Dublin Array
Generation for generations

EIAR Volume 4: Offshore Infrastructure Technical Appendices Appendix 4.3.13-1 Technical Baseline Report – Marine Archaeology

Kish Offshore Wind Ltd

RWE SLR GoBe APEM Group

www.dublinarray-marineplanning.ie

Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 4, Appendix 4.13-1 - Technical Baseline Report – Marine Archaeology

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Acronyms

Term	Definition
AEZ	Archaeological Exclusion Zone: areas where archaeological receptors are present and will be avoided during project works
AMP	Project specific Archaeological Management Plan document forming the agreement between the Applicant, the appointed archaeologists, contractors and the relevant stakeholders. The document sets out methods to mitigate the effects on all the known and potential archaeological receptors within the development area.
BIIS	British-Irish Ice Sheet
BP	Before Present (1950)
BS	Backscatter
BSB	Below seabed
cal	Calibrated
CD	Chart Datum
DAU	Development Application Unit
DHLGH	Department for Housing, Local Government and Heritage
DTM	Digital Terrain Model
ECC	Offshore Export Cable Corridor
EGN	Empirical Gain Normalisation
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ESRI	Environmental Systems Research Institute (E.S.R.I.),
GNSS	Global Navigation Satellite System
HC	Heritage Council
INFOMAR	Integrated Mapping for the Sustainable Development of Ireland's Marine Resource
ISB	Irish Sea Basin
ISIS	Irish Sea Ice Stream
ka	Kiloannus- period of 1000 Julian years, equal to 365,250 days
kHz	Kilohertz
km	Kilometres
LAT	Lowest Astronomical Tide
LGM	Last Glacial Maximum
MA	Maritime Archaeology Limited

MAG	Magnetometer
MBES	Multi-Beam Echo Sounder
MHWS	Mean High Water Springs
MRU	Motion Reference Unit
nT	Nano Tesla
NMI	National Museum of Ireland
NMS	National Monuments Service
OD	Ordnance Datum
OSL	Optically Simulated Luminescence
RSL	Relative Sea-Level
SBP	Sub-Bottom Profiler
SMR	Sites and Monuments Record
SSS	Side Scan Sonar
UAU	Underwater Archaeological Unit
UHRS	Ultra-High Resolution Seismic
UKHO	United Kingdom Hydrographic Office
USBL	Ultra-Short Baseline
WIID	Wreck Inventory of Ireland Database

1 Introduction

1.1 Overview

1.1.1 This document has been prepared by Maritime Archaeology Ltd (MA) to support the Environmental Impact Assessment (EIA) of the Dublin Array Offshore Wind Farm.

1.1.2 This technical baseline should be read in conjunction with the following documents included within the Environmental Impact Assessment Report (EIAR):

- Volume 3, Chapter 13: Marine Archaeology (hereafter referred to as the Marine Archaeology chapter). This chapter provides an assessment of the potential impacts of the project upon the known and potential marine archaeology receptors;
- Volume 3, Chapter 1: Physical Processes (hereafter referred to as the Physical Processes chapter): to be referenced for an overview on the surficial sediment properties, suspended sediments, and seabed features for indication on seabed sediment movements potentially impacting marine archaeology receptors;
- Volume 4, Appendix 4.3.13-2: Stage 1 Geoarchaeological Assessment of Geotechnical Cores, which provides an assessment of site-specific survey data for geoarchaeological potential; and
- Volume 6, Appendix 6.5.8-1: Onshore Cultural Heritage which presents the Onshore Archaeology and Cultural Heritage Setting Baseline and provides a holistic understanding and assessment of cultural aspects of past land and sea use.

1.2 Purpose of this report

1.2.1 The purpose of this Technical Baseline Report is to robustly characterise the baseline environment for marine archaeology, for the purposes of informing the EIAR.

1.2.2 The aim of this report is to identify known or potential marine archaeological receptors within the marine archaeology study area and provide a baseline assessment of the receptors potentially impacted by the proposed offshore windfarm.

1.2.3 The key objectives for this assessment are to:

- Undertake a review of known and potential archaeological receptors within the marine archaeology study area;
- Undertake an assessment of the site-specific geophysical data for known and potential archaeological receptors within the marine archaeology study area; and
- Summarise the environmental context and identify deposits of archaeological potential.

1.3 Report structure

1.3.1 This report is structured as follows:

- Section 1 introduces the report and outlines its aims;
- Section 2 presents the methodology and data sources applied to characterise the marine archaeology baseline;
- Section 3 outlines relevant previous archaeological investigations and the environmental context of the receiving environment;
- Section 4 outlines the future receiving environment informed by the baseline assessment;
- Section 5 presents data gaps or uncertainties in the current datasets available for this Technical Baseline;
- Section 6 is a summary of this report; and
- Section 7 contains references.

2 Methodology

2.1 Approach

2.1.1 This section details the methodology applied to characterising the known and potential marine archaeology receptors. It includes details on the data and information sources which have been collated, examined, and analysed within the defined study area (see Section 2.2) and as a basis for the marine archaeology assessment in the EIAR.

2.2 Marine archaeology study area

2.2.1 The marine archaeology study area for this baseline report comprises the array area, and the Offshore Export Cable Corridor (Offshore ECC) up to mean high water springs (MHWS) (as illustrated in Figure 1). This is to ensure overlap with the onshore archaeological works on the Shanganagh landfall route. The marine archaeological study area also comprises a 1.5[1] km buffer around both the array area and Offshore ECC[2] boundary up to MHWS (Figure 1) and extends to cover the areas to the southwest and northwest of the array areas and at landfall where the temporary occupation area is cropped.

2.2.2 The extended areas used for the study area are designed to accommodate the potential imprecision of historic marine positioning and provide context for the historic use of the area.

2.3 Marine archaeology receptors

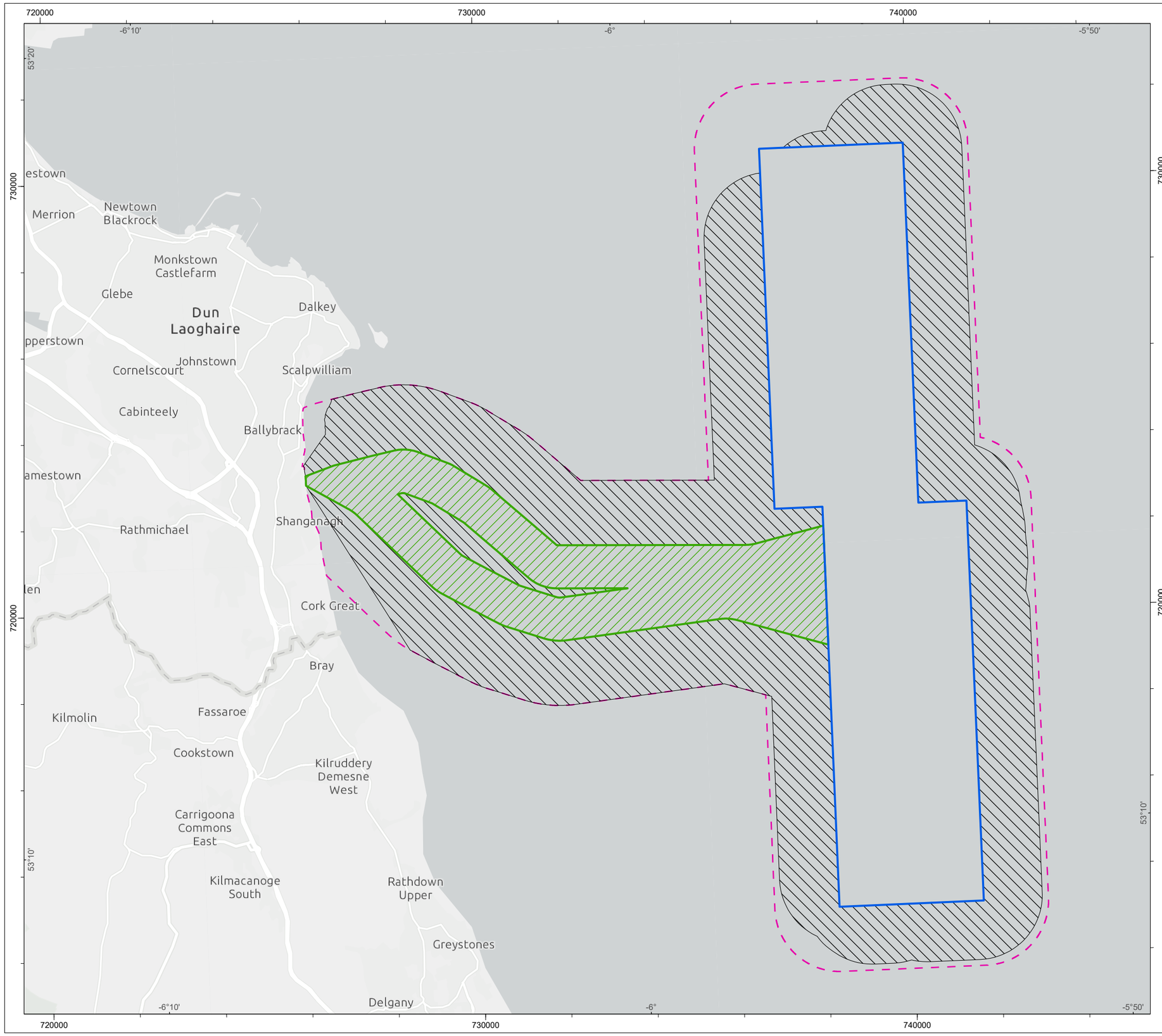
2.3.1 The term 'marine archaeology receptors' used within this report are defined as:

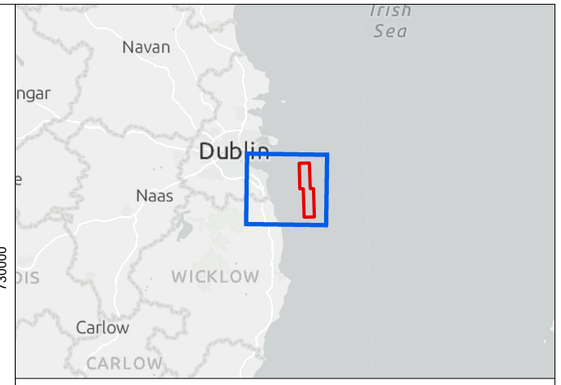
- Known receptors for example, physical resources such as shipwrecks, aviation remains, archaeological sites, archaeological finds and material including pre-historic deposits; and
- Unknown receptors such as documented losses or other archival documents and/or oral accounts of wrecking events recognised as of historical/ archaeological or cultural significance which do not correspond with identified physical remains.

2.3.2 Known receptors as defined above consist of known, unknown and uncharted sites. Known wreck sites are charted wrecks that have been identified and related to documented losses. Unknown wrecks are charted wrecks that have not been identified yet, and uncharted wrecks are new wrecks whose location had not been previously identified.

[1] All distances are taken from the outer boundary of all offshore works incorporating the offshore infrastructure, the buffer also incorporates the temporary occupation area and as such are inherently precautionary

[2] Activities undertaken within the temporary occupation area, namely the use of jack-up vessels and anchors during the construction, O&M, and decommissioning phases have been screened out within the physical processes chapter for suspended sediment and deposition with their use not resulting in notable changes in SSC and associated sediment deposition, however the use of a buffer ensures a precautionary approach is taken.





- Array Area
- Export Cable Corridor
- Offshore Temporary Occupation Area
- MarineArchaeology Study Area

DRAWING STATUS

FINAL

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MAP NOTES / DATA SOURCES:

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community ©Ordnance Survey Ireland 2023 © Tailte Eireann. (CYSL50270365) Not to be used for Navigation.

PROJECT TITLE

Dublin Array

DRAWING TITLE

Marine Archaeology Study Area and Offshore Temporary Occupation Area

DRAWING NUMBER: **01**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-03	DRAFT	HA	CH	#####

0 0.7 1.3 2 2.6 Kilometers

0 1 1 2 2 Miles

N GRID NORTH

SCALE 1:90,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF. ODN/LAT/MLLW

PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

Dublin Array Generation for generations

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2.4 Data sources

2.4.1 A systematic review of marine archaeological and historical data available to the project has been undertaken to characterise the marine archaeological baseline.

2.4.2 The archaeological reports produced for the original EIAR included a baseline assessment which provided the baseline characterisation of the marine archaeology study area and assessment of geophysical data collected by Hydrographic Surveyors Ltd (Headland Archaeology, 2009).

2.4.3 Where the information and data from the original EIA remains relevant it has been considered and used in this marine archaeological Technical Baseline Report. Where more contemporary data are available, these have been used to either supplement and validate the previously defined baseline and / or update as appropriate. The data sources used to inform the baseline are provided in Table 1 below, alongside their temporal extents, and spatial extents in the context of the project.

2.4.4 For the marine zone, the two databases used, the Wreck Inventory of Ireland Database (WIID) and the Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) databases, were cross-referenced to remove duplicated entries. Where relevant the Wrecksite.eu database was used to provide more detail on the known wrecks identified within the marine archaeology study area.

Table 1 Data sources considered in the development of the marine archaeology baseline

Data source	Type of data	Temporal and spatial coverage
Dublin Array Environmental Impact Statement (2012/2013 baseline) Saorgus Energy Limited, 2012; 2013a; 2013b[3]	Original Dublin Array Offshore Wind Farm EIAR and technical appendices for marine archaeology.	Marine archaeology study area
Archaeological Excavations Bulletin	Database of Irish excavation reports carried out across Ireland. Irish database compiled from the published Excavations Bulletin with additional online-only material from 2011 onwards. The map search was used to find relevant reports.	Data collected from 1970 to date across Ireland
Heritage Maps Viewer	The Heritage Council (HC) run the Heritage Maps Viewer. It contains compiled heritage data for Dublin County. However, it is important to note that the data is still in the process of being uploaded to the database as it is a relatively new website. It was used primarily to access archaeological reports	Ireland wide, including the offshore environment

[3] https://www.gov.ie/en/foreshore-notice/60c81-bray-offshore-wind-ltd/

Data source	Type of data	Temporal and spatial coverage
	from assessments and excavations in the area.	
Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) Shipwreck Database	INFOMAR aims to map the physical, chemical, and biological features of Ireland's seabed. The shipwreck data was downloaded in vector form and contained all Irish shipwrecks, their known location and associated information.	Waters around Ireland, data taken from surveys undertaken since 1999
INFOMAR Geophysical Data	The geophysical data from INFOMAR was assessed in ArcGIS to identify any additional targets or anomalies in the marine archaeology study area.	Waters around Ireland, data taken from surveys undertaken since 1999
National Museum of Ireland (NMI)	The topographical files relating to the townlands along the coast from Dublin Bay, Co. Dublin to Bray, Co. Wicklow were consulted at the NMI in Dublin. Although the archives of twenty townlands were investigated, only five returned relevant records, including: Blackrock, Bray, Dalkey Island, Killiney and Sandymount.	Ireland wide
Sites and Monuments Records (SMR), held by the National Monuments Service (NMS)	The SMR onshore and intertidal data was made available through the online Historic Environment Viewer database. A polygon was created to include the townlands along the coastline from Howth, Co. Dublin to Bray, Co. Wicklow and extended from MHWS to approximately 1 km inland.	Ireland wide
United Kingdom Hydrographic Office (UKHO) via INFOMAR	UKHO wrecks are included in the INFOMAR data and are categorised as; ▪ Obstruction; or ▪ Wreck. The are then classified as: ▪ LIVE, detected in recent surveys; ▪ DEAD, not detected in recent surveys; or ▪ LIFT, removed from the seafloor.	As above INFOMAR database
Wrecksite.eu	Database used to find additional information and wreck reports for identified shipwrecks in both the UKHO and INFOMAR datasets.	International
Wreck Inventory of Ireland Database (WIID), held by the NMS	Data from the WIID was downloaded from the NMS online Wreck Viewer. The known locations of wrecks are represented, however, these only account for *c.* 22% of the total number of records held by the NMS. The coordinates given represent the known approximate center of the record and is not indicative of its geographic extent.	Recorded wrecks across Ireland's waters out to the continental shelf

Data source	Type of data	Temporal and spatial coverage
Brooks and Edwards Sea-level Database for Ireland (2006)	This database is relevant to the palaeoenvironmental potential of the marine archaeology study area.	Ireland wide
Reports produced ahead of the Kish and Bray Banks Offshore Windfarm Development[4]	EIAR Vol 3, Archaeological Assessment for the Kish and Bray Banks Offshore Windfarm Development, Co. Dublin and Co. Wicklow (Headland Archaeology, 2009); Dublin Array - An Offshore Wind Farm on the Kish and Bray Banks Environmental Impact Statement Revision 1 (Saorgus Energy Limited, February 2012); Dublin Array - An Offshore Wind Farm on the Kish and Bray Banks Environmental Impact Statement Volume 1 Non-Technical Summary (Saorgus Energy Limited, February 2013a); and Dublin Array - An Offshore Wind Farm on the Kish and Bray Banks Environmental Impact Statement Addendum (Saorgus Energy Limited, February 2013b).	Archaeological and geophysical assessment undertaken within Dublin Array Offshore ECC and array area and the wider area. Multiple cable route options have been considered and covered by reports, which provide additional context to the archaeological assessment.

Project-specific survey data

2.4.5 Project-specific surveys as detailed in Table 2 were used to characterise the known and potential marine archaeology receptors within the study area. The results are presented in Section 3.

Table 2 Dublin Array site specific survey data

Data source	Summary	Coverage of Dublin Array
RWE Renewables Ireland Ltd. (2022). Dublin Array Offshore Wind Farm Geophysical Survey 2021: Archaeological Report. Detection Device Licence 21R0027	Archaeological assessment of baseline environment and geophysical survey taken over the array area and Offshore ECC, including side scan sonar, magnetometry, bathymetry, and sub-bottom data.	Full coverage of the Dublin Array Offshore ECC and array area.
Niall Brady and Dominick Gallagher, 'Archaeology Monitoring, Site Investigations, Benthic Grab Samples, Dublin Array Offshore Wind Farm 21E0082' (ADCO, 2021).	Archaeological monitoring of the benthic survey conducted for Dublin Array took place and a record was made of the observations and samples recovered. No	Coverage within Dublin Array Offshore ECC and array area.

[4] https://www.gov.ie/en/foreshore-notice/60c81-bray-offshore-wind-ltd/

Data source	Summary	Coverage of Dublin Array
	archaeologically significant material was recorded.	
Niall Brady, 'Archaeological intertidal survey, Ringsend, Dublin Array. 21D0045, 21R0070' (ADCO, 2021).	Archaeological intertidal survey conducted for the Dublin Array Offshore Wind Farm took place of the proposed cable landfall location at Ringsend, Co. Dublin. No archaeologically significant material was recorded.	Coverage within Dublin Array Offshore ECC intertidal areas.
Niall Brady, 'Archaeological intertidal survey, Shanganagh, Dublin Array. 21D0046, 21R0071' (ADCO, 2021).	Archaeological intertidal survey conducted for the Dublin Array Offshore Wind Farm took place of the proposed cable landfall location at Shanganagh, Co. Dublin. The survey highlighted the footings of the former retaining wall for the nineteenth-century railway that are exposed along much of the southern half of the survey area. The wall base is revealed at low water. It is not a registered archaeological site; however, it is a heritage asset.	Coverage within Dublin Array Offshore ECC intertidal areas.

Methodology for the archaeological assessment of geophysical data

2.4.6 Fugro Ltd. was contracted by the Applicant to acquire data across the array area and Offshore ECC for Dublin Array.

2.4.7 The Fugro Mercator was tasked with carrying out geophysical surveys within the geophysical survey extent in water depths >7 m. The Mercator conducted ultra-high resolution seismic (UHRS) only over the Kish and Bray Banks where water depths exceeded 7 m. A third-party vessel, the Spectrum 1 conducted geophysical surveys to acquire data for the project over the shallowest parts of the Kish and Bray Banks in water depths <7 m. The Fugro Seeker conducted geophysical surveys of the nearshore of the geophysical survey extent in water depths <7 m.

2.4.8 The survey equipment used, and associated vessels are outlined below in Table 3. These are in line with or exceed the following requirements outlined by the Underwater Archaeology Unit (UAU) in the general preliminary requirements for a geophysical survey for archaeological purposes. Side scan sonar:

- For archaeological purposes the side scan sonar should have an operational frequency of 410/500 khz;

- Side scan should be set at 50m survey line spacing;
- If this is narrower then it should be corrected;
- This should not be slant-range corrected; and
- There should be 100% coverage of sites and therefore overlap of areas may be required.

Magnetometer:

- A magnetometer should always be used in tandem with side scan sonar;
- Proton or caesium magnetometer should be used as well as, again, using 50m side spacing;
- This should be used with DGPS.

Sub-bottom profiler (optional):

- If using a sub-bottom profiler then the Chirp system is the preferred one as this gives the ultimate resolution;
- This should be used in conjunction with DGPS.

General:

- Co-ordinates should preferably be given in National Grid references but supported by latitude and longitude;
- Track plots should also be recorded;
- Track plots should be superimposed onto a locational chart;
- All geophysical survey should be carried out by suitably qualified personnel. Preferably they should also have underwater archaeological experience. If this is not possible then the results must be viewed by a qualified archaeologist with experience in underwater archaeology;
- A copy of the original data/traces as well as the interpreted results of the geophysics should be sent to the Underwater Archaeological Unit of the National Monuments Service Further archaeological mitigation may be required once the data has been reviewed by the National Monuments Service;

- Section 2(2) of the 1987 (Amend.) National Monuments Act states that it is prohibited to use, without the consent of the Minister for Housing, Local Government and Heritage, any detection devices in any place '*for the purpose of searching for archaeological objects'.* It is therefore necessary for any geophysical survey to be licenced by the National Monuments Service. Application forms are available from the licensing section of the National Monuments Service, *Department of Housing, Local Government and Heritage*, Custom House, Dublin 1; and

- It should be noted that all sites should be dealt with on an individual basis. As such each site will have its own specific requirements. Therefore, a method statement should be attached to the application when applying for the survey licence. A copy of this method statement should also be forwarded to the office of the Underwater Archaeology Unit so that the proposed methods are in line with the necessary requirements.

Table 3 Survey vessels and geophysical survey equipment specs.

Vessel	Requirement	Equipment
Fugro *Mercator*	Primary global navigation satellite system (GNSS)	Fugro StarPack GNSS receiver with Starfix.G2+ corrections
	Secondary GNSS	Fugro StarPack GNSS receiver with Starfix.G2+ corrections
	Motion Reference Unit (MRU) and heading sensor	▪ 2 x Applanix POS MV IMUs and Antennas, 1 x iXBlue Octans 3000 MRU; ▪ 2 independent systems for deriving vessel motion; and ▪ ± 0.1 m horizontally (2-sigma, 95%).
	Ultra-Short Baseline (USBL)	▪ Kongsberg HiPAP 351P with C-Node mini S34 beacons ▪ 0.25° angular accuracy (1 sigma); ▪ <0.5% of slant range (1 sigma) range accuracy; ▪ Antenna aperture 200°; ▪ Operating frequency 20 to 30 kilohertz (kHz)
	Multibeam echosounder	▪ 3 Soundings per 0.25 m bin in 95% of the survey area; ▪ Dual Teledyne RESON Seabat T50R (400 kHz) multibeam echo sounders; ▪ Dual Applanix POS MV 320 IMUs and Antennas; ▪ Valeport mini–Sound Velocity Sensor (SVS); ▪ Starfix NG software; ▪ Caris processing software; and ▪ Starfix. VBAProc processing software.
	Side Scan Sonar	▪ 15 m to 75 m line spacing with 100% coverage; ▪ Fish altitude above seabed, between 5% and 12% of the range operated; ▪ 1 x EdgeTech 4205 tri-frequency (230/540/850kHz) side scan sonar (SSS); - 540 kHz used to acquire data; ▪ 1 x Oceanenviro EIVA standalone winch with armoured cable; ▪ 1 x Kongsberg HiPAP 351P USBL subsea positioning; ▪ EdgeTech Discover data acquisition software; and ▪ Chesapeake SonarWiz data processing software.
	Magnetometer	▪ Resolution of 0.1 nT ▪ Tow height above the seabed ≤ 3.0 m in water depths below 10 m LAT, ≤ 4.0 m in water depths above 10 m LAT and ≤ 6.0 m for lengths spanning less than 200 m when flying over sand waves; ▪ Geometrics G-882 caesium vapour marine magnetometer ▪ STR MI-DTS MiniPort DTS Subsea Unit;

Vessel	Requirement	Equipment
		▪ Geometrics G-88x telemetry system frame; ▪ Kongsberg HiPAP 351P USBL subsea positioning; ▪ Mag Log acquisition software; ▪ Oasis Montaj data processing software.
	Parametric Sub-bottom Profiler	▪ Frequency set at 8kHz and 1 pulse ▪ Vertical resolution of 0.2m with up to 5 m penetration below seabed (BSB) ▪ Innomar Medium SES-2000 parametric sub-bottom profiler ▪ Acquisition system: SESWIN 24bit; ▪ Conversion Software: SES Convert 2.3.3.1; ▪ Processing Software: RadExPro 2020.1; ▪ Interpretation Software: Kingdom Suite 2018.
	Sound velocity probe	1x Valeport Mini SVS installed on SSS
	Sound velocity sensor	1x Valeport Mini SVS installed near MBES head
	Tidal heights	Fugro StarPack GNSS receiver with Starfix.G2+ corrections
	UHRS	▪ 200 m line spacing; ▪ Penetration of at least 50 m BSB depending on geology; ▪ 2 x Geo-Source stacked dual 400; ▪ 2 x Geo-Spark 6kW power supplies; ▪ 1 x Geo-Sense Ultra Hi-Res 48 Channel Streamer; and ▪ 1 x Geo-Sense single channel reference hydrophone.
Spectrum 1	Primary GNSS	Applanix POS MV Primary Antenna
	Secondary GNSS	Applanix POS MV Secondary Antenna
	MRU and heading sensor	▪ Teledyne 16 Reson INS Type-20 (Applanix POS MV Wavemaster II); ▪ 2 independent systems; ▪ ± 0.1 m horizontally (2-sigma, 95%); and ▪ ± 0.2 m vertically (2-sigma, 95%).
	USBL	▪ Sonardyne Mini Ranger 2 USBL ▪ WSM 6+ Transponders (2 x operational + 1 x spare); ▪ 0.25° angular accuracy (1 sigma); ▪ <0.5% of slant range (1 sigma) range accuracy; ▪ Antenna aperture 200°; and ▪ Operating frequency 20 to 30 kHz.

Vessel	Requirement	Equipment
	Surface-towed equipment positioning	Fugro MarineStar™
	Multibeam echosounder	▪ Single head MBES (512 - 1024 soundings per head per ping); and ▪ RESON SeaBat T50-R (0.5° across track, 1.0° along track at 400 kHz) multibeam echosounder.
	Side Scan Sonar	▪ 15 m line spacing and 100% coverage; ▪ Fish altitude above seabed of between 10% and 15% of the range operated; ▪ EdgeTech 4125i side scan sonar (400/900kHz); ▪ 1 x STR PCR-75-SS sonar winch with armoured cable; ▪ Sonardyne Mini-Ranger 2 USBL sub-sea positioning; ▪ EdgeTech Discover data acquisition software; and ▪ Chesapeake SonarWiz data processing software.
	Magnetometer	▪ Resolution of 0.1 nT; ▪ Flying height of 3.0 m when water depths <10 m LAT and 4.0 m for water depths >10 m LAT; ▪ Geometrix G-882 Magnetometer; ▪ Cable and winch; ▪ Sonardyne Mini-Ranger 2 USBL sub-sea positioning; ▪ MagLog data acquisition software; and ▪ Oasis Montaj data processing software.
	Parametric Sub-bottom Profiler	▪ Frequency set at 8kHz and 1 pulse; ▪ Vertical resolution of 0.1m with up to 8 m penetration BSB; ▪ Innomar SES-2000 Medium-100 Parametric sub-bottom profiler; ▪ Acquisition system: SESWIN; ▪ Conversion Software: SES Convert 2.3.3.2; and ▪ Processing Software: ISE 2.9.5.63 and RadExPro 2020.4.
	Sound velocity probe	Valeport SwiFT
	Sound velocity sensor	Valeport Mini
Fugro *Seeker*	Primary GNSS	Fugro StarPack GNSS receiver with Starfix.G2+ corrections
	Secondary GNSS	Fugro StarPack GNSS receiver with Starfix.G2+ corrections
	MRU and heading sensor	▪ Applanix POS MV MRU ▪ 2 independent systems; ▪ ± 0.1 m horizontally (2-sigma, 95%); and ▪ ± 0.2 m vertically (2-sigma, 95%).

Vessel	Requirement	Equipment
	USBL	▪ Nexus Easytrak USBL systems with Applied Acoustics beacons; ▪ 0.25° angular accuracy (1 sigma); ▪ <0.5% of slant range (1 sigma) range accuracy; ▪ Antenna aperture 200°; and ▪ Operating frequency 17 to 30 kHz.
	Multibeam echosounder	▪ 3 soundings per 0.25 m bin in 95% of the survey area ▪ Dual Teledyne RESON 7125 (400 kHz) multibeam echo sounders; ▪ Applanix POS MV 320 IMU and Antennas; ▪ Valeport mini–Sound Velocity Sensor (SVS); ▪ Fugro Starfix NG; ▪ Caris processing software; ▪ Applanix POSPac 8.4 processing software.
	Side Scan Sonar	▪ 40 m to 55 m line spacing with 100% coverage; ▪ Fish altitude above seabed of between 8% and 12% of the range operated; ▪ 1 x EdgeTech 4200 (300/600 kHz) side scan sonar; ▪ 1 x STR ESW-500 series winch with armoured cable; ▪ Nexus Easytrak USBL subsea positioning; ▪ EdgeTech Discover data acquisition software; and ▪ Chesapeake SonarWiz data processing software.
	Single towed Magnetometer	▪ Resolution of 0.1 nT ▪ Tow height above the seabed ≤ 3.0 m in water depths below 10 m LAT, ≤ 4.0 m in water depths above 10 m LAT and ≤ 6.0 m for lengths spanning less than 200 m when flying over sand waves; ▪ 1 x Geometrics G-882 caesium vapour marine magnetometer; ▪ Geometrics G-88x telemetry system frame; ▪ 1 x Nexus Easytrak USBL subsea positioning; ▪ Mag Log acquisition software; ▪ Oasis Montaj data processing software
	Parametric Sub-bottom Profiler	▪ Frequency set at 8kHz and 1 pulse; ▪ Vertical resolution of 0.2m with up to 5 m penetration BSB; ▪ Innomar Medium SES-2000 parametric sub-bottom profiler; ▪ Acquisition system: SESWIN 24bit; ▪ Conversion Software: SES Convert 2.3.3.1; ▪ Processing Software: RadExPro 2020.1; and

Vessel	Requirement	Equipment
		▪ Interpretation Software: Kingdom Suite 2017/2018.
	Sound velocity probe	2 x Valeport Mini SVP
	Sound velocity sensor	RESON SVP-70 installed within MBES transducer fairing
	Tidal heights	Post processed Applanix POS MV GNSS heights

2.4.9 The data quality, for archaeological purposes, across all shallow geophysical data sets has been defined as Good, as described below.

- Good: Clear data which has been unaffected or only slightly affected by conditions such as weather, sea state or background noise in which anomalies can be clearly identified and interpreted. Upstanding or partially buried wrecks, debris fields and small, isolated anomalies as well as subtle reflectors within the sub-bottom profiler (SBP) data are clearly discernible. Data of this quality provide the highest probability for marine heritage receptors to be identified;
- Adequate: Data which has been moderately affected by conditions such as weather, sea state or background noise, in which anomalies can been seen but are difficult to identify and interpret. Upstanding wrecks and larger debris fields are discernible, however the identification and interpretation of dispersed or partially buried wrecks, small, isolated anomalies, and continuous reflectors within SBP datasets may be difficult. Data of this quality is considered usable, but the clear identification of marine heritage receptors made be impaired;
- Dissatisfactory: Data which has been significantly affected by conditions such as weather, sea sate or background noise, in which only large anomalies such as relatively intact upstanding wrecks can be suitably identified and interpreted. The identification and interpretation of dispersed or partially buried wrecks, small, isolated anomalies and small palaeogeographic features will be impaired; and
- Variable: Where the quality of data between individual lines varied leading to a variation in confidence in the identification and interpretation of marine heritage receptors within the dataset.

Multi-beam echo sounder data

2.4.10 Multibeam Echo Sounder (MBES) swath bathymetry data was received as un-gridded ASCII files, and .asc grids reduced to LAT. The data was visualised using the Fledermaus 7 suite; DMagic to produce a digital terrain model (DTM) gridded at 1 m according to the highest resolution xyz data received and hillshaded. These were exported for interpretation into Fledermaus with a 32-step colour map overlaid to aid interpretation and later into ArcGIS Pro for synthesis with other data.

2.4.11 Backscatter (BS) data has also been recorded, measuring the intensity of the echo sounder pings which are assigned a grey-scale value and gridded. This provides an acoustic intensity map that is similar in appearance to SSS data, but without shadows to highlight relief. The data is useful for the interpretation of bathymetric anomalies and enables an understanding of material type for discrete features, and sediment classification of shallow deposits.

2.4.12 The MBES and BS data was reviewed by a qualified marine archaeologist for targets identified during the assessment of other datasets and information regarding the length, width and anomaly height above the seabed was cross-referenced with SSS and SBP results where these features possessed a surface expression.

2.4.13 Target imagery was captured, and feature IDs were assigned ranging between MA4000 – MA4999.

Side Scan Sonar data

2.4.14 The SSS raw data was received in Triton XTF format and post-processed in SonarWiz, imported with a 'threshold' value calculated for the specifics of the instrumentation and the environment, bottom tracked and normalised using the 'Empirical Gain Normalisation' (EGN) function.

2.4.15 The SSS data was reviewed on a line-by-line basis by a qualified marine archaeologist. All anomalies were identified and assessed for archaeological potential as per Table 4, target reports were developed and exported as ESRI shapefiles into ArcGIS Pro for synthesis with other data sets.

2.4.16 All SSS anomalies were assigned feature IDs ranging between MA2000 – MA2999.

Magnetometer data

2.4.17 Magnetometer (MAG) data was assessed using GeoMetrics MagPick software package. Raw xyz profile text files were assessed on a line-by-line basis and only smoothed using low and/or high pass filters where necessary. Data was also gridded from the analytic signal to produce a spatial distribution map of anomalies. Interpreted magnetic targets were identified by combining a manual assessment of the magnetic profiles with a visual assessment of the gridded data.

2.4.18 Magnetic anomalies greater than 5 nT have been accepted as a standard for the smallest change in magnetic field reliably detected (Dix *et al*., 2008). It has been argued that a minimum detectable deflection of 5 nT may be on the conservative side and that, where the data is relatively noise free, 3 or even 2 nT may be practical depending on noise levels, instrument type, data rate and purpose of investigation (Camidge *et al*., 2009). The current filtering of 5 nT was deemed appropriate given the survey parameters.

2.4.19 Objects giving a 5 nT return from a 6 m distance are likely to be ferrous objects of around 100 kg (for example, a small anchor) (Camidge *et al*., 2009). Anomalies smaller than this are not likely to be discernible from signal noise unless passed over directly by the fish at extremely short range (c. 2 m). Such signals are not expected to be of archaeological interest, constituting isolated debris or single instances of ferrous anthropogenic material.

2.4.20 These surveys, like most magnetometer surveys of large areas, are of variable sensitivity (Camidge *et al*., 2009:62). At 6 m range, run lines directly over targets are able to detect a target with a mass of around 100 kg, whereas the line spacing for this survey varies with the average line spacing at 75 or 150 m. At 150 m line spacing the slant range will be around 80 m, which means that only objects of more than 100 tonnes will be discernible at 5 nT deflection. Benefiting the data collection for this case is that the run lies were cross lined which can possibly reduce the large differential sensitivity (Camidge *et al*., 2009:63).

2.4.21 All magnetic targets over 5 nT were exported into ArcGIS Pro for comparative analysis with other geophysical datasets and data collected during the baseline review.

2.4.22 Correlation between magnetic targets and other datasets were based on a 50 m buffer due to the issues inherent in accurately positioning magnetic targets by their detectable magnetic field.

2.4.23 All magnetic anomalies correlating with SSS anomalies or MBES anomalies, and magnetic anomalies ≥100 nT were included in Annex D and Figure 5. Feature IDs for all magnetic anomalies were assigned IDs ranging between MA5000 – MA21399. Magnetic anomalies <100 nT were grouped as geophysical anomalies along with low potential archaeological anomalies seen in the acoustic data (as described in Table 4). These locations are noted, but not recommended specific avoidance or other mitigation measures.

Sub-bottom profiler data

2.4.24 Interpretation of SBP data was undertaken on a line-by-line basis by a qualified marine archaeologist.

2.4.25 The data was received in SEG-Y format, imported, and visualised using SonarWiz. Lines were bottom tracked, and gain corrected, and then reviewed in numerical order with features digitised continuously. Features were picked by digitising reflectors and horizons of potential archaeological interest. Discrete reflectors consist of point hyperbolae and blanking effects indicative of potential buried archaeological deposits, such as wreck and debris.

2.4.26 Feature IDs for all SBP anomalies were assigned ID's ranging between MA3000 – MA3999.

Methodology geophysical data interpretation

2.4.27 A qualified and experienced maritime archaeologist has undertaken the archaeological assessment of geophysical data. Following delivery of the survey data as specified above. The raw data has been processed and interpreted as per guidance in Marine Geophysics Data Acquisition, Processing, and Interpretation (Plets *et al*., 2013).

2.4.28 All anomalies of archaeological potential were assessed against the criteria in Table 4 and the results of the assessment of all datasets were further reviewed against the baseline data collated for the marine archaeology study area.

Table 4 Definition of archaeological categories

Archaeological categorisation	Archaeological definition
Wreck	Known or reported wrecks and apparent shipwreck or aviation material.
Possible wreck or wreck debris	Features not previously recorded as wrecks or aviation, but which are considered likely to be wrecks or associated debris.
Anchor	Features interpreted as anchors not associated with identified wreck sites based on geophysical data including MAG, SSS and MBES.

Archaeological categorisation	Archaeological definition
Archaeological anomalies	Anomalies considered to map material of archaeological potential such as buried and confirmed palaeolandscapes, as well as potential outcropping palaeolandscapes and their margins or locations where a wreck has been recorded but is not clearly defined in the geophysical datasets or defined structural outlines or coherent material distributions with strong backscatter, or clearly upstanding objects with shadow, or pronounced scour features; or a combination of these.
Magnetic anomalies	All magnetic reflectors with a return of over 100 nT that were not visible in MBES or SSS or relate to any of the known, unknown and uncharted wrecks.
Geophysical anomalies	Geophysical targets with low archaeological potential, including magnetic anomalies with a return under 100 nT. For example, rock outcrops with no other clear anthropogenic features and potential fishing or modern debris. These could potentially be of archaeological interest as rocks and stones have historically been used as ballast, and so can be indicative of wreck remains however more data is needed to verify this.

3 Receiving environment

3.1.1 The following sections outlines previous archaeological investigations that were carried out within the marine archaeology study area (see Section 2.2 for definition) and other relevant Irish coastal locations, known receptors within the marine archaeology study area and an analysis of the geophysical data collected in 2021. This informs the baseline review of potential maritime activity and wrecks within the marine archaeology study area.

3.2 Maritime activity: baseline review

Introduction

3.2.1 The following section provides a broad overview of human activity within the marine archaeology study area and provides the context of the historic use of the wider area. This is used to indicate the potential archaeological site types and that may be encountered within the marine archaeology study area. Relevant records located onshore are also included in this assessment and are detailed in Section 3.5.

Palaeolithic (800,000-8,000 BC)

3.2.2 The colonisation of Ireland during the Palaeolithic has been the subject of considerable debate in recent decades and within multiple disciplines. During the Palaeolithic, Ireland had several periods of warmer temperate climates and substantial evidence of recolonisation of mammalian species but there is a paucity of definitive evidence of human colonisation of Ireland during this time (Monaghan, 2017). The limited evidence of Palaeolithic tools in Ireland have been recovered from redeposited contexts as opposed to *in situ* contexts. This absence of *in situ* evidence for early settlement in Ireland may be associated with the Last Glacial Maximum (LGM) ice cover. Ice sheets may have scoured archaeological deposits, removing all evidence of human activity and re-depositing it deep within gravel beds or till deposits (Warren, 2017). It is also possible that Ireland was not colonised during the Palaeolithic. More recently, however, evidence for human presence was found in the south-west of Ireland in the Alice and Gwendoline Cave; a brown bear patella containing butchery marks was dated to 12,810-12,590 cal. BP (Before Present) (Dowd and Carden, 2016). To date there have been no finds of Palaeolithic remains reported within the marine zone of Irish waters.

3.2.3 Following the LGM, Britain was recolonised by c. 14.6 cal ka BP (calibrated kiloannus (period of 1000 Julian years, equal to 365,250 days) before present (1950)). At this time Britain was connected to continental Europe, although Ireland was already an island.

Mesolithic (8,000 - 4,000 BC)

3.2.4 Ireland was mostly ice-free by 16,000 cal BP; however, it is not until the Mesolithic period that the earliest definitive evidence of human activity in Ireland is present, with colonisation thought to have begun along the north-eastern coast. In this post-glacial phase, the climate was warmer, dense woodland covered the landscape and faunal populations increased. The people that populated these landscapes hunted, fished and foraged for food in mainly coastal, riverine and lacustrine environments. The Mesolithic period is typically marked by a more mobile lifestyle than observed in later periods, however, there has been increasing evidence of permanent housing structures in both Britain and Ireland (Robertson *et al*., 2013; Woodman, 1985; Waddington *et al*., 2007; Waddington and Wicks, 2017).

3.2.5 Ireland was not connected to Britain during the Mesolithic, however, large swathes of land along the Irish coastline were submerged during the last marine transgression, c. 8,000 years ago. Waterborne travel during the Mesolithic was likely undertaken in logboats or skin/hide boats (as summarised in McGrail, 2001: 172-183). Such watercraft were able to operate in sheltered inshore waters, estuaries, and rivers but the extent to which they were capable of making repeated open sea voyages is less clear.

3.2.6 Although no sites are located within the marine archaeology study area itself, the archaeological potential of the area is informed by a series of sites along the Irish coast. As discussed in the previous section, a Mesolithic submerged forest is located c. 1 km south of the marine archaeology study area. Samples taken dated parts of the forest to the Late Mesolithic (7432-7832 cal. BP), indicating that the mean sea-level at this time was -3.6 m (Mitchell, 1976). A possible relict palaeochannel was also noted in the geophysical surveys conducted for the 2012/2013 EIS (Saorgus Energy Limited, 2012; 2013a; 2013b). This submerged forest is further outlined in Section 3.4 and in the Archaeological Intertidal Survey report (Brady N., 2022).

3.2.7 During works associated with the development of the North Wall Quay along the River Liffey in 2004, the remains of five Mesolithic fish traps, dating between c. 6100-5720 BC, were discovered (McQuade and Donnell, 2007). The traps indicate significant human engagement with maritime activities during a considerable period of time. Four of the traps were located close to the Mesolithic shoreline, some 6 m below current OD (ordnance datum) The other trap was located close by, between 5 m and 4.66 m below OD. A Neolithic period wattle fence was also found here (c. 5980-5760 BC) suggesting the duration of these activities from the late Mesolithic to middle Neolithic (McQuade and Donnell, 2007).

3.2.8 Excavations of Dalkey Island, approximately 2 km from the Offshore ECC to the southeast of Dublin Bay, has produced substantial evidence of Mesolithic occupation. Shell middens containing Mesolithic artefactual evidence, such as ‘Bann’ flakes (large leaf-shaped lithic blades associated with later Mesolithic assemblages of Northern Ireland), were found in two sites located within the lower, western area of the promontory, on the platform that lies below and west of the cliff face that separates the upper and lower levels (Liversage, 1968; SMR no. DU023-029002). A Mesolithic shell midden was also excavated north of Dublin Bay at Sutton (Mitchell, 1956; 1972).

Neolithic (4,000 - 2,500BC)

3.2.9 During the Neolithic, communities seemingly became less mobile than those of the Mesolithic. Agriculture, the cultivation of cereals and the rearing of stock, became the main source of subsistence. The demands of agriculture led to a physical alteration of the landscape with evidence of forest clearing and the construction of boundaries. Such boundaries were erected through the creation of monumental constructions such as megalithic tombs and stone circles, which have become characteristic of the Neolithic. The current available evidence suggests that Neolithic watercraft, much like those in the Mesolithic, are likely to comprise skin/hide boats or logboats (summary in McGrail, 2001: 172-183).

3.2.10 There are no known Neolithic sites within the marine archaeology study area. However, there have been finds within the surrounding area which include;

- Three polished stone axe heads, typologically attributed to the Neolithic, were acquired by the NMI, including: one found in Blackrock (NMI 1978:283); one found near a tumulus on Killiney Hill (NMI 1448: W117); and the other found at Sandymount (NMI 1976). The axe head found at Sandymount was confirmed as manufactured of porcellanite from Tievebulliagh, Co. Antrim and of a Neolithic date. Further south along the Irish coast at Bray Beach, a flint struck pebble with two flakes removed, was also found (NMI 2012:271).

- A flint javelin head, with a part of cortex on one side, was found on Dalkey Island in 1988. It was found on the surface of a small mound, possibly burrowed by rabbits. The soil also contained various seashell types, some flint waste flakes, blades with possible secondary working and some bone (NMI 1988:11). During the Liversage excavations (1968), evidence for Neolithic occupation was also found on Dalkey Island. Finds included polished stone axe heads, grinding stones, post holes and middens.

- A Neolithic 'dolmen' tomb enclosed by a circle of stones was located in Dalkey Commons (SMR DU023-038). The dolmen was destroyed in the 18th century during the construction of a Martello tower (SMR no. DU023-052003). Two more dolmen tombs were found in Ballybrack (SMR no. DU026-030) and in Howth (SMR no. DU015-032) as well as a megalithic structure in Killiney (SMR no. DU026-010).

Bronze Age (2,500 - 800 BC)

3.2.11 The Bronze Age is defined by significant technological change with the introduction of metalworking technology to Ireland that coincided with substantial social change. There was a marked increase in sedentary populations, and this was reflected in terms of the material culture as well as the nature of the sites and monuments, although there was a level of continuity from the Neolithic. Burial sites were not as monumental as those observed in the Neolithic, but there were new types of burials, including cist burials, wedge tombs, barrows and cairns. Barrows became more popular in the latter part of the Bronze Age. The most common Bronze Ages sites are burnt mounds known as fulacht fia, with over 4,500 known in Ireland (Waddell, 1998). Fulacht fia are interpreted as open-air cooking places.

3.2.12 The Bronze Age population used routes of communication along the coasts and waterways of the region. Tin is essential in the creation of bronze materials and the closest source of tin was in Devon and Cornwall. Boats were essential for the movement of this resource across the Irish Sea. Skin boats and logboats were still used throughout the Bronze Age in Ireland, however, there is evidence that logboats, such as the Lurgan boat (c. 3900 BP), were adapted and equipped with outriggers to allow for more stability, possibly for open water journeys (Robinson *et al*., 1999). Despite evidence for sewn-plank boats in the British Isles, no such evidence has yet been found in Ireland (McGrail, 2001).

3.2.13 There are no known Bronze Age sites within the marine archaeology study area, however, sites along the Irish coast include two fulacht fia that were excavated in Castle Farm, Shanganagh in 1990 in advance of a housing development (SMR no. DU026-116). Further to this, the remains of seven skeletons with associated bronze fibulae were recovered, however the date of this material is not clear (SMR no. DU026-067). Finally, to the north of the marine archaeology study are, a Bronze Age logboat, possibly modified with outriggers to aid long-distance sea travel, was uncovered 1 km offshore under two metres of sand during trenching for a pipeline making landfall at Gormanstown, Co. Meath (Brady N., 2002). Although not located in proximity to the marine archaeology study area, this find demonstrates the potential for early craft to survive offshore.

Iron Age (800 BC- AD 400)

3.2.14 The Iron Age is defined by the transition to the widespread use of iron instead of bronze. The transition from the Late Bronze Age to Early Iron Age is one of the least understood periods in Irish prehistory as there is comparatively less evidence of settlement from this period than previous periods (Garstki, 2019). There is a paucity of Early Iron Age sites in Ireland until the appearance of La Tène material in the third century BC.

3.2.15 The archaeological evidence for Iron Age boats in Ireland is poor. There are also no extant remains of larger sea-going vessels within Irish waters. However, evidence that they did exist in Ireland during this time comes from a gold boat model, known as the Broighter boat, found in 1896 on farmland near Limavady, Northern Ireland. The model measures 18.4 cm in length and 7.6 cm in width and is generally assumed to represent a hide-built boat from the 1st century BC. The boat model is outfitted with nine benches for rowers, 18 oars with rowlocks, a steering oar at the stern, three forked barge poles, a grappling anchor and a mast with a yard arm (Waddell, 1998).

3.2.16 Several Iron Age logboats / dugouts have been found in Ireland, but they are rarely found in coastal or marine contexts. The construction of logboats during this time was slightly more complex than those observed in previous periods. An example of this more complex construction can be seen on the Lees Island 5 logboat, dated to 754-409 BC, found in Lough Corrib, Co. Galway (Brady K., 2014). The boat was fitted with seats and was found with a well-preserved paddle and axe lying inside the boat.

3.2.17 In Britain, we see the continuation and adaptation of the sewn-plank boats from the Bronze Age, although there is currently no recorded evidence of this type of shipbuilding in Ireland. However, an example of a smaller plank-built craft was found in 1968 in Lough Lene, Co. Westmeath. The boat has been interpreted as representing a Roman style, which indicates either the presence or knowledge of Mediterranean or northern European boat-building traditions in Ireland in the Iron Age (O'Sullivan and Breen, 2007).

3.2.18 Although there are no Iron Age finds or sites within the marine archaeology study area, there are three Iron Age promontory forts, constructed as defensive settlements recorded along the Irish coast: one at Howth (SMR no. DU016-003001); one on Dalkey Island, (SMR no. DU023-029001); and one in Dún Laoghaire (SMR no. DU023-052001).

3.2.19 The NMI held a record of a tanged iron blade (NMI 1946: 421), that was found among the rocks at Sandycove. This was interpreted as out of context and cannot be positively dated to the Iron Age.

Early Medieval (AD 400 - 1100)

3.2.20 Through the early medieval period, population and demographic changes in Ireland saw the expansion and intensification of settlement landscapes alongside innovations in agricultural technology and crop production, livestock management (dairying) and in craft and industry (O'Sullivan and Breen, 2007). There was also a transition from a society based on tribal chiefdoms and kin-based social groups to one, by the 9th and 10th century, based on dynastic lordships whereby a lord would oversee the urban markets and international trade and exchange. The shift to Christianity also saw an increase in monastic centres and church estates (O'Sullivan and Breen, 2007).

3.2.21 The Dublin Bay area was of increasing maritime importance in the early medieval period as it became more involved in the wider trading networks of northwest Europe. Monastic settlements are evidenced at Dalkey Island, Howth and Ireland's Eye and indicate the prominence of trading posts within the Dublin Bay area (Cunliffe, 2001). The Bay provided a natural advantage of sheltered waters, allowing safe passage for vessels, whilst also allowing access to inland waters.

3.2.22 The archaeological finds from Dalkey Island indicate long-distance maritime activity, with Mediterranean amphorae found, as well as a large amount of E-ware pottery, a grey ware thought to originate from Western Gaul (Doyle 1998; Loveluck and O'Sullivan, 2016). There is little archaeological evidence in Ireland of the varying types of watercraft that were built and in use in the early medieval period when compared to other parts of north western Europe. Historical sources, such as Adomnan's Life of St. Columba, reference multiple Irish vessel types including the early constructions of the currach and a long boat made from pine and oak timbers, but also vessels from other international traders such as the Gaulish barca or Nordic style boats (Wooding, 2002).

3.2.23 From the 10th century onwards, the Hiberno-Norse developed many ports and harbours in Ireland, including Dublin. This enabled the expansion of maritime trade to this area and Ireland was drawn into other maritime trading networks, this time with a focus in the North Atlantic (O'Sullivan and Breen, 2007). There was also an increased focus of fishing along the Irish coastline with a corresponding growth in evidence of early medieval fish traps. Although no fish traps have been recorded in the marine archaeology study area, there are notable examples in the northeast at Strangford Lough and on the western coast in the Shannon Estuary. Lead line-weights, wooden net-floats and stone sinkers have been found during excavations in Dublin indicating the use of nets and lines from both the shoreline and offshore in boats (O'Sullivan and Breen, 2007).

3.2.24 Land reclamation for Dublin's waterfront is evident from c. 900 AD, with the reuse of ship timbers in the revetments of the bank evident at Wood Quay, the original site of Dublin port which is now further upstream. The timbers found represent Nordic, clinker-built traditions but the timber was of Irish origin suggesting that boats were being built in Dublin (Wallace, 1981; McGrail, 1993).

Medieval (1100 - 1550)

3.2.25 During the Medieval period, the arrival of Anglo-Normans in 1169 saw the further development of Dublin port and it began to take on a more official role; under the new Anglo-Norman laws, the waterfront became property of the Crown and Charter of King John (1167-1216). Through this, came a large increase in the amount of trade and mercantile activity along the coast and an investment in the waterfront facilities and building of boats and ships (O'Sullivan and Breen, 2007).

3.2.26 With the Anglo-Norman colonisation and development of maritime ports and harbours came a concerted effort to fortify and protect the coast through the construction of castles and mottes. Such examples near the Irish coast include Howth Castle and motte (SMR no. DU016-002001 / DU015-025 / DU015-027001); Bullock Castle (SMR no. DU023-020001); and Dalkey Castle (SMR no. DU023-023010).

3.2.27 Coastal and fishing communities continued to thrive along this coastline and although there is no archaeological evidence within the marine archaeology study area itself, examples of this fishing activity can be seen along the Irish coast, with the discovery of a 14th century fish weir (SMR no. DU023-035) associated with the castle at Bullock (SMR no. DU023-020001).

3.2.28 In wider northern Europe, a range of ship and boat types had developed during the medieval period, including cogs, hulks and galleys. However, the paucity of material remains of shipwrecks in Ireland is still evident in the Medieval period, and no finds of cogs or hulks have been recovered in Irish waters, but there are multiple documentary references to their usage (O'Sullivan and Breen, 2007).

3.2.29 Land reclamation and revetments of the banks of the River Liffey continued through the medieval period and as a result of this by the 14th century Dublin Port began silting up and close approach by larger ships was made increasingly difficult. Larger ships were therefore forced to anchor at places away from the city, such as Dalkey (Wallace, 1981). There was also further evidence that timbers from ships were used in the revetments in the 13th century, again these were of Irish origin.

Post-medieval (1550 onwards)

3.2.30 In the 16th century Dublin experienced an increase in trade with northern European ports. This gave rise to the city leasing its slips and piers to individuals and the installation of equipment aiding ship steerage, such as buoys and marks at the bar near the mouth of the Liffey. During the reign of Elizabeth I (1533-1603) the use of the first regular packet ships carrying official correspondence between Dublin and Liverpool and Chester was instigated (Gilligan, 1988).

3.2.31 The 17th century saw the redevelopment and modernisation of the major ports around the coast, including Dublin. Dublin Bay presented major dangers for the increasing shipping trade and in 1674 it was even described as wild, open, and exposed to every wind, and as a result shipwrecks were common (Dublin Port, 2019). In order to combat these dangers substantial stone quays were built; the Great South Wall (1715-1730) and the North Bull Wall (1815-1823). This resulted in the development of a safe harbour and dramatic changes to the bay with the formation of Bull Island (Dublin City Council, 2007). To further increase the safety of the port, Dublin Bay was mapped in 1685 and 1686 by Thomas Phillips and Captain Greville Collins respectively and a number of lighthouses were constructed, including Poolbeg Lighthouse in 1768 (O'Donoghue, 2004).

3.2.32 By 1804 a series of Martello towers were built down the east coast from Dublin to Wexford as a line of defence (O'Sullivan and Breen, 2007). Two of these towers are situated along the coast close to the landfall: one is at Killiney (DU026-014001) and is associated with an earthwork (DU026-014002); the other is at Shanganagh (DU026-055001) and is associated with a defensive redoubt (DU026-055002) that has since been removed by coastal erosion. Further defensive structures exist along the coastline including gun batteries in Dublin South City (SMR no. DU019-028), Dalkey Island (SMR no. DU023-029011) and Killiney (SMR no. DU026-012).

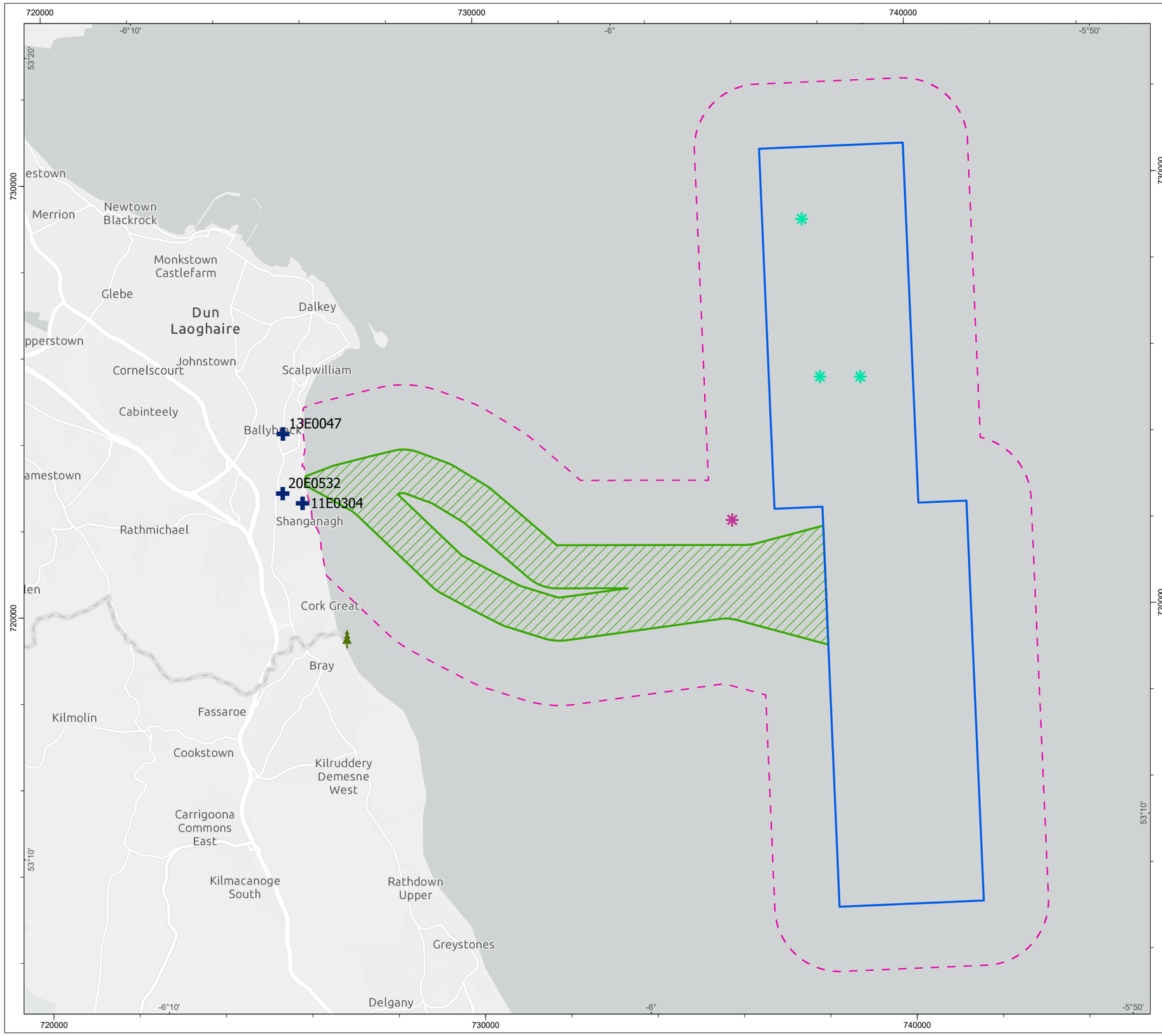
3.2.33 The shipping industry and traffic into Dublin Port increased significantly throughout the 19th and 20th centuries, with linen being one of the major exports (Friel, 2003). The increased shipping traffic resulted in higher numbers of wrecks, detailed further in Section 3.4 below.

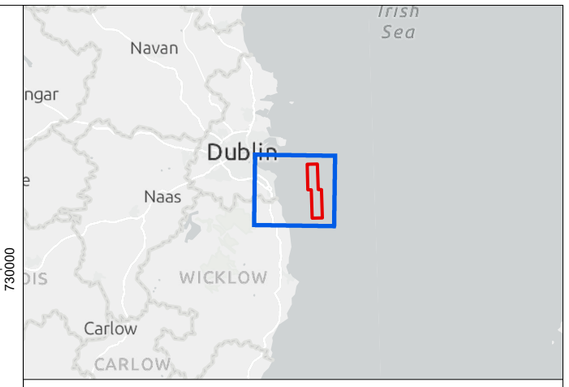
3.3 Previous archaeological investigations

3.3.1 The Kish Bank geotechnical investigations conducted by Glover in 2008 (Glover Site Investigations, 2008; Figure 2) were assessed by MA for geoarchaeological potential. It was concluded that the three boreholes had not recovered deposits of archaeological potential and no further work was recommended on the deposits within these boreholes (Stage 1 geoarchaeological assessment of geotechnical cores, Volume 5, Appendix 5.3.13-2).

3.3.2 Three previous archaeological investigations, as detailed below were undertaken within 1 km onshore of the marine archaeology study area as illustrated in Figure 2 and summarised in Table 2. However, none of these investigations produced archaeological finds (Table 2).

3.3.3 A linear earthwork constructed in the late 19th or early 20th century was identified at Ravenswell, Bray Commons (licence no. 20E0482).





- Array Area
- Export Cable Corridor
- MarineArchaeology Study Area
- Previous Archaeological Investigations
- Geotechnical Boreholes (2008)
- Vibrocore
- Submerged Forests

DRAWING STATUS

FINAL

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Previous Archaeological Investigations

DRAWING NUMBER: **02**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-03	DRAFT	HA	CH	#####

0 0.7 1.3 2 2.6 Kilometers

0 1 1 2 2 Miles

N GRID NORTH

SCALE 1:90,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF ODN/LAT/MLLW

PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

Dublin Array
Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.4 Wrecks, aviation, and documented losses

3.4.1 Multiple datasets were used in the compilation of this updated baseline assessment. The locations of the wrecks identified below are shown in Figure 3 The reference number for each entry is written in bold (e.g., **W10597** or **GSI 289**) for ease of identification. Seven wrecks were found during surveying that did not previously have reference numbers. They were assigned MA ID numbers and reported to the UAU of the Department of Housing, Local Government and Heritage (DHLGH) within three days of finding. Six of the seven wrecks are labelled **MA02, MA03, MA04, MA05, MA07 and MA08** and the seventh wreck, **MA01**, has since been related to an unknown charted wreck (**W09300**). Two further wrecks **MA06 and MA09** were reported, but their locations have been attributed to the known wrecks, *Sir Charles Napier* and *Glenorchy*, respectively.

3.4.2 There are a total of 43 known, unknown and uncharted wrecks within the marine archaeology study area. This total is divided into seven known records (including the two locations for the bow and stern of the MV *Bolivar*), 30 unknown records and six uncharted records. All wrecks discussed here are also detailed in Figure 3 and Figure 4.

3.4.3 There are over 3000 wrecks off the coastal waters of Dublin listed in the WIID. A small percentage of the recorded have been located, as detailed below, however there is potential for further wreck sites to be exposed and located in the future.

Known wrecks

3.4.4 There are seven known wreck (identified wrecks) records within the marine archaeology study area as described below (Figure 3 and Figure 4).

3.4.5 Two identified wreck records are the bow and stern sections from the same vessel, the *MV Bolivar* (**W09480** and **W09846**), a Norwegian motor-powered cargo ship built in 1946 by Akers Mekaniske Verksted A/S, Oslo. The vessel was owned by Fred. Olsen & co., had a gross tonnage of 5320 tons and measured 135.7 x 17.5 x 8.3 m. On the 4 March 1947, MV *Bolivar* was on its maiden voyage to South America, via Dublin and Liverpool, with a cargo of maize. During a snowstorm it ran aground off the Kish Bank. The 45 passengers were saved by the Dún Laoghaire lifeboat, but the vessel was lost. The vessel's extant remains were dispersed with explosives. The status of the wreck is LIVE[5].

3.4.6 The *Glenorchy* (**W01572**) was an iron, fully rigged sailing ship built in 1868 by McMillan A. & Son Ltd. and owned by Gow A. C. & Co., Glasgow. The vessel's gross tonnage was 1348 tons and it measured 60 x 20 x 5 m. On 1 January 1869 during its maiden voyage from Glasgow to Bombay with a cargo of iron, coal, railway sleepers, machinery and spirits, the vessel wrecked after striking the Kish Bank due to gale force winds and poor visibility. The status of the wreck is LIVE.

[5] As defined in Table 1, live denotes wreck was detected in a recent survey

3.4.7 The *Loch Fergus* (**W01828**) was an iron barque, built at Glasgow by Henderson D. and W. & Co. Ltd., Meadowside and owned by J. Sproat & Co., Liverpool and the master was T. Williams. The vessel had a gross tonnage of 847 tons and measured 61.6 x 10.1 x 5.7 m. On 6 February 1899, *Loch Fergus* was sailing from Glasgow to Brisbane with general cargo when strong gales forced the vessel to run aground in Killiney Bay, Co. Dublin. All crew survived. The vessel is listed as LIVE by the UKHO.

3.4.8 The *Sir Charles Napier* (**W01588**) was a merchant vessel built in 1841 by Miramichi, New Brunswick, Canada and was owned by Locketts of London. The vessel's gross tonnage was 638 tons and measured 30 x 7.5 x 1.2 m. On 19 November 1875, the *Sir Charles Napier* ran aground on the Kish Bank carrying a cargo of iron, due to a compass error possibly caused by the cargo. One man was lost. The wreck is listed as LIVE. Another wreck on the Kish Bank has been recorded as the possible remains of the *Sir Charles Napier* (**W01629**).

3.4.9 The *Trustful* is the only known wreck recorded on the Bray Bank (**W01593**). The *Trustful* was a steam-powered fishing drifter built in 1906 by Carnegie, Peterhead. The vessel had a gross tonnage of 87 tons and measured 25.6 x 5.8 x 2.9 m. It was fitted with a cylinder compound engine by Hall A. & Sons Ltd. On the 29 December 1924, *Trustful* was fishing off Bray Head, Co. Wicklow when, during a south-westerly gale, the vessel took on a lot of water. The engine room was flooded and at approximately 17:00 the vessel anchored and set off flares. The crew took to a lifeboat and abandoned the vessel. The boiler then exploded and the *Trustful* foundered. After several hours, the lifeboat was picked up by Kingstown pilot boat, landed and the crew taken to Dublin. The wreck's status in the UKHO database is DEAD.

3.4.10 The *SS Vesper* (**W01594**) was an iron merchant steamer of Hartlepool, built in Dundee by Barclay Curle and Company, with a nominal horsepower of 60. Owned at the time of loss by Huntley Burne & Co. The vessel had a gross tonnage of 478 tons and measured 54.8 x 7.8 x 3 m. On 13 January 1876 during a voyage from Glasgow to Dunkirk, carrying a cargo of sugar and coal, SS *Vesper* wrecked on the Kish Bank and broke into two. The wreck has been listed as LIVE.

Unknown wrecks

3.4.11 There are 30 unknown wrecks recorded within the marine archaeology study area (Figure 3 and Annex C) and seven unknown wrecks within the Operations Base study area.

3.4.12 One unknown wreck (**W10597**) is recorded offshore, approximately 6 km east of Shankill, Co. Dublin. No further information is known. The status of the wreck is unknown.

3.4.13 Five unknown wrecks have been recorded on the Codling Bank (**W11360, W11361, W11365**, **W11366** and **W11367**), between 600 – 3000 m east to southeast of Shankill. Their locations are approximate and are located much closer to shore and off of the Frazer bank and their statuses unknown. The position of these wrecks is uncertain.

3.4.14 Two additional unknown wrecks have been recorded on the Codling Bank (**W11349** and **W11350**) whose locations are approximate and statuses unknown.

3.4.15 Two wrecks were discovered on the Kish Bank by Marlin Sub Aqua Club in 2003. These wrecks are as follows;

- **W01629** is the remains of a 300-400 tonne wooden vessel that is partially exposed on the seabed in 8-10 m of water. The remains of pottery, clay pipes, iron pots, a number of anchors, a capstan and a winch were recorded on the wreck site. This is believed to be one of the two possible remains of the *Sir Charles Napier*; and
- **W01630** is an unknown wooden wreck that is partially exposed and upside down on the seabed. The hull of the vessel is copper sheathed and stands 1 m proud of the seabed, it measures 17 m in length.

3.4.16 Six unknown wrecks on the Kish Bank were detected in 2010 as part of the INFOMAR seabed mapping programme. Although the wrecks are unknown, dates of loss have been ascribed to two wrecks, however it is not clear where this information originated from. These wrecks are as follows:

- **W08691**, measuring 4 m in length and 1.8 m in maximum width and is recorded as being lost on the 15 January 1802;
- **W09300**, measuring 21.2 m in length and 3.7 m in maximum width and is recorded as being lost on the 4 June 1800. This wreck correlates with the coordinates for **MA01**;
- **W11332**, a wooden wreck first identified in a geophysical survey carried out in 2008 by Browne and Stokes. It measures 26.5 m in length by 4.3 m in maximum width;
- **W11626**, a wooden wreck, known as the 'Iron Pipe Wreck', first located in a geophysical survey carried out in 2008 by Browne and Stokes. It measures 19 m in length by 5 m in maximum width;
- **W18562**, measuring 13.5 m in length and 3.5 m in maximum width; and
- **W11610**, measuring 18.3 m in length and 4.5 m in width.

3.4.17 A further 13 wrecks were located on the Kish Bank, however these either have limited or no further information provided (e.g., measurements) (**W10276**, **W10297**, **W11331**, **W11333**, **W11334**, **W11337**, **W11338**, **W11339**, **W11340**, **W11341**, **W11581** (known as the '9.5 fathom wreck'), **GSI 281**, and **GSI 285**).

3.4.18 One additional unique wreck was listed in the INFOMAR database and located on the Kish Bank. **MA0181/ GSI 278**, measuring 13 x 4 m. This unknown wreck could potentially be associated with historical documented losses within the marine archaeology study area and wider area. However, there is not enough information at present to positively identify it.

3.4.19 The seven unknown wrecks within the Operations Base study area are:

- **W01966**, measurements unknown;
- **W01967**, measuring 27 m in length, 5 m in maximum width, with a height of 1 m above the seabed;

- **W11481**, a wreck recorded in 1932 as being in two different sections;
- **W11611**, measuring 0.75 m long;
- **W11584**, measuring 2 m long;
- **W11594**, measuring 4.5 m long; and
- **W11604**, measuring 4.5 m long.

Uncharted wrecks

3.4.20 Six uncharted wrecks (Figure 3 and Figure 4) were identified during site-specific geophysical survey in 2021 (RWE, 2022) for the Foreshore Licence Application (FS007029), sent to MA for interpretation and then reported to the UAU. Upon the archaeological assessment of the complete geophysical data set conducted by MA, these wrecks were identified in other datasets (collected during the 2021 campaign), such as SSS. An additional wreck was given an MA ID (**MA02**). These six wrecks are further described below

3.4.21 **MA02**: The Development Applications Unit (DAU) highlighted the presence of further wreck sites that had not yet been logged in the WIID. One wreck site was detailed in consultation as a new wreck site centred on 53 16.200N, 05 56.500W, measuring 21.2 x 3.7 m with a recommended Archaeological Exclusion Zone (AEZ) of 300 m (DAU, 2019). This wreck was not visible in the SSS, MBES or MAG data.

3.4.22 **MA0140** (**MA03**/GM814_contact0028): The Survey Vessel Fugro Mercator located an unknown possible wreck on 1/03/2021. The wreck was identified by SSS **(**MA2139). Linear and circular reflectors are clearly visible as well as an area that seems to indicate a snagged net. The area measures 16 x 9 m and height above the seabed was measured as 0.5 m. There is also a smaller anomaly (3 x 3 m) located 46 m west of the main target represented by semi-circular hard reflectors. If the anomaly is a wreck or anthropogenic debris the material is well buried within the sandy sediments of Kish Bank. There is a magnetic return of 24 nT (MA21210) associated with this site.

3.4.23 **MA0098** (**MA04**/GM771_contact0102): The possible wreck is lying in a southwest to northeast position and is mostly buried within the sandy sediments. There are several objects on the seafloor around the wreck associated with the vessel which might represent part of the broken hull, propulsion mechanism and a bowsprit and/or mast. The SSS (MA2097) image suggests that the wreck might be a wooden schooner. The main part of the visible hull measures 16 m, the hard reflector anomaly west of the main site is 5 m long, the linear anomaly north of the main site measures 6 m and the linear anomaly south of the main site measures 5 m. There is a magnetic return of 3645 nT (MA21060) associated with this site.

3.4.24 **MA0096** (**MA05**): Substantial reflector approximately 15 m long and 5 - 6 m wide (MA2095). Scour north and south at each end shows it stands proud of the seabed. This could be a 20th century vessel. The site was marked with a buoy and suggested to be a lost container. Also measured as: length: 12 m, width: 4 m, height above seabed: 2 m.

3.4.25 **MA0178** (**MA07**): Substantial anomaly in two parts measuring 21 x 6 m and 7 x 7 m. Debris on the sea floor is clearly visible on the SSS (MA2177). Reported by the survey vessel as "Possible Uncharted Wreck (seen in mag data). Clearly a large target - wreck shaped but probably broken in two associated with a large magnetic response." The wreck location is 410 m from the unknown shipwreck (**MA01**/ **W09300**) and 916 m from unknown wreck reported to UAU by a previous survey campaign (letter to innogy Renewables Ireland Ltd, 2019[6]), referred to in our reports as **MA02** and 440 m from SS *Vesper* (**W01594**). There is a magnetic return of 666 nT (MA20250) associated with this site.

3.4.26 **MA0171** (**MA08**): Oval shaped depression 12 x 7 m with linear hard reflectors, could possibly be wreck material or outcropping geology (**MA2170**). Reported as "A Possible Buried Wreck (NOT seen in mag data). Possibly wood due to the absence of a magnetic response. Overall, about 8 m in length and can be seen on sonar and MBES records". Not associated with any known wreck records.

3.4.27 During the archaeological assessment of geophysical data an additional wreck (**MA0134**) was identified. This wreck is wooden, with visible planking and sized approximately 10.8 x 5 m. Currently no further details are known about the origin or loss.

Aviation remains

3.4.28 No aviation remains have been found within the marine archaeology study area, however historical records confirm that this area has been an active flight path since and especially during the Second World War. Examples from Second World War aircraft finds in marine contexts can be found at Lough Erne, Northern Ireland where a Catalina flying boat was found in 2019. Unidentified anomalies as described below can potentially be associated with aviation remains.

Documented Losses

3.4.29 Within the WIID, there are over 3000 documented losses listed off the coastal waters of County Dublin and roughly 1,500 are recorded as having wrecked within or in close proximity to the marine archaeology study area (Brady K., 2008). Examples of these wrecks include but are not limited to, 41 barques; 17 brigantines; 32 colliers; 10 ketches; 107 schooners; 78 sloops; 33 steamships; and 716 unknown vessels. The majority of documented losses within the WIID are post-1700 in date (Brady L., 2008). This is due largely to the lack of earlier written sources, and as a result, the actual number of wrecking events is expected to far exceed the current numbers.

[6] https://www.gov.ie/pdf/?file=https://assets.gov.ie/121260/07fa920b-e2c9-4020-98d2-836d68d3c9fb.pdf#page=null

3.4.30 The majority of wrecking events off the coast of Dublin and county Wicklow have occurred at the entrances to ports or in other shallow waters as well as on the offshore sandbanks. Within the marine archaeology study area there are seven major sandbanks which, from north to south include, Bennet, Rosbeg, Burford, Kish, Frazer, Bray, and Codling. There are also shallow areas such as the North Bull and South Bull where ships have become stranded in the past. The entrances to Dublin Bay and its harbour are a challenge to navigate due to the sandbanks which run parallel to the coast and the strong tidal currents contributing to the high number of documented losses (Lowth, 2002).

3.4.31 There are 379 records that are defined as having been lost within the general area of Dublin Bay. Furthermore, there are additional records within Dublin Bay stretching from Howth Peninsula to Dalkey Island within the marine archaeology study area that are listed with more specific locations. These current number estimates are listed below in coastline order from north to south;

- 24 recorded off Bailey Lighthouse located on the tip of Howth Peninsula;
- An additional 111 listed as lost off Howth;
- 161 records off the North Bull and three more specified as lost at Bull Wall;
- 23 records off Clontarf;
- 44 Recorded as lost off Poolbeg Lighthouse;
- 63 records on the South Bull with an additional 2 off Booterstown, and 10 off Blackrock;
- 229 documented losses off Dún Laoghaire and its harbour;
- 14 records off Sandy Cove and two off Bolluck; and
- 31 records off Dalkey and Dalkey Island with an additional ten off the Muglins Lighthouse.

3.4.32 Within county Dublin south of Dalkey there are additional records which include 17 documented losses off Killiney and seven off Shankill.

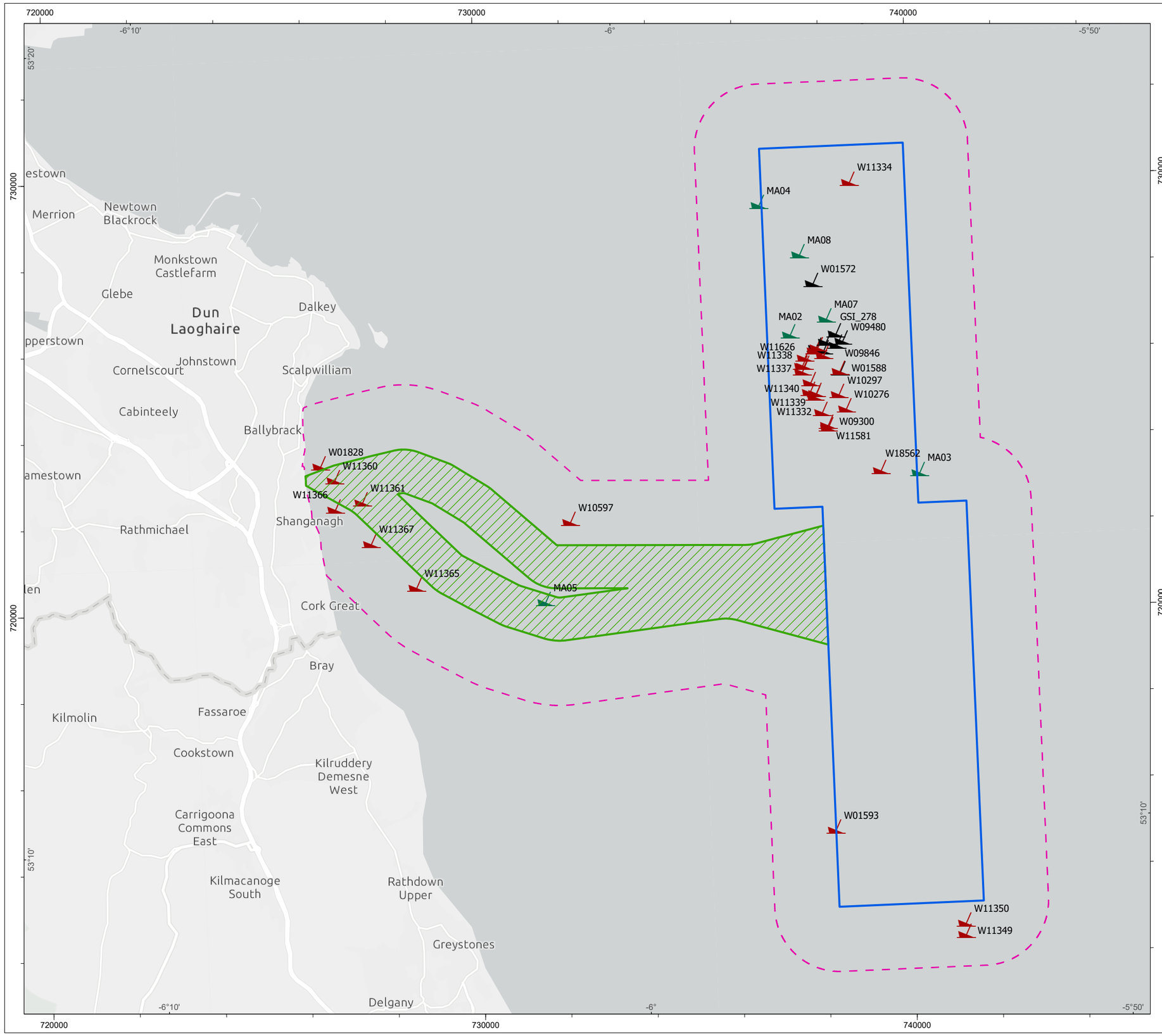
3.4.33 Along the coastline of County Wicklow (approximately within the boundary of the marine archaeology study area) from north to south documented losses are as follows;

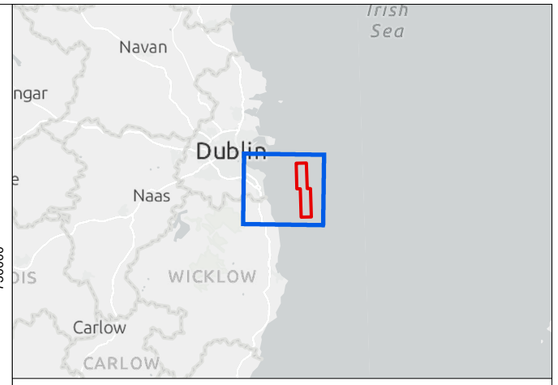
- There are 110 recorded loses off Bray, and Bray Head;
- 34 recorded losses off Greystones;
- seven recorded losses off Glen Strand;
- six recorded losses off Kilcoole;
- four recorded off Six Mile Point; and
- 14 records off Five Mile Point.

3.4.34 The sandbanks within the marine archaeology study area have been an additional cause of shipping losses. The current estimated casualties are listed below from north to south;

- Two recorded off Bennet Bank;
- Nine records on Burford Bank;
- 141 records on the Kish Bank (believed to be only half the actual number (Brady L., 2008);
- Three records on the Bray Bank; and
- 48 records off Codling Bank.

3.4.35 The unknown and uncharted wrecks outlined previously in Section 3.4 could potentially be associated with any of the historical documented losses within the marine archaeology study area and wider area, however, there is not enough information at present to positively relate or identify them. There is also the potential for earlier wrecks to have occurred in the study area, for which no documentation survives, and which await discovery.





Array Area
Export Cable Corridor
Marine Archaeology Study Area

Recorded wrecks
- INFOMAR
- MA ID
- WIID

DRAWING STATUS
FINAL

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Recorded Wrecks within the Marine Archaeology Study Area

DRAWING NUMBER: **03**
PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-03	DRAFT	HA	CH	#####

0 0.7 1.3 2 2.6 Kilometers
0 1 1 2 2 Miles

N GRID NORTH

SCALE 1:90,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF ODN/LAT/MLLW
PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.5 Assessment of geophysical data

3.5.1 The results following the archaeological assessment of geophysical data are presented below and summarised in Table 5. The archaeological categories and archaeological potential of the anomalies were determined following the criteria as stated in Table 4.

Table 5 Archaeological categories identified in the geophysical data

Archaeological categorisation	Number of records
Wreck	21
Possible wreck or wreck debris	16
Anchor	0
Archaeological anomalies	20
Magnetic anomalies	41
Geophysical targets	7,434

Wrecks

3.5.2 Twenty one records, as identified from the assessment of geophysical data, were classed as known or reported wrecks and apparent shipwreck or aviation material as described below and illustrated in Figure 4 and Annex E.

3.5.3 **MA0096** (SSS MA2095; MA wreck ID **MA05**; MBES MA4076), (Annex E, Figure E-1) an unknown and uncharted wreck with visible features measuring 15 m long and 5 – 6 m wide. Previously identified in the Marine Archaeology Assessment for Foreshore Licence FS007029 application and identified in the SSS data.

3.5.4 **MA0098** (SSS MA2097; MA wreck ID **MA04**; MBES MA4078; MAG MA21060), (Annex E, Figure E-2) an unknown and uncharted wreck with visible debris in an area measuring 5.5 x 2.5 m. Previously identified in the Marine Archaeology Assessment for Foreshore Licence FS007029 application and seen in the SSS data. There is an associated magnetic return of 3645 nT.

3.5.5 **MA0106** (SSS MA2105; **W11626**; MBES MA4081; MAG MA20526), (Annex E, Figure E-3), an unknown wreck. Described in the INFOMAR data as a wooden wreck known as the 'Iron Pipe Wreck,' measuring 19 x 5 m. Seen in the SSS data as a linear scattering of hard reflectors measuring 20 x 9.2 m. There is an associated magnetic return of 736 nT.

3.5.6 **MA0107** (SSS MA2106; **W11333**; MBES MA4082), (Annex E, Figure E-4) an unknown wreck. Seen in the SSS data as an isolated rectangular buried feature measuring 3.8 x 3.9 m.

3.5.7 **MA0108** (SSS MA2107; **W01630** or **W11331** or **GSI 281**; MBES MA4083), (Annex E, Figure E-5) seen in the SSS data as an isolated curved hard reflector with shadow and 2.9 m scour, measuring 8.8 x 2.9 m and a height of 0.6 m above the seabed. **W01630** is recorded as an unknown wooden wreck lying upside down with a copper sheathed hull, measuring 17 m long and is located 174 m southeast from the feature seen in the SSS data. **W11331** is recorded as an unknown wreck with no further details and is located 173 m south southeast from the feature seen in the SSS data. **GSI 281** is recorded as an unknown wreck with no further details and is located 154 m south southeast from the feature seen in the SSS data.

3.5.8 **MA0110** (SSS MA2109; **W11610**; MBES MA4083), (Annex E, Figure E-6) an unknown wreck. Seen in the SSS data as a linear reflector measuring 25 x 2.5 m with a pronounced shadow sitting 1.1 m above the seabed. **MA0109** and **MA0111** are both seen as banded features in the SSS data, likely planking and wreck debris associated with **MA0110** and are located 12 m northwest and 14.9 m east, respectively, from the main wreck assemblage.

3.5.9 **MA0115** (SSS MA2114; **W11332**; MBES MA4087; MAG MA20534), (Annex E, Figure E-7) an unknown wooden wreck recorded as measuring 26.5 x 4.3 m in the 2010 INFOMAR seabed mapping programme. Seen in the SSS data as a partially buried linear feature measuring 30 x 5.6 m and sitting 0.6 m above the seabed. MA0114 and MA0116 are likely associated wreck debris located 9m at southwest and 12.5 m due north, respectively.

3.5.10 **MA0118** (SSS MA2117; **W09300**; MBES MA4089; MAG MA20528), (Annex E, Figure E-8) an unknown wreck previously described as 21 m long and 3.7 m wide and recorded in the INFOMAR mapping programme. Seen in the SSS data as the buried outline of a wreck measuring 20 x 3.3 m. There is an associated magnetic return of 56 nT.

3.5.11 **MA0120** (SSS MA2119; **W01594**; MBES MA4090; MAG MA21101), (Annex E, Figure E-9) the iron merchant steamer SS *Vesper*. Seen in the SSS data the scattered remains of a wooden composite wreck with an array of linear reflectors measuring 30.7 x 9.5 m and sitting 2 m above the seabed. Associated with a magnetic return of 9015 nT.

3.5.12 **MA0127** (SSS MA2126; **W01629** or W01588; MBES MA4095; MAG MA21117), (Annex E, Figure E-10). Seen in the SSS data as a scattered array of angular reflectors over an area of 29 x 8 m with a height of 1 m above the seabed. W01629 lies 7.4 m west of the feature seen in the SSS and is listed as the remains of a 300-400 tonne wooden wreck, partially exposed with a number of anchors, pottery, clay pipes, iron pots, a capstan and winch recorded on the wreck site. W01588 is the recorded site for the *Sir Charles Napier*, a 638 tonne merchant sailing vessel carrying a cargo of iron pots and iron hoops. Associated magnetic return of 106 nT.

3.5.13 **MA0132** (SSS MA2131; **W11334**; MBES MA4096; MAG MA21288), (Annex E, Figure E-11) an unknown wreck. Seen in the SSS data as an isolated buried ovate outline of a wreck measuring 23 x 7.5 m. Associated magnetic return of 58 nT.

3.5.14 **MA0134** (SSS MA2133; MBES MA4097; MAG MA21302), (Annex E, Figure E-12) an unknown and previously uncharted wreck. Seen in the SSS data as a wooden wreck with visible planking, measuring 10.8 x 5 m. Associated magnetic return of 37 nT.

3.5.15 **MA0140** (SSS MA2139; MA wreck ID **MA03**; MBES MA4104; MAG MA21210), (Annex E, Figure E-13) an unknown wreck measuring 15.6 x 7.5 m. Previously identified in the Marine Archaeology Assessment for Foreshore Licence FS007029 application and seen in the SSS data. Associated magnetic return of 24 nT.

3.5.16 **MA0171** (SSS MA2170; MA wreck ID **MA08**; MBES MA4119), (Annex E, Figure E-14) an unknown and uncharted wreck with visible feature measuring 11 x 6.7 m. in the Marine Archaeology Assessment for Foreshore Licence FS007029 application and seen in the SSS data.

3.5.17 **MA0173** (SSS MA2172; **W01572**; MBES MA4121; MAG MA20348), (Annex E, Figure E-15) the sailing vessel *Glenorchy*. Seen as a scattered wooden wreck array measuring 63 x 16.7 m with a height of 1 m in the SSS data. An upstanding mast measuring 3.5 m above the seabed was visible on the forward-facing sonar as well. Associated magnetic return of 3525 nT.

3.5.18 **MA0178** (SSS MA2177; MA wreck ID **MA07**; MBES MA4123; MAG MA20250), (Annex E, Figure E-16) an unknown and uncharted wreck with visible feature measuring 20 x 14.5 m. Previously identified in the Marine Archaeology Assessment for Foreshore Licence FS007029 application and seen in the SSS data. Possibly associated with **MA0180** and **MA0179**, which appear as wreck debris in the SSS data and are located 19 m southeast and 21 m south southeast, respectively. Associated magnetic return of 665.5 nT.

3.5.19 **MA0181** (SSS MA2180; **GSI 278**; MBES MA4125; MAG MA20278), (Annex E, Figure E-17) an unknown wreck measuring 13 x 4 m. Seen in the SSS as an isolated collection of cylindrical hard reflectors with pronounced shadows measuring 12 x 10 m and sitting 1.4 m above the seabed. Associated magnetic return of 428 nT.

3.5.20 **MA0182** (SSS MA2181; **W09846**; MBES MA4126; MAG MA20351) (Annex E, Figure E-18) *MV Bolivar* (stern), seen in the SSS data as a partially buried wooden composite wreck measuring 68 x 17 m and sitting 1.6 m above the seabed. Associated magnetic return of 18427 nT.

3.5.21 **MA0185** (SSS MA2184; **W09480**; MBES MA4128; MAG MA20195) (Annex E, Figure E-19) MV *Bolivar* (bow), seen in the SSS data as a hard reflector in an area of 3 m scour measuring 2.8 x 0.3 m and 0.6 m above the seabed. The wreck is listed in INFOMAR as a 5320 tonne cargo vessel with the stern (**MA0182**/**W09846**) recorded approximately 160 m southwest of the bow. Associated magnetic return of 15165 nT.

3.5.22 **MA0192** (SSS MA2191; **W18562**; MBES MA4129; MAG MA21127), (Annex E, Figure E-20) an unknown wreck. Described in the INFOMAR data as measuring 13.5 x 3.5 m. Seen in the SSS data as a collection of liner hard reflectors associated with a potential wooden wreck, measuring 19 x 28 m and sitting 1 m above the seabed. Associated magnetic return of 1951 nT.

3.5.23 **MA0302** (MA wreck ID MA02), (Annex E, Figure E-21) a new wreck discovered by the DAU that had not been logged in the WIID. The wreck is centred on 53 16.200N, 05 56.500W, measuring 21.2 x 3.7 m with a recommended AEZ of 300 m (DAU, 2019). This wreck was not visible in the SSS, MBES or MAG data.

Possible wreck or wreck debris

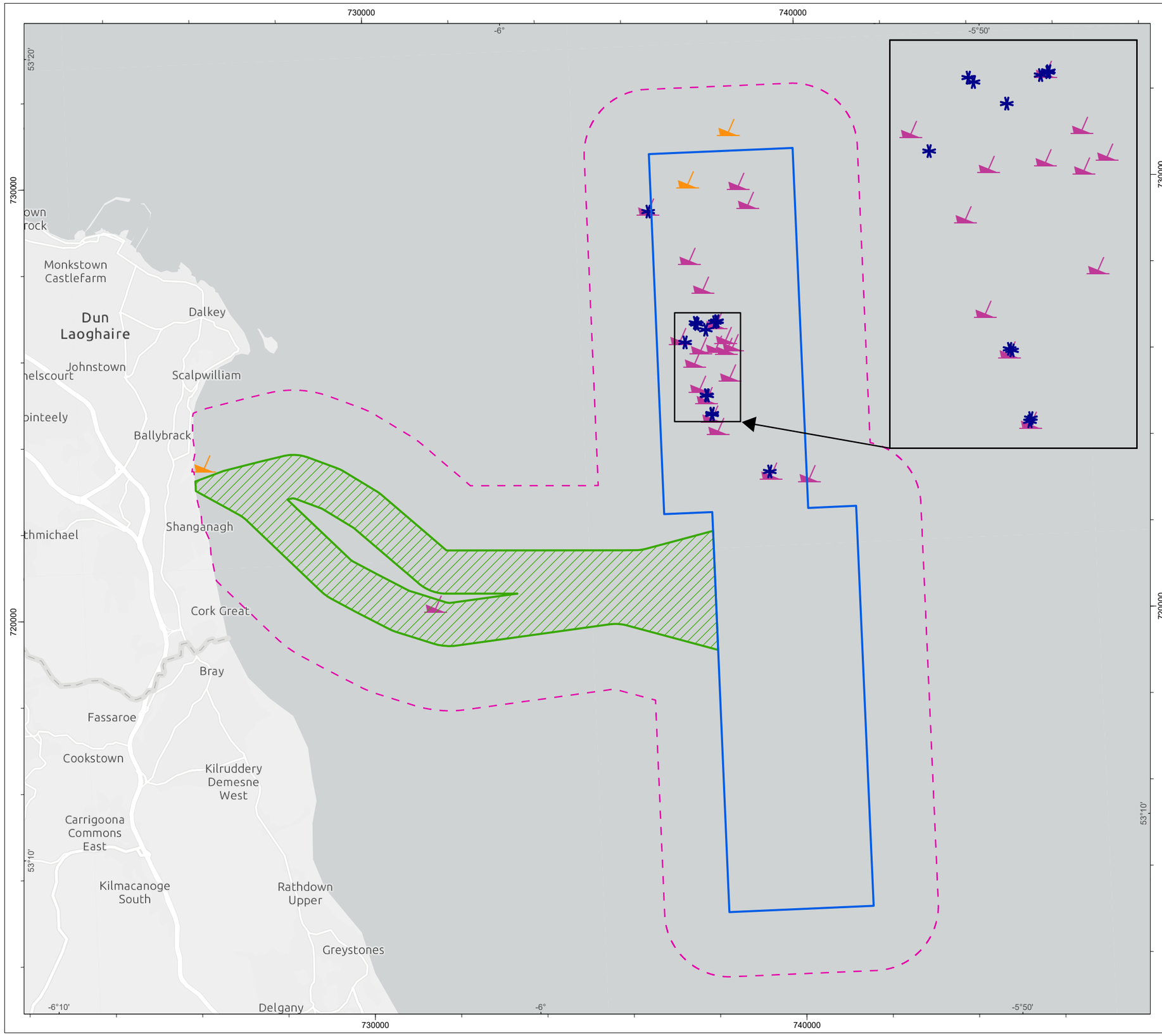
3.5.24 Sixteen records as identified from the assessment of 2021 geophysical data were not previously recorded as wrecks or aviation remains but have been considered likely to be wrecks or associated debris (Figure 4 and Figure 5). At this stage none of the anomalies have been identified as potential aviation remains. The identified records are described below:

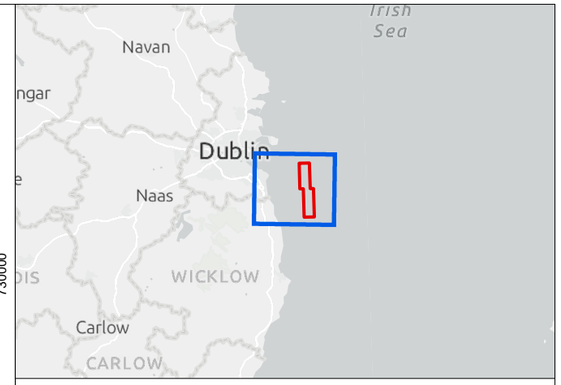
- **MA0109** (SSS MA2108; MBES MA4084) is a partially buried banded feature measuring 24 x 2 m, potentially planking associated with MA0110 which lies 12 m southeast.
- **MA0111** (SSS MA2110; MBES MA4085) is a partially buried banded feature measuring 3.7 x 0.9 m, potentially planking associated with the wreck MA0110 which lies 15 m west northwest.
- **MA0114** (SSS MA2113; MBES MA4087; MAG 20534) is an isolated partially buried reflector measuring 21 x 2.5 m, sitting 0.7 m above the seabed with 2.5 m of associated scour. There is a magnetic reading of 21 nT associated with this feature. This feature is likely wreck debris associated with MA0115 which is located 9 m northeast.
- **MA0116** (SSS MA2115; MBES MA4087; MAG MA20534) is a linear partially buried hard reflector with pronounced shadow and scour measuring 10.5 x 1.7 m, sitting 0.5 m above the seabed with 1.8 m of associated scour. There is a magnetic reading of 21 nT associated with this feature. This feature is likely wreck debris associated with MA0115 which is located 15.5 m to the south.
- **MA0130** (SSS MA2129; MAG MA21297) is an isolated feature measuring 25.4 x 10.7 m, potentially a wreck or wreck debris. Associated magnetic return of 61 nT.
- **MA0136** (SSS MA2135; MBES MA4098) is a linear hard reflector measuring 0.8 x 0.5 m. The feature is probable wreck debris associated with MA0192, which is located 31 m E. Associated magnetic return of 15 nT.
- **MA0156** (SSS MA2155; MBES MA4113) is a pile of hard reflectors containing some linear features, with a long, linear cable-like feature extending from the main feature. The visible extent of the feature measures 24 x 6.3 m sits 1.4 m above the seabed and lies 100 m south of MA0098.
- **MA0158** (SSS MA2157; MBES MA4114; MAG MA20535) is an isolated hard reflector measuring 5.6 x 6.7 m and sitting 0.65 m above the seabed. The feature is located 83 m northwest of MA0105 (a feature interpreted as low significance debris). Associated magnetic return of 128 nT.
- **MA0159** (SSS 2158; MBES MA4115; MAG 21159) is an isolated pair of partially buried linear reflectors measuring 3.9 x 2.1 m, with 0.9 m of associated scour; potentially a wreck or wreck debris. Associated magnetic return of 1648 nT.

- **MA0160** (SSS MA2159; MBES 4116) is a feature of multiple linear hard reflectors at intersecting angles measuring 9.2 x 3.7 m and sitting 0.3 m above the seabed. The feature is located 41 m northwest of MA0161 and is potentially associated wreck debris.
- **MA0161** (SSS MA2160; MBES MA4117) is a linear feature with 1.2 m of associated scour. The feature measures 4.4 x 1.7 m and sits 0.27 m above the seabed, adjacent to large sand wave that can be seen in the MBES.
- **MA0164** (SSS MA2163) is a feature of multiple linear hard reflectors measuring 4.3 x 4.3 m and potentially associated with the wreck MA0178 which is located 400 m northeast.
- **MA0176** (SSS MA2175; MAG MA20356) is a partially buried reflector measuring 8.9 x 1.6 m, potentially rigging associated with MA0178, which lies 46 m west southwest. Two other associated features of wreck debris, MA0179 and MA0180, are located 20 m south southeast and southeast respectively. There is an associated magnetic reading of 90 nT and a potentially associated return of 416 nT 58 m to the east.
- **MA0179** (SSS MA2178; MBES MA4124) is a scattering of partially buried linear reflectors, likely planking associated with MA0178 which is located 21 m northwest. The feature measures 8 x 2.6 m and has a potentially associated magnetic return of 416 nT, 20 m SE.
- **MA0180** (SSS MA2179) is partially buried reflectors, likely debris associated with MA0178 which is located 20 m northwest. The feature measures 3.7 x 0.5 m and has a potentially associated magnetic return of 416 nT, 21 m SSE.
- **MA0305** (MBES MA4217; MAG MA12959) is a high magnetic anomaly that can be seen as a raised linear feature measuring 50 x 7 m in the MBES data. This feature is located 183 m northwest of the NMS location for the *Loch Fergus* (W01828) and is potentially the correct location of this wreck. Associated magnetic reading is 14051 nT.

Anchors

3.5.25 There were no anchors identified in the acoustic geophysical data within the marine archaeology study area. However, there is the potential for magnetic anomalies to represent buried anchors.





Array Area

Export Cable Corridor

Marine Archaeology Study Area

Geophysical_Wrecks_WreckDebris

Archaeological anomalies seen in geophysical data

Potential Wreck

Wreck

Wreck Debris

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Wrecks, Potential Wrecks and Wreck Debris seen in Geophysical Data

DRAWING NUMBER: **04**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-03	DRAFT	HA	CH	#####

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0 1 1 2 2 Miles

GRID NORTH

SCALE 1:90,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF ODN/LAT/MLW

PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

Dublin Array
Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

Archaeological anomalies

3.5.26 Twenty archaeological anomalies seen in the SSS data have been considered to map material of archaeological potential such as buried and confirmed palaeolandscapes, or locations where a wreck has been recorded but is not clearly defined in the other geophysical datasets. The records have been included in Annex D and illustrated in Figure 5.

Magnetic anomalies

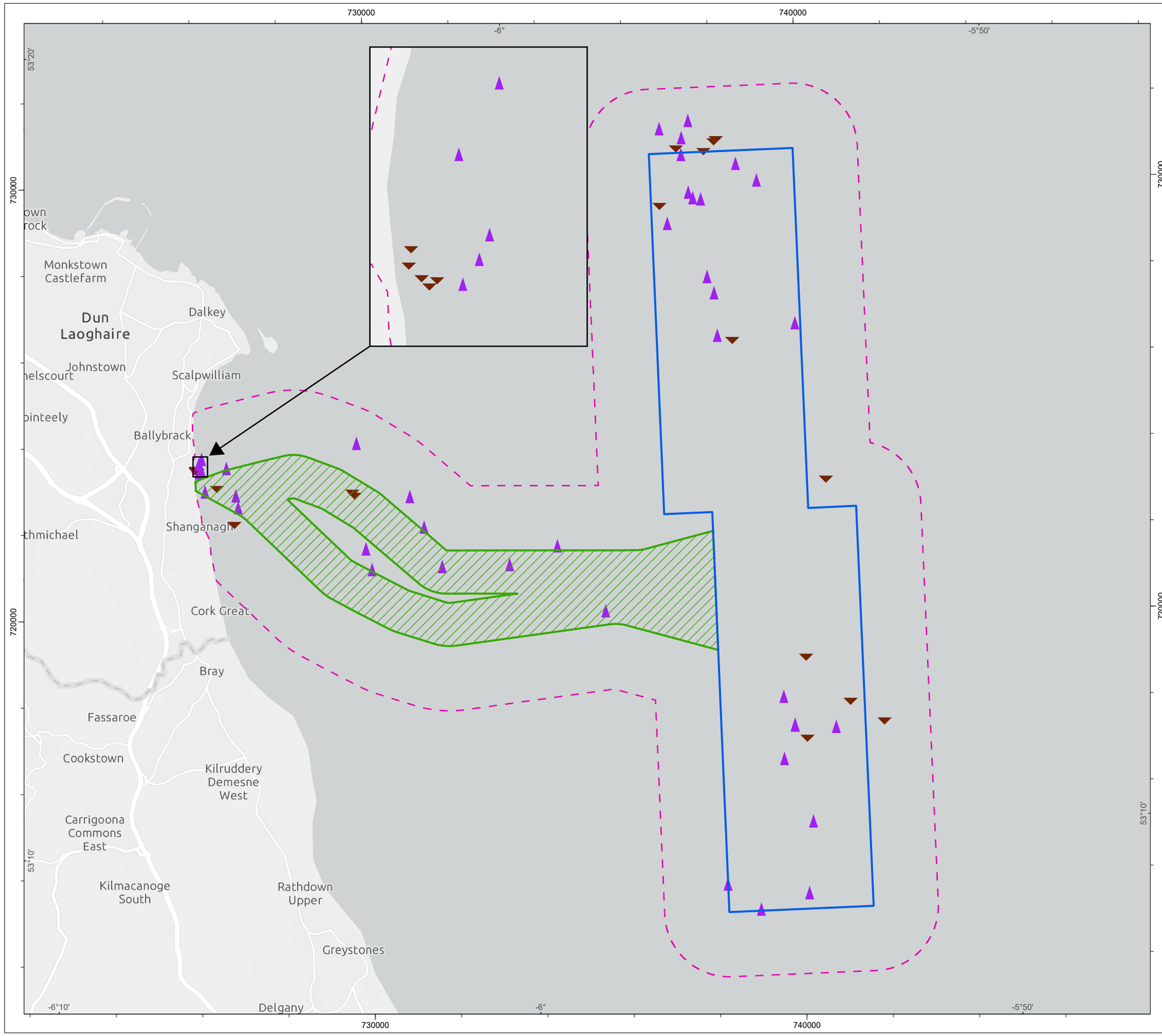
3.5.27 Forty one magnetic anomalies with a return of 100 nT or larger have been considered to map material of archaeological potential such as buried wrecks or wreck material that was not seen or clearly defined in the other geophysical datasets. Twenty three of these records were identified within the MBES data but not in the SSS data so they have remained classified as magnetic anomalies due to the limited information. All records have been included in Annex D and illustrated in Figure 5.

3.5.28 Additionally, 7,367 targets with a return under 100 nT considered to be of anthropogenic origin but likely associated with contemporary activity with little or no archaeological significance such as modern debris, ropes, chains or fishing gear and magnetic returns under 100 nT with no other corresponding geophysical indication have not been included here.

Geophysical targets

3.5.29 There are 7,434 geophysical targets, including the 7,367 magnetic targets <100 nT, within the marine archaeology study area.

3.5.30 Rock outcrops with no other clear anthropogenic features have been included as potential debris within the geophysical targets with low archaeological potential. These could potentially be of archaeological interest as rocks and stones have historically been used as ballast, and so can be indicative of wreck remains however further assessment is needed to verify this.



Array Area

Export Cable Corridor

Marine Archaeology Study Area

Geophysical_Arch_Anomalies_2024

Archaeological anomalies seen in geophysical data

Archaeological anomaly

Magnetic anomaly

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Archaeological and Magnetic Anomalies seen in Geophysical Data

DRAWING NUMBER: 05

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-03	DRAFT	HA	CH	#####

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0 1 1 2 2 Miles

N GRID NORTH

SCALE 1:90,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF CDN/LAT/MLLW

PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

Palaeogeographic assessment of geophysical data

3.5.31 The geoarchaeological assessment of SBP data to a depth of about 5 m below seabed was undertaken on a line-by-line basis with focus on relict palaeochannels underlying the seafloor sediments.

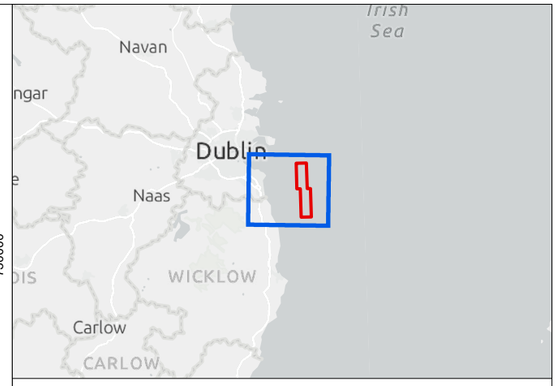
3.5.32 The results from the assessment have been combined with the results from the assessment of both SBP data and interpretation of the UHRS data undertaken in the main array by Fugro (Detection Licence 21R0027) to provide higher resolution information on the Quaternary geology (Table 6), the units identified within the SBP data are illustrated in Figure 6.

3.5.33 The area where survey data was collected follows a previous outline of the development area, which has since been refined, however the assessment outside of the Offshore ECC is included in the assessment to provide context for the extent and prevalence of palaeogeographic features in and around the Dublin Array Offshore Wind Farm and will be used to provide a more robust interpretation of the deposit model.

Table 6 Units identified from the archaeological assessment of Sub Bottom Profiler data, supported by UHRS data (Detection Licence 21R0027).

Unit	Lithology	Stratigraphy	Geoarchaeological potential
Unit A	Mobile, unconsolidated sediments. Present across the majority of the site but mostly associated with the presence of large sandwaves and sandbanks with clear bedding in some areas.	Seabed sediment, assumed to have been deposited during the Flandrian transgression and reworked from the underlying units.	The deposit could contain archaeological artefacts but is not of geoarchaeological potential.
Unit B	Fine to medium silty SAND, medium amplitude reflectors, chaotic to sub-parallel with erosion surfaces.	Possibly subtidal to estuarine sediments deposited in the early to mid-Holocene.	Unit B is of high geoarchaeological potential and could contain prehistoric human, animal, and plant material.
Unit C	Low to moderate amplitude, parallel internal reflectors with a high amplitude basal reflector. Associated with data blanking.	Interpreted as glaciolacustrine/glaciomarine prograded deposits.	High potential for the preservation of micro and macro fossils.
Unit D	SAND and GRAVEL, chaotic in places but well-bedded/highly structured in others.	Complex coastal environment with a braided glacial delta or an outwash plain.	The unit is of limited archaeological potential due to re-working but can possibly be dated using OSL.

Unit E	Silty CLAY or silty SAND, wavy parallel, low amplitude internal reflectors. The basal reflector within the deep channel is high amplitude.	Glaciomarine/glaciolacustrine to subglacial channel infill.	The deposit is not likely to be contemporary with hominin presence in the area.
Unit F	Chaotic – low to high amplitude internal reflector. Only seen in the UHRS data.	Subglacial till and evident channels. Likely to be glaciogenic in origin.	The deposit is not likely to be contemporary with hominin presence in the area.
Unit G	Consistent layer at base of large channels across the site, well bedded with strong internal reflectors. Only seen in the UHRS data.	Identified at the base of the deepest mapped channels below all other Quaternary units.	The deposit is not likely to be contemporary with hominin presence in the area.
Bedrock	Low to moderate to high amplitude reflector present across the site in SBP and UHRS.	Either Mid-Tertiary sandstones or permo-Triassic mudstones.	Not of geoarchaeological potential.



- Array Area
- Export Cable Corridor
- Marine Archaeology Study Area

Units identified in the Sub-Bottom data

Unit

- Unit B
- Unit C
- Unit D
- Unit E
- Bedrock
- Shallow blanking
- Deep blanking

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Dublin Array

DRAWING TITLE

Units of Geoarchaeological Potential Identified in the Sub Bottom Data

DRAWING NUMBER: 06

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-03	DRAFT	HA	CH	#####

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0 1 1 2 2 Miles

N GRID NORTH

SCALE 1:90,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF ODN/LAT/MLLW

PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

Dublin Array
Generation for generations

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3.5.34 The substrate of the marine archaeology study area is mainly made up of sand, possibly silty sand, and silt (**Unit A**). Areas of outcropping bedrock are noted seaward of Dalkey and in Killiney Bay, stretching south towards Shankill. The main depositional features are sand dunes making up the Kish and Bray Banks as also seen from the bathymetric data.

3.5.35 **Unit B** shows a complicated system of channel features and a shallow riverine pattern which is interpreted to represent an intertidal /estuarine to shallow marine / coastal environment with sediment likely to have been deposited in the early to mid-Holocene. Unit B has been located along the Offshore ECC and across the Array as illustrated on Figure 7. Unit B (**MA3005-MA3014**) is of high geoarchaeological potential and could contain prehistoric human, animal, and plant material.

3.5.36 **Unit C** (**MA3015-MA3018**) is found across the array and parts of the marine archaeology study area (Figure 8) and is likely to represent prograded late glacial marine / glaciolacustrine sediments. In places the unit seems to infill deeper channels. One borehole has confirmed this to be composed of clay which would have a high potential for preservation of micro and macro fossils that can be used to further date the deposit and understand its relationship with human interaction.

3.5.37 **Unit D** appears as sandy gravel and may represent a complex coastal environment with a braided glacial delta or an outwash plain. The deposit may have been laid down between periods of submergence. Unit D is found in the north part of the survey area and south part of the Array (Figure 8) (**MA3019-MA3021**). The unit looks chaotic in places but well-bedded / highly structured in others across the marine archaeology study area. The complex cross bedding could derive from its position close to the oscillating ice margin. The unit is of limited archaeological potential due to the likelihood that it is re-worked making a secure date difficult. Should organics be found within a secure context it is likely that the material would be outside the limit for c14 dating where samples generally older than 55-60,000 years BP cannot be securely dated as the amount of c14 remaining is negligible. The sandy, gravelly deposit can possibly be dated using optically stimulated luminescence (OSL) where the time since the sediment grains were deposited to light is measured. Should OSL dating be used it is paramount that the samples are collected in opaque liners and opened in a OSL laboratory to prevent light or heat resetting the luminescence.

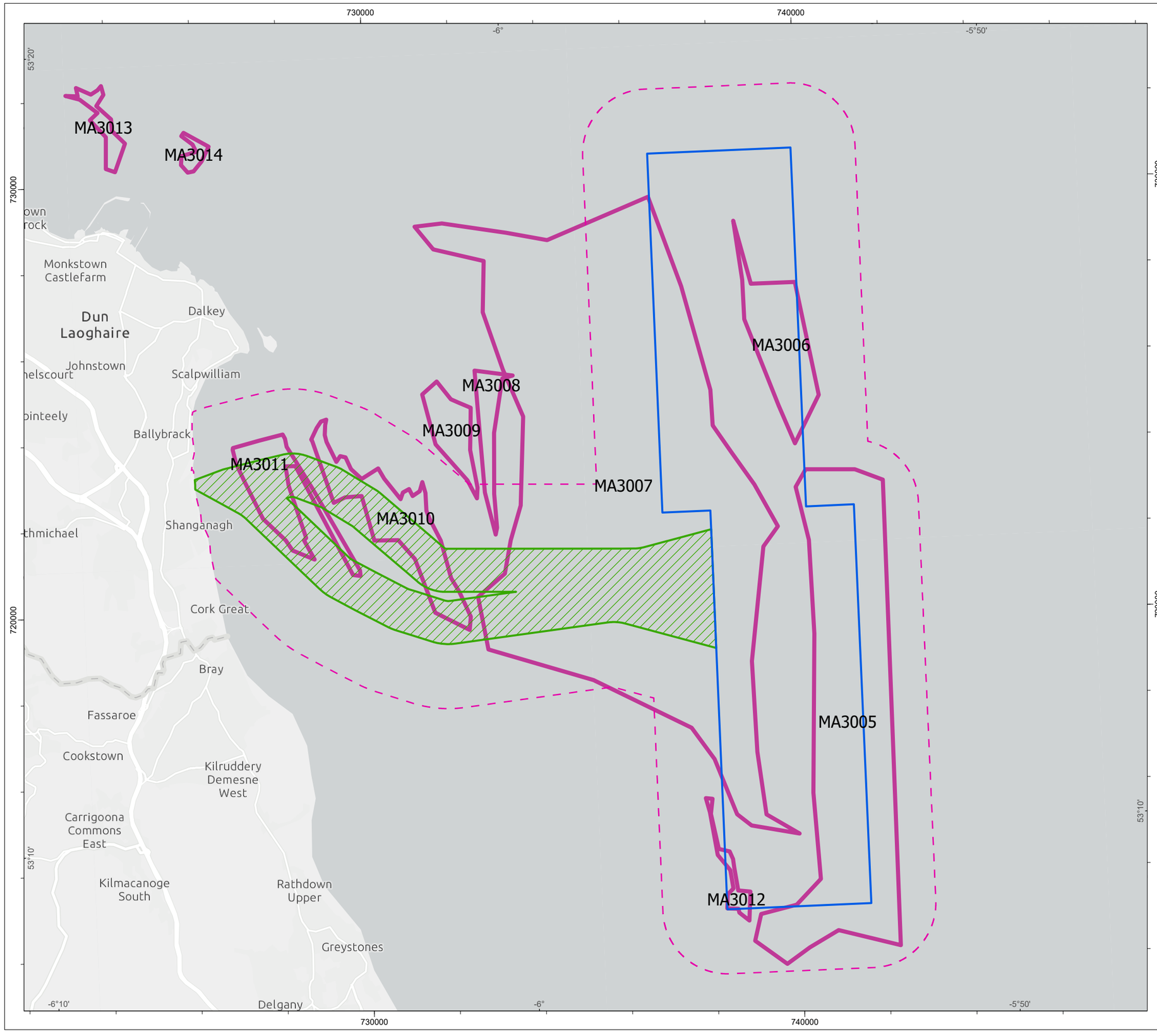
3.5.38 **Unit E** is represented by a high-amplitude, localised erosional unconformity and channel features (**MA3022**) with a localised presence across the survey area, but not within the current marine archaeology study area. The unit may be made up of glaciomarine or glaciolacustrine to subglacial channel infill of clay or sand. The potential for macro or micro fossils or material suitable for dating is presently unknown but it is likely that the time scale for depositions is not contemporary with hominin presence in the area.

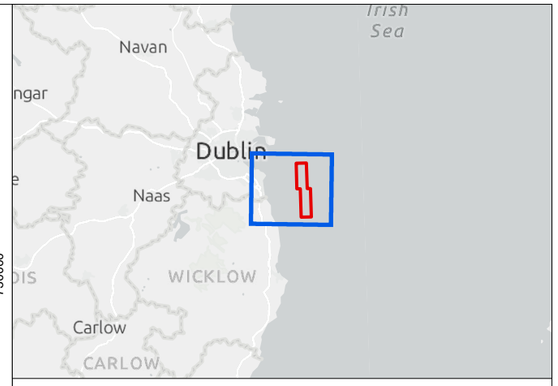
3.5.39 **Unit F** is a complex geophysical unit, only identified on the URHS data (Fugro, 2022 and 2021b) which is likely to be glaciogenic in origin and could be linked to Cardigan Bay Fm Upper till. The unit shows many internal incisions including more prominent channel features. As with Unit E, the potential for macro or micro fossils or material suitable for dating is presently unknown but it is likely that the time scale for the deposition is not contemporary with hominin presence in the area.

3.5.40 **Unit G** is a well bedded deposit with strong internal reflectors. It is consistently visible at the base of the deepest mapped channels across the site and in some areas where the bedrock is closer to the seafloor. The unit is only identified on the URHS data (Fugro, 2022and 2021b). The potential for macro or micro fossils or material suitable for dating is presently unknown but it is likely that the time scale for depositions is not contemporary with hominin presence in the area.

3.5.41 **Bedrock** (**MA3000-MA3004**) is represented by a low to moderate to high amplitude faulted and folded reflector present across the site and seen in both the SBP and UHRS data. The bedrock is thought to be made up of either Mid-Tertiary sandstones or permo-Triassic mudstone. The bedrock as a deposit is not of geoarchaeological potential.

3.5.42 Data blanking is evident across large areas of the marine archaeology study area, the blanking may represent biogenic origin shallow gas or thermogenic gas which blanks out the signal below resulting in lack of information on any potential channels below.





Array Area
Export Cable Corridor
Marine Archaeology Study Area
Unit B

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Dublin Array

DRAWING TITLE

Unit B as Identified in the Sub Bottom Profiler Data

DRAWING NUMBER: 07

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-03	DRAFT	HA	CH	#####

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0 1 1 2 2 Miles

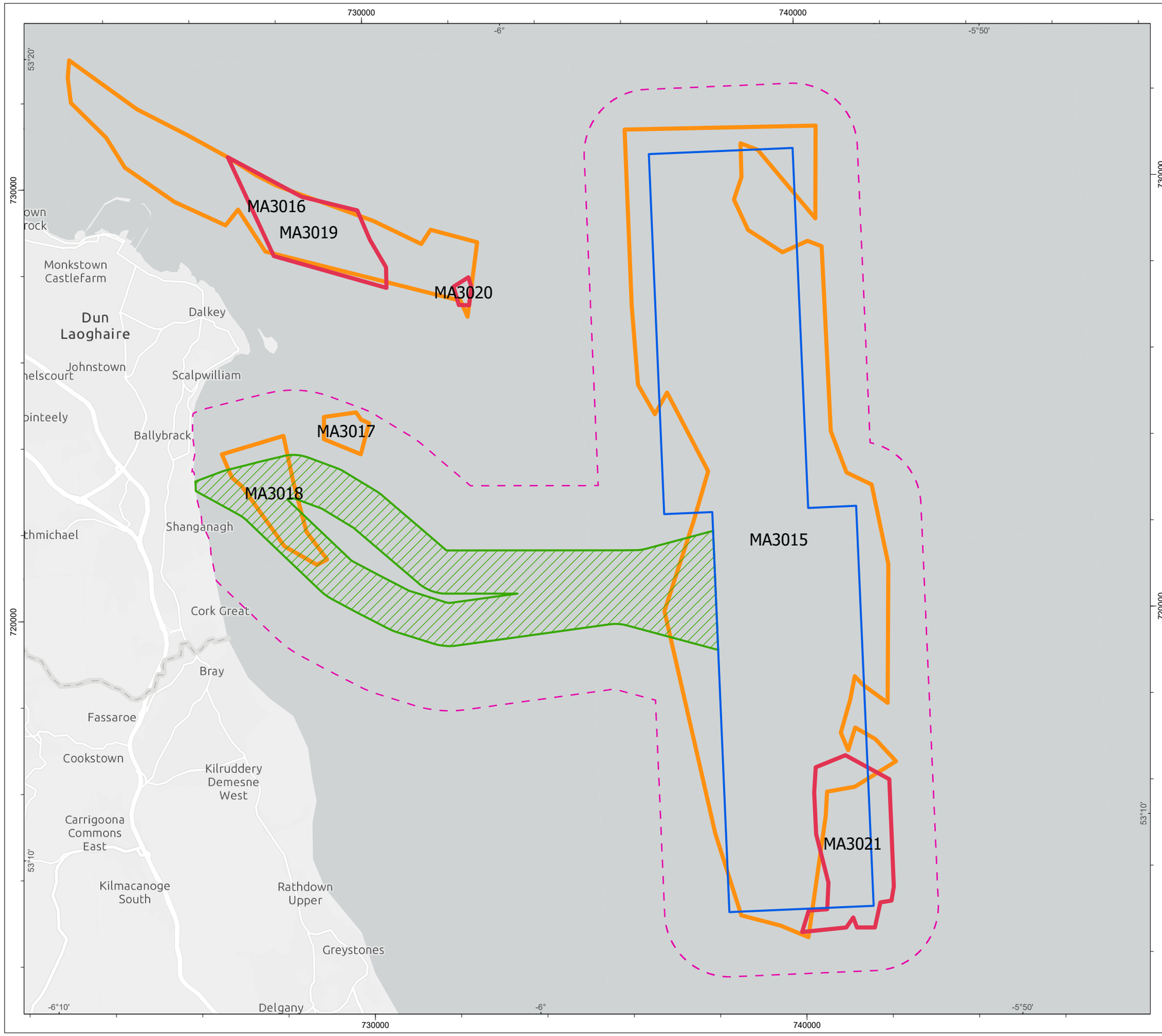
N GRID NORTH

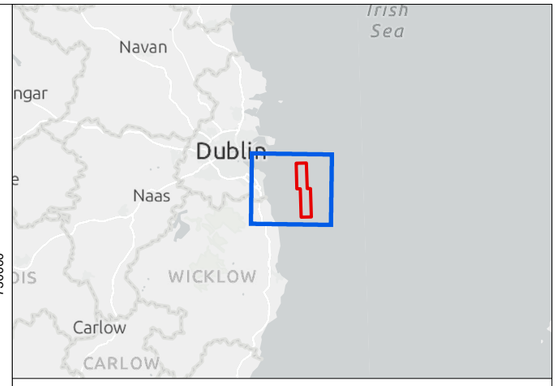
SCALE 1:90,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF CDN/LAT/MLLW
PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

Dublin Array
Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited





Array Area
Export Cable Corridor
Marine Archaeology Study Area
Unit C
Unit D

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Dublin Array

DRAWING TITLE

Unit C and D as Identified in the Sub Bottom Profiler Data

DRAWING NUMBER: **08**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-03	DRAFT	HA	CH	#####

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0 1 1 2 2 Miles

N GRID NORTH

SCALE 1:90,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF. ODN/LAT/MLLW

PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

Dublin Array
Generation for generations
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Environmental context

3.5.43 During the Quaternary, much of Northern Europe experienced extensive ice sheet cover during a number of glaciation events. The most recent of these glacial events was in the LGM, c. 34,000 BP to 12,000 BP (Clark *et al*., 2012; Chiverrell *et al*., 2013). During this event, an ice sheet, known as the British-Irish Ice Sheet (BIIS) merged across much of Britain and Ireland. The BIIS began forming in the northern and upland area before advancing across the landscape, marine and terrestrial, creating various glacial environments where sediments were deposited or eroded depending on the stage of ice sheet advance or retreat (Scourse *et al*., 2019).

3.5.44 The BIIS extended into the Celtic Sea to reach its maximum limits c. 25.3-24.5 ka before collapsing with rapid marginal retreat to the northern Irish Sea Basin (ISB) (Chiverrell *et al*., 2018). This retreat was largely a result of the Irish Sea Ice Stream (ISIS), the largest marine terminating ice stream draining the former BIIS. The main axis of the ISIS flowed from north to south through the ISB, with catchment areas in southern Scotland, northern England, Ireland, and Wales (Scourse *et al*., 2019).

3.5.45 The retreat of the ISIS is the single agent responsible for the glacial stratigraphy and geomorphology of the current ISB (Chiverrell *et al*., 2013). Significant amounts of sediment were eroded and reworked with variable thicknesses of glaciogenic deposits formed, referred to as 'Irish Sea Till,' (Eyles and McCabe, 1989). These deposits are composed of shelly, grey and muddy, unsorted sediments with some angular clasts. By approximately 22,500 – 21,200 years BP ice had retreated to a line just south of the marine archaeology study area. Ice sheet decay slowed thereafter with episodic meltwater discharge (Chiverrell *et al*., 2013).

3.5.46 Following the retreat of the BIIS, relative sea-level rose c. 120 m globally and the climate warmed at the beginning of the Holocene period, approximately 11,200 BP. Large areas of habitable land emerged and palaeogeographic and relative sea-level (RSL) models have indicated that the marine archaeology study area could have been terrestrial landscape as early as 11,000 BP (Sturt *et al*., 2013) through to 7500 BP (Shennan *et al*., 2008).

3.5.47 Previous studies have shown that the area of land exploited by humans and animals was subsequently inundated and the palaeolandscapes were preserved beneath the Irish Sea. Within the study area, intertidal mud deposits have previously been recorded buried beneath the Kish Bank c. -30 m to –35 m below Chart Datum (CD), indicating the presence of palaeoshorelines (Westley and Edwards, 2017: 265). These mud deposits may correlate with Unit E or Unit F as described above.

3.5.48 Evidence for *in situ* intertidal peat beds and a submerged forest have been recorded c. 1 km south of the marine archaeology study area (Figure 2), near Bray Harbour, Co. Wicklow. The remains of the submerged forest were first discussed by Praegar (1896), in which he describes 'some stumps and boughs of trees […] embedded in a compact layer of peat' (Praegar, 1896: 155). Bolton re-surveyed this submerged forest in 1999, however only three trees were partially exposed. Samples obtained from the trees returned a radiocarbon date of 6,180 (+/-80) years BP (early Neolithic). In 2001, the beach levels dropped by an average of 1 m and this time 35 trees were exposed at low tide. However, no samples were taken. This site was also listed in Brooks and Edwards (2006) Irish sea-level database, with samples taken dated to 7432-7832 cal. BP (late Mesolithic) and the palaeoshore mean sea level listed as -3.6 m (Mitchell, 1976). Both positions are outside the extent of the covered survey area which is why no comparison with the geophysical data can be made.

3.5.49 Known instances of subtidal or intertidal assemblages with prehistoric evidence have been compiled in a database of submerged archaeological sites around Ireland for the SPLASHCOS project (Bailey and Sakellariou, 2012). The database does not include any sites within the marine archaeology study area, however two worked undiagnostic lithics were discovered within seabed sand and gravel during dredge monitoring c. 10 km offshore during works associated with the Arklow Bank wind park and one polished stone axe was found by a sport diver at the base of Muglins Roc, Dalkey Sound in 1991 (http://www.splashcos-viewer.eu/).

1.1.1 Further to this, a SSS and magnetometer survey carried out in 2009 to inform the preparation of the Environmental Impact Statement (Saorgus Energy Limited, 2012; 2013a; 2013b) indicated a dark area that may represent a relict submerged landscape such as former soil profiles and/or peat deposits within the marine archaeology study area (Headland Archaeology, 2009). The area is outside the extent of the 2021 geophysical coverage, however the assessment of geophysical data collected in 2021 shows that the nearshore area where the dark reflector was located shows increased presence of bedrock protruding through the overlying sediments. Table 6 summarises the geological Units identified from the 2021 assessment.

4 Future receiving environment

4.1.1 Archaeological receptors within the marine environment are identified by a combination of baseline assessment of the relevant marine archaeology study area and analysis of geophysical and/or geotechnical data for archaeological potential.

4.1.2 On the assumption that Dublin Array Offshore Wind Farm is not constructed, the current baseline will remain the same as described in Section 3.2.

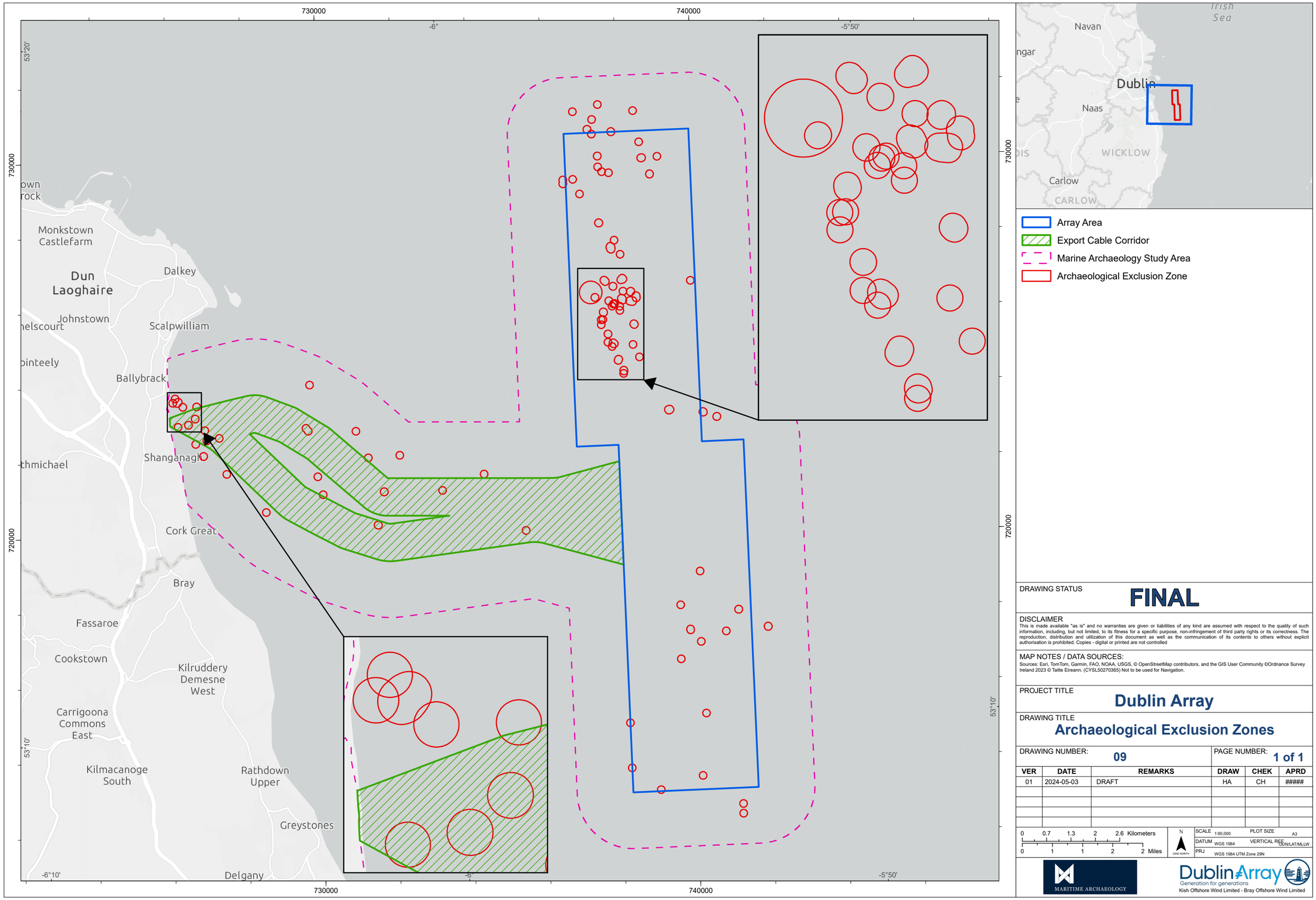
4.1.3 Natural sediment movements might uncover and/or cover the identified receptors. Covered receptors are likely to be protected from impacts, whereas uncovered receptors may be exposed to natural and chemical degradation.

4.1.4 Archaeological Exclusion Zones (AEZ) around known wrecks and receptors of high archaeological potential, as identified in the archaeological assessment of baseline and geophysical data (Section 3) are recommended as illustrated on Figure 9. All activities interfering with the seabed during all project phases must be micro sited to avoid the AEZs which may be altered, increased, reduced, or removed as more information on the receptor becomes available.

4.1.5 All wrecks, potential wrecks, archaeological anomalies and magnetic anomalies have been recommended to have 100 m AEZs with the exception of MA02 which has been recommended to have a 300 m AEZ.

4.1.6 Further, general interference with wrecks over 100 years old and archaeological objects underwater is prohibited under Section 3 of the National Monuments (Amendment) Act 1987.

4.1.7 There is potential for the scientific knowledge of marine archaeology within the marine archaeology study area to develop over the project lifetime. Alongside studies of existing data and newly collected data in the area ahead of other marine developments or undertaken as part of future research projects our understanding of the baseline and identified receptors could therefore be enhanced.



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PROJECT TITLE

Dublin Array

DRAWING TITLE

Archaeological Exclusion Zones

DRAWING NUMBER: **09**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
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0 1 1 2 2 Miles

N GRID NORTH

SCALE 1:90,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF. CDN/LAT/MLW

PRJ WGS 1984 UTM Zone 29N

MARITIME ARCHAEOLOGY

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5 Data gaps or uncertainties

5.1.1 The geotechnical sampling data gives limited spatial coverage of the array area to inform the palaeoarchaeology baseline. Future geotechnical investigations will be undertaken prior to construction. The data obtained will be subject to archaeological assessments as per the Archaeological Management Plan (AMP) (EIAR, Volume 7: Outline Plans: 7.7).

6 Summary

6.1.1 The offshore infrastructure of the proposed Dublin Array Offshore Wind Farm is to be located in the area known as the Kish and Bray Banks, approximately 10 km off the east coast of Ireland. This area demonstrates extensive use from the Palaeolithic to modern day which can be seen in both the data collected for the baseline review and the site-specific geophysical data.

6.1.2 Baseline data from previous archaeological excavations as well as geophysical survey data collected in 2021 have been combined in this assessment. The marine archaeology study area includes a 1.5 km buffer around both the Offshore ECC and array area.

6.1.3 Of the 43 known, unknown and uncharted wrecks (Section 3.4 and Figure 3) within the marine archaeology study area, 21 were identified in the geophysical data, as well as three new features considered to be potential wreck sites.

6.1.4 Features identified within the geophysical data as wrecks, potential wreck, wreck debris and of high or medium marine archaeological significance will be mitigated. This will be detailed in the EIAR.

6.1.5 The characterisation of the region and the marine archaeology study area, as detailed in this report, is considered to be adequate for the purposes of undertaking an EIA.

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Annex A Summary of previous archaeological investigations

Site name	SMR no.	License no.	Author	Summary	Date	Latitude	Longitude
Great South Wall	DU019-029002	15E0454	Magnus Archaeology	Monitoring of ground investigation (borehole) works on the Great South Wall, an 18th-century marine structure. Five boreholes were drilled along the length of the wall, one of which (BH 3) appears to have struck timber 0.5m below the base of the wall (-2.46m OD). Although nothing was recovered, location and depth suggest a possible wreck buried on the sand beneath the wall.	2015	53.341179	-6.1634
Pigeon House Fort, Ringsend	DU019-027	09E259	ArchTech Ltd	An archaeological and architectural survey was carried out on the Pigeon House Fort Complex. The existing extent of monument on the ground was defined and its constituent features along with potential subsurface remains were identified. 18th and 19th-century artillery fort.	2009	53.339604	-6.19484
Pigeon House Road, Poolbeg	DU019-029	09E0022 ext.	Margaret Gowen and Co. Ltd	Site investigations revealed no features or finds of archaeological significance.	2010	53.339016	-6.20054
Dublin Bay, Ringsend, Dublin	2001:459	01E0402	Emer Dennehy, Eachtra Archaeological Projects	Another undated wreck was identified during pipeline works in the intertidal zone in Dublin Bay. This wood and metal shipwreck incorporated wooden dowels. A number of spent bullets and musket balls were recovered from two sump trenches close to the wreck site.	2001	53.339863	6.204935
Dun Laoghaire Harbour	2014:328	14D0441	Niall Brady, ADCO	Wreck remains at two locations, which represented scattered remains with only sections of wreckage visible on the surface was located (W01966, W01967).	2014	53.302883	53.302883
Ravenswell, Bray Commons (Co. Wicklow), Cork Great (Co. Dublin)	2020:193	20E0482	Padraig Dunne	A Linear earthwork constructed in the late 19th early 20th century was identified.	2020	53.210858	-6.106064

Annex B Gazetteer of onshore archaeological records

SMR No.	Class	Townland	ITM Easting	ITM Northing	Irish Grid Easting	Irish Grid Northing
DU019-028----	Battery	DUBLIN SOUTH CITY	722275	733892	322351	233866
DU023-029011-	Battery	DALKEY ISLAND	727832	726185	327909	226157
DU026-012----	Battery	KILLINEY	725924	724871	326001	224843
DU016-002001-	Castle - motte	HOWTH	728803	739245	328880	239220
DU015-025----	Castle - tower house	HOWTH DEMESNE	726771	739443	326848	239418
DU015-027001-	Castle - tower house	HOWTH DEMESNE	727772	739032	327849	239007
DU023-020001-	Castle - tower house	BULLOCK	726114	727747	326191	227719
DU023-023010-	Castle - tower house	DALKEY	726343	726961	326420	226933
DU026-055002-	Defensive redoubt	SHANGANAGH	726276	721825	326353	221796
DU026-014002-	Earthwork	KILLINEY	725949	723824	326026	223796
DU023-052003-	Martello tower	DUNLEARY	723852	728973	323928	228946
DU026-014001-	Martello tower	KILLINEY	725941	723838	326018	223810
DU026-055001-	Martello tower	SHANGANAGH	726277	721822	326354	221793
DU026-010----	Megalithic structure	KILLINEY	725432	724741	325509	224713
DU015-032----	Megalithic tomb - portal tomb	HOWTH DEMESNE	727590	738320	327667	238295
DU026-030----	Megalithic tomb - portal tomb	BALLYBRACK (Rathdown By., Killiney UD)	725312	723295	325389	223266
DU023-029002-	Midden	DALKEY ISLAND	727614	726512	327691	226484
DU016-003001-	Promontory fort - coastal	HOWTH	729410	736741	329487	236715
DU023-029001-	Promontory fort - coastal	DALKEY ISLAND	727624	726494	327701	226466
DU023-052001-	Promontory fort - coastal	DUNLEARY	723849	728974	323925	228947

DU026-116----	Fulacht fia	SHANGANAGH	725388	721220	325465	221191
DU026-067----	Burial	OLDCONNAUGHT	725244	720028	325321	219999

Annex C Gazetteer of all known, unknown and uncharted wrecks

Wreck ID	Wreck Name	Classification	Description	Date of	AEZ (m)	Longitude/ Latitude
W09480	*MV Bolivar* (bow)	Cargo Ship	The *MV Bolivar* was a 5,320-ton cargo vessel and at the time of its loss was owned by the Norwegian shipping company, Fred Olsen. The cargo ship was laid down in the yard of Akers Mekaniske Verksted of Oslo in 1939 and was launched, ready for fitting out, in 1940. The Bolivar was finally completed in 1946, setting out on her maiden voyage, to South America, in December of that year. It was upon her return from Buenos Aires to Dublin via Liverpool in early March 1947, with a cargo of grain and bales of leather, that the diesel-powered vessel ran aground on the Kish Bank during a snow storm.	1947	100	-5.9238, 53.2683
W09846	*MV Bolivar* (stern)	Cargo Ship	The *MV Bolivar* was a 5,320-ton cargo vessel and at the time of its loss was owned by the Norwegian shipping company, Fred Olsen. The cargo ship was laid down in the yard of Akers Mekaniske Verksted of Oslo in 1939 and was launched, ready for fitting out, in 1940. The Bolivar was finally completed in 1946, setting out on her maiden voyage, to South America, in December of that year. It was upon her return from Buenos Aires to Dublin via Liverpool in early March 1947, with a cargo of grain and bales of leather, that the diesel-powered vessel ran aground on the Kish Bank during a snow storm.	1947	100	-5.9258, 53.2675
W01572	*Glenorchy*	Sailing Ship	1,285-ton vessel of Glasgow, official no. 60,391. The master was Thomas Meiklejohn. En route from Greenock to Mumbai (Bombay) (maiden voyage), cargo of coal, railway sleepers. Struck the Kish Bank, became a wreck. Crew saved. Four tugs saved materials off the wreck.	1869	100	-5.93317, 53.28058
W01828	*Loch Fergus*	Barque	UKHO wreck no. 009000318. 818/ 874 ton, 23/24-year-old Iron barque of Liverpool / Glasgow. Classed as 100 A1 by Lloyd's. Owned by J. Sproat & Co., Liverpool, the master was T. Williams. En route from Glasgow to Brisbane, seventeen crew, three passengers, general cargo. Went ashore during SSE force 7 gale.	1899	100	-6.10667, 53.24667
W09962	*Privet*	Fishing boat	Fishing vessel sank. Mapped by INSS in 2003.	1988	100	-6.13603, 53.32952
W01588	*Sir Charles Napier*	Ship	The *Sir Charles Napier* was a 638-ton merchant vessel built in Miramichi, New Brunswick, Canada, and owned by Locketts of London. The sailing ship was en route from Liverpool to Sierra Leone, carrying a cargo that included 6,000 iron pots and iron hoops, when it was stranded and wrecked on the Kish Bank during a force 6 wind.	1857	100	-5.925, 53.262
W01593	*Trustful*	Fishing drifter	Sprang a leak during a SW gale while fishing off Bray Head. Crew took to the lifeboat and were picked up by the Dun Laoghaire Pilot boat a few hours later.	1924	100	-5.93333, 53.16667
GSI_278	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.926, 53.2699
GSI_281	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.933, 53.2671
GSI_285	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.9305, 53.2665
MA02	Unknown	Unknown	Descriptive details of this record not available.	-	300	-5.9418343, 53.2700941
MA03	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.8989959, 53.2403312
MA04	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.9508502, 53.2972627
MA05	Unknown	Unknown	Descriptive details of this record not available.	-	100	-6.0305888, 53.2165457
MA07	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.9290853, 53.2730765
MA08	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.9374636, 53.286664
W01526	Unknown	Unknown	One of five wrecks plotted on William Bligh's 1803 map of Dublin Bay. It is located in shallow water just off the South Bull.	1803	100	-6.11471, 53.31846
W01532	Unknown	Unknown	One of 4 wrecks marked on a chart (Admiralty Chart 1415) of Dublin. It is described as "remains of wrecks" and is located in about 10m of water.	1869	100	-6.11119, 53.31217
W01533	Unknown	Unknown	One of four wrecks marked on a chart (Admiralty Chart 1415) of Dublin. It is described as "remains of wrecks" and is located in about 10m of water.	1869	100	-6.10214, 53.3118
W01543	Unknown	Yacht	UKHO wreck no. 009000045. Chart symbol NDW. Sunken yacht reported in September 1946 as being dangerous to navigation. In October 1946 Irish Lights Commissioners' reported mast of wreck visible at low water. In November 1946 wreck was dispersed, no longer considered dangerous to navigation.	1946	100	-6.02083, 53.29917
W01544	Unknown	Unknown	Dutch dredging company discovered a wreck in June 1989 while excavating route for new sewerage pipe. Wreck lay exposed in the southern bank of the trench, measuring c. 15ft across and consisting of a 'wooden framework'. Cargo of tightly packed, uncut slates was also evident.		100	-6.16793, 53.32575
W01629	Unknown	Unknown	Remains of a 300–400-ton vessel (approx.) wooden wreck. Discovered by Marlin Sub Aqua Club in 2003. The vessel is partially exposed on the seabed in 8-10m of water. Pottery, clay pipes, iron pots, a number of anchors, a capstan and a winch were recorded on the wreck site. Possible remains of the *Sir Charles Napier*.	-	100	-5.92517, 53.2621
W01630	Unknown	Unknown	Wooden wreck discovered by Marlin Sub Aqua Club in 2003. The wreck is partially exposed on the seabed in 8–10m of water and is upside-down. Hull is copper sheeted. The wreck rises approximately 1m in height off the seabed and measure 17m long.	-	100	-5.9325, 53.26722
W01731	Unknown	Unknown	One of five wrecks plotted on William Bligh's 1803 map of Dublin Bay. It is located in shallow water, just off the South Bull, at the entrance to the 'Cock Lake.' It also appears to feature on John Taylor's 1816 map of Dublin.	1803	100	-6.17133, 53.32326
W01734	Unknown	Unknown	Wooden wreck, known as the 'Ringsend Wreck,' became exposed during dredging operations for the Dublin Bay pipeline in April 2001. A test excavation conducted on the wreck by Lar Dunne and Emer Dennehy (01E0402) revealed the wreck is orientated E–W and is a composite structure built of timber and metal.	-	100	-6.17844, 53.33625
W08691	Unknown	Unknown	Wreck surveyed by the *RV Keery* in 2010 as part of the INFOMAR seabed mapping programme. Wreck measures 4m long, 1.8m in maximum width and lies in 10m of water. GSI Wreck No_285.	1802	100	-5.9305, 53.2655
W09300	Unknown	Unknown	Wreck surveyed by the *RV Keery* in 2010 as part of the INFOMAR seabed mapping programme. Wreck measures 21m long, 3.7m in maximum width and lies in 15m of water. GSI Wreck No_288.	1800	100	-5.93, 53.251
W10276	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.92347, 53.25417
W10297	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.92583, 53.25722
W10596	Unknown	Unknown	Anchor and cable.	-	100	-6.12, 53.32083
W10597	Unknown	Unknown	Descriptive details of this record not available.	-	100	-6.02083, 53.23305
W11331	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.93355, 53.2666
W11332	Unknown	Unknown	Wooden wreck identified by Browne & Stokes during a geophysical survey in 2008. The wreck was surveyed by the *RV Keery* in 2010 as part of the INFOMAR seabed mapping programme. Wreck measures 26.5m long, 4.3m in maximum width and lies in 15m of water. GSI Wreck No_287.	-	100	-5.93183, 53.25367
W11333	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.93542, 53.26
W11334	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.9191, 53.30132
W11337	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.93818, 53.26226
W11338	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.93812, 53.26346
W11339	Unknown	Unknown	Descriptive details of this record not available.	-	100	-5.9342, 53.25694

Annex D Gazetteer of geophysical data

MA ID	Name	Description	Wreck ID	Geophysical Data IDs	nT	Classification	AEZ (m)	Longitude/ Latitude
MA0132	Unknown	Isolated ovate hard reflector; partially buried outline of a wreck.	**W11334**	SSS: MA2131, MBES: MA4096, MAG: MA21288	58.72	Wreck	100	705269.6, 5910273
MA0134	Unknown	Isolated soft reflector; wooden wreck or wreck debris with visible planking.	-	SSS: MA2133, MBES: MA4097, MAG: MA21302	37.2	Wreck	100	705492.1, 5909837
MA0098	Unknown	Cluster of hard reflectors with pronounced shadow; probable wreck debris. Correlates with the known coordinates for **MA04**.	**MA04**	SSS: MA2097, MBES: MA4078, MAG: MA21060	3644.87	Wreck	100	703179.6, 5909679
MA0171	Unknown	Patch of seafloor disturbance; possible buried anthropogenic feature or low reef; correlates with the known coordinates for **MA08**.	**MA08**	SSS: MA2170, MBES: MA4119,	-	Wreck	100	704137.4, 5908535
MA0173	*Glenorchy*	Scattered array of wreck; potential wooden wreck. Correlates with the known coordinates for *Glenorchy.*	**W01572**	SSS: MA2172, MBES: MA4121, MAG: MA20348	9684.64	Wreck	100	704451.5, 5907874
MA0178	Unknown	Hard reflector with large shadow; correlates with the known coordinates for **MA07**.	**MA07**	SSS: MA2177, MBES: MA4123, MAG: MA20250	665.5	Wreck	100	704758.5, 5907052
MA0181	Unknown	Isolated collection of cylindrical hard reflectors with pronounced shadows; potential barrels. Feature correlates with coordinates for wreck GSI 278.	**GSI 278**	SSS: MA2180, MBES: MA4125, MAG: MA20278	428.74	Wreck	100	704981.1, 5906705
MA0302	Unknown	Newly discovered wreck highlighted by the UAU.	**MA02**	-	-	Wreck	300	703924, 5906680
MA0185	*MV Bolivar* (bow)	Isolated hard reflector with shadow and scour; potential anthropogenic debris. Correlates with coordinates for the bow section of *MV Bolivar.*	**W09480**	SSS: MA2184, MBES: MA4128, MAG: MA20195	15165	Wreck	100	705137.1, 5906540
MA0120	*SS Vesper*	Scattered array of linear reflectors with pronounced scour; scattered remains of wooden or composite wreck. Correlates with coordinates for the *SS Vesper.*	**W01594**	SSS: MA2119, MBES: MA4090, MAG: MA21101	9015.67	Wreck	100	704755.8, 5906507
MA0108	Unknown	Isolated curved hard reflector with shadow and scour; potential wreck debris or boulder.	**W01630/ W11331**	SSS: MA2107, MBES: MA4083,	-	Wreck	50	704404.2, 5906465
MA0182	*MV Bolivar* (stern)	Large partially buried wreck with pronounced shadow and scour; probable wooden or composite wreck. Correlates with coordinates for the stern section of *MV Bolivar* .	**W09846**	SSS: MA2181, MBES: MA4126, MAG: MA20351	18427.5	Wreck	100	704994.2, 5906455
MA0106	Unknown	Linear scatter of hard reflectors; probable wreck or wreck debris.	**W11626**	SSS: MA2105, MBES: MA4081, MAG: MA20526	736.1	Wreck	100	704261.8, 5906153
MA0127	*Sir Charles Napier* (potentially)	Scattered array of angular reflectors with shadow and scour; probable wreck or collection of wreck debris.	**W01588/ W01629**	SSS: MA2126, MBES: MA4095, MAG: MA21117	106.77	Wreck	100	705080.6, 5905840
MA0107	Unknown	Isolated square buried soft reflector; possible buried anthropogenic debris or sandwaves. Feature correlates with location of **W11333**.	**W11333**	SSS: MA2106, MBES: MA4082,	-	Wreck	100	704384.8, 5905571
MA0110	Unknown	Isolated linear reflector with pronounced shadow; probable wreck.	**W11610**	SSS: MA2109, MBES: MA4084,	-	Wreck	100	704534.3, 5905318

MA0115	Unknown	Isolated linear partially buried reflector; probable wreck.	**W11332**	SSS: MA2114, MBES: MA4087, MAG: MA20534	21.72	Wreck	100	704665, 5904886
MA0118	Unknown	Soft reflector with some shadow; outline of buried wreck.	**W09300/ MA01**	SSS: MA2117, MBES: MA4089, MAG: MA20528	56.08	Wreck	100	704804.8, 5904596
MA0192	Unknown	Collection of linear hard reflectors with scour and extended shadow; probable wooden wreck.	**W18562**	SSS: MA2191, MBES: MA4129, MAG: MA21127	1951.11	Wreck	100	706031.3, 5903559
MA0140	Unknown	Isolated hard reflector with shadow; possible anthropogenic debris or reef; correlates with the known coordinates for MA03.	**MA03**	SSS: MA2139, MBES: MA4101, MAG: MA21210	24.67	Wreck	100	706920.9, 5903499
MA0096	Unknown	Seen in the SSS data as an isolated hard reflector with extended shadow; possible anthropogenic debris or boulder. Seen in the MBES data as a large linear raised feature surrounded by associated scour.	**MA05**	SSS: MA2095, MBES: MA4076,	-	Wreck	100	698255.4, 5900476
MA0159	-	Isolated buried pair of linear reflectors; possible anthropogenic debris or potential wreck.	-	SSS: MA2158, MBES: MA4115, MAG: MA21159	1648.22	Potential Wreck	100	704097.3, 5910317
MA0305	*Loch Fergus* (potentially)	High magnetic anomaly; potentially the wreck of the *Loch Fergus* .	**W01828**	MBES: MA4217, MAG: MA12959	14051.2	Potential Wreck	100	692897.1, 5903732
MA0130	-	Isolated hard reflector; possible anthropogenic debris.	-	SSS: MA2129, MAG: MA21297	61.39	Potential Wreck	100	705041.2139, 591152
MA0156	-	Pile of hard reflectors with some linear reflectors with extended shadow and linear cable-like reflector extending from main reflector; probable anthropogenic debris or potential wreck debris.	-	SSS: MA2155, MBES: MA4113,	-	Wreck Debris	100	703180.4, 5909578
MA0180	-	Partially buried hard reflector; probable wreck debris associated with wreck **MA0178**.	-	SSS: MA2179,	-	Wreck Debris	100	704776.4, 5907041
MA0179	-	Scattering of linear partially buried hard reflectors; probable planking from wreck **MA0178**.	-	SSS: MA2178, MBES: MA4124,	-	Wreck Debris	100	704771.4, 5907035
MA0176	-	Partially buried reflector; potential cable or rigging associated with **MA0178.**	-	SSS: MA2175, MAG: MA20356	90.15	Wreck Debris	100	704725.8, 5907017
MA0160	-	Linear hard reflectors at intersecting potentially associated with **MA0161**; probable anthropogenic debris, potential wreck debris.	-	SSS: MA2159, MBES: MA4116,	-	Wreck Debris	100	704278.8, 5907001
MA0161	-	Isolated parallel pair of linear hard reflectors with extended shadow and scour; probable wreck or anthropogenic debris.	-	SSS: MA2160, MBES: MA4117,	-	Wreck Debris	100	704310.5, 5906974
MA0164	-	Isolated linear hard reflectors; probable anthropogenic debris or potential wreck debris.	-	SSS: MA2163,	-	Wreck Debris	100	704516.6, 5906841
MA0158	-	Isolated hard reflector with extended shadow; probable wreck debris.	-	SSS: MA2157, MBES: MA4114, MAG: MA20535	128.8	Wreck Debris	100	704037, 5906547
MA0109	-	partially buried banded feature measuring **MA0110**.	**W11610**	SSS: MA2108, MBES: MA4084,	-	Wreck Debris	100	704534.3, 5905326
MA0111	-	Partially buried banded anomaly probably associated with **MA0110**; possible planking.	-	SSS: MA2110, MBES: MA4085,	-	Wreck Debris	100	704549.1, 5905316

MA0116	-	Linear partially buried hard reflector with pronounced shadow and scour; probable debris associated with a wreck.	**W11332**	SSS: MA2115, MBES: MA4087, MAG: MA20534	21.72	Wreck Debris	100	704665.5, 5904898
MA0114	-	Isolated partially buried hard reflector with shadow and scour; probable wreck.	**W11332**	SSS: MA2113, MBES: MA4087, MAG: MA20534	21.72	Wreck Debris	100	704660.1, 5904878
MA0136	-	Linear hard reflector; probable wreck debris associated with **MA0192**.	-	SSS: MA2135, MBES: MA4098,	-	Wreck Debris	100	705999.7, 5903558
MA0063	-	Isolated angular hard reflector with pronounced shadow; possible anthropogenic debris or boulder.	-	SSS: MA2062, MBES: MA4050, MAG: MA13009	13.44	Archaeological anomaly	100	693189.7, 5903138
MA0075	-	Isolated angular hard reflector with extended shadow; possible anthropogenic debris or boulder.	-	SSS: MA2074, MBES: MA4061,	-	Archaeological anomaly	100	693594.6, 5902306
MA0093	-	Isolated circular hard reflector; probable wheel or fishing pot.	-	SSS: MA2092, MAG: MA17600	20.66	Archaeological anomaly	100	696326.6, 5903053
MA0094	-	Isolated circular hard reflector; probable wheel or fishing pot.	-	SSS: MA2093,	-	Archaeological anomaly	100	696386.6, 5902980
MA0099	-	Buried ovate softer reflector with scour; potential wreck debris cable chain or rope.	-	SSS: MA2098,	-	Archaeological anomaly	100	703442, 5909696
MA0104	-	Angular hard reflector with shadow and scour; possible anthropogenic debris.	-	SSS: MA2103, MBES: MA4079,	-	Archaeological anomaly	100	703823.3, 5911028
MA0117	-	Isolated patch of hard reflector; possible anthropogenic debris or reef.	-	SSS: MA2116, MBES: MA4088,	-	Archaeological anomaly	100	704460.8, 5910966
MA0122	-	Isolated trio of curved hard reflectors with shadow and scour; possible anthropogenic debris or boulders.	-	SSS: MA2121, MBES: MA4092,	-	Archaeological anomaly	100	704696.6, 5911193
MA0124	-	Isolated cluster of hard reflectors with pronounced shadow; possible anthropogenic debris reef or boulders.	-	SSS: MA2123, MBES: MA4093,	-	Archaeological anomaly	100	704747.2, 5911244
MA0144	-	Isolated linear hard reflector; collection of cables or rigging.	-	SSS: MA2143, MBES: MA4102,	-	Archaeological anomaly	100	707301.3, 5903379
MA0149	-	Scattered collection of six hard reflectors with scour and shadow; possible anthropogenic debris or boulders.	-	SSS: MA2148, MBES: MA4106,	-	Archaeological anomaly	100	707873.3, 5898231
MA0155	-	Pair of isolated hard reflectors with shadow and scour; possible anthropogenic debris or boulders.	-	SSS: MA2154, MBES: MA4112,	-	Archaeological anomaly	100	708659.8, 5897776
MA0184	-	Isolated linear hard reflector with lines of shadow and pronounced scour; probable anthropogenic debris.	-	SSS: MA2183, MBES: MA4127, MAG: MA20196	688.47	Archaeological anomaly	100	705130.5, 5906591
MA0201	-	Isolated linear hard reflectors with sitting above seafloor; probable anthropogenic debris potential planking or frame pieces from a wreck.	-	SSS: MA2200, MAG: MA20385	31.13	Archaeological anomaly	100	706874.6, 5897376
MA0204	-	Isolated area of seabed disturbance with shadow; possible buried anthropogenic debris or sandwaves.	-	SSS: MA2203, MBES: MA4130,	-	Archaeological anomaly	100	706842.5, 5899253
MA0310	-	Magnetic anomaly	-	MAG: MA21305	1440.11	Magnetic anomaly	100	706581.4, 5907005
MA0312	-	Magnetic anomaly	-	MAG: MA21141	1080.26	Magnetic anomaly	100	704109.6, 5910030
MA0316	-	Magnetic anomaly	-	MBES: MA4220, MAG: MA18214	443.78	Magnetic anomaly	100	698410.2, 5901357
MA0329	-	Magnetic anomaly	-	MAG: MA17489	319.96	Magnetic anomaly	100	696785.6, 5901287
MA0330	-	Magnetic anomaly	-	MAG: MA14008	308.6	Magnetic anomaly	100	693627.5, 5902995

MA0332	-	Magnetic anomaly	-	MAG: MA20425	291.68	Magnetic anomaly	100	706325.4, 5898351
MA0335	-	Magnetic anomaly	-	MAG: MA18107	269.72	Magnetic anomaly	100	697990.5, 5902270
MA0341	-	Magnetic anomaly	-	MAG: MA20358	239.87	Magnetic anomaly	100	703434.69, 5911501
MA0344	-	Magnetic anomaly	-	MAG: MA21151	234.08	Magnetic anomaly	100	704213.7, 5909902
MA0350	-	Magnetic anomaly	-	MAG: MA21166	207.37	Magnetic anomaly	100	703940.5, 5910904
MA0352	-	Magnetic anomaly	-	MAG: MA20328	201.97	Magnetic anomaly	100	706591.3, 5897683
MA0355	-	Magnetic anomaly	-	MAG: MA21189	193.14	Magnetic anomaly	100	703947.3, 5911293
MA0357	-	Magnetic anomaly	-	MAG: MA21392	189.44	Magnetic anomaly	100	705033.2, 5894003
MA0358	-	Magnetic anomaly	-	MAG: MA21313	185.81	Magnetic anomaly	100	705690.1, 5910313
MA0360	-	Magnetic anomaly	-	MAG: MA20247	177.92	Magnetic anomaly	100	704707.9, 5907700
MA0361	-	Magnetic anomaly	-	MAG: MA20096	177.9	Magnetic anomaly	100	704784, 5906716
MA0364	-	Magnetic anomaly	-	MAG: MA20400	169.8	Magnetic anomaly	100	706588.2, 5897707
MA0366	-	Magnetic anomaly	-	MAG: MA18387	159.57	Magnetic anomaly	100	699971.8, 5901401
MA0368	-	Magnetic anomaly	-	MAG: MA20285	153.6	Magnetic anomaly	100	704546.9, 5908076
MA0369	-	Magnetic anomaly	-	MAG: MA12336	149.31	Magnetic anomaly	100	692819, 5903604
MA0373	-	Magnetic anomaly	-	MAG: MA17498	144.22	Magnetic anomaly	100	696643.2, 5901765
MA0374	-	Magnetic anomaly	-	MAG: MA21178	143.02	Magnetic anomaly	100	704397.5, 5909874
MA0376	-	Magnetic anomaly	-	MAG: MA17841	139.64	Magnetic anomaly	100	696421.5, 5904211
MA0380	-	Magnetic anomaly	-	MAG: MA19569	135.92	Magnetic anomaly	100	693680.9, 5902721
MA0386	-	Magnetic anomaly	-	MAG: MA20643	130.06	Magnetic anomaly	100	706923.5, 5893802
MA0388	-	Magnetic anomaly	-	MAG: MA12225	128.07	Magnetic anomaly	100	692803.1, 5903566
MA0390	-	Magnetic anomaly	-	MBES: MA4236, MAG: MA19024	126.57	Magnetic anomaly	100	702199, 5900333
MA0400	-	Magnetic anomaly	-	MAG: MA21084	119.36	Magnetic anomaly	100	703625.5, 5909307
MA0402	-	Magnetic anomaly	-	MAG: MA18020	116.69	Magnetic anomaly	100	697658.9, 5902979
MA0406	-	Magnetic anomaly	-	MAG: MA20454	114.06	Magnetic anomaly	100	705806.1, 5893422
MA0408	-	Magnetic anomaly	-	MAG: MA16584	112.39	Magnetic anomaly	100	693407.7, 5903627
MA0409	-	Magnetic anomaly	-	MAG: MA21296	111.79	Magnetic anomaly	100	705203.3, 5910698
MA0410	-	Magnetic anomaly	-	MBES: MA4239, MAG: MA20826	110.72	Magnetic anomaly	100	707542, 5897655
MA0411	-	Magnetic anomaly	-	MAG: MA12715	110.29	Magnetic anomaly	100	692833.9, 5903839
MA0413	-	Magnetic anomaly	-	MAG: MA11910	108.07	Magnetic anomaly	100	692914, 5903084
MA0416	-	Magnetic anomaly	-	MAG: MA20381	107.45	Magnetic anomaly	100	706340.8, 5896911
MA0417	-	Magnetic anomaly	-	MAG: MA21230	106.85	Magnetic anomaly	100	704100.63, 5911692
MA0418	-	Magnetic anomaly	-	MAG: MA20695	105.67	Magnetic anomaly	100	707013.8, 5895465
MA0421	-	Magnetic anomaly	-	MAG: MA12232	103.54	Magnetic anomaly	100	692771.5, 5903728
MA0425	-	Magnetic anomaly	-	MAG: MA18592	101.61	Magnetic anomaly	100	701079.4, 5901838

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