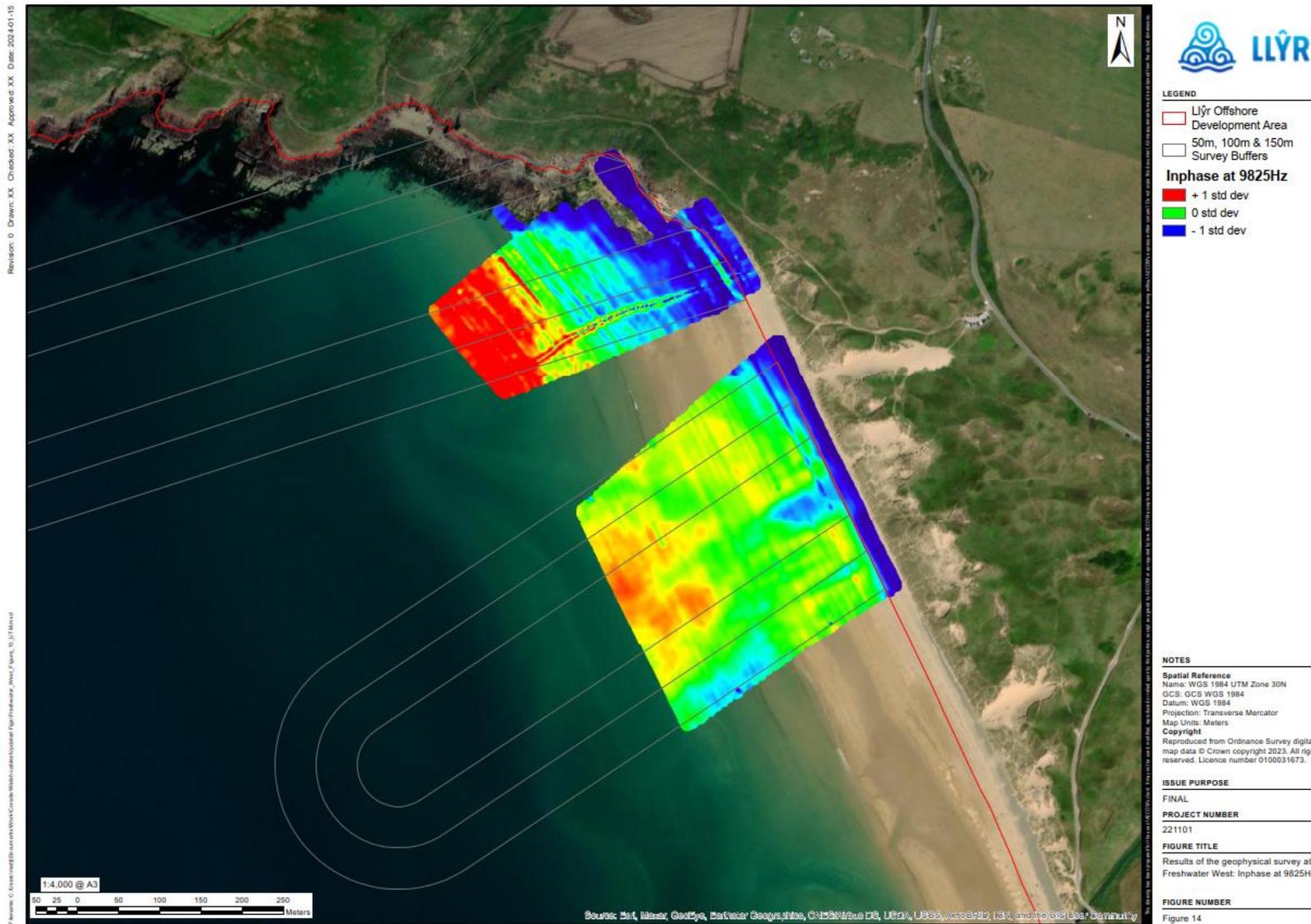




Figure 24B-15 Results of the geophysical survey at Freshwater West: quadrature at 2825 Hz

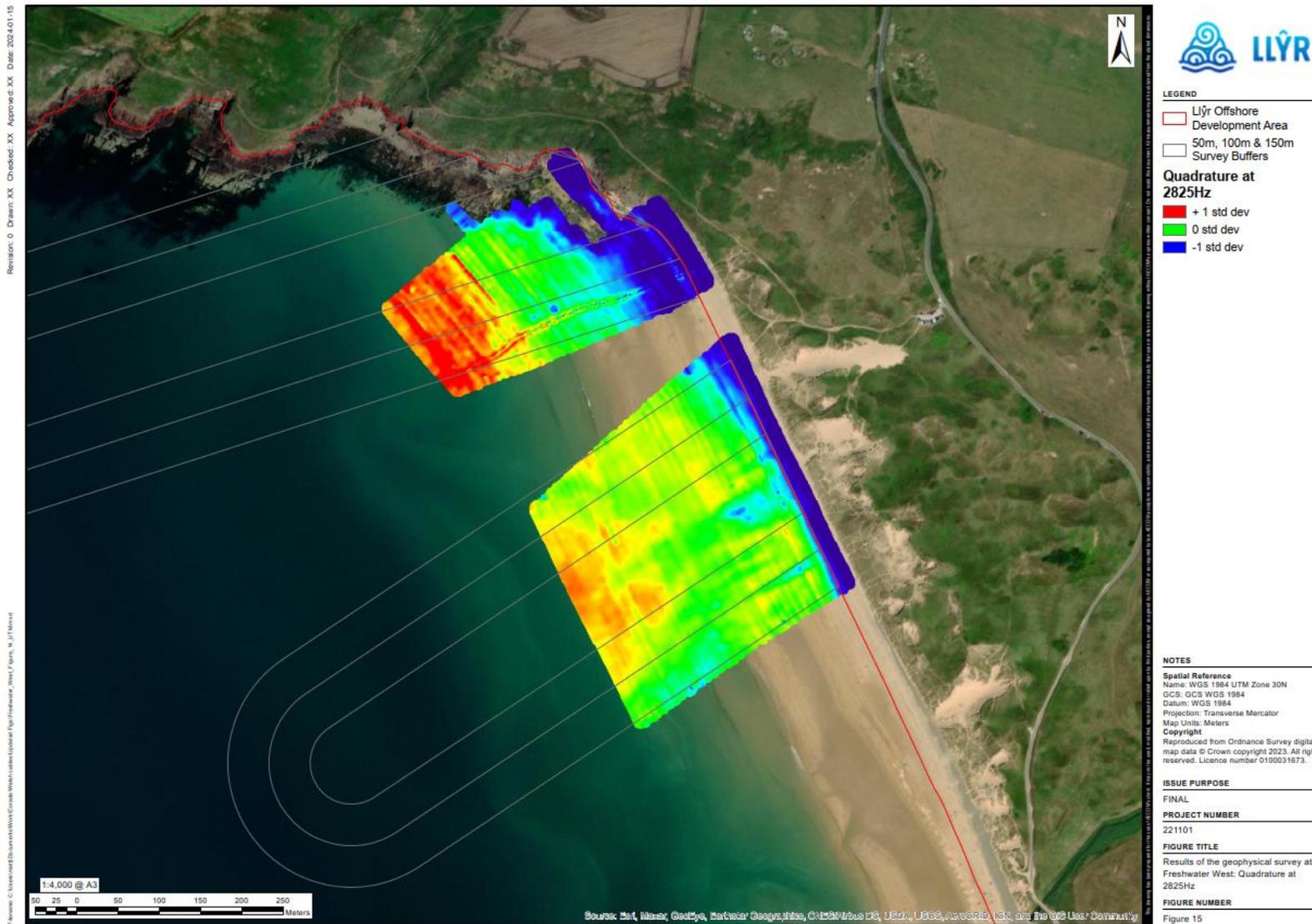
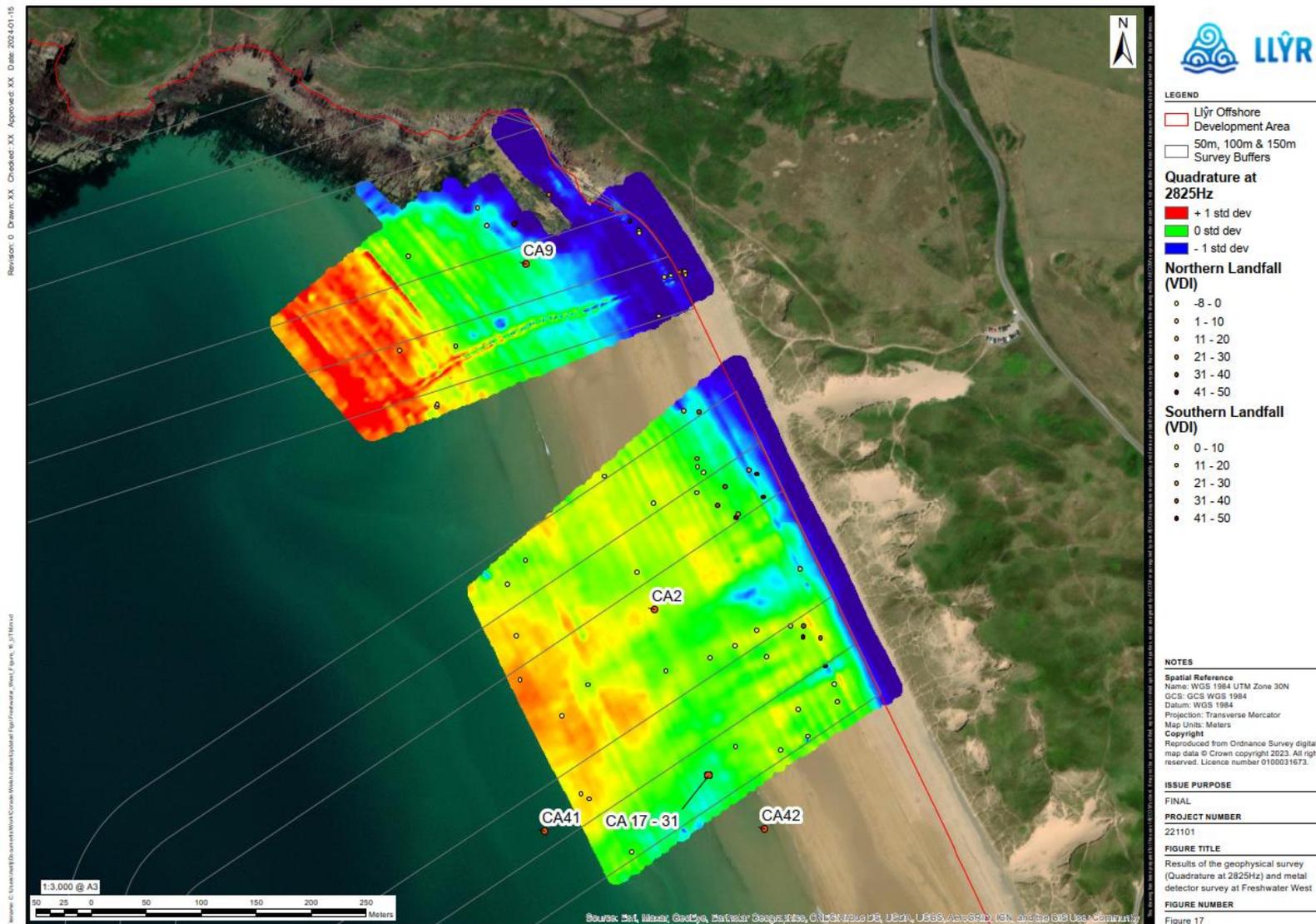


Figure 24B-17 Results of the geophysical survey (quadrature at 2825 Hz) and metal detector survey at Freshwater West



48. Archaeological assessment of additional geophysical survey data will be required to ensure the archaeological potential of the entirety of the Offshore Development Area has been fully assessed.
49. Twenty-nine geophysical anomalies with archaeological potential were identified within the collected marine geophysical survey data (**Table 24B-2**); **Volume 5**: Error! Reference source not found.). Of these, five are considered of high and 12 of medium archaeological potential. The remaining 12 are considered of low archaeological potential. Four of the anomalies of high archaeological potential correspond to live wrecks recorded in the DBA (Coracle Archaeology 2023a). AEZs have been proposed around all anomalies considered of high or medium archaeological potential. The distribution of geophysical anomalies is shown in— **Volume 5**: Error! Reference source not found.; anomalies with high or medium archaeological potential, and associated AEZs, are shown in **Volume 5**: Error! Reference source not found. to Error! Reference source not found.. It should be noted that only four of these anomalies are located within the boundaries of the revised Offshore Development Area (**CA1025-6**; **CA1028-9**). The remaining 25 anomalies are located within previous iterations of the OfECC and are unlikely to be impacted by the proposed Project. Where necessary, this is highlighted below.
50. Other geophysical anomalies identified in the survey data include small (<2 m) boulders in areas where bedrock was not exposed on the surface, often with associated scour. These anomalies did not have an associated magnetic signal and are therefore considered to be natural in origin. Several cables were also identified within the survey, including those making landfall at Freshwater West. These are not considered in this archaeological assessment.

Table 24B-2 Marine geophysical anomalies with archaeological potential

CA no.	Easting UTM 30N	Northing UTM 30N	Description*	Archaeological potential	Proposed AEZ radius
1001	351371	5726305	Magnetic anomaly M-2387-ECR_N_UB-UB (150 nT)	Low	n/a
1002	351624	5726068	SSS anomaly S-ECR_N_UB-0130-UB, 7x0.3 m, associated with magnetic anomaly M-2554-ECR_N_UB-UB (69 nT). No associated bathymetric feature	Medium	20
1003	351308	5726074	SSS anomaly S-ECR_N_UB-0132-UB, 2.5x2.2 m, associated with bathymetric depression, 9x7x0.5 m, with central upstanding feature, 3.4x2.6x0.7 m.	Medium	20
1004	350841	5725869	Upstanding SSS anomaly, measuring 8.8x5.5 m, associated with a prominent upstanding bathymetric feature, 8.1x4.5x0.7 m, with scour to the west, extending up to 15 m. Associated with three magnetic anomalies, M-1172-ECR_N_UB-UB (77 nT), M-2586-ECR_N_UB-UB (7138 nT) and M-2653-ECR_N_UB-UB (2991 nT), suggesting the presence of a large ferrous object	High	25
1005	353629	5725735	Magnetic anomaly M-2289-ECR_X-BSP (51 nT)	Low	n/a
1006	352855	5725759	SSS anomaly S-ECR_X-0197-BSP, 2.8x1.8 m, associated with a raised feature in the bathymetry, 2.8x2.0x1.0 m, associated with magnetic anomaly M-2288-ECR_X-BSP (18 nT)	Medium	20
1007	351145	5725767	SSS anomaly S-ECR_N_UB-0215-UB, 1.9x1.5 m, associated with bathymetric depression,	Medium	30



CA no.	Easting UTM 30N	Northing UTM 30N	Description*	Archaeological potential	Proposed AEZ radius
			7x5x0.3 m, with magnetic anomaly M-2264-ECR_N_UB-UB (191 nT) located on a survey line 28 m SW		
1008	350773	5725781	Magnetic anomaly M-2588-ECR_N_UB-UB (275 nT), located within an area with slightly roughened seabed and probable boulders	Low	n/a
1009	350541	5725760	Magnetic anomaly M-2614-ECR_N_UB-UB (305 nT), within an area of featureless seabed	Low	n/a
1010	356543	5725560	Two angular SSS dark reflectors, c. 1.2 m diameter, within an area with localised pockmarks, associated with magnetic anomaly M-2198-ECR_X-BSP (412 nT).	Medium	20
1011	354019	5725512	Clearly visible collapsed wreck on the seabed, aligned west-east (SSS Anomaly S-ECR_X-0285-BSP). Visible wreckage covers an area c. 80 x 46 m, with hull visible in the centre of the site with ribs spread out north and south from the mid-ship alignment of the wreck. Area of slightly elevated wreckage to the eastern end, possibly the bow. The wreck is associated with magnetic anomaly M-2320-ECR_X-BSP (7365 nT). A series of cables and associated small anomalies are seen extending eastwards from the wreck, up to 82 m, associated with SSS anomalies S-ECR_X-0286-BSP and S-ECR_X-0290-BSP, which may be associated with lost fishing gear. The wreckage appears to extend under the seabed, so is partially buried around its margins.	High	100
1012	351129	5725439	SSS anomalies S-ECR_N_UB-0312-UB and S-ECR_N_UB-0317-UB, possibly debris or fishing gear, spread over an area of c. 20x10 m, and associated with magnetic anomaly M-1089-ECR_N_UB-UB (56 nT)	Medium	20
1013	350842	5725491	SSS and bathymetric anomaly, 9.0x6.8x0.2 m, associated with magnetic anomalies M-1090-ECR_N_UB-UB (32 nT) and M-2082-ECR_N_UB-UB (240 nT)	Medium	20
1014	350414	5725460	Magnetic anomaly M-1171-ECR_N_BSP-BSP (439 nT). No visible features on the seabed	Low	n/a
1015	353348	5725264	Magnetic anomaly M-2122-ECR_X-BSP (4719 nT). No visible features on the seabed	Low	n/a
1016	353589	5725233	Clearly visible wreck, aligned NE-SW, associated with SSS anomaly S-ECR_X-0330-BSP. Bow of the ship appears to be at the NE, though the bow and stern show signs of damage, specially the stern at the SW end of the wreck. Wreck is c. 52 m long, 10 m wide and up to 2.5 m above the surrounding seabed. The main superstructure appears to be aft of	High	70



CA no.	Easting UTM 30N	Northing UTM 30N	Description*	Archaeological potential	Proposed AEZ radius
			mid-ships. There is no scour associated with the wreck, though there is some buildup of sediment along the hull margins at the NE end of the vessel. The wreck is associated with magnetic anomaly M-2142-ECR_X-BSP (3347 nT).		
1017	350630	5725213	SSS anomalies S-ECR_N-0016-BSP and S-ECR_N-0017-BSP, measuring 10.1x0.7x0.2 m and 1.2x1.2x0.2 m respectively, both clearly visible within the bathymetry. While the latter might be a boulder, the former is distinctive suggesting probable anthropogenic material. 20 m WNW is a magnetic anomaly, M-1183-ECR_N_BSP-BSP (30 nT)	Medium	30
1018	350590	5725133	Magnetic anomaly M-2021-ECR_N_BSP-BSP (247 nT)	Low	n/a
1019	350856	5725052	Magnetic anomaly M-1184-ECR_N_BSP-BSP (577 nT), associated with a bathymetric anomaly, in two sections, measuring c. 3.0x1.0x0.25 m each	Medium	25
1020	351233	5725011	SSS anomaly S-ECR_X-0778-BSP, 8.1x3.2 m, associated with a mound on the seabed measuring 10.9x6.1x0.5 m	Low	n/a
1021	350647	5724651	SSS anomaly S-ECR_X-0046-BSP, measuring 3.5x1.4x0.2 m, associated with magnetic anomaly M-2050-ECR_X-BSP (93 nT)	Medium	25
1022	351215	5724718	Clearly visible wreck, SSS anomaly S-ECR_X-0204-BSP, with the keel orientated SW-NE. Measures 25.6x8.2x2.5 m, seemingly intact. Large open hold area, 14x5 m, visible. Associated with magnetic anomaly M-2018-ECR_X-BSP (208 nT) on survey line 12 m south of wreck. Some scour along the southern edge, with buildup of sediment to the west and north.	High	50
1023	349466	5724114	Magnetic anomaly M-1031-ECR_N_BSP-BSP (118 nT) associated with a bathymetric depression, 3.5x3.0x0.2 m	Low	n/a
1024	346387	5717668	Magnetic anomaly M-1130-ECR_M-BSP (580 nT)	Low	n/a
1025	334581	5701370	Clearly visible wreck, aligned N-S, associated with SSS anomalies S-ECR_S-0224-BSP, S-ECR_S-0225-BSP, S-ECR_S-0227-BSP and S-ECR_S-0429-BSP, with bow pointing south. Wreck appears largely intact, measuring 38x9x3.5 m, with hull and superstructure appearing to be intact. Scour is present at the stern and bow, with some W-E scour also evident. Associated with magnetic anomaly M-1049-ECR_S-BSP (279 nT)	High	75



CA no.	Easting UTM 30N	Northing UTM 30N	Description*	Archaeological potential	Proposed AEZ radius
1026	333161	5696796	SSS anomalies S-OWF-0002-BSP, S-OWF-0003-BSP, S-OWF-0004-BSP and S-OWF-0005-BSP, a group of anomalies up to 1.5 m, within an area of scour between bedforms, measuring 15x14x0.3 m	Medium	30
1027	324310	5694265	SSS anomaly S-OWF_B-0922-BSP, 3x0.5 m, located within an area of scour within the bathymetry, 27x17x0.5 m, associated with magnetic anomaly M-0147-OWF_B-BSP (11.5 nT)	Low	n/a
1028	329667	5692267	Magnetic anomaly M-0233-OWF_C-BSP (126 nT), in close proximity to a series of small probable boulders	Low	n/a
1029	340382	5685354	Magnetic anomalies M-0019-OWF_G-BSP (255 nT) and M-0258-OWF_G-BSP (21nT)	Medium	40
1001	351371	5726305	Magnetic anomaly M-2387-ECR_N_UB-UB (150 nT)	Low	n/a
Greyed cells indicate that the anomaly is located outside of the revised Offshore Development Area					

* Anomaly IDs (e.g. anomaly M-2387-ECR_N_UB-UB) are taken from N-Sea (2023)

51. The marine archaeological DBA (Coracle Archaeology 2023a) recorded a total of 45 cultural heritage assets within the Offshore Development Area, including 26 wrecks, two aircraft, two obstructions, one maritime named location, one seascape, four findspots, five sites, two monuments and two features; where necessary, these are defined in the DBA. The majority of the wrecks (**CA13-34**) are reports of losses in the general area, and should not be considered indicative of the physical location of wreck remains; these include the fourteen wrecks and one aircraft recorded at the maritime named location on the beach at Freshwater West. No anomalies of archaeological potential corresponding to any of these reported losses were visible in the marine geophysical survey data, and therefore they will not be considered further.
52. Five anomalies are considered of high archaeological potential. A SSS anomaly measuring c. 8.8 x 5.5m (**CA1004; Volume 5: Error! Reference source not found.**) is associated with a prominent upstanding feature, visible in the bathymetric data and measuring c. 8.1 x 4.5 x 0.7 m. Scour is also present on the seabed at this location, extending c. 15 m to the west. Three magnetic anomalies are located in close proximity to these features, measuring 77 nanoTesla (nT), 7138 nT and 2991 nT respectively. This would appear to suggest the presence of a large ferrous object on the seabed. This anomaly has been assigned an AEZ of 25 m, designed to encompass all features visible in the geophysical datasets. This anomaly is located beyond the revised Offshore Development Area and is unlikely to be impacted by the proposed Project.
53. A collapsed wreck (**CA1011; Volume 5: Error! Reference source not found.**) is clearly visible on the seabed in the MBES, SSS and magnetic datasets (7365 nT). The wreck is aligned west-east, with visible wreckage covering an area of c. 80 x 46 m. The hull is visible in the centre of the site, with collapsed ribs splayed north and south from the hull’s centre line. An area of slightly elevated wreckage towards the eastern extent of the wreck site may be indicative of the bow. A series of cables and associated small anomalies extend eastwards from the wreck for c. 82 m; it is possible that these represent fishing gear subsequently snagged on the wreckage. The



- wreck is partially buried around its margins; its lateral extent cannot therefore be determined.
54. The location of this wreck corresponds with the position recorded in the DBA for the Highland Home (**CA1**) a British iron-hulled barque of 1371 grt, built in Leith in 1886 (Coracle Archaeology 2023a; **Figure 24B-10**). On 10th November 1895, the Highland Home became separated from the steam tug Warrior while under tow, with the loss of 20 lives (wrecksite.eu). Artefacts from the wreck, including the ship's bell, have been recovered from a location c. 3 km to the south-east of the recorded position of the wreck (see Coracle Archaeology 2023a); the wreck site corresponds to the location of the wreck recorded in both the UKHO and RCAHMW datasets. An AEZ of 100 m has been assigned to the wreck site. This anomaly is located beyond the revised Offshore Development Area and is unlikely to be impacted by the proposed Project.
55. Another wreck site is visible in the SSS and bathymetric datasets, with an associated magnetic anomaly measuring 3347 nT. (**CA1016; Volume 5: Error! Reference source not found.**). The wreck is aligned NE-SW and measures c. 52 x 10 x 2.5 m, with the bow at the north-eastern end and the main superstructure seemingly located aft of mid-ships. Both the bow and stern show signs of damage, with damage to the stern especially significant. No scour is associated with the wreckage, though some build-up of sediment is visible along the hull margins at the NE of the vessel. The wreck site corresponds with the recorded location of LCG-15 (CA3; Coracle Archaeology 2023a).
56. The LCG-15 (**CA3**) was a British Navy landing craft of 627 grt, built in 1940 in Belfast for the invasion of Sicily (UKHO 11985; NPRN 273231; Coracle Archaeology 2023a; **Figure 24B-10**). The vessel was wrecked in bad weather on 25th April 1943 while travelling to Falmouth with LCG-16. Both vessels attempted to seek shelter at Milford Haven but were swamped by heavy seas. The first to founder was LCG-15 with the loss of all 39 crew, along with six crew from the lifeboat attempting a rescue. LCG-16 was also lost, though it is located beyond the Offshore Development Area and therefore beyond the survey area. Bodies from both vessels were reported to have been washed ashore at Freshwater West. Two plaques bearing the names of the lost service personnel were unveiled at a ceremony at Freshwater West on 25 April 2013 to mark the 70th anniversary of the tragedy. The wreck site is classified as a war grave; and an AEZ of 70 m has been assigned. This anomaly is located beyond the revised Offshore Development Area and is unlikely to be impacted by the proposed Project.
57. The wreck of the SS Antonio (**CA4**) is also reported to lie within the Offshore Development Area (NPRN 273252; Coracle Archaeology 2023a). The SS Antonio was a British cargo ship of 5257 grt, built in Sunderland in 1918 under the First World War (WWI) emergency shipbuilding programme. On 28th March 1945, the Antonio collided with SS Fort Moose approximately 8km off St Anne's Head while en route from Cardiff to Gibraltar with a cargo of coal. The wreck is considered by the UKHO to be live, but well dispersed, with wreckage covering an area of c. area of 110 x 95 m (NPRN 273252; wrecksite.eu). No geophysical survey data was collected for the area in which the wreck is reported to be located, and no further assessments can be made.
58. The wreckage of another vessel is visible in the SSS and MBES datasets (**CA1022; Volume 5: Error! Reference source not found.**), with an associated magnetic anomaly measuring 208 nT. The wreck sits upright on the seabed and measures c. 25.6 x 8.2 x 2.5 m. The hull appears to be largely intact, with scour visible along the southern edge of the hull and a build-up of sediment to both the north and west. The wreck is clearly identifiable as a barge, with a large open hold area measuring c. 14 x 5 m. The location coincides with CA5, tentatively identified in the DBA as a single hold barge (Coracle Archaeology 2023a);

59. **Figure 24B-10).** The anomaly has been assigned an AEZ of 50 m; it is nevertheless located beyond the revised Offshore Development Area and is unlikely to be impacted by the proposed Project.
60. A north-south aligned wreck (**CA1025; Volume 5: Error! Reference source not found.**) is associated with a number of SSS anomalies (**Table 24B-2**). Scour is visible at the bow and stern of the vessel, up to 2 m deep and extending up to 9 m north and south of the wreck. Two large pieces of debris are also visible on the seabed, c. 7 m and 11 m west of the wreck, measuring c. 7 m and 4 m in length respectively. Both these linear features are likely to be part of the ship's rigging and may be the remains of beams or masts. Additional debris can be seen close to the stern of the wreck at its north-eastern end; a further cluster of debris is visible on the seabed c. 33 m NE of the stern, measuring up to 3 m in length.
61. This largely intact wreck has a prominent upstanding bow (though there is limited MBES data to establish the exact height of this feature), behind which lies a large open deck, potentially up to 3 m lower than the bow. A large rectangular opening measuring c. 9 x 3.5 m is also visible; this is likely to be the hold access. The hold doors appear to be either open or missing, which may account for the large decrease in deck elevation visible in the bathymetry. Aft of the deck opening, the ship housing is visible with a single funnel, the latter extending c. 2 m above the housing. This is located just aft of mid-ships, c. 21 m from the tip of the bow. Aft of the house and funnel, the decking is not clearly defined but appears to comprise additional structures at a higher elevation than the open foredeck, though this may represent closed hold hatches on the aft deck. The stern of the ship is not clearly defined in the SSS dataset, but it appears to be intact, with the bathymetry showing a slightly rounded stern. It is possible that there may be some damage at the stern, with debris visible on the starboard side.
62. Two magnetic anomalies are associated with this wreck site, measuring 279 nT and 43 nT respectively. The former is suggestive of a large ferrous mass, with shorter wavelength dipoles associated with the smaller anomaly likely caused by debris.
63. The profile of the ship is indicative of a large open deck with mid-ship housing and a steam engine, though it is probable that it also carried a pair of masts or beams. It is likely that it is late 19th or early 20th century in origin and was most likely used for the transport of goods, such as a cargo ship, a collier or a trawler. The location of the wreck site corresponds to **CA6**, originally recorded as a sonar contact at the end of WWII. The wreck is reported at two different locations in the DBA, c. 85 m apart. This location coincides with the position recorded by the UKHO (see Coracle Archaeology 2023a).
64. A review of reported wreck sites in the wider area identified one potential candidate for this ship, with a similar deck layout and dimensions (see also Coracle Archaeology 2023b) - the Hungate, a steel screw steamer of 204 grt, registered in Grimsby in October 1900. Originally named the Florence, the vessel is reported to have measured 115 feet (ft; 35 m) x 22 ft (6.5 m) x 11 ft (3.3 m); although it has also been reported as being 155 ft or 47 m); the geophysical anomaly measures c. 38 x 9 x 3.5 m.
65. The Hungate was originally owned by the Central Steam Fishing Company, Hull between 1900-1904, before being transferred to the Phoenix Trawling Company Docks, Milford in August 1904 when it was renamed the Hungate. On the 6th October 1904, the steamer foundered in force 4 north-north westerly wind conditions, 25 miles south-west by south of St Ann's Head, Pembrokeshire (wrecksite.eu; see also Coracle Archaeology 2023b).
66. It is notable that the UKHO records this wreck as dead (UKHO number 11875), at a location c. 600 m south of the southern extent of the Offshore Development Area, and c. 21 km from the current wreck position. This 'dead' location would suggest that the assigned coordinates are



incorrect, as the wreck has not been detected in recent surveys in that location. Larn and Larn provide an alternative position in their Shipwreck Index of the British Isles (2000), though this places the wreck 112 km north-east of the current wreck site, within St George's Channel and north-west of Pembrokeshire. This position must therefore be seen as erroneous. The current wreck lies 30 km (19 miles) south-south-west of St Ann's Head.

67. As the structure of the wreck appears to be largely intact (including the housing, bow and stern) a positive identification of this wreck is likely to be possible through inspection using a remotely operated vehicle (ROV), if required. Scour around the wreck is localised, which implies that any local impacts on the wreck from seabed processes are also likely to be localised and aligned north-south in the direction of any prevailing currents. Although the wreck is intact, debris is visible on the seabed both immediately to the west and north-west of the wreck. An AEZ of 75 m has been assigned.
68. A further 12 anomalies are classified as being of medium archaeological potential. Typically, these have multiple lines of evidence to suggest the presence of surface or near-surface features but are not clearly identifiable as archaeological in origin. These include:
- **CA1002**, an SSS anomaly associated with a magnetic anomaly measuring 69 nT;
 - **CA1003**, an SSS anomaly measuring c. 7 x 0.3 m, associated with a depression in the bathymetric data (9 x 7 x 0.5m) and a central upstanding feature (3.4 x 2.6 x 0.7 m);
 - **CA1006**, an anomaly visible in the SSS and bathymetric datasets, with an associated magnetic anomaly measuring 18 nT;
 - **CA1007**, a bathymetric and SSS anomaly with a corresponding magnetic signature measuring 191 nT;
 - **CA1010**, two angular SSS dark reflectors c. 1.2 m in diameter, located in an area of localised pockmarks. These are associated with a magnetic anomaly measuring 412 nT;
 - **CA1012**, a cluster of SSS anomalies spread over an area of c. 20 x 10 m and associated with a magnetic anomaly of 56 nT. These are likely to be anthropogenic in origin, and are perhaps indicative of fishing gear;
 - **CA1013**, SSS and bathymetric anomalies associated with two magnetic anomalies measuring 323 nT and 240 nT respectively;
 - **CA1017**, two SSS anomalies measuring 10.1 x 0.7 x 0.2 m and 1.2 x 1.2 x 0.2 m respectively. Both are clearly visible in the bathymetric dataset. It is possible that one of the anomalies is a boulder, though one would appear to have an anthropogenic origin. A magnetic anomaly measuring 30 nT is located c. 20 m to the NW;
 - **CA1019**, a magnetic anomaly measuring 577 nT associated with an anomaly visible in the bathymetric dataset;
 - **CA1021**, a SSS anomaly measuring 3.5 x 1.4 x 0.2 m with a corresponding magnetic anomaly (93 nT);
 - **CA1026**, a cluster of SSS anomalies within an area of scour between bedforms; and
 - **CA1029**, two magnetic anomalies measuring 255 and 21 nT respectively.
69. These have been assigned AEZs ranging in radius from 20 to 40 m; only **CA1026** and **CA1029** are located within the revised Offshore Development Area. The remaining ten anomalies with medium archaeological potential are located beyond the boundaries of the revised OfECC and are unlikely to be impacted by the proposed Project.
70. Twelve of the identified anomalies are considered of low archaeological potential. These



typically comprise magnetic anomalies with no corresponding features in the SSS, SBP or MBES datasets. No AEZs are considered necessary for these anomalies (Table 24B-2).

71. No other features with archaeological potential were identified in the supplied geophysical datasets. This includes the position listed for the reported loss of an Armstrong Whitworth Whitley V Z6941 aircraft (**CA34**), located immediately to the north of the proposed Array Area. The seabed in this area shows a series of bedforms and the occasional boulder, with no anomalies in the area that might suggest the presence of ferrous material just below the seabed surface. The relative scarcity of identified wreck sites within the original iteration of the Offshore Development Area suggests that the potential to encounter unexpected cultural remains during works associated with the proposed Project can be considered low. This will be reassessed once survey data for the revised OfECC has been collected and assessed for archaeological potential.

24.6.4. *Submerged Palaeo-Landscapes*

72. Seismic SBP survey data was acquired within the frequency band of 2-16 kHz. This type of higher frequency system is suitable for producing high resolution images that can resolve small features and of identifying acoustic impedance in sub-surface deposits. It is, however, limited by shallow seabed penetration, typically only 10s of metres in optimal conditions. For much of the survey area, the full thickness of the Quaternary sedimentary sequence, down to underlying bedrock, is not visible in the collected dataset.
73. Bedrock is present at or close to the seabed surface at the approaches to Freshwater West, indicated by a strong impedance reflector with occasional sub-surface dipping reflectors, indicative of some faulting. Approaching the beach at Freshwater West, a wedge of coarser grained sediments can be seen thickening landward (**Volume 5: Error! Reference source not found.**); this is likely to be representative of sand. The base of this sediment facies shows a strong impedance reflector signifying the underlying geology, with no apparent basal features (such as organics) sitting above the bedrock channel base.
74. South of the entrance to Milford Haven, bedrock remains close to the seabed surface, with only a thin capping of sediment. This overlying sediment thickens to the south where it encounters a large sandbank, whose sands can be seen sitting over the bedrock surface (**Volume 5: Error! Reference source not found.**). This pattern, of thin surface sediments overlying the bedrock, thickening where sandwaves and sandbanks are present, continues south until the central part of the Offshore Development Area, where a series of sub-surface late Pleistocene channels have been observed in the data. These channels cross the Offshore Development Area corridor at an oblique angle (**Volume 5: Error! Reference source not found.**); it is possible that they represent different phases of activity, with the deeper channel appearing to be truncated by the shallower. The fill of the deeper channel is unclear, though it appears to have a slightly grainy acoustic fill with some high amplitude reflectors, perhaps representing coarse-grained sediments. By contrast, the shallower channel appears to have a smoother acoustic fill with some low amplitude reflectors, which may imply the presence of finer-grained sediments. Away from the channels, bedrock appears close to the surface where both sandwave and bank thickness thins.
75. Further south, these channels disappear and are replaced by a veneer of parallel stacked facies, though the base of the lower fill, its relationship to the underlying geology, and the internal structure of the upper Pleistocene facies remains unclear (**Volume 5: Error! Reference source not found.**). As the Offshore Development Area crosses another large pair of sandwaves, the sub-surface structure of these Pleistocene deposits becomes more complex, featuring a series of stacked high amplitude reflectors, sitting on a series of lower amplitude



dipping and onlapping reflectors, likely associated with another channel fill (**Volume 5: Error! Reference source not found.**). These features appear to be laterally extensive in the southern parts of the Offshore Development Area as it approaches the Array Area.

76. The sub-surface stratigraphy of the Array Area is also not particularly clear. In some areas, a transparent sub-surface unit appears to predominate, with the hyperbolae visible in some survey lines at 10-20 m below the seabed surface, likely indicative of boulders within Pleistocene sediments (**Volume 5: Error! Reference source not found.**). Near-surface channels remain a prominent feature in the western and south-west corner of the Array Area, showing late Pleistocene incision into the underlying Pleistocene deposits. These channels are orientated predominantly in a southern direction (**Volume 5: Error! Reference source not found.**).
77. The high frequency SBP survey has demonstrated the presence of several Pleistocene channels and thick fills present in the southern half of the Offshore Development Area and across the Array Area. The relationship between these different features suggests multi-phased, late Pleistocene deposition. Deposits are likely to consist of a till facies of clay, sand, gravel, cobbles and boulders, with hyperbolae visible in the centre of the Array Area implying the presence of boulders at depth.
78. Channel features appear to be extensive throughout the Offshore Development Area, though lacking any associated adjacent floodplain areas. Instead, a multi-phased incision is traceable laterally between adjacent survey lines. These are likely all late Pleistocene deposits, formed as a result of pro-glacial processes and subsequent catchment drainage. The geoarchaeological potential of these deposits is therefore likely to be low, as no deposits or features attributable to temperate environments, or those within which occupation might have occurred, appear to be observed. The use of optically-stimulated luminescence (OSL) dating to date deposits recovered from these areas during geotechnical site investigations would, however, have the potential to enhance our understanding of late glacial dynamics in the eastern Celtic Sea, a topic of considerable interest (see Coracle Archaeology 2023a).
79. In the northern half of the Offshore Development Area, bedrock is present closer to the seabed surface, with overlying sediments typically associated with areas containing sandbanks or sandwaves. No visible palaeo-landscape features are present beneath these features, with coarse-grained sands, gravels and modern marine bedform deposits sitting directly on the bedrock surface.
80. Penetration of the high frequency SBP was at times poor, however, limiting the ability to differentiate sub-surface features or deposits. Further survey, using techniques such as ultra-high resolution seismic (UHRS), are likely to yield improved penetration and contrasts, thus helping to define and refine the sub-surface Quaternary geology of the area. If required, these will be undertaken post-consent.

24.7 Conclusions

81. Walkover, metal-detecting and geophysical surveys conducted at both proposed landfill locations at Freshwater West did not identify any anomalies with archaeological potential. One linear anomaly is visible in both the geophysical and metal-detecting survey data. This would appear to be a buried cable, believed to be a relict MoD listening cable.
82. It is interesting to note that the wreck of the Willemoes of Thuro was not visible at Freshwater West, nor does it appear to have been detected in the geophysical survey data collected from the beach. This is presumed to be the result of elevated levels of mobile beach sand at the time of the survey. Using the precautionary principle, an AEZ of 50 m has nevertheless been



assigned to mitigate any impacts on this heritage asset from works associated with the proposed Project.

83. The archaeological assessment of marine geophysical survey data identified 29 anomalies with archaeological potential within the Offshore Development Area. Of these, five are considered of high archaeological potential, including four positively identified wreck sites. Twelve anomalies are considered of medium archaeological potential. The remaining 12 anomalies are considered of low archaeological potential. AEZs, ranging in radius from 20 to 100 m have been assigned to each of the anomalies with high or medium archaeological potential.
84. Only three of these AEZs are located within the latest iteration of the Offshore Development Area, including one considered to be of high (a wreck site), and two of medium, archaeological potential. The remaining 14 AEZs are beyond the revised boundaries and are therefore unlikely to be impacted by the proposed Project. Marine archaeological assessment of geophysical datasets collected over the revised OfECC will be required to ensure that the archaeological potential of the Offshore Development Area is fully understood, and that significant impacts to identified cultural heritage assets are avoided. These surveys will be undertaken post-consent.
85. Assessment of the available seismic SBP data has shown thick Quaternary deposits, largely consisting of late glacial (Devensian) deposits distributed across both the Array Area and the southern part of the Offshore Development Area as it funnels towards the shore. Mobile sediments appear to sit above the underlying geology as the Offshore Development Area approaches the coast at Freshwater West; many of these features are likely to consist of till clays, sands and gravels, with boulders also visible in the Array Area. No deposits of geoarchaeological potential were observed within the Offshore Development Area. OSL dating of deposits recovered during geotechnical investigations associated with the proposed Project would, however, have the potential to further the understanding of late glacial dynamics in the region. Geotechnical surveys will be undertaken post-consent.



24.8 References

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24.9 Additional Figures

86. Additional figures **24B-18** to **24B-47** are presented in Volume 5: Figures.