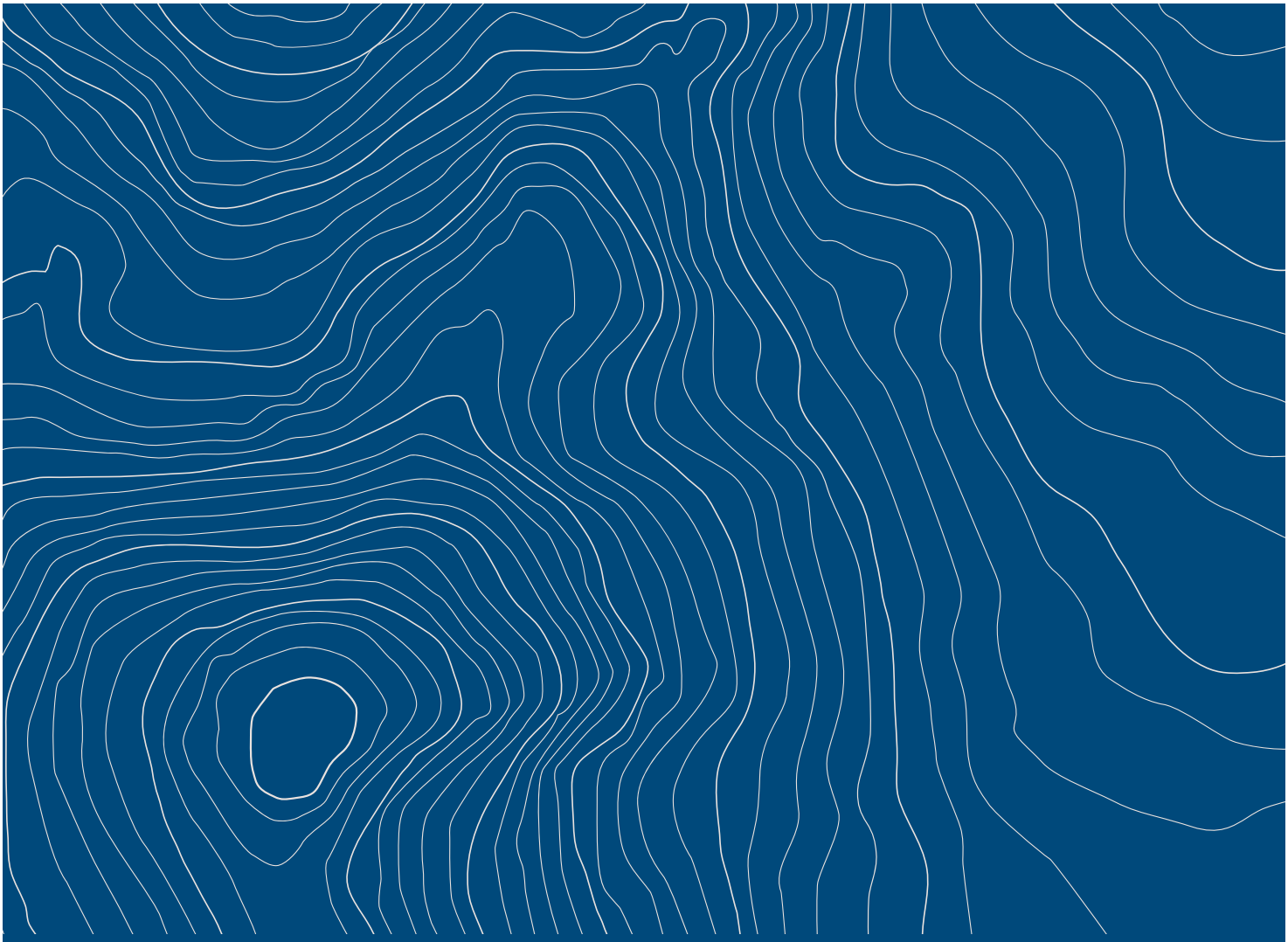

DublinArray
Generation for generations

EIAR Volume 4: Offshore Infrastructure Technical Appendices Appendix 4.3.20-1: Offshore Technical Baseline Report – Operations and Maintenance Base

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 4.3.20-1: Offshore Technical Baseline Report – Operations and Maintenance Base

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Contents

Annexes

Not applicable

Figures

Tables

Glossary

Term	Definition
Abundance	Number of individuals in a community.
Array area	The area within which the WTGs and OSP's will be located.
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Biotope	A region of habitat associated with a particular ecological community.
Diversity	Number of different species in a community.
Drop Down Video (DDV)	A non-invasive, passive survey method in which imagery of habitat is collected, used predominantly to survey marine environments.
EIAR	Environmental Impact Assessment Report – a report to inform an Environmental Impact Assessment.
Offshore Export Cable Corridor (Offshore ECC)	Corridor for an export transmission cable from the array to landfall.
Intertidal	The area of the shoreline which is covered at high tide and uncovered at low tide.
Lowest astronomical tide	The lowest tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.
Macro	Large scale.
Mean High-Water Springs (MHWS)	MHWS is the highest level that spring tides reach on average over a period of time (often 19 years). The height of MHWS is the average throughout the year (when the average maximum declination of the moon is 23.5°) of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
Mean Low Water Springs (MLWS)	MLWS is the average of the levels of each pair of successive low waters when the range of the tide is greatest. The height of MLWS is the average throughout a year of the heights of two successive low waters during those periods of 24 hours (approximately once a fortnight) when the range of the tide is greatest.
Subtidal	The region where the seabed is below the lowest tide
Total Organic Carbon (TOC)	The total amount of carbon found within an organic compound.
Zone of Influence (ZoI)	The area or 'zone' where impacts from the proposed development may impact upon benthic and intertidal ecology receptors.

Acronyms

Term	Definition
ADO	Alternative Design Options
CD	Chart Datum
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CIEEM	Chartered Institute of Ecology and Environmental Management
cm	Centimetres
CTV	Crew Transfer Vessel
DBT	Dibutyl Tin
DCCAE	Department of Communications, Climate Action and Environment
DDT	Dichlorodiphenyltrichloroethane
DDV	Drop down video
DECC	Department of Environment, Climate and Communications
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
EU	European Union
HDD	Horizontal Directional Drilling
IAC	Inter-Array Cabling
IAS	Invasive Alien Species
IFI	Inland Fisheries Ireland
INFOMAR	Integrated Mapping for the Sustainable Development of Ireland's Marine Resource
JNCC	Joint Nature Conservation Committee
JUV	Jack Up Vessel
km	Kilometres
LAT	Lowest Astronomical Tide
LOI	Limiting oxygen index
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	Marine Life Information Network
mCD	Meters Composite Depth
MDO	Maximum Design Option
MFE	Mass Flow Excavation

Term	Definition
MHWS	Mean High Water Springs
MI	Marine Institute
MLWS	Mean Low Water Springs
MPA	Marine Protected Area
MW	Megawatt
NBDC	National Biodiversity Data Centre
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
OESEA	Offshore Energy Strategic Environmental Assessment
O&M	Operations and Maintenance
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PEMP	Project Environmental Management Plan
PSA	Particle Size Analysis
PSD	Particle Size Distribution
SAC	Special Ares of Conservation
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
TBT	Tributyltin
THC	Total Hydrocarbon
TSHD	Trailer Suction Hopper Dredger
TJB	Transition Joint Bays
TOC	Total Organic Carbon
WTG	Wind Turbine Generator
ZoI	Zone of Influence

1 Introduction

1.1 Overview

1.1.1 This document has been prepared to support the Environmental Impact Assessment (EIA) of the marine-based infrastructure and activities associated with the Dublin Array Offshore Wind Farm (Dublin Array) Operations and Maintenance (O&M) Base (referred to in this document as the O&M Base).

1.1.2 The O&M Base will be located at Dún Laoghaire Harbour and is the location from which the daily operations needed to preserve the offshore assets will be conducted. The O&M Base will also provide supporting services (control, monitoring, storage, welfare) for the offshore wind farm during the project's lifecycle.

1.1.3 This technical baseline should be read in conjunction with the following document included within the EIAR:

- Volume 3, Chapter 20: Operations and Maintenance Base: to be referenced for the assessment of the potential impacts of the project upon the marine environment in the vicinity of the O&M Base development.

1.1.4 The purpose of this baseline document is to provide a description of the study areas and receiving environment in the vicinity of the proposed Dublin Array O&M Base at Dún Laoghaire Harbour as it relates to the offshore works and offshore receptors not considered elsewhere. For the avoidance of doubt, the land-based infrastructure and activities relevant to the O&M Base are characterised and assessed across the relevant onshore EIA chapters in volume 5.

1.1.5 The assessment of the onshore works for the O&M Base is undertaken for all onshore receptors and topics within the relevant topic chapters within Volume 5 of the EIAR with baseline characterisations provided in supporting appendices in Volume 6: Onshore Technical Appendices. The assessment of the onshore works for Dublin Array takes an integrated approach to assessing the development of the O&M Base alongside the Onshore Electrical System (OES) and onshore ECC, where it is considered therein and is therefore not repeated here where no pathway exists for potential impacts to arise from offshore works.

1.1.6 All appendices referenced to support this baseline, such as technical baselines and survey reports referenced throughout are provided in, Volume 4: Offshore Infrastructure Technical Appendices, of the EIAR and Volume 6: Onshore Infrastructure Technical Appendices.

Background

1.1.7 A full description of the works proposed at the O&M Base is included within Volume 2, Chapter 6: Project Description.

1.1.8 The proposed development will be located on, and directly adjacent to St. Michaels Pier, within Dún Laoghaire Harbour, Co. Dublin. Dún Laoghaire Harbour is owned and operated by Dún Laoghaire-Rathdown County Council (DLRCC) who is the statutory harbour authority and is responsible for the management and safety of the harbour.

1.1.9 The O&M Base will act as a storage and loading area for small and medium spare parts for the wind turbines and small ancillary equipment such as tools and consumables. The O&M Base will provide offices and warehouse space together with berthing facilities for maintenance vessels (hereafter referred to as crew transfer vessels (CTVs)) associated with the ongoing operation and maintenance of the Dublin Array Offshore Wind Farm.

1.1.10 The range of general harbour activities within Dún Laoghaire Harbour at present consists of a mix of general harbour operation and maintenance activities, commercial and leisure uses ranging from commercial activities on Carlisle Pier, St. Michael's Pier and Traders Wharf, as well as leisure activities on the existing marina's, pontoons and slipways within the harbour. The harbour is enclosed by two piers, the East and West Piers which provide shelter within the harbour.

1.1.11 The proposed planning application boundary for the O&M Base in Dún Laoghaire Harbour can be seen in Figure 1, including the footprint of offshore works adjacent to St Michael's Pier and the existing RoRo ramp. The immediate surroundings of the site are used on a daily basis for harbour related uses. This includes a harbour maintenance building and service yard for maintenance activities associated with harbour operations by DLRCC. The current infrastructure within the site includes a parking area, office buildings, storage buildings and storage containers. Each of these elements have been presented in Figure 2. Following the development of an O&M Base, the existing harbour operations[1] by DLRCC will continue.

1.1.12 A full description of the works proposed at the O&M Base are included within Volume 2, Chapter 6: Project Description. As set out therein and on the relevant drawings accompanying this development consent application, the key components of the marine works for the proposed O&M Base comprise:

- Partial removal of the fender structure at the end of St. Michaels Pier, which includes the removal of the supporting steelwork and fender panel which was previously used during berthing operations of the Stena Line ferry. The existing pile supporting the fender panel is not proposed to be removed.
- Installation of the CTV pontoon & gangway adjacent to Berth No.5 and associated services. The pontoon is likely to be either lifted in place or towed into position by tugboat subject to contractor methodology. The proposed pontoon will be anchored to the quay wall by means of steel guide beams; and

[1] DLRCC Harbour Section is responsible for the maintenance, management, promotion and conservation of Dún Laoghaire Harbour. This involves working with an extensive array of internal and external stakeholders. They are also responsible for the management of vessels within or on approach to the harbour, aids to navigation, port security requirements, events, cleansing, enforcement of the Harbour Byelaws.

- Rock armour was previously installed on the seabed adjacent to Berth 5 to protect the quay wall from scouring during ferry operations. There may be a requirement to undertake local levelling or reprofiling works to this rock armour to prevent the pontoon, or CTVs from hitting the armour at low tide. The degree of levelling required will be subject to a review of the under keel clearance of the chosen CTV's. It is anticipated that the armour would be reprofiled by means of an excavator and shall not be recovered to land. For the purpose of this assessment it is assumed that levelling will be required across the entire length of the armouring.

- It is understood that there will be up to two jack-up vessels with barge cranes used during the site preparation and construction phase of the O&M Base development. The jack-up vessel is likely to resemble the OCM 50 Jack-up Barge. Jack-up barges such as this typically have a leg diameter of 50.8 cm, thus there is an assumed footprint on the seabed of 10,320 cm^2.

    - For the duration of the demolition and construction works, there will also be one safety vessel on site in Dún Laoghaire Harbour.

1.1.13 As outlined in the Decommissioning and Restoration Plan (Volume 7 Appendix 7.2), the O&M building will be either re-purposed for an alternative use or demolished following the decommissioning of the offshore infrastructure. Following the decommissioning of the offshore infrastructure the fencing and pontoon will be removed and the hardstanding area will be taken over by Dún Laoghaire-Rathdown County Council for general harbour operations.

Planning Application Boundary

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Existing Dún Laoghaire Harbour Site Plan

DRAWING NUMBER: **005532727-01**

FIGURE NUMBER: **1**

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0 20 40 60 80 Yards

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SCALE 1:2,500 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

Dublin Array
Generation for generations
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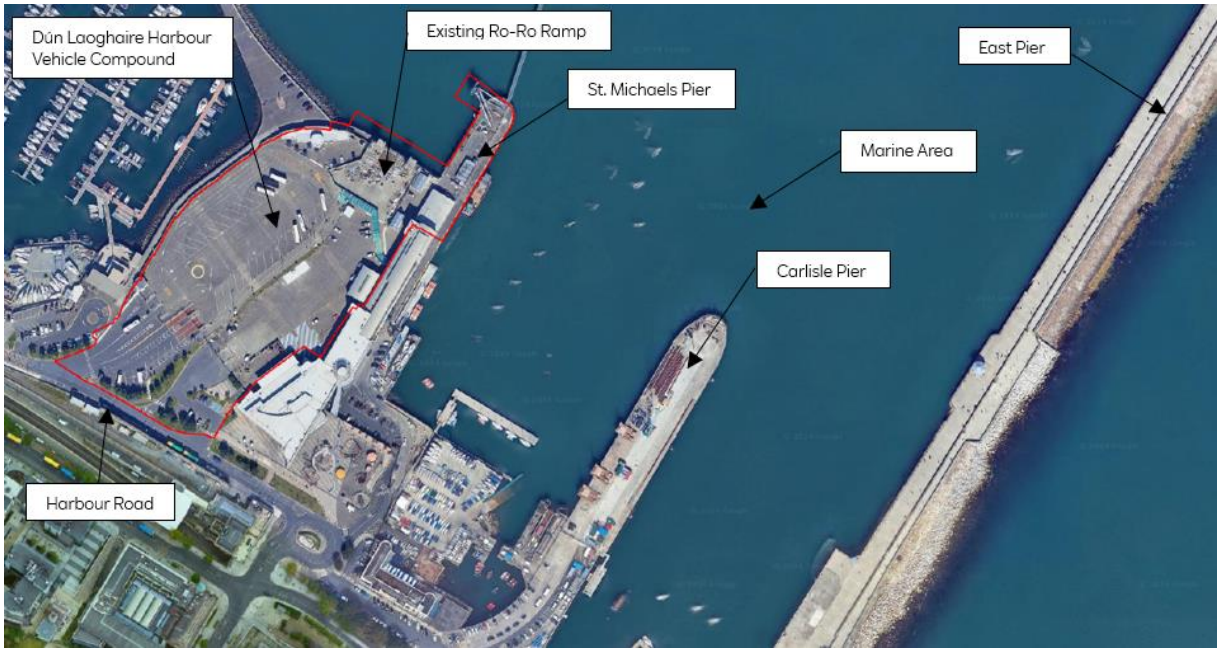


Figure 2 Location of the proposed O&M Base (Source: Google Maps)

1.2 Methodology

Approach

1.2.1 The baseline characterisations have drawn upon site specific data where relevant to the O&M Base along with supporting data from topic specific technical baselines. As such, the baseline was established through the compilation of best available evidence from desk-based studies available from a mixture of literary sources, survey data and online data sources as outlined within each section and drawing from the topic specific EIAR chapters to provide a broader regional context as relevant for mobile species.

1.2.2 This baseline has not sought to replicate data where this is presented in other chapters or technical baselines for the wider region of the Western Irish Sea and has provided a study area that is precautionary and considered appropriate to the nature of the works proposed in the marine environment.

1.2.3 A list of the data sources utilised to inform the baseline characterisations is provided for each receptor with reference to additional data presented in Appendices provided as relevant.

Topics scoped out

1.2.4 A number of offshore topics have not been considered within this baseline characterisation where other chapters of the EIAR comprehensively present the baseline receiving environment and cover all potential effects.

1.2.5 The receptors/topics not presented herein are;

- Bats;
- Commercial Fisheries;
- Shipping and Navigation;
- Marine Infrastructure and Other Users;
- Aviation and Radar; and
- SLVIA.

1.2.6 Justifications for these topics being scoped out is provided in the sections below.

Bats

1.2.7 A comprehensive baseline for bats is captured within Volume 5, Chapter 2, Biodiversity Chapter and accompanying Appendix Volume 6, Appendix 6.5.2-1 relevant to all works associated with the O&M Base and the OES and is therefore not repeated herein. Furthermore, as the O&M Base is predominantly onshore in its nature, the bats technical baseline takes an integrated approach to assessing the development of the O&M Base, where it is considered therein.

Commercial Fisheries

1.2.8 An assessment of the potential impacts of the proposed development on commercial fisheries is contained within Volume 3, Chapter 9 Commercial Fisheries, which encapsulates commercial fishers working out of Dún Laoghaire Harbour.

1.2.9 Commercial fishing activities are not undertaken within the harbour limits and whilst commercial fishing vessels utilise the harbour for landings, it is a busy, operational harbour and as such, the development of the O&M Base will not lead to any potentially significant impacts on commercial fisheries within the harbour in that respect. All aspects of navigational safety with commercial fishing vessels is considered with Volume 3, Chapter 10, Shipping and Navigation (see below). On this basis, Commercial Fisheries is not considered further.

Shipping and Navigation

1.2.10 The movement of vessels to and from the floating pontoon from crew transfer vessels (CTVs) are assessed in Volume 3, Chapter 10 Shipping and Navigation, including an assessment of increased collision risk from O&M related vessels. The assessment therein concludes that potential impacts arising from the vessels used to maintain the offshore infrastructure will be either 'broadly acceptable' or 'tolerable with mitigation and As Low As Reasonably Practicable (ALARP).

1.2.11 All project vessels will be managed in line with the vessel management procedures as outlined in the Vessel Management Plan (VMP) (Volume 7, Appendix 6).

1.2.12 On this basis, Shipping and Navigation arising from the marine-based infrastructure and activities O&M Base is not considered further herein.

Marine Infrastructure and Other Users

1.2.13 Volume 3, Chapter 11: Marine Infrastructure and Other Users provides a comprehensive overview of all fixed infrastructure including oil and gas, subsea cables and pipeline, other marine renewables energy projects, waste water assets and other offshore uses including dredging and dumping at sea. The O&M works will not overlap with any other users outside the confines of the Dún Laoghaire Harbour. Other recreational users are considered across shipping and Navigation and the Socioeconomic chapter.

1.2.14 On this basis Marine Infrastructure and Other Users are not considered further herein.

Aviation and Radar

1.2.15 Owing to the limited scale and nature of the proposed marine-based infrastructure and activities O&M Base this does not pose any issue for radar systems as aviation radar processing techniques remove stationary objects from the radar display, there will be no extension into any controlled airspace, nor will there be any potential for significant impact upon recreational aviation activities at the nearby Killiney Hill.

1.2.16 On this basis, potential impacts upon Aviation and Radar arising from the marine-based infrastructure and activities O&M Base are not considered further.

Seascape Landscape and Visual Impacts (SLVIA)

1.2.17 The proposed O&M Base will be openly visible from the Dún Laoghaire village seafront, from the surrounding piers, the waters within the harbour and the wider bay. It will be approximately 83 m in length, 16 m in width at its widest reducing to 12.4 m with a height of 12.3 m. The design is based upon the shape of a shipping vessel in dry dock and will form a prominent feature on St. Michael's Pier.

1.2.18 The O&M Base is assessed within the assessment of visible onshore infrastructure, in Volume 5, Chapter 7 Landscape and Visual, and assessed for whole-project effects within the assessment of Offshore Infrastructure, in Volume 3, Chapter 15 Seascape, Landscape and Visual Impact Assessment. As such, Seascape, Landscape and Visual Impacts arising from the construction of the O&M Base is not repeated herein.

2 Offshore O&M: Receiving Environment

2.1 Overview

2.1.1 This section provides a characterisation of the receiving baseline for the topics considered. It has not sought to replicate data from other sources in the EIAR and therefore cross references relevant chapters and appendices throughout.

2.1.2 The study areas as outlined for each topic have been used to identify features and receptors within the immediate vicinity of the proposed O&M Base at Dún Laoghaire Harbour, while the baseline data is, in the absence of site specific data, used to describe a wider/more general use of the area and features that can stretch further afield, and is indicative of the types of receptors which may be present within the study area(s).

2.2 Physical Processes Baseline

Study Area

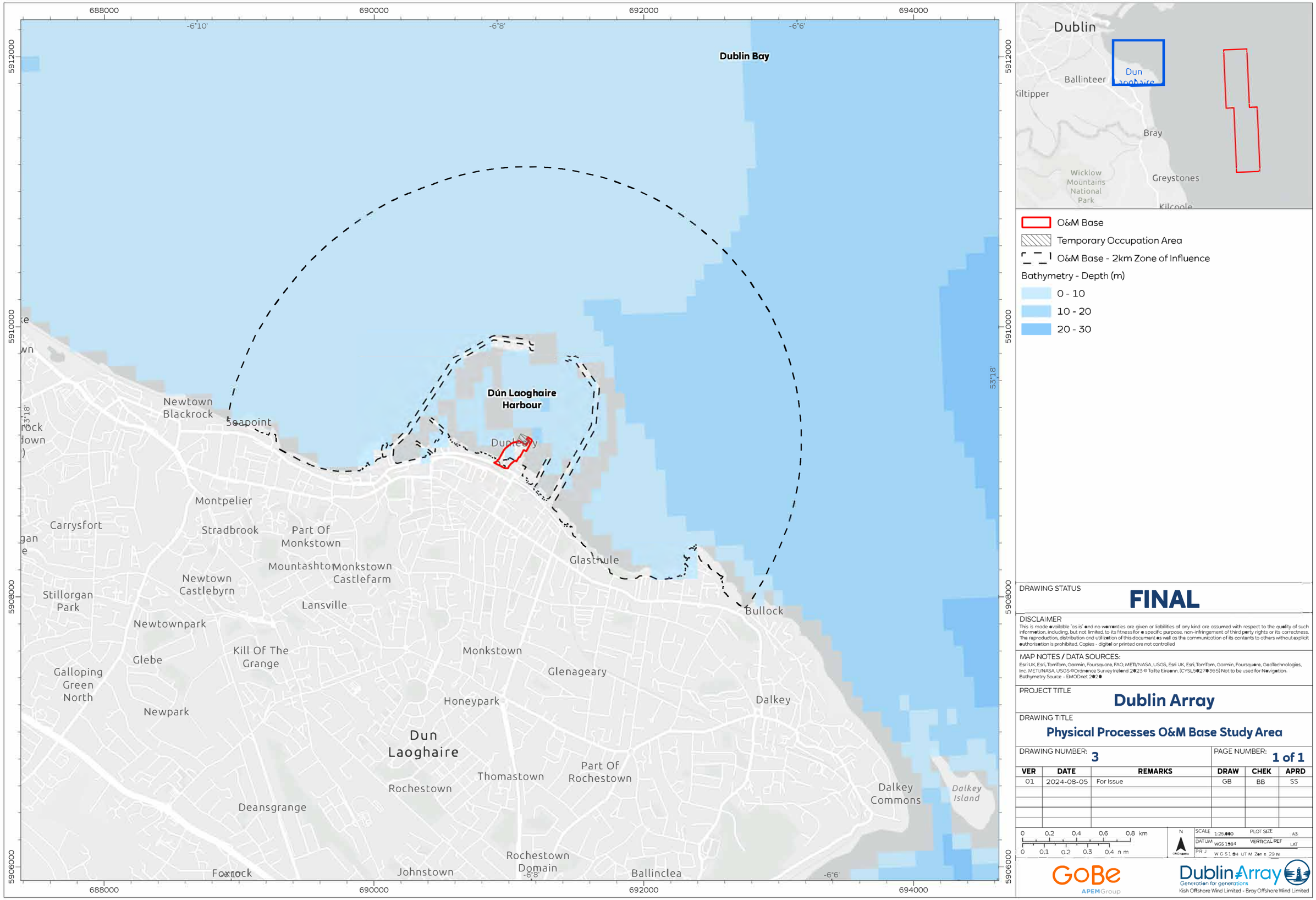
2.2.1 For the purposes of the assessment of the O&M Base, the study area used for physical processes encompasses both the (i) immediate area of the proposed works in Dún Laoghaire Harbour; and (ii) area of secondary impact Zone of Influence (ZoI).

2.2.2 The secondary ZoI is defined as the distance over which material released from the proposed works may be dispersed over a spring tidal cycle. Activities that will generate suspended sediment include levelling of the rock armour within its existing footprint and placement of the jack up legs. The rock armour reprofiling is expected to be similar in nature with comparable impacts as with dredging within the harbour. As such, in the absence of project-specific modelling, assumptions herein are based on the plume modelling conducted for the dredging included as part of the cruise liner terminal development in Dún Laoghaire Harbour. The modelling indicated that dredging within the harbour would result in a temporary sediment plume where:

- Sands will redeposit within the harbour minutes after dredging stops; and
- Silt sized sediment and smaller may remain suspended for hours to a day, leading to an increase in suspended sediment concentration (SSC) within the harbour. The suspended fines are shown to exit the harbour at the end of the ebb tide[2], although SSC levels reduce to negligible within 2 km of the harbour entrance (ABPmer, 2014).

2.2.3 Consequently, a 2 km study area around the Dún Laoghaire Harbour is considered both precautionary and sufficient to encapsulate all significant effects that may occur on the physical marine environment as a result of the proposed O&M Base works within the marine environment. (Figure 3). The physical processes study area is limited to the marine and coastal environment below the High Water Mark (HWM).

[2] Ebb tide is defined as the period between high tide and low tide during which water flows away from the shore.



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PROJECT TITLE

Dublin Array

DRAWING TITLE

Physical Processes O&M Base Study Area

DRAWING NUMBER: **3**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
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N

SCALE 1:25,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF LAT

PRJ WGS 1984 UTM Zone 29N

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Baseline Data

2.2.4 In addition to the data sources used to characterise the wider physical environment detailed in Volume 4: Appendix 4.3.1-1, a number of data sources specific to O&M Base are presented in Table 1.

Table 1 Key Sources of Physical Processes Literature and Data[3]

Data Source	Type of data	Spatial coverage	Limitations
Dún Laoghaire Harbour Environmental Impact Assessment (EIA), Stephen Little and Associates (2015)	Includes seabed sample data, benthic sediment grabs.	Covers the majority of the study area, including the site of the proposed O&M Base works at St. Michaels Pier.	Published in 2015 with surveys conducted between 2014 – 2015. May have been some slight changes to the baseline environment since then.
Cruise Berth, Dún Laoghaire Harbour: Wave Tide Sediment Plume Modelling, ABPmer (2014)	The report utilises bathymetric, tidal, wave, current, and sediment data from various sources including surveys, observations, and hindcast models to characterise Dublin Bay's marine environment.	Covers the majority of the study area in detail.	Limitations include model simplifications, uncertainties in predicting extreme events and climate change impacts, potential data gaps, and challenges in resolving small-scale local effects within regional models.
Other Published literature (Various dates)	A literature review has been undertaken to provide regional context of the tides within the Irish Sea, the outputs of this literature review being used to inform the description of the baseline.	Various across Dublin Bay and the Irish Sea	Not project specific

[3] No site-specific surveys have been undertaken in relation to the Dublin Array O&M Base.

Receiving Environment

2.2.5 The study area is situated on the east coast of the Republic of Ireland, within the Irish Sea with water depths within the study area are at maximum 15 m LAT and are typically below 10 m LAT due to its proximity to the coast. Water depths approaching Dún Laoghaire Harbour are typically between 8 and 10 mcD, reducing to 6 mCD at the harbour entrance (ABPmer, 2014). The depths within the outer harbour are shallower, between 2.5 and 4 mCD. A deeper navigational channel extends from the harbour entrance to the fast ferry berth, which is typically between 10 and 12 m and up to 15 mCD at the berth (ABPmer, 2014). This is the result of previous dredging and local scour from the wash of the Stena Line ferry (ABPmer, 2014).

Metocean

2.2.6 The orientation and aspect of Dublin Bay provide shelter from offshore waves and wind from the southwest clockwise through to northerly directions. Waves from other directions can enter the bay, with the greatest exposure to waves from the east. The exterior of Dún Laoghaire Harbour is exposed to these typical conditions. For most wind and wave directions, including the most frequent, the harbour is sheltered from waves (Stephen Little and Associates, 2015). Waves within the harbour are typically caused by local wind fetch only. Waves can enter the harbour from the north clockwise through to south-easterly directions, mainly affecting the western and central parts of the outer harbour (Stephen Little and Associates, 2015).

2.2.7 Offshore from Dublin Bay, the tidal currents flow north on the flood tide and south on the ebb tide, following the coastline within the bay. Tidal currents play a significant role in the hydrodynamics of the study area. Typical tidal currents offshore of Dublin Bay flow north on the flood tide and south on the ebb tide, following the coastline within the bay (ABPmer, 2014). The East and West Piers surrounding Dún Laoghaire Harbour obstruct both flood and ebb currents that would otherwise flow parallel to the adjacent coastline, resulting in flow acceleration outside the entrance to the harbour, extending to the north and east. Current speeds near the Dún Laoghaire Harbour entrance are typically 0.35 to 0.5 m/s (maximum 0.6 m/s) on a mean spring tide, or 0.2 to 0.35 m/s (maximum 0.4 m/s) on a mean neap tide (ABPmer, 2014). Within Dún Laoghaire Harbour, the current speeds are more benign than further offshore, being between 0.02 to 0.05 m/s during both spring and neap tides (ABPmer, 2014). A stronger, narrow current occurs between the main harbour entrance and the inner harbour entrance during flood tides, with speeds of 0.1 to 0.25 m/s (ABPmer, 2014 and Stephen Little and Associates, 2015). During ebb tides, a relatively weaker and more dispersed current, ranging from 0.05 to 0.1 m/s, develops between the entrance to the inner harbour and the main harbour entrance, particularly in the northeastern part of the outer harbour. Characteristic weak recirculating flow patterns are set up within the harbour on both flood and ebb tides.

2.2.8 The Irish Sea is characterised by a high degree of spatial and temporal (both annual and inter-annual) variability in SSC. In general, there exists an inshore to offshore gradient in SSC, with the highest concentrations observed close to and especially within bay inlets, such as Dublin Bay (Cefas, 2016). Monthly average satellite imagery of (surface) SPM[4] the region of Dublin Bay, for the period of 1998 to 2015, shows a monthly mean sea surface SPM of between 6 and 8 mg/l. These levels are likely much higher in a storm events due to seabed disturbance and at times of heavy rainfall due to terrestrial run off.

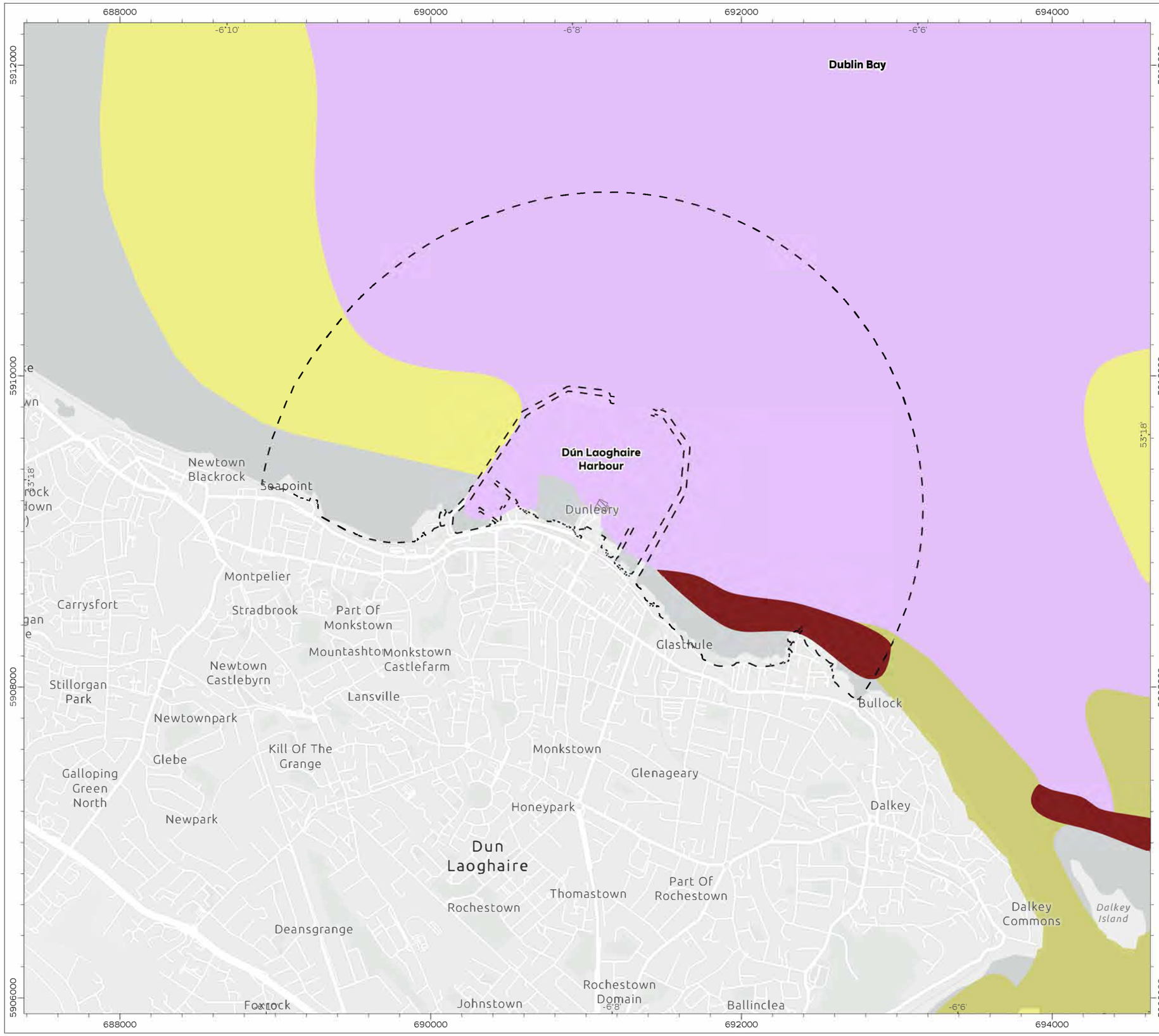
Seabed

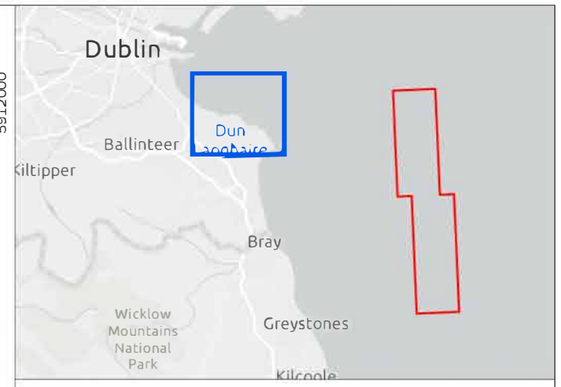
2.2.9 The seabed within Dún Laoghaire Harbour is typically sandy mud (Folk, 1954; EMODnet, 2020). Outside the East and West Piers the seabed consists of sandy mud, as well as sand and fractions of gravel and boulders closer to the coast.

2.2.10 The underlying Quaternary deposits within Dublin Bay consist of Pleistocene diamicton deposits with granite bedrock transitioning into limestone further in the bay (EMODnet, 2020). The nature of the proposed works is such that there will be no disturbance of the underlying Quaternary deposits.

2.2.11 While specific dates for maintenance dredging in Dún Laoghaire Harbour have not been set, it is anticipated that dredging will occur within the next ten years. This expectation is based on the nature of the harbour, which requires regular dredging to maintain navigable depths and ensure safe passage for vessels. The Dún Laoghaire-Rathdown County Council has already initiated the process by issuing tenders for marine consultancy services to design and oversee the dredging operations, indicating that preparations are underway (Dún Laoghaire-Rathdown County Council, 2024).

[4] SPM refers to all particles suspended in water, including organic and inorganic materials. SSC specifically measures the concentration of sediment particles. While SPM includes a variety of particles, SSC focuses solely on sediment, providing a more precise measure of sediment load in water.





O&M Base - 2km Zone of Influence

Temporary Occupation Area

Seabed Substrate

1. Mud to muddy Sand
2. Sand
3. Coarse substrate
5. Rock and Boulders

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Substrate Source - EMODnet

PROJECT TITLE

Dublin Array

DRAWING TITLE

Surficial Seabed Sediments within the Study Area

DRAWING NUMBER: **4**

PAGE NUMBER: **1 of 1**

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0 0.2 0.4 0.6 0.8 km
0 0.1 0.2 0.3 0.4 nm

SCALE 1:25,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GRID NORTH

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

2.3 Marine Water & Sediment Quality Baseline

Study Area

2.3.1 For the purposes of this assessment of the O&M Base, the Marine Water and Sediment Quality (MW&SQ) study area is consistent with that defined for physical processes (see Figure 3), and aligns with the distance over which material released from the proposed works may be dispersed over a single tidal cycle. Consequently, a study area with a 2 km buffer around the Dún Laoghaire Harbour entrance is considered precautionary and sufficient to encapsulate the area within which all potential significant secondary or indirect effects on MW&SQ receptors might occur. The MW&SQ study area is limited to the marine and coastal environment below HWM.

Baseline Data

2.3.2 In addition to the data sources captured within Volume 3, Chapter 2: Marine Water and Sediment Quality, those specific to Dún Laoghaire harbour are listed in Table 2.

Table 2 Key sources of MW&SQ Literature and Data[5]

Data Source	Type of data	Spatial coverage	Limitations
Sediment Quality			
Dún Laoghaire Harbour Environmental Impact Assessment (EIA) (2015)	Includes sample data, benthic sediment grabs to inform sediment quality	Includes the majority of the study area	Published in 2015 which presents likely changes in baseline conditions.
Dún Laoghaire Harbour EIA (2015)	Includes water quality assessment of data collected for the project	Coverage of Dún Laoghaire Harbour	Published in 2015 so potential for changes to the baseline environment in the intervening period.
Cruise Berth, Dún Laoghaire Harbour: Wave Tide Sediment Plume Modelling, ABPmer (2014)[6]	Includes water quality data	Coverage of Dún Laoghaire Harbour	Local level data within the harbour but not project specific.

[5] No site-specific surveys have been undertaken in relation to the Dublin Array O&M Base.
[6] https://www.pleanala.ie/en-ie/case/PA0042

Receiving Environment

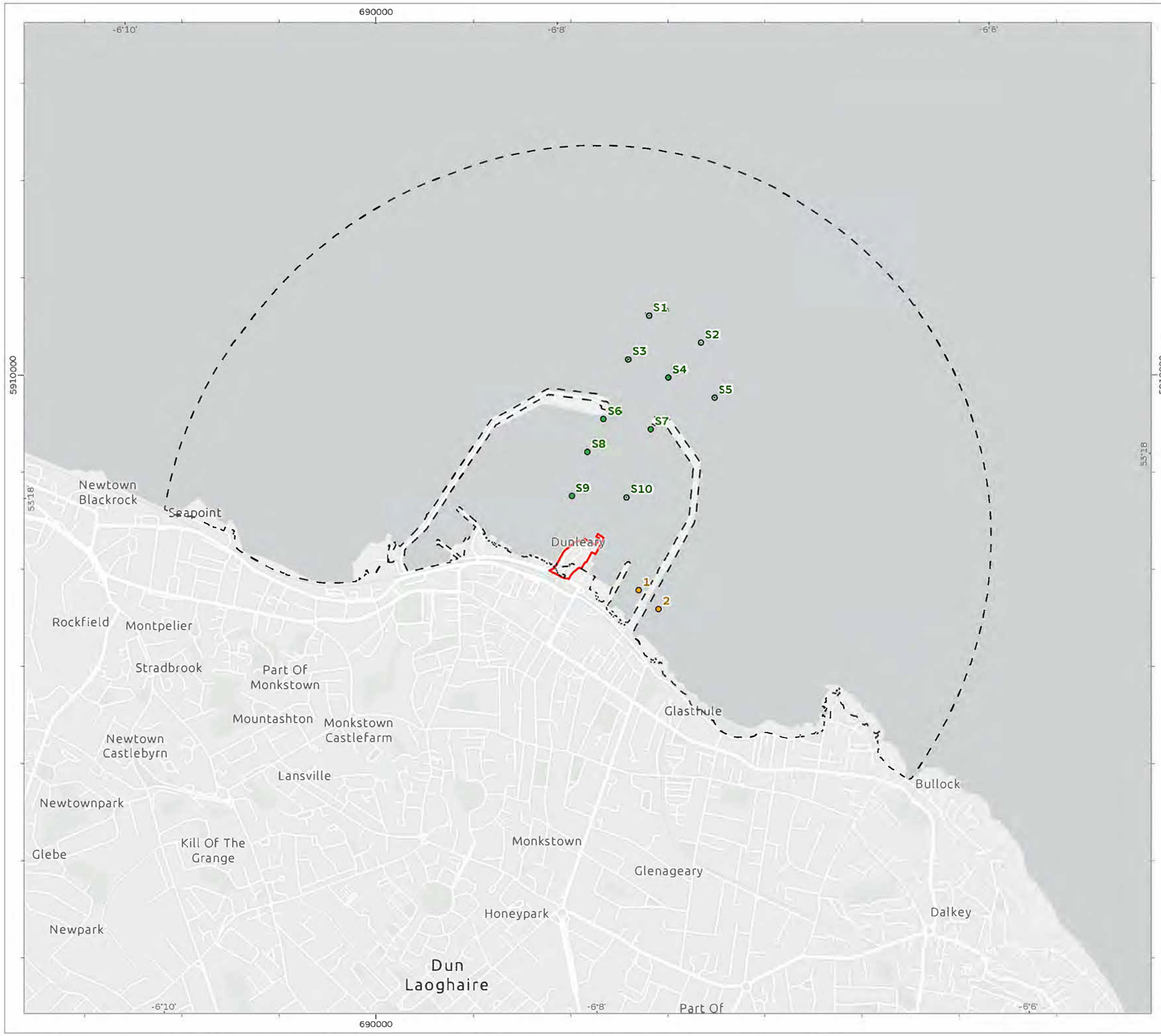
Suspended sediments

2.3.3 The Irish Sea is characterised by a high degree of spatial and temporal (both annual and inter-annual) variability in Suspended Particulate Matter (SPM). In general, there exists an inshore to offshore gradient in SPM, with the highest concentrations observed close to and especially within bay inlets, such as Dublin Bay (Cefas, 2016). Monthly average satellite imagery of (surface) SPM the region of Dublin Bay, from the period of 1998 to 2015, shows a monthly mean sea surface SPM of between 6 and 8 mg/l (Cefas, 2016). These levels are likely much higher in a storm events due to seabed disturbance and at times of heavy rainfall due to terrestrial run off (Cefas, 2016).

2.3.4 For the purposes of determining the contamination levels within seabed sediments, the thresholds outlined in 'Guidelines for The Assessment of Dredge Material for Disposal in Irish Waters' (Marine Institute, 2006 & 2019) (hereafter referred to as the Irish action levels) have been adopted in this assessment[7].

2.3.5 Sediment contaminant analysis was undertaken by Hydrographic Surveys on behalf of the Dún Laoghaire Port Company (Stephen Little and Associates, 2015) in November 2013, see Figure 5.

[7] Chapter 2: MW&SQ Chapter provides an overview of Irish Action Levels. Source (Marine Institute, 2006 & 2019).



- O&M Base
- O&M Base - 2km Zone of Influence
- Sediment Grab Locations
- Water Sample Locations

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Dùn Laohaire Water and Sediment Sample Locations

DRAWING NUMBER: **5**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-08-05	For Issue	GB	BB	SS

0 0.1 0.3 0.4 0.6 km
0 0.1 0.2 0.3 0.4 nm

SCALE 1:20,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

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

Table 3 Hydrographic Surveys Sediment Quality Results (Stephen Little and Associates, 2015)

Metal	Sample ID									
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Cadmium	<0.03	0.046	0.039	0.051	0.057	0.044	0.483	0.203	0.164	0.17
Mercury	0.002	0.002	0.004	0.003	0.004	0.01	0.025	0.074	0.077	0.05
Arsenic	6.39	6.32	6.27	5.01	4.88	2.57	8.7	8.05	9.89	9.38
Chromium	9.47	11.3	14.5	9.47	13.8	12.6	104	84.4	107	103
Copper	2.97	3.34	3.71	3.37	6.63	6.34	34.4	31.1	35.5	**55.9**
Lead	11.2	11.9	12.9	11.3	14	12.8	38.7	32.7	38.7	36.8
Nickel	5.93	6.09	6.37	5.09	14.4	6.15	4.8	40	**60.2**	**55**
Zinc	27.5	30.1	31.8	26	**442**	24.4	107	94.2	114	116

*Numbers in **bold** surpass the Irish Action Levels 1
*Numbers underlined surpass the Irish Action Levels 2

2.3.6 Three samples recorded exceedance of the Irish action levels:

- Nickel which exceeded Irish action level 1 in sample S9 and S10;
- Copper which exceeded Irish action level 1 in sample S10; and
- Zinc exceeded Irish action level 2 in sample S5.

Table 4 Polychlorinated Biphenyls (PCB) sediment samples (Stephen Little and Associates, 2015)

Contaminant (ug/kg)	Sample ID									
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
PCB 028	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.28	0.28	0.28	<0.2
PCB 052	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 101	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 118	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB 138	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	<0.1	<0.1
PCB 153	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.16	0.12	0.2	<0.1
PCB 180	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	<0.1	<0.1
PCB S 7 PCB	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.68	0.4	0.48	<0.1

*Numbers in **bold** surpass the Irish Action Level 1
*Numbers underlined surpass the Irish Action Level 2

2.3.7 From the ten sediment samples tested and reported in Stephen Little and Associates, 2015 for Polycyclic Aromatic hydrocarbons (PAHs), none of the samples exceeded the Irish Action Levels.

Temperature and Salinity

2.3.8 Temperature and salinity determine the density and subsequently the vertical movement of the water column. In an estuarine environment these factors are regularly changing with the tides and rainfall.

2.3.9 The EPA Water Quality Report 2007-2009 was published in 2010 and presented a review of Irish ambient water quality for the years 2007 to 2009[8].

2.3.10 The data indicated over the winter months, salinity levels are lower due to increased precipitation and decrease evaporation.

2.3.11 During the summer months, salinity levels are higher likely due to increased sea surface evaporation and lower rainfall thus reducing the riverine freshwater input. This is reflected in the salinity reading as shown Table 5. Sea surface temperature, (see Table 5) algin with regional expectations.

Table 5 EPA Water Quality Report Results (2007-2009)(Stephen Little and Associates, 2015)

Winter Summary Stats				Summer Summary Stats		
Parameters	Minimum	Median	Maximum	Minimum	Median	Maximum
Salinity (ppt)	20.7	32.92	34	27.7	33.3	34.9
Temp (°C)	4.5	6.95	11.7	4.9	13.4	17.28

2.3.12 In September 2013 samples were undertaken (Stephen Little and Associates, 2015).for water quality analysis at two locations in Dún Laoghaire Harbour, one within the breakwater (Sample A) and one outside (Sample B) the results are shown in Table 6 below.

Table 6 ARUP Water Samples from within Dún Laoghaire Harbour (Stephen Little and Associates, 2015).

Parameter	Sample A	Sample B
Atrazine (ng/l)	<3.400	<3.400
Cyanide (ug/l)	<0.4	<0.4
Lead (ug/l)	1.9	18.8
Chromium (ug/l)	19	7
Cadmium (ug/l)	13.2	8.1
Chlorophyll a (ug/l)	1.6	1
Arsenic (ug/l)	2.7	2.8
Nitrite (mg/l)	<0.005	<0.005
Ammonia(mg/l)	0.39	0.45
Phenol PPT	<20.000	20
Nitrate (mg/l)	<2	<2

[8] EPA (2009) Water Framework Directive Monitoring Programme

Parameter	Sample A	Sample B
Mineral Oil (mg/l)	<0.001	<0.001
Salinity PPT	25.25	25.2
Conductivity (µs/com)	50500	50400
TSS (mg/)	16	26
pH (pH Units)	8.08	8.11
Faecal streptococci (cfu/100m)	3	<1
Orthophosphate (mg/l)	1.15	0.08
Faecal Coliforms (cfu/100ml)	10	4
E. coli (MPN/100ml)	<1	<1

Nutrient Inputs

2.3.13 Information pertaining to the monitoring of nutrient inputs in the Irish Sea is documented in the Water Quality in Ireland Report (2016 to 2021) (EPA, 2022). Therein, nearly all estuaries and coastal waters assessed (97%) were in satisfactory condition for phosphate (EPA Water Quality In 2022 – An Indicators Report, 2023). Regarding excessive nutrients in the MWSQ study area for the O&M Base, the most recent information provided by the EPA shows that the water quality in this region is considered unpolluted (EPA, 2021).

Water Framework Directive

2.3.14 This baseline document should be read in conjunction with the Volume 3, Chapter 2: MW&SQ and Appendix 4.3.2-1 Water Framework Directive and Marine Strategy Framework Directive Summary which incorporates the offshore and Volume 6, Appendix 6.5.4-1 that covers the onshore elements of the WFD. Both documents provide a guide to where the various elements have been assessed within the Applicant's EIAR.

Coastal and transitional waterbodies

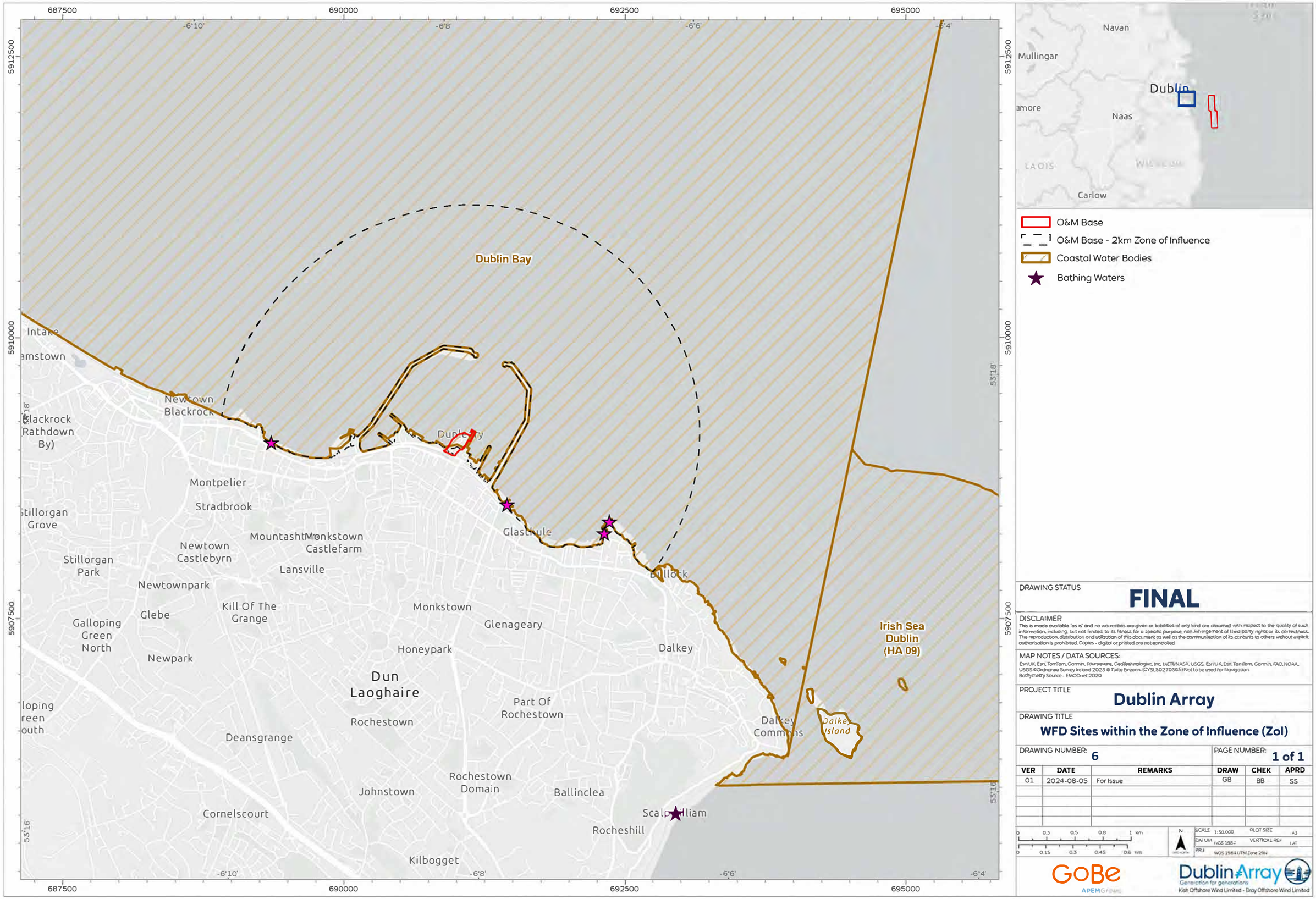
2.3.15 There are currently 84 transitional waterbodies and 47 coastal waterbodies that are monitored and managed under the WFD. Of these, two sites were identified to be within the MW&SQ O&M Base study area. Transitional waters were all reported as 'Moderate' indicating a potential source of pollution. While the aim of the WFD is to ensure all transitional and coastal waterbodies achieve good qualitative health, it is typical for transitional waters to report higher pollution levels due to in-flow from rivers that carry agricultural and urban run-off. Moreover, all coastal sites were reported as either 'High' or 'Good' which indicates good physiochemical status in coastal areas in and around the MWSQ O&M Base study area.

2.3.16 Dún Laoghaire Harbour falls within the Dublin Bay waterbody, which is identified as not at risk and an overall status of high.

Bathing waters

2.3.17 The only designated bathing waters within the ZoI are: Seapoint which has a rating of excellent water quality, Sandycove Beach which has good water quality and Forty Foot Bathing Place, as well as Dún Laoghaire Baths which have excellent water quality[9] (See Figure 6).

[9] https://www.dlrcoco.ie/beaches/bathing-water-quality



- O&M Base
- O&M Base - 2km Zone of Influence
- Coastal Water Bodies
- Bathing Waters

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PROJECT TITLE

Dublin Array

DRAWING TITLE

WFD Sites within the Zone of Influence (ZoI)

DRAWING NUMBER: **6**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-08-05	For Issue	GB	BB	SS

0 0.3 0.5 0.8 1 km
0 0.15 0.3 0.45 0.6 nm

SCALE 1:30,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

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Shellfish waters

2.3.18 No shellfish areas are located within the MWSQ O&M Base study area.

Urban Waste Water Treatment Directive

2.3.19 There are currently no nutrient-sensitive areas within the MWSQ O&M Base study area.

Marine Strategy Framework

2.3.20 As a framework directive, the MSFD draws on the water quality work under WFD and OSPAR. Volume 5, Appendix 3.2-1, provides consideration of how Dublin Array and the Dún Laoghaire Harbour works adheres to the requirements of the MSFD and WFD and details the implications the proposed activities could have on the attainment of the respective objectives.

2.4 Benthic Ecology Baseline

Study Area

2.4.1 For the purposes of this assessment of the O&M Base, the benthic subtidal and intertidal ecology aligns with the physical processes study area (see Figure 3) covering a secondary ZoI, defined as the distance over which material released from the proposed works may be dispersed over a single tidal cycle. Consequently, a study area with a 2 km buffer around the Dún Laoghaire Harbour entrance is considered precautionary and sufficient to encapsulate the area within which all potential significant secondary or indirect effects on benthic subtidal and intertidal ecology receptors might occur. The benthic subtidal and intertidal ecology study area is limited to the marine and coastal environment below HWM.

Baseline Data

2.4.2 In Addition to the data sources listed in Appendix 4.3.3-1, list of the supporting data sources specific to Dún Laoghaire harbour and used to inform the benthic ecology baseline is presented[10] in Table 7.

Table 7 Key sources of pre-existing benthic ecology data

Data Source	Type of data	Spatial coverage	Limitations
Dún Laoghaire Harbour Proposed Cruise Berth Facility Environment/al Impact Statement (Stephen Little and Associates, 2015).	A total of 12 subtidal samples collected in Dún Laoghaire harbour and adjacent coastal waters in April 2014, using a 0.1 m^2 van-Veen grab for Particle Size Analysis (PSA), TOC and faunal analysis.	Covers the proposed O&M base, Dún Laoghaire Harbour and adjacent subtidal habitat.	Subtidal only

[10] No site-specific surveys have been undertaken in relation to the Dublin Array O&M Base.

Data Source	Type of data	Spatial coverage	Limitations
Dún Laoghaire Harbour sediment samples analysis (Hydrographic Services Ltd. 2015).	A total of 10 subtidal samples were collected in Dún Laoghaire harbour and adjacent coastal waters in January 2015 for Particle Size Analysis (PSA), TOC and chemical analysis.	Covers the proposed O&M base, Dún Laoghaire Harbour and adjacent subtidal habitat.	Subtidal only
Report of Survey: Dún Laoghaire Bathymetric Survey Sediment Samples & Analysis (Hydrographic Surveys Ltd., 2013).	A combined bathymetric survey and subtidal sediment sampling survey at Dún Laoghaire Harbour. 10 subtidal stations were sampled with 0.1 m^2 van Veen grab in November 2013. PSA and faunal analysis were undertaken.	Covers the proposed O&M Base and Dún Laoghaire Harbour.	Subtidal only and limited to confined of Dún Laoghaire Harbour.
Littoral and sublittoral Reef habitats of Dún Laoghaire Rathdown County Council area (MERC Consultants, 2022)	Identification and mapping of intertidal and subtidal reef habitat between Dún Laoghaire and Bray.	Covers shallow subtidal and intertidal areas to south east of Dún Laoghaire Harbour.	Only covers areas to south east of Dún Laoghaire Harbour.

Receiving Environment

Subtidal

2.4.3 As detailed in 2.2, sediments within Dún Laoghaire Harbour where the O&M Base will be sited are predominantly sandy muds, while coarser substrate is recorded from the adjacent coastal waters which is characterised as muddy sands. However, at the mouth of the harbour coarse shell and sand is evident. These patterns are clearly driven by the predominant current regimes (Stephen Little and Associates, 2015).

2.4.4 Similarly, reported levels of Total Organic Carbon (TOC) from Dún Laoghaire harbour in the vicinity of the O&M Base were low with a mean level of 1.5%, while in the coarser sediments in the immediate adjacent coastal waters the mean value was 0.25% (Hydrographic Services, 2015).

2.4.5 Benthic studies carried out in the vicinity of the proposed O&M Base in relation to a proposed cruise berth facility in Dún Laoghaire Harbour and adjacent coastal waters recorded a relatively diverse and abundant fauna characterised by polychaetes, molluscs and crustaceans with the white furrow shell *Abra alba* being most commonly recorded species (1,139 individuals recorded). This was followed by the shiny nut clam (*Nucula nitidosa*), with 137 individuals recorded. Other abundant molluscs included the wavy hatchet shell (*Thyasira flexuosa*, *Thracia papyracea*), the surf clam (*Spisula solida*) and the bean-like tellin (*Angulus fabula*). The communities across benthic subtidal and intertidal study area for the O&M Base were considered to be similar and were classified as the biotope:

- *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc / EUNIS Code MC5214): This biotope is representative of non-cohesive muddy sands or slightly shelly/gravelly muddy sand characterised by the bivalves *A. alba* and *Nucula nitidosa*. Other important taxa include *Nephtys* spp., *Chaetozone setosa* and *Spiophanes bombyx* with the bivalve *Fabulina fabula* also common in many areas. The echinoderms *Ophiura albida* and *Asterias rubens* may also be present.

Intertidal

2.4.6 The intertidal areas of Dún Laoghaire Harbour where the planned O&M Base is to be sited are comprised of man-made structures such as the breakwater and harbour walls, concrete jetties and rock armoured structures. All substrates are of hard materials including primarily rock, stone and concrete.

2.4.7 The Dún Laoghaire Harbour Masterplan Environmental Report (Dún Laoghaire Harbour Company, 2011) indicated that the intertidal habitats within the harbour comprise:

- *Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock (LR.HLR.MusB.Sem / EUNIS Code MA1223): Found on exposed to moderately exposed mid to upper eulittoral bedrock and large boulders characterised by dense barnacles (*Semibalanus balanoides*) and the limpet (*Patella vulgata*). The community has a relatively low diversity of species although occasional cracks and crevices in the rock can provide a refuge for small individuals of the mussel (*Mytilus edulis*), the winkle (*Littorina saxatilis*) and the whelk (*Nucella lapillus*). Seaweeds are usually not found in high numbers although fissures and crevices in the bedrock can hold a sparse algal community including the green seaweed (*Ulva intestinalis*). On some shores, the olive green lichen (*Verrucaria mucosa*) can be present in some abundance (Frequent).

- Barnacles and fucoids on moderately exposed shores (LR.MLR.BF / EUNIS Code MA124): Mid and lower eulittoral moderately exposed on bedrock and boulders with a lichen zone above and a kelp dominated community below in the sublittoral zone. Characterised by a mosaic of fucoids and barnacles, where the extent of the fucoid cover is typically less than the blanket cover associated with sheltered shores. Other species are normally present as well in this habitat including the winkle (*Littorina littorea*), the whelk (*Nucella lapillus*) and the red seaweed (*Mastocarpus stellatus*).

- Fucus spiralis on full salinity sheltered upper eulittoral rock (LR.LLR.F.Fspi / EUNIS Code MA123C1): Sheltered upper eulittoral bedrock characterised by a band of the spiral wrack (*Fucus spiralis*) overlying the black lichen (*Verrucaria maura*) and the olive green lichen (*Verrucaria mucosa*). Underneath the fronds of *F. spiralis* is a community consisting of the limpet (*Patella vulgata*), the winkles *Littorina saxatilis* and *Littorina littorea* and sparse individuals of the barnacle (*Semibalanus balanoides*) while the mussel (*Mytilus edulis*) can be found attached in cracks and crevices. A variety of red algae including *Hildenbrandia rubra* may be present underneath the fronds. During the summer months ephemeral green seaweeds such as *Ulva intestinalis* can be common.

2.4.8 Intertidal reefs are also present outside the harbour in the Dún Laoghaire Rathdown area where 12 ha of bedrock, boulders and cobbles were reported by MERC Consultants (2022). All areas of reef recorded in the area conform to the EU Annex I habitat "Reefs".

2.4.9 Two dominant habitat complexes were present, 'Low energy littoral rock' (LR.LLR) and 'Moderate energy littoral rock' (LR.LMR). The most commonly identified biotopes were:

- 'Ascophyllum nodosum on full salinity mid eulittoral rock' (LR.LLR.F.Asc.FS/EUNIS Code MA123E1);.
- 'Ascophyllum nodosum on very sheltered mid eulittoral rock' (LR.LLR.F.Asc/EUNIS Code MA123E);
- 'Fucus vesiculosus and barnacle mosaics on moderately exposed mid eulittoral rock' (LR.MLR.BF.FvesB/EUNIS Code MA1243); and
- 'Fucus serratus and red seaweeds on moderately exposed lower eulittoral rock' (LR.MLR.BF.Fser.R/EUNIS Code MA12441).

2.4.10 MERC Consultants (2022) also noted a number of additional Invasive species such as the Leathery Sea squirt (*Styela clava*) Wakame (*Undaria pinnatifida*) and Japanese skeleton shrimp (*Caprella mutica*) have been recorded in Dún Laoghaire Harbour which constitute a significant threat to the local biodiversity of the area. An additional study in 2021 (O'Shaughnessy *et al*, 2023) recorded 25 non native species in harbours around Ireland (including Dun Laoghaire), the most frequently recorded non-native species was Darwin's barnacle, *Austrominius modestus.*

2.4.11 The control of marine IAS is particularly problematic due to the nature of the marine environment. While numerous publications resulting from research projects have attempted to address the issue of marine IAS and international regulations to address issues such as the release of ships ballast water have been come into force, marine IAS are likely to continue to provide a significant challenge in the future.

2.5 Fish & Shellfish Baseline

Study Area

2.5.1 For the purposes of this assessment of the O&M Base, the fish and shellfish study area is defined as the area of the proposed works in Dún Laoghaire Harbour together with a wider buffer to encompass the underwater noise ZoI. This has been defined by the underwater noise ZoI, the distance over which noise-producing activities have the potential to affect fish and shellfish species. Underwater noise sources for works at the O&M Base will be limited to vessel movement, the use of jack-up vessels, and the potential local levelling or reprofiling works to existing rock armour (see section 1.1). The loudest underwater noise source for those activities proposed at the O&M Base is the levelling of the rock armour which is under the proposed pontoon at the O&M Base.

2.5.2 Given the depths in the harbour, rock is unlikely to be removed, rather just reprofiled across the existing rock armour profile. It is considered that the noise production from rock levelling will be similar to or less than that produced during underwater rock placement activity.

2.5.3 Using the non-impulsive unweighted SELcum thresholds for recoverable injury and TTS recommended by Popper *et al.* (2014) resulted in estimated impact ranges of <50 m for the most sensitive fish species for all continuous construction noise associated with activities within the array area and Offshore ECC (Volume 4, Appendix 4.3.5-7: Underwater Noise Assessment). No modelled impact ranges are available for activities at the O&M Base; however, similarly small impact ranges are predicted for non-lethal injuries and TTS for the most sensitive receptors (e.g. fish with a swim bladder involved in hearing) with impact ranges for less sensitive species likely to be smaller. Following the recommendations by Popper *et al.* (2014), the relative risk of behavioural changes in the most sensitive receptors is likely to be high within 10s of meters from continuous noise sources, moderate at intermediate within 100s of meters, and low at 1,000s meters from the construction activities. For the remaining receptors including their eggs and larvae, the likelihood of behavioural responses is considered to be moderate at near and intermediate distances and low at far field distances from the noise source (Popper *et al.*, 2014).

2.5.4 Consequently, a buffer of 5 km around Dún Laoghaire Harbour entrance is considered to be precautionary and to encapsulate the area within which all of the potential significant effects associated with underwater noise on fish and shellfish receptors might occur.

2.5.5 Whilst potential noise impacts are not the only source of potential impacts to fish and shellfish receptors resulting from the proposed O&M Base development activities, it is considered that the underwater noise ZoI presents the largest spatial footprint of potential effects.

Baseline Data

2.5.6 In addition to the data sources used to inform Appendix 4.3.4-1, a list of the supporting data sources used to inform the fish and shellfish baseline in relation to a proposed O&M Base at Dún Laoghaire Harbour is presented in Table 8.

2.5.7 No site-specific fish and shellfish surveys have been undertaken in relation to the O&M Base, but site-specific DDV data was collected within the central sections of Dublin Bay as part of the benthic ecology baseline survey (Fugro, 2021). In addition, findings from surveys undertaken for other projects within and adjacent to Dublin Bay have been reviewed to provide additional context.

2.5.8 The desk study has drawn upon spawning and nursery grounds data published by Marine Institute, Coull et al. (1998), Ellis et al. (2010, 2012) and Ireland's Marine Atlas (Marine Institute, 2016) to provide some context for the general area given the mobile nature of fish species.

Table 8 Key sources of pre-existing fish and shellfish ecology data[11]

Data Source	Type of data	Spatial coverage	Limitations
EIA undertaken to inform the Dún Laoghaire Harbour Cruise Berth Facility (Stephen Little & Associates, 2015)	Benthic grab sampling deployed within and adjacent to Dún Laoghaire Harbour. Data provided on the sediment characteristics within the surveyed area.	Covers the proposed O&M base, Dún Laoghaire Harbour and adjacent subtidal habitat.	Sampling method was not developed to provide data on the distribution of fish and shellfish receptors.
Inland Fisheries Ireland publications on the status of migrating fish populations (2018-2023).	Findings of monitoring programs designed to assess the status of fish populations in river catchments throughout Ireland. Used to establish the baseline for migrating fish species.	Coverage of Irish rivers draining into the study area at Dún Laoghaire.	Not project specific. High level data may lack detailed information relating to the study area in some instances. Not project specific.
Fish spawning and nursery ground data from Coull et al. (1998), Ellis et al. (2010, 2012) and Ireland's Marine Atlas (Marine Institute, 2016).	Location of spawning and nursery grounds of commercially important fish species and selected elasmobranch species.	Coverage of the Irish Sea including the study area.	Lacking detailed resolution for within Dún Laoghaire Harbour.

Receiving Environment

2.5.9 The distribution of fish and shellfish species varies in response to a range of environmental factors such as substratum type, water depth and salinity. The details of which are reported on above in Sections 2.2 and 2.3. The fish and shellfish communities present at Dún Laoghaire Harbour are likely to be comparable with those found inhabiting similar habitats elsewhere in Dublin Bay.

[11] No site-specific surveys have been undertaken in relation to the Dublin Array O&M Base.

Marine and Estuarine Fish

2.5.10 Beam trawls and fyke nets deployed within the middle and outer Dublin shipping channel to inform the ABR Project EIA (RPS, 2014) were dominated by juvenile flatfish, namely dab (*Limanda limanda*) and plaice (*Pleuronectes platessa*), with sand goby (*Pomatoschistus minutus*) and Nilsson's pipefish (*Syngnathus rostellatus*) also frequently recorded. Other species encountered were 5-beared rockling (*Ciliata mustela*), scaldfish (*Arnoglossus laterna*), flounder (*Platichthys flesus*), butterfish (*Pholis gunnellus*), dragonet (*Callionymus lyra*), and whiting (*Merlanguis merlangus*).

2.5.11 Beam trawls undertaken across the Dublin shipping channel between 2016 and 2020 (Aquatic Services Unit, 2019, 2020) recorded a similar suite of species including dab, plaice, flounder, cod (*Gadus morhua*), whiting, butterfish, dragonet, gobies (*Pomatoschistus* sp.), short-spined sea scorpion (*Myxocephalus scorpius*), and pipefish. Fish species recorded in trawls and gill nets deployed in outer Dublin Bay west of Burford Bank in 2016, 2018 and 2020 included gobies, dab, plaice, brill (*Scophthalmus rhombus*), poor cod (*Trisopterus minutus*), cod, sandeels (*Ammodytes* spp.), gurnards (Triglidae), lesser weever (*Echiichthys vipera*), dragonet, whiting, pipefish, red mullet (*Mullus surmuletus*) and herring (*Clupea harengus*) (Aquatic Services Unit, 2019, 2020).

2.5.12 Fish stock surveys in the lower river Liffey conducted in 2008 and 2010 as part of the WFD transitional water monitoring recorded high numbers of sprat (*Sprattus sprattus*), sand goby and juvenile thick-lipped grey mullet (*Chelon labrosus*). Other species encountered included sand smelt (*Osmerus eperlanus*), 3-spined stickleback (*Gasterosteus aculeatus*), flounder, dab, plaice, long-spined sea scorpion (*Taurulus bubalis*), cod, whiting, pollack (*Pollachius pollachius*) and European eel (*Anguilla anguilla*) (IFI, 2008a; IFI, 2010a). Inshore transitional water monitoring data for the Tolka estuary (IFI, 2008b; IFI, 2010b) recorded very similar fish assemblages, which were dominated by sand goby, sprat, grey mullet and cod, with sand smelt, flounder, lesser sandeel (*Ammodytes tobianus*), pollack, 3-spined stickleback, 3-beared rockling (*Gaidropsarus vulgaris*), 5-bearded rockling, whiting and short-spined sea scorpion also recorded, albeit in lower numbers.

2.5.13 Recreational angling is common along the coastline of Dublin Bay, including at Dún Laoghaire Harbour, where pier fishing has yielded dab, conger eel (*Conger conger*), whiting, pouting (*Trisopterus luscus*), saithe (*Pollachius virens*), mackerel, pollack and occasionally bass (*Dicentrarchus labrax*) (Dunlop, 2009).

2.5.14 Of the fish species commonly found further offshore, several are known to display seasonal movements into shallower coastal spawning and nursery areas. Analysis of egg and larvae data suggest that the waters within Dublin Bay provide spawning grounds for a range of commercially important fish species, including whiting, cod, plaice, sole, lemon sole, sandeel, sprat, and mackerel (Coull *et al.*, 1998; Ellis *et al.*, 2010, 2012; Marine Institute, 2016; see figures within the Fish and Shellfish Technical Baseline). The inshore waters are also likely to act as nursery grounds for several fish species, including whiting, cod, haddock, plaice, lemon sole, anglerfish, mackerel, and horse mackerel (Coull *et al.*, 1998; Ellis *et al.*, 2010, 2012; Marine Institute, 2016).

Elasmobranchs

2.5.15 Dublin Bay and the adjacent marine areas are also an important habitat for elasmobranchs. Basking shark (*Cetorhinus maximus*) are now legally protected since October 2022 under the Irish Wildlife Act 1976 (Section 23). Basking shark which are known to migrate through the Irish Sea, have been observed occasionally inside and outside Dublin Bay, including near Dún Laoghaire Harbour (National Biodiversity Data Centre, 2024); however, basking shark hotspots are typically located across the central Irish Sea outside the study area (Dolton *et al.*, 2020; Southall *et al.*, 2005). Irish Whale and Dolphin Group (IWDG) collaborate with the Irish Basking Shark Group and collate and validate basking shark sighting records from Irish waters. Basking shark sightings are rare in Dublin Bay with only one recent validated sighting in 2020.

2.5.16 The most common skate species within Dublin Bay appears to be the thornback ray (*Raja clavata*), which was regularly recorded within outer Dublin Bay west of Burford Bank and at the outer end of the Dublin Bay shipping channel during trawl and gill net surveys in 2016, 2018 and 2019 (Aquatic Services Unit, 2019, 2020; RPS, 2014). Furthermore, IFI tag and recapture data recorded the presence of starry smooth-hound (*Mustelus asterias*), nursehound (*Scyliorhinus stellaris*) and tope (*Galeorhinus galeus*) within Dublin Bay (MPA Advisory Group, 2023), while recreational angling data show the presence of spiny dogfish (*Squalus acanthias*) as well as starry smooth-hound within the bay area (Dunlop, 2009). Thornback ray, tope, nursehound, spiny dogfish and starry smooth-hound are also present further offshore outside Dublin Bay, with small-spotted catshark (*Scyliorhinus canicular*), blonde ray (*Raja brachyura*), spotted ray (*Raja montagui*) and cuckoo ray (*Leucoraja naevus*) also known to be present (see Appendix 4.3.4-1 Technical Baseline Report - Fish and Shellfish Ecology). Limited information is available to delineate elasmobranch spawning and nursery grounds within Irish waters. Using the distribution of juveniles, Ellis *et al.* (2010, 2012) predicted the presence of low intensity nursery grounds for tope, thornback ray and spotted ray within the inshore waters of the western Irish Sea, including Dublin Bay.

Diadromous Species

2.5.17 Diadromous fish species known to migrate through Dublin Bay include Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*), river lamprey (*Lampetra fluviatilis*), and European eel. Atlantic salmon are known to be present within several rivers flowing into Dublin Bay including the Rivers Liffey, Dodder and Tolka (IFI, 2018, 2022; Millane et al., 2023; O'Connor, 2006). A review of monthly fish counter returns on the Liffey shows that while salmon can run into the River Liffey in every month of the year, the main months are June to September, with years when October can also contribute significantly (Aquatic Services Unit, 2020; IFI, 2018). Analysis of data from fish counters indicate that salmon stocks within the River Liffey are currently below river-specific conservation limits (Millane *et al.*, 2023).

2.5.18 Sea trout are widespread in all major rivers and lakes systems of Ireland, including the Rivers Liffey, Tolka and Dodder (Cocoran *et al.*, 2022; CSTP, 2016; IFI, 2022). Environmental DNA (eDNA) samples collected upstream in rivers surrounding the Dublin Array onshore export cable route showed the presence of brown/sea trout within the Shanganagh River, the Carrickmines Stream and the Kill-O-The-Grange River, confirming the wide distribution of trout in rivers draining into the western Irish Sea.

2.5.19 European eel are present in many rivers on the east coast of Ireland including the Tolka, Dodder and Liffey river systems (e.g., IFI, 2008a,b; IFI 2010a,b). eDNA samples confirmed the presence of eel within the Shanganagh River, the Carrickmines Stream and the Kill-O-The-Grange River (Appendix 6.5.2-1 Biodiversity Technical Baseline Report). River lamprey have been reported from the Rivers Liffey and Dodder (Kelly and King, 2001; King and Linnane, 2004; O'Connor, 2006). There are no recent records of sea lampreys in rivers along Ireland's east coast, though historic records exist for sea lampreys in the Liffey (Igoe *et al.*, 2004; RPS, 2014).

Epibenthic Invertebrates and Shellfish

2.5.20 Epibenthic invertebrates present within the trawls undertaken across the Dublin shipping channel and inner Dublin Bay (Aquatic Services Unit, 2019, 2020) included common whelk (*Buccinum undatum*), brown shrimp (*Crangon crangon*) and green crab (*Carcinus maenas*); the latter two species numerically dominated the epibenthic assemblages in the mid to inner sections of the Dublin port shipping channel. Other invertebrates recorded included brown crab (*Cancer pagurus*), hermit crabs, velvet crab (*Necora puber*), and spider crabs (*Majidae*).

2.5.21 Beam trawls and fyke nets deployed in 2013 to inform the EIA of the ABR Project (RPS, 2014) recorded similar assemblages, with brown shrimp and green crab again dominating the middle sections of the Dublin shipping channel, which was thought to be a feature of the estuarine nature of the area. Within the outer sections of Dublin Bay (near the Poolberg Lighthouse), trawl and video data showed assemblages dominated by hermit crabs (*Pagurus bernhardus*) and masked crabs (*Corystes* sp.), with whelk, shrimp, and razor clams (*Ensis* spp.) also present (RPS, 2014).

Marine turtles

2.5.22 Five species of marine turtle have been recorded in the seas around Ireland and the UK: leatherback turtle (*Dermochelys coriacea*), loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), green turtle (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbricata*). The leatherback turtle is the largest of the marine turtles and is the only species of turtle to have developed adaptions to cold water (Goff and Stenson 1988).

2.5.23 Aerial surveys for the ObSERVE project from 2015-2016 recorded a handful of leatherback turtle sightings at the southern limits of Irish offshore waters in summer; none were observed in the Irish Sea (Rogan *et al*., 2018), within which the study area of the O&M Base at Dún Laoghaire is located.

2.6 Marine Mammals Baseline

Study Area

2.6.1 For the purposes of this assessment of the O&M Base, the marine mammal study area is defined as the area of the proposed works in Dún Laoghaire Harbour together with a wider buffer to encompass the underwater noise ZoI.

2.6.2 The underwater noise ZoI has been defined as the distance over which noise-producing activities have the potential to affect marine mammals.

2.6.3 It is considered that the noise production from rock levelling will be similar to or less than that produced during underwater rock placement activity. Using the non-impulsive weighted SEL_{cum} permanent threshold shift (PTS) thresholds from Southall *et al.* (2019) resulted in estimated PTS impact ranges of <100 m for all marine mammal species for all non-piling construction noise. These values mean that almost any marine mammal would have to be closer than 100 m from the continuous noise source at the start of the activity to acquire the necessary exposure to induce auditory injury. There is no information on disturbance impact ranges from rock placement, and as such, precautionary impact ranges for dredging is applied instead. Consequently, a buffer of 5 km around Dún Laoghaire Harbour entrance is considered to be precautionary and to encapsulate the area within which all of the potential significant effects associated with underwater noise on marine mammal receptors might occur.

2.6.4 Whilst potential noise impacts are not the only source of potential impacts to marine mammals resulting from the proposed O&M Base development activities, it is considered that the underwater noise ZoI presents the largest spatial footprint of potential effects.

Baseline Data

2.6.5 The baseline characterisation included within the marine mammal technical baseline (Volume 4, Appendix 4.3.5-1) incorporates a large number of survey data for Dublin Bay and the wider Irish Sea, as such this section provides a summary of those findings, together with a characterisation applicable to the Dub Laoghaire Harbour with references throughout.

Receiving Environment

2.6.6 The marine mammal technical baseline provides a summary of the data sources and densities of individual species across the wider Dublin Bay and Irish Sea.

2.6.7 The existing environment for marine mammals in the area of the Dublin Array Offshore Wind Farm includes several species commonly found in the region, such as harbour porpoises, bottlenose dolphins, common dolphins, minke whales, grey seals, and harbour seals. Harbour porpoises are the most frequently sighted marine mammals, inhabiting the Celtic and Irish Seas. Sightings are common from June through the autumn/winter, but reduced encounter rates from well-watched sites such as Howth Head, Dublin suggest they move offshore in spring between March and June (IWDG, 2010). Encounter rates typically increase in June, when calves are first recorded, which suggests they move to offshore calving/breeding grounds.

2.6.8 Bottlenose dolphins are present in the Irish Sea, often returning to the same areas due to their high site fidelity. Common dolphins, known for their large groups and wide distribution, are frequently recorded in Irish waters. Minke whales, typically seen in the spring and summer months, have a patchy distribution within the Irish Sea. Grey seals and harbour seals are found in the East and South-east regions of the Republic of Ireland and Northern Ireland, with grey seals known for their wide-ranging behaviour and harbour seals often seen near their haul-out sites on land.

2.6.9 Of note to the assessment of offshore works for the O&M base is the presence of harbour and grey seals, with anecdotal sightings of seals within the Dún Laoghaire Harbour itself[12].

Seals

2.6.10 To the north of Dublin Bay is the Lambay Island SAC which is designated for both harbour and grey seals. This is approximately 21 km from Dún Laoghaire Harbour. Seal densities in the waters surrounding the SAC are relatively high (up to 0.253 harbour seals/km^2 and 1.252 grey seals/km^2) (Carter et al 2022). By comparison, the predicted density of seals in the 5x5 km grid cell in which Dún Laoghaire Harbour is located is much lower, with 0.016 harbour seals/km^2 and 0.075 grey seals/km^2 (Carter et al 2022).

2.6.11 Within the Dublin Bay area, both grey seals and harbour seals have been recorded hauled-out[13] off the Poolbeg Lighthouse in August 2017, and grey seals have been recorded hauled-out just along the coast from Dún Laoghaire Harbour around White Rock, Killiney in August 2017 (including August 2011/2012 and August 2003) (Morris & Duck, 2019).

2.6.12 Berrow et al (2024) conducted surveys of haul-out sites close to Dublin Port between June 2023 and January 2024 during period with increased construction activity in the area related to Dublin Port's Masterplan 2040. These surveys included sites within Dublin Bay (and of relevance to Dún Laoghaire Harbour), included Sandy Cove which lies to the south, between the harbour and the Dalkey & Maidens Islands. Berrow et al (2024) conducted surveys of haul-out sites close to Dublin Port between June 2023 and January 2024 during period with increased construction activity in the area related to Dublin Port's Masterplan 2040.

2.6.13 Across the surveyed area, grey seals were more abundant that harbour seals. The maximum number of harbour seals counted in a month was 117 harbour seals in July 2023 (Figure). Of the sites within Dublin Bay, no harbour seals were counted at Dalkey Island, only 3 were counted in total at Sandy Cove and a maximum of 19 were counted at Bull Island.

2.6.1 Harbour seals were counted in highest numbers on Lambay Island and at Rush Head. The number of seals counted in the Dublin Bay and adjacent waters (Skerries to Dalkey Islands) were consistent with those counted in 2017 (Morris and Duck, 2019). Accounting for seals at sea at the time of the survey, the local abundance of harbour seals in the survey area (Skerries to Dalkey Islands) was estimated as >115. The maximum number of grey seals counted in a month was 326 grey seals in October 2023 (Figure 8). Of the sites within Dublin Bay, a maximum of 79 grey seals were counted at Dalkey Island in Nov 2023, a maximum of 4 were counted in Sandy Cove and a maximum of 25 were counted at Bull Island. Grey seals were counted in highest numbers on Lambay Island and Ireland's Eye. The number of seals counted in the Dublin Bay and adjacent waters (Skerries to Dalkey Islands) were consistent with those counted in 2017 (Morris and Duck, 2019). Accounting for seals at sea at the time of the survey, the local abundance of grey seals in the survey area (Skerries to Dalkey Islands) was estimated as >1,250.

[12] https://afloat.ie/port-news/dun-laoghaire-news/item/48435-seal-pup-hauls-out-at-dun-laoghaire-harbour and https://www.southdublinbirds.com/reports/outings23/reports55.php

[13] Hauling out is a behaviour associated with pinnipeds temporarily leaving the water, typically onto land. Hauling-out typically occurs between periods of foraging activity.

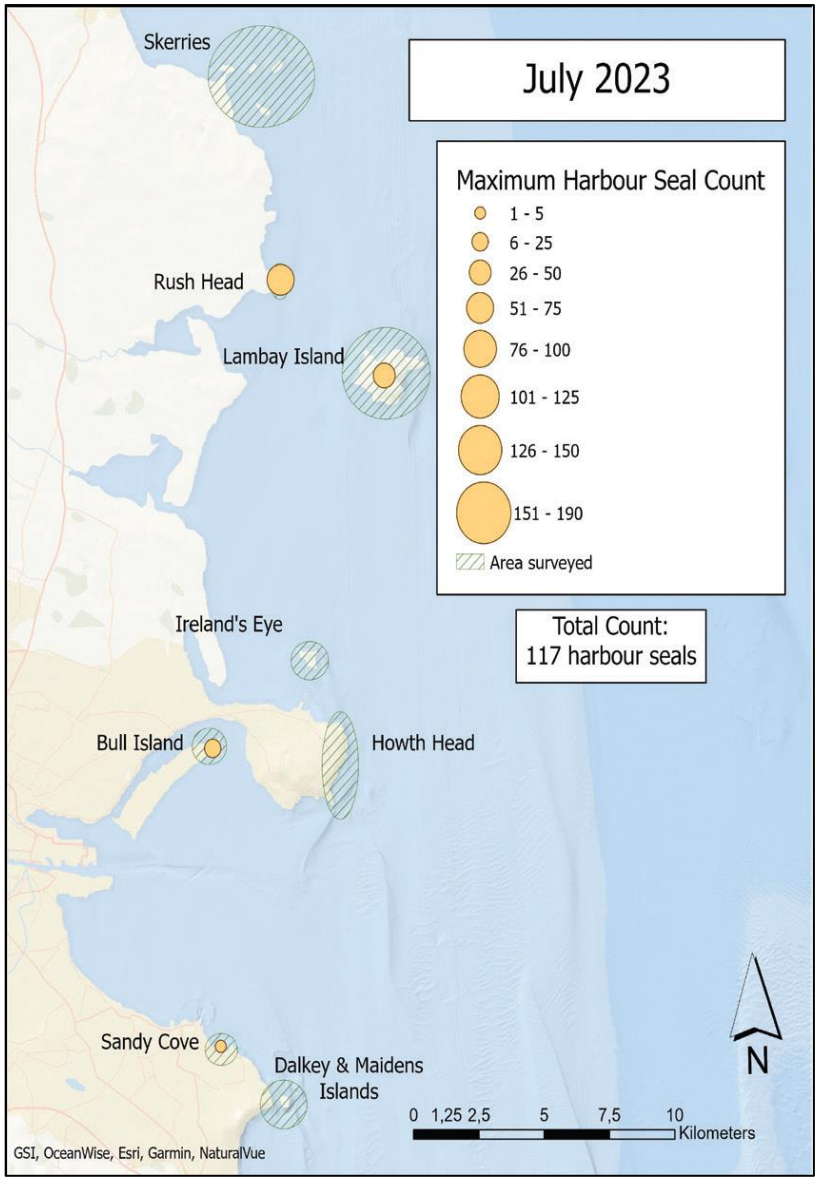


Figure 7 Counts of harbour seals at sites surveyed in July 2023 (Berrow et al., 2024)

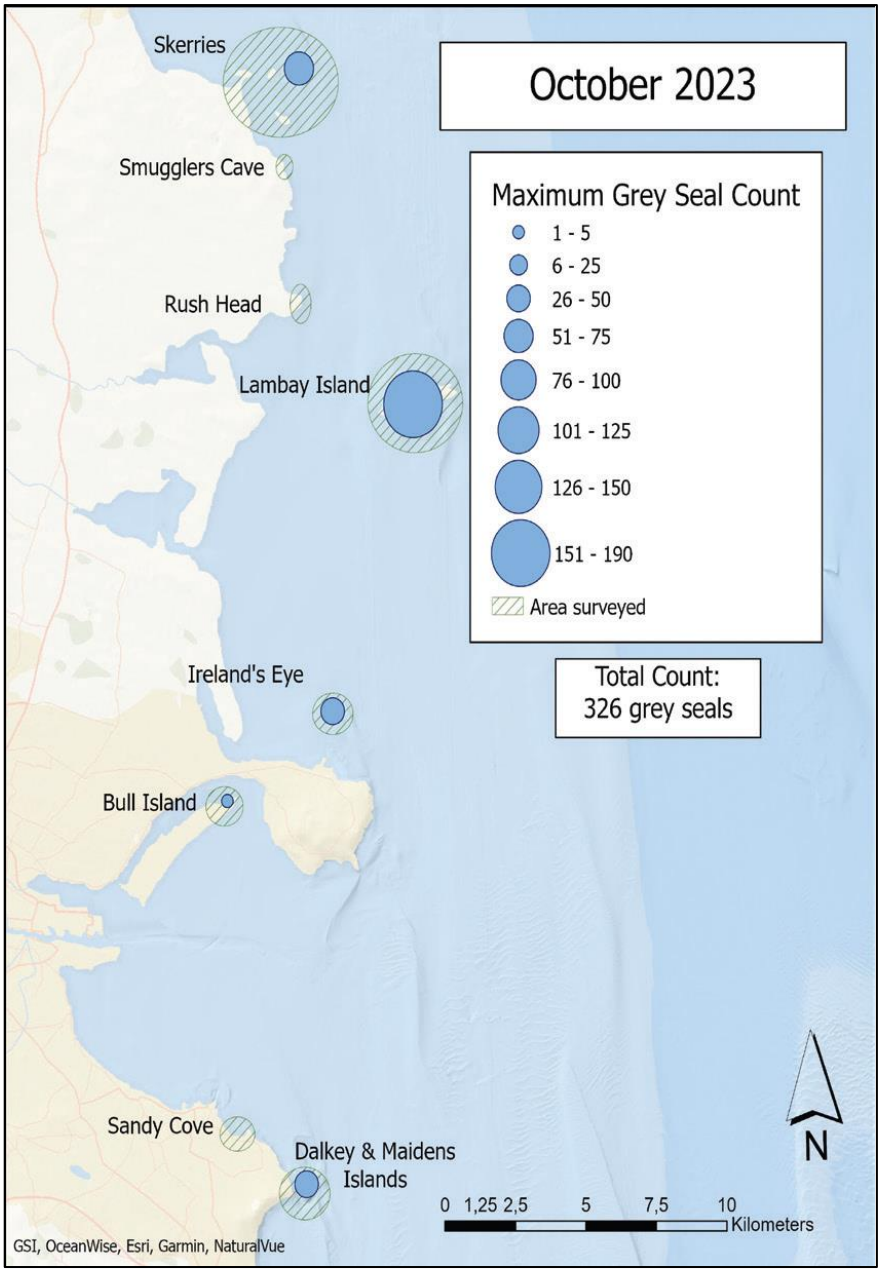


Figure 8 Counts of grey seals at sites surveyed in October 2023 (Berrow et al., 2024)

IWDG Rockabill SAC Survey 2021

2.6.2 From September to August of 2021, line transect surveys were conducted within the Rockabill to Dalkey Island SAC (site code 003000) to estimate density and abundance of harbour porpoise. A portion of the southern part of this SAC falls within the marine mammal O&M Base study area and as such, aids in setting the baseline. In total, six survey days were completed, with 137 sightings, totalling 181 individual porpoise. The density estimates for each survey ranged between 0.50 porpoises/km² to a maximum of 0.98 porpoises/km², with an overall pooled density of 0.83 ± 0.14 porpoises/km².

2.7 Offshore Ornithology Baseline

Study Area

2.7.1 The surveys undertaken to inform the EIAR for the Dublin Array Offshore Wind Farm include the location of the Operations and Maintenance (O&M) Base in Dún Laoghaire Harbour and the floating pontoon adjacent to the harbour wall where CTV vessels will berth. Based on the scale of the proposed development, and its current status as an operational harbour, a 500 m buffer around the O&M Base was used to define the study area for ornithological receptors. Displacement buffers for waterbirds are based on a 0.5 km displacement buffer (precautionary based upon Cutts *et al*, 2013[14]).

2.7.2 Ornithological receptors are presented within the following

- Volume 4, Chapter Offshore and intertidal ornithology;
- Volume 5, Chapter 2, Biodiversity;
- Volume 6, Appendix 6.5.2-1, Biodiversity Technical Baseline Report; and
- Volume 6, Appendix 6.5.2-2, O&M Base Onshore Bird Technical Baseline Report.

Baseline Data

2.7.3 To understand which species may have potential connectivity with the O&M base, the baseline characterisation draws upon Irish Wetland Bird Survey (IWeBS) data. It is noted that O&M base itself is not within an IWeBS site, however, it is adjacent to two subsites within the Dublin Bay site (site code: 0U404):

- East Pier - Bullock Harbour (subsite code: OU472); and
- Dún Laoghaire – Seapoint (subsite code: OU460).

2.7.4 It is noted that the spatial extent of these subsites is larger than the study area (the O&M Base plus 500m buffer); however, no finer spatial breakdown of the data is available. The IWeBS data presented are therefore likely to overestimate the number of birds occurring within the study area. The IWeBS data from the two adjacent subsites were considered against the national and international population sizes to provide context of relative importance of the area to the species recorded. Importance was quantified using the 1% criterion as employed by the IWeBS procedure itself. For example, if 1% or more of a national population is present within the area, then the area is likely to be of national importance[15].

[14] Cutts N, Hemingway K, Spencer J. (2013) Waterbird Disturbance Mitigation Tools Informing Estuarine Planning and Construction Projects. Version 3.2

[15] BirdWatch Ireland (2022). Annual Report 2022. https://birdwatchireland.ie/app/uploads/2023/06/Annual-Report-2022.pdf [Accessed November 2023].

Field Survey

2.7.5 A dedicated field survey was undertaken to search for breeding birds at the O&M Base (see Volume 6: Onshore Technical Appendices, Appendix 6.5.2.2). The survey methodology was based upon guidelines from the Bird Survey & Assessment Steering Group (2023), the full methodology and results can be found within O&M Base Onshore Bird Technical Baseline Report.

2.7.6 A scoping survey undertaken on 27/04/2023 suggested that in general, the O&M Base was of lower value for breeding birds. The exception was the presence of potentially nesting black guillemots *Cepphus grylle*. Consequently, the survey methodology was tailored to focus on this species, with a second visit carried out in the early morning on the 08/07/2023 to determine which potential nest sites had fish delivered to them, thereby indicating breeding success.

2.7.7 Any evidence of breeding terns or other notable birds was also searched for following the British Trust for Ornithology's (BTOs) breeding bird survey methodology[16]. For details on the methodology please refer to O&M Base Onshore Bird Technical Baseline Report.

Receiving Environment

IWeBS Desktop Data

2.7.8 Species recorded within the IWeBS subsites adjacent to the O&M Base during five winter seasons (2018/19 to 2022/23) is detailed in Table 9. There were 54 species recorded, with. the most abundant species being dunlin (*Calidris alpina*), herring gull (*Larus argentatus*), great black-backed gull *(Larus marinus*), black-headed gull (*Chroicocephalus ridibundus*), oystercatcher (*Haematopus ostralegus*), and sanderling (*Calidris alba*). Three species within these sub-sites were estimated in nationally important numbers (>1% of the national population). These species were dunlin, great crested grebe and sanderling (highlighted in bold in Table 9). However, as stated in paragraph 2.7.4, the spatial extent of these subsites is larger than the study area (the O&M Base plus 500m buffer) therefore, the IWeBS data presented are therefore likely to overestimate the number of birds occurring within the study area. Moreover, it is highly unlikely that these species would be present within the harbour itself in nationally important numbers.

[16] BTO (n.d.) Common bird census instructions. BTO / JNCC / RSPB. https://www.bto.org/sites/default/files/u31/downloads/details/CBC-instructions-g100.pdf [Accessed November 2023].

Table 9 Mean annual peak counts of intertidal bird species recorded at the study area[17].

Common name	Scientific name	Mean annual count at study area over last five winters 2018/19 – 2022/23[18]	All-Ireland population peak count[19]	1% population[20]	
				National	International
Arctic tern	*Sterna paradisaea*	1	-	-	-
Black-headed gull	*Chroicocephalus ridibundus*	128.75	20,197	-	-
Black-tailed godwit	*Limosa limosa*	30	19,314	200	1,100
Common gull	*Larus canus*	4	8,032	-	-
Common scoter	*Melanitta nigra*	24	7,377	110	7,500
Common tern	*Sterna hirundo*	1	-	-	-
Cormorant	*Phalacrocorax carbo*	24.5	2,987	110	1,200
Curlew	*Numenius arquata*	2.5	14,994	350	7,600
Dunlin	***Calidris alpina***	**2,885**	**34,135**	**460**	**13,300**
Great black-backed gull	*Larus marinus*	127.5	1,780	-	-
Great crested grebe	***Podiceps cristatus***	**33.5**	**879**	**30**	**6,300**
Great northern diver	*Gavia immer*	1	812	20	50
Greenshank	*Tringa nebularia*	3.5	649	20	3,300
Grey heron	*Ardea cinerea*	5.25	759	25	5,000
Herring gull	*Larus argentatus*	149.9	14,060	-	-
Kingfisher	*Alcedo atthis*	1	23	-	-
Lesser black-backed gull	*Larus fuscus*	4	3,644	-	-
Light bellied brent goose	*Branta bernicla hrota*	28	16,191	350	400
Little egret	*Egretta garzetta*	2	808	20	1,100
Little grebe	*Tachybaptus ruficollis*	1	1,242	20	4,700
Mallard	*Anas platyrhynchos*	4	8,098	280	53,000

[17] Results are shown for two subsites Dublin Bay: East Pier – Bullock Harbour (site code OU472) and Dublin Bay: Dún Laoghaire – Seapoint, over the last five winters. Note that birds highlighted as **bold** comprise populations >1% of the national population.

[18] This includes the sum of the two mean averages for each of the two subsites: Dún Laoghaire - Seapoint & East Pier - Bullock Harbour (BirdWatch Ireland, 2023a)

[19] Taken as the peak count from Tables 3a and 3b from Fitzgerald et al., (2021).

[20] Taken from IWeBS site summary table for OU404 Dublin Bay. https://c0amf055.caspio.com/dp/f4db30005dbe20614b404564be88 [Accessed November 2023].

Common name	Scientific name	Mean annual count at study area over last five winters 2018/19 – 2022/23[18]	All-Ireland population peak count[19]	1% population[20]	
				National	International
Mediterranean gull	*Ichthyaetus melanocephalus*	40	181	-	-
Moorhen	*Gallinula chloropus*	3	398	-	-
Oystercatcher	*Haematopus ostralegus*	50.6	29,797	610	8,200
Purple sandpiper	*Calidris maritima*	2.7	68	20	110
Red-breasted merganser	*Mergus serrator*	3	942	25	860
Redshank	*Tringa totanus*	12.5	11,885	240	2400
Red-throated diver	*Gavia stellata*	2	258	20	3,000
Ringed plover	*Charadrius hiaticula*	24	3,743	120	540
Sanderling	***Calidris alba***	**100**	**2454**	**85**	**2,000**
Sandwich tern	*Thalasseus sandvicensis*	6	256	-	-
Shag	*Phalacrocorax aristotelis*	16.75	1,120	-	-
Turnstone	*Arenaria interpres*	33.8	1,612	95	1,400
Yellow-legged gull	*Larus michahellis*	1	-	-	-

Field Survey

2.7.9 A total of 13 bird species were recorded within the field surveys (see Volume 6: Onshore Technical Appendices, Appendix 6.5.2.2) and of these, five are SCI species for nearby SPAs, which are listed within Table 10 below. Table 10 provides a summary of birds considered to be breeding / non-breeding at the O&M Base location.

2.7.10 Black guillemots were confirmed to be breeding within the underside of Carlisle Pier within the study area, located at approximate ITM coordinates 724617, 728820, ca. 190 m from the development footprint. A peak count of 10 birds was recorded during the survey.

2.7.11 Herring gull were confirmed to be breeding on the roof of the existing Ferry Terminal Building, located at approximate ITM coordinates 724466, 728895. Two chicks were observed begging for food from an adult bird. This was the only species confirmed breeding that is also an SCI for nearby SPAs.

2.7.12 Other species recorded but not assessed for offshore works given their onshore range include house martin (*Delichon urbicum*), house sparrow (*Passer domesticus*) and starling (*Sturnus vulgaris*) were assessed as possibly breeding within the study area due to their presence in suitable nesting habitat. A remaining eight species were recorded as non-breeding within the study area. See Volume , BiodiversityChapter.

2.7.13 Other relevant ornithological observations included large numbers (c. 500 individuals) of starlings roosting on the steel walkways leading to the fenders at the end of St Michael's pier, c. 200 m from the proposed O&M Base.

Table 10 Breeding status for birds identified on the site / within the study area

Species	Breeding Status[21][22]	Justification	SCI From Nearby SPA
Black guillemot	**Confirmed breeding**	**Repeated returning to nest sites with food, and begging chicks heard**	**No**
Common guillemot *Uria aalge*	Non-breeding	Only single individuals observed foraging recorded during surveys	Yes – Ireland's Eye SPA 004117
Common tern	Non-breeding	Foraging within harbour waters. No breeding behaviours observed	Yes - South Dublin Bay and River Tolka Estuary SPA
Cormorant	Non-breeding	Likely use the coastal structures and buildings for roosting, but no evidence of nesting behaviours observed	Yes – Ireland's Eye SPA
Gannet *Morus bassanus*	Non-breeding	Flyover	No
Grey heron	Non-breeding	Flyover	No
Goldfinch *Carduelis carduelis*	Non-breeding	Sighting made within habitat of negligible nesting value. No breeding behaviours observed	No
Herring gull	**Confirmed breeding**	**Chicks observed on the roof of existing building begging for food from adult birds**	**Yes – Ireland's Eye SPA**
House martin	Possible breeding	Historical nesting observed. None found to be in use at the time of the surveys	No
House sparrow	Possible breeding	Multiple birds heard in suitable nesting habitat	No
Linnet *Linaria cannabina*	Non-breeding	Incidental sighting within habitat of negligible nesting value. No breeding behaviours observed	No
Oystercatcher	Non-breeding	Flyover	Yes - South Dublin Bay and River Tolka Estuary SPA; North Bull Island SPA
Starling	Possible breeding	Breeding unconfirmed on the Site. Whilst significant numbers of roosting starlings were observed on coastal structures, it is unlikely that suitable nesting features within the Site could support a breeding population of this size. The presence of small numbers of breeding starling cannot be discounted	No

[21] Species confirmed breeding are shown in **bold**
[22] Breeding status taken from O&M Base Onshore Bird Technical baseline Report

2.8 Nature Conservation Baseline

Study Area

2.8.1 For the purposes of this assessment of the O&M Base, the Nature Conservation study area encompasses both the (i) immediate area of the proposed works in Dún Laoghaire Harbour; and (ii) area of secondary impact Zone of Influence (ZoI).

2.8.2 The secondary ZoI is defined as the distance over which material released from the proposed works may be dispersed over a single tidal cycle.

2.8.3 Consequently, a study area with a 2 km buffer around the Dún Laoghaire Harbour entrance is considered precautionary and sufficient to encapsulate the area within which all potential significant secondary or indirect effects on nature conservation receptors might occur. The nature conservation study area is limited to the marine and coastal environment below HWM.

Baseline Data

2.8.4 Information on nature conservation sites within the study area was collected through a detailed desktop review and interrogation of existing studies and datasets to characterise the baseline. The data sources considered are provided in Table 11.

2.8.5 The aim of this section is to identify and assess nature conservation sites that are designated for ecological and physical features/receptors. In many cases, the receptors/features identified (i.e. fish, benthic features, birds etc.) which qualify a site for a nature conservation designation are assessed fully within the other sections of this chapter. As such, this section aims to avoid repetition of the assessments contained within those other sections, but does draw upon information contained therein.

2.8.6 Furthermore, consideration of designated European sites is required under The European Communities (Birds and Natural Habitats Regulations 2011 (S.I. No. 477 of 2011)), as amended, which transpose the EU Habitat and Birds Directives. An assessment of the impact of the onshore and offshore infrastructure for the O&M Base on European sites and their supporting species and habitat qualifying interests is presented in the Natura Impact Statement (NIS) (Habitats Directive Assessments: Part 3 NIS). As such, the assessment of these sites is not repeated herein.

Table 11 Key sources of pre-existing nature conservation site data[23]

Data Source	Type of data	Spatial coverage	Limitations
Dublin Bay Biosphere Partnership	Information on the Dublin Bay Biosphere.	Information regarding the Dublin Bay Biosphere.	No limitations.
Marine Irish Digital Atlas	Data indicating the locations of nature conservation sites	Information regarding designated sites across Ireland, including marine sites.	No limitations.

[23] No site-specific surveys have been undertaken in relation to the Dublin Array O&M base.

Data Source	Type of data	Spatial coverage	Limitations
	within the Dublin Bay area.		
National Parks & Wildlife Service	Information and data on National Parks and Nature Reserves.	Information regarding designated sites across Ireland, including marine sites.	No limitations.
Ramsar Sites Information Service.	Information and maps on all designated Ramsar sites.	Limited to information regarding Irish Ramsar sites.	No limitations.

Receiving Environment

2.8.7 No designations cover Dún Laoghaire harbour, however a number of sites designated within the study area, immediately adjacent to the harbour.

2.8.8 For an overview of the designations and relevant legislator frameworks please see Volume 4, Chapter 8, Nature conservation.

2.8.9 The potential for likely significant effect to occur from the offshore and onshore works relating to the O&M Base are covered within the SISAA and NIS. And as such are not repeated herein.

Ramsar sites

2.8.10 Only one Ramsar sites is located within the study area for the proposed O&M Base, namely Sandymount Strand / Tolka Estuary Ramsar site, which is also designated within the Dublin Bay Biosphere, and as both an SAC and SPA, and thus are protected as part of the Natura 2000 network.

2.8.11 The Qualifying Interests of the Sandymount Strand / Tolka Estuary Ramsar site are outlined in Table 12 and presented on Figure 9.

Table 12 Identified Ramsar sites within the 2 km study area

Site Name	Qualifying Interest(s)
Sandymount Strand / Tolka Estuary (site no. 832)	An intertidal system supporting a large bed of eelgrass (*Zostera noltii*) with extensive areas of sandflats. The site is important for various species of waterbirds, supporting internationally important numbers of Brent Geese and large numbers of roosting gulls and terns. Various species of annelids, bivalves and small gastropods occur. **Flora:** Dwarf eelgrass (*Zostera noltii*) **Bird:** Common teal (*Anas crecca*) Eurasian wigeon (*Anas Penelope*) Pale-bellied Brent Goose (*Branta bernicla hrota*) Dunlin (*Calidris alpina*) Mute Swan (*Cygnus olor*)

Site Name	Qualifying Interest(s)
	Little egret (*Egretta garzetta*) Common Snipe (*Gallinago gallinago*) Great northern diver (Gavia immer) Red-throated diver (*Gavia stellata*) Eurasian oystercatcher (*Haematopus ostralegus*) Mediterranean gull (*Ichthyaetus melanocephalus*) Bar-tailed godwit (*Limosa lapponica*) Black-tailed godwit (*Limosa limosa*) Eurasian Curlew (*Numenius Arquata*) Great cormorant (*Phalacrocorax carbo*) Great crested grebe (*Podiceps cristatus*) Common tern (*Sterna hirundo*) Common shelduck (*Tadorna tadorna*) Sandwich tern (*Thalasseus sandvicensis*) Common redshank (*Tringa tetanus*) Northern lapwing (*Vanellus vanellus*) **Ecological Communities:** Saltmarsh community *Zostera noltii* community [1140] Tidal Mudflats and Sandflats [1310] Salicornia and other annuals colonising mud and sand

Biosphere Reserves

2.8.12 . The Dublin Bay UNESCO Biosphere Reserve is the only biosphere reserve in the vicinity of the O&M Base at Dún Laoghaire. The Biosphere is comprised of three different management zones - the core zone, buffer zone and transition zone. The core zone which includes Dún Laoghaire Harbour comprises 50 km² of areas of high natural value within Dublin Bay coastal areas, which overlaps with the nature conservation study area for the O&M Base, at the Tolka Estuary and along Sandymount Strand[24]. Protected areas within the core zone are managed for the conservation of landscapes and biodiversity.

2.8.13 The Qualifying Interests of the Dublin Bay Biosphere Reserve are outlined in Table 13 and presented on Figure 9.

[24] https://www.dublinbaybiosphere.ie/about/

Table 13 Identified Biosphere Reserves within the 2 km study area

Site Name	Qualifying Interest(s)
Dublin Bay Biosphere	The Dublin Bay Biosphere Reserve (former North Bull Island) comprises Dublin Bay, North Bull Island and adjacent land, including parts of Dublin. The Biosphere also encompasses three Ramsar sites, Sandymount Strand, North Bull Island and Baldoyle Bay. The biosphere reserve is significant from a conservation perspective since it supports well-developed salt marshes and dune systems displaying all stages of development from the earliest phase of colonization to stable and full maturity. The biosphere is also important for nesting and wintering waterfowls. The major habitats and land cover types are saltmarsh with glasswort (*Salicornia dolichostachya* and *S. europaea*), Puccinellia maritima and sea lavender (*Limonium humile*); sand dune complex with saltwort (*Salsola kali*), sea rocket (*Cakile maritima*), sea couchgrass (*Agropyron junceiforme*) etc.; beaches; lagoonal sand flat; lagoonal mud flats with algae such as *Enteromorpha intestinalis*, *E. compressa* and *Ulva lactuca*. It also qualifies for international importance as the numbers of three species exceed the international threshold – Light-bellied Brent Goose (*Branta bernicla hrota*), Black-tailed Godwit (*Limosa limosa*) and Bar-tailed Godwit (*Limosa lapponica*). Species such as Grey Heron (*Ardea cinerea*), Goldeneye (*Bucephala*), Red-breasted Merganser (*Mergus serrator*) and Greenshank (*Tringa nebularia*) are regular in winter in numbers of regional or local importance. The North Bull Island and parts of the buffer zone in north Dublin include populations of Irish Mountain Hare (*Lepus timidus hibernicus*), a uniquely Irish sub-species of a species of national and international importance, but under severe pressure from recreational disturbance and illegal poaching.

Proposed Natural Heritage Areas

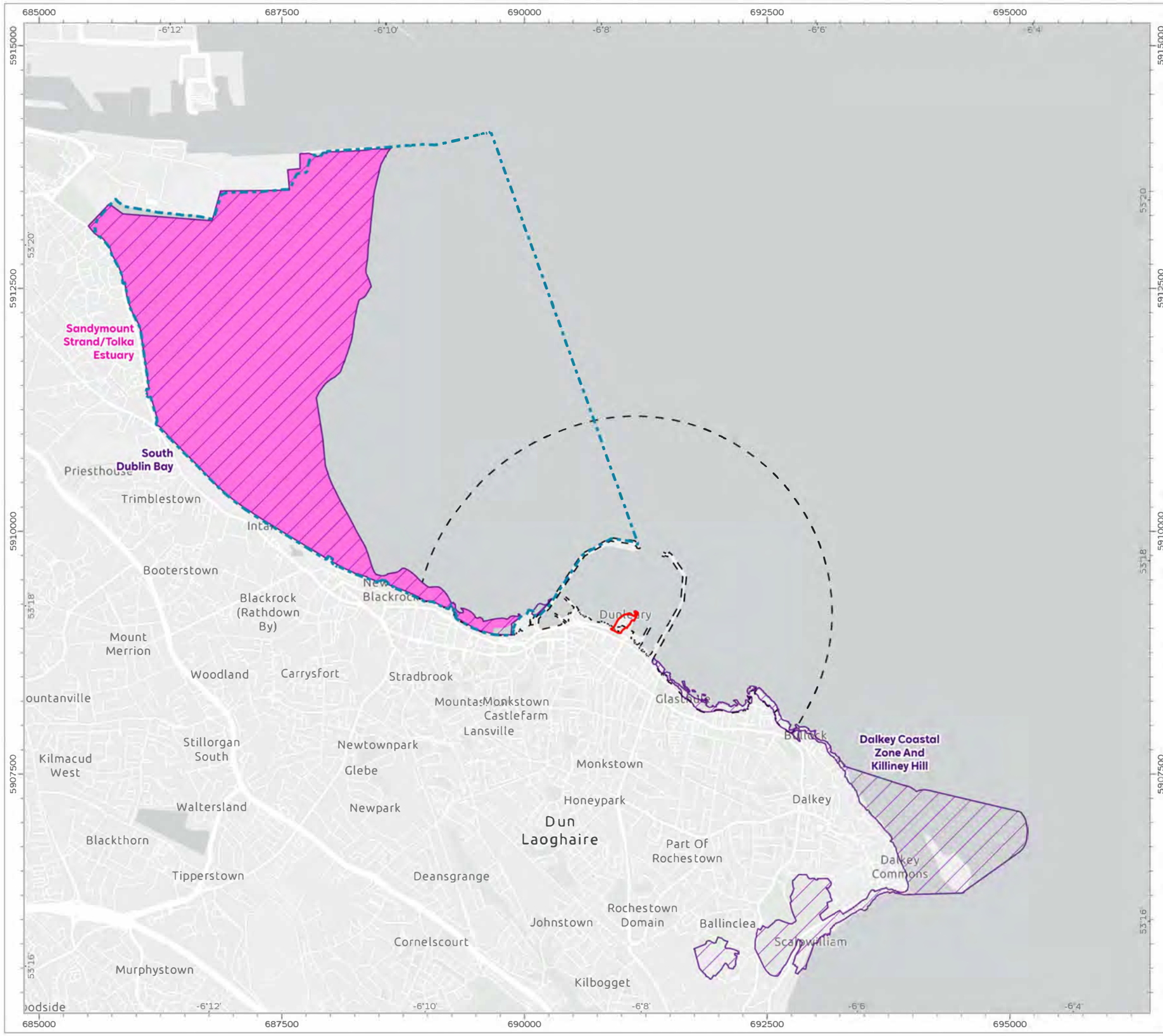
2.8.14 The two pNHAs which occur within the study area for the O&M Base are; Dalkey Coastal Zone and Killiney Hill pNHA and South Dublin Bay pNHA.

2.8.15 The Qualifying Interests of Dalkey Coastal Zone and Killiney Hill pNHA and South Dublin Bay pNHA are outlined in Table 14 and presented on Figure 9.

Table 14 Identified pNHAs within the 2 km study area

Site Name	Qualifying Interest(s)
Dalkey Coastal Zone and Killiney Hill (pNHA 001206)	This site represents a fine example of a coastal system with habitats ranging from the sub-littoral to coastal heath. The flora is well developed. The islands are important bird sites with known nesting and roosting areas for many species including: Herring Gulls; Great Black-backed Gull; Lesser Black-backed Gull; Shelduck; Fulmar; Mallard; Oystercatcher; Cormorants; Shag; Curlew. The site is also known for the presence of various tern species including: Common tern; Arctic tern; and Roseate tern. Dalkey Sound is noteworthy for the occurrence of many coastal invertebrate species including: Squat lobsters (*Galathea spp.*); Swimming crabs (*Portunus spp.*); Crawfish (*Palinurus vulgaris*); European species of the Order Nudibranchia; and Spiny Starfish (*Marthasterias glacialis*). The site is also classified for its geological importance.
South Dublin Bay (SAC 000210 / SPA 004024)	The qualifying interests for this nature conservation site have been sourced from the South Dublin Bay SAC and South Dublin Bay and River Tolka Estuary SPA. SAC qualifying interests: Mudflats and sandflats not covered by seawater at low tide; Annual vegetation of drift lines; Salicornia and other annuals colonising mud and sand; and Embryonic shifting dunes. SPA qualifying interests: Light-bellied Brent Goose (*Branta bernicla hrota*); Oystercatcher (*Haematopus ostralegus*) Ringed Plover (*Charadrius hiaticula*); Grey Plover (*Pluvialis squatarola*); Knot (*Calidris canutus*); Sanderling (*Calidris alba*); Dunlin (*Calidris alpina*); Bar-tailed Godwit (*Limosa lapponica*);

Site Name	Qualifying Interest(s)
	Redshank (*Tringa tetanus*); Black-headed Gull (*Chroicocephalus ridibundus*); Roseate Tern (*Sterna dougallii*); Common Tern (*Sterna hirundo*); Arctic Tern (*Sterna paradisaea*) ; Wetland and Waterbirds.



DRAWING STATUS

FINAL

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Nature Conservation Sites within the Study Area

DRAWING NUMBER: **9**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-08-05	For Issue	GB	BB	SS

0 0.3 0.6 0.9 1.2 km
0 0.15 0.3 0.45 0.6 nm

N (GRID NORTH)

SCALE 1:40,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

2.9 Cultural Heritage and Marine Archaeology Baseline

Study Area

2.9.1 The study area used to consider the archaeological potential consists of a 1 km buffer around the O&M Base at Dún Laoghaire (see Figure 10).

2.9.2 This study area has been assessed for archaeological potential using the National Monuments Service (NMS)[25] datasets and publicly available literature to inform the baseline within the O&M Base study area at Dún Laoghaire Harbour. No project specific geophysical surveys were conducted over the area given the scale and nature of the works in an already busy, operational harbour.

2.9.3 As outlined above, the study area (1 km) was used to identify shipwreck records and previous investigations that are present to show known sites, while the baseline data below is used to describe a wider/more general use of the area, as well as geoarchaeological features such as channels and deposits (units) that can stretch further afield, and is indicative of the types of sites/finds which may be present within the study area but may not yet have been identified.

2.9.4 There are over 3000 wrecks off the coastal waters of Dublin, listed in the WIID, however only a small percentage have been located. Due to the known use of this area prior to official records being kept there is potential for earlier, undocumented wrecks to have occurred in this area.

2.9.5 There are 229 ships recorded as sinking within or in close proximity to Dún Laoghaire Harbour with only 12 of these records where the precise coordinates are known.

Baseline Data

2.9.6 The high and continuous historical and current use of the harbour has resulted in a number of wrecking events, with 229 documented losses off Dún Laoghaire and within its harbour. The vast majority of these do not have specifically known locations, however, are representative of the archaeological potential of the area.

2.9.7 There have been no geotechnical surveys conducted for the O&M Base study area due to the shallow depth and busy, operational nature of the harbour along with the limited direct impact to the seafloor by the O&M Base. The sub-bottom data collected in 2021 (described further in Volume 4: Appendix 4.3.13-1 Marine Archaeology Technical Baseline) addressed the area immediately north of the O&M Base at Dún Laoghaire which contained evidence of Units B and C:

- 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.

[25] Datasets used include; Archaeological Survey of Ireland - https://data.gov.ie/dataset/national-monuments-service-archaeological-survey-of-ireland (including SMR & SMRZones) and Wreck Inventory of Ireland - https://data.gov.ie/dataset/national-monuments-service-wreck-inventory-of-ireland

- Unit C (MA3015-MA3018) is found across the array and parts of the marine archaeology study area 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.

2.9.8 Units D and E were also noted within 5 km, and further illustrate the regional palaeoenvironment:

- 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. 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 carbon-14 dating where samples generally older than 55-60,000 years before present (BP) cannot be securely dated as the amount of carbon-14 remaining is negligible;

- 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.

Receiving Environment

Palaeolithic (800,000-8,000 BC)

2.9.9 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 (Dowd and Carden, 2016). To date there have been no finds of Palaeolithic remains reported within the marine zone of Irish waters, encompassing the O&M Base study area at Dún Laoghaire.

Mesolithic (8,000 - 4,000 BC)

2.9.10 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).

2.9.11 Although Ireland was not connected to Britain during the Mesolithic, 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.

2.9.12 Dún Laoghaire, and thus the O&M Base study area for marine archaeology, was most likely a sheltered inlet at this time and evidence for the exploitation of the coastline and maritime resource has been found around the Dublin Bay area, including a shell midden and flint scatter from Dalkey Island, Mesolithic fish traps at Spencer Dock and a shell midden at Sutton (McQuade, 2008; Bennet, 2004; and Mitchel, 1972).

Neolithic (4,000 - 2,500BC)

2.9.13 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).

2.9.14 There is no evidence for Neolithic activity that has been found within the O&M Base study area at Dún Laoghaire or surrounding area.

Bronze Age (2,500 - 500 BC)

2.9.15 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.

2.9.16 The Bronze Age population used routes of communication along the coasts and waterways of the region. Tin was 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).

2.9.17 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.

Iron Age (500 BC- AD 400)

2.9.18 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.

2.9.19 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. 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.

2.9.20 In Britain, 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).

Early Medieval (AD 400 - 1100)

2.9.21 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).

2.9.22 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.

2.9.23 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).

2.9.24 The term dún refers to a stronghold, possibly ring-shaped, of importance (Edwards, 2006), with the name Dún Laoghaire translating as 'the fort of Laoghaire', a 5th century king of Ireland who allegedly chose the area as a sea base from which raids could be carried out. The name Dún Laoghaire is commonly held to refer to an early Medieval fort situated somewhere in the area, however the namesake forts location remains unknown.

2.9.25 From the 10th century onwards, the Hiberno-Norse developed many ports and harbours in Ireland, including Dublin Port. 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). Medieval (1100 - 1550)

Medieval (1100 – 1550)

2.9.26 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).

2.9.27 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.

2.9.28 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).

2.9.29 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)

2.9.30 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).

2.9.31 However, Dublin Bay had become dangerous to enter it silted up by the post-medieval period and it became common practice for ships to land their passengers ashore at Dún Laoghaire leading to a pier to be built between 1755 and 1767. The harbour at Dún Laoghaire was completed in 1842 and has since been an important resource for commercial activity as well as a civic amenity, with the inclusion of ferry services, a yacht marina, lifeboat station and publicly accessed piers.

2.9.32 The 17th century saw the redevelopment and modernisation of the major ports around the coast, including Dublin Port. 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).

2.9.33 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). All recorded losses are from this period, however, this is also the time when records became commonly kept so there is the potential for older wrecks that remain unrecorded.

Recorded losses

2.9.34 There are seven recorded losses within the O&M Base study area:

- W01966 – unknown wreck, no additional information known;
- W01967 – possible unknown wreck (INSS No. G145) identified during the National Seabed Survey. Wreck. Measures 27 m x 5m with a height of 1 m off the seabed and lies in a general sea depth of 8 m;
- W11481 – unknown wreck recorded by the UK Hydrographic Office (UKHO)[26] in 1932 as being in two different sections;
- W11584 – possible section of unknown wreck surveyed by the Geological Survey of Ireland in 2004 as part of the Irish National Seabed Survey. Wreck measures 2 m long and lies in 4.6 m of water;
- W11594 – section of a possible unknown wreck surveyed by the Geological Survey of Ireland in 2004 as part of the Irish National Seabed Survey. Wreck measures 4.5m long and lies in 4.5m of water;
- W11604 – section of a possible unknown wreck surveyed by the Geological Survey of Ireland in 2004 as part of the Irish National Seabed Survey. Wreck measures 4.5 m long and lies in 4.3 m of water; and
- W11611 – possible section of unknown wreck surveyed by the Geological Survey of Ireland in 2004 as part of the Irish National Seabed Survey. Wreck measures 0.75 m long and lies in 4.3 m of water.

[26] the UK's agency for providing hydrographic and marine geospatial data to mariners and maritime organisations across the world.

2.9.35 These locations, the closest of which is recorded approximately 400 m from the proposed O&M Base will be avoided during the proposed works. As outlined in Volume 3, Chapter 13, AEZs will be implemented around known and identified potential sites of archaeological interest. All activities interfering with the seabed during the construction phase will be micro sited to avoid these AEZs.

Previous archaeological investigations

2.9.36 A total of eight archaeological investigations have occurred within the O&M Base study area:

- 03E1190 in 2003 – A significant amount of modern material was recovered, but there was nothing of archaeological significance noted during the dredging works;
- 05E0097 in 2005 – Nothing of archaeological significance;
- 05E1053 in 2005 – Nothing of archaeological significance;
- 06E0009 in 2006 – No features of archaeological significance were encountered during monitoring;
- 07E0733 in 2007 – Nothing of archaeological significance;
- 12E210 in 2012 – Nothing of archaeological significance;
- 14D0441 in 2014 – Archaeological investigations over two wreck site locations (W01966, W01967);
- 18E0390 in 2020 – Nothing of archaeological significance;
- 20E0125 in 2021 – Nothing of archaeological significance.

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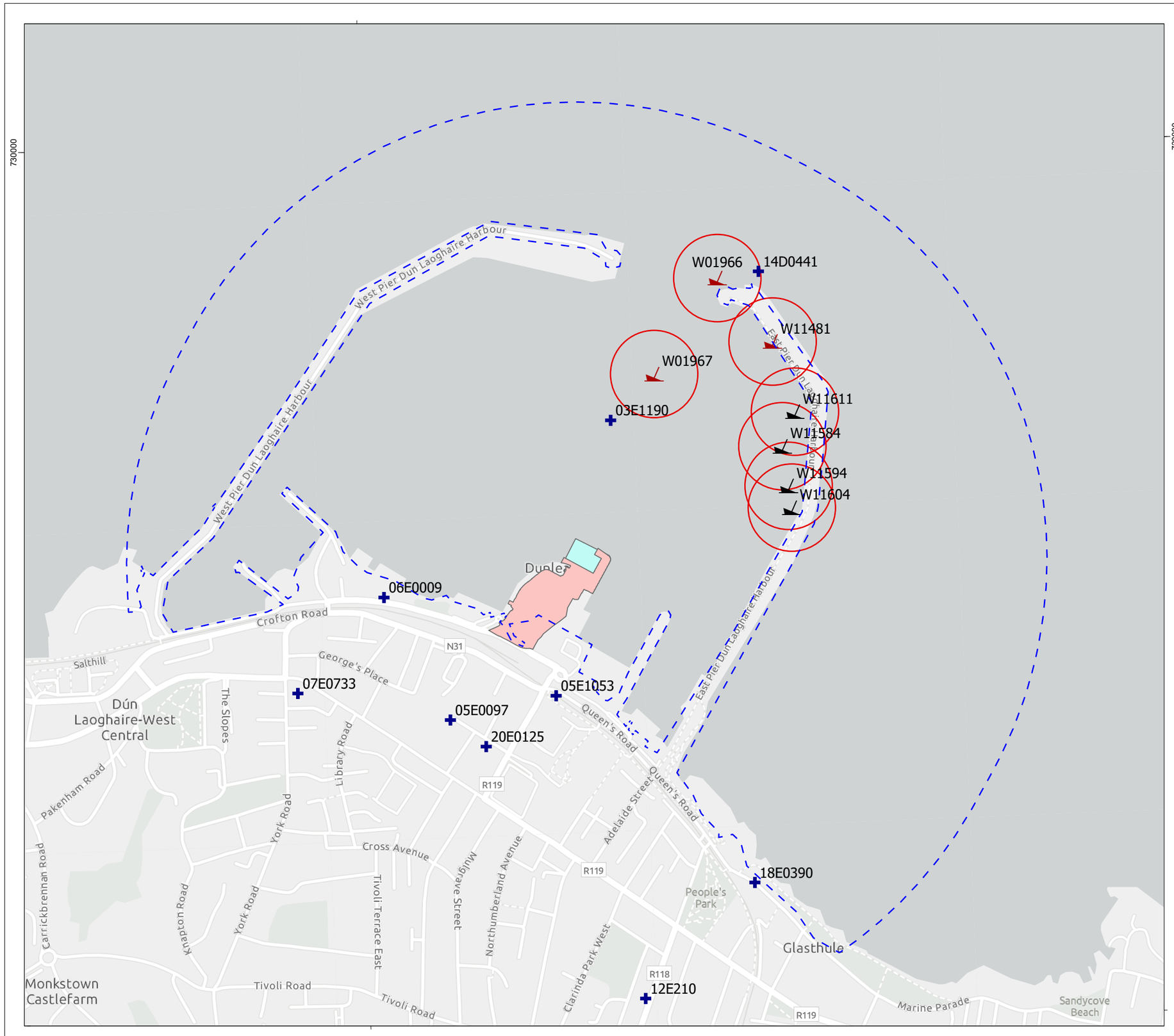

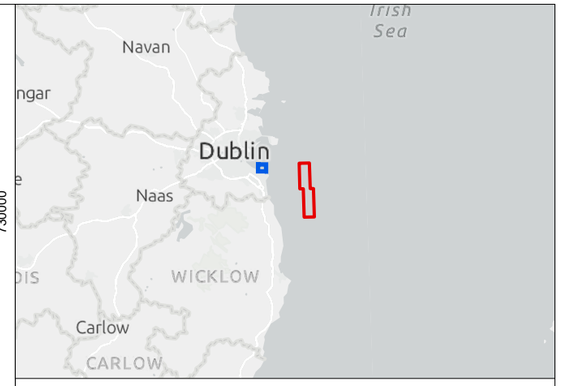

Dun Laoghaire Operations Base Area
Dun Laoghaire Operations Base Site Boundary
Dun Laoghaire Operations Base Study Area
Archaeological Exclusion Zone (AEZ)
Previous archaeological investigations

Recorded wrecks within the O&M Base study area

INFOMAR
WIID

DRAWING STATUS **FINAL**

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PROJECT TITLE **Dublin Array**

DRAWING TITLE **Recorded Wrecks, AEZ and Previous Archaeological Investigations**

DRAWING NUMBER: 10

PAGE NUMBER: 1 of 1

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

0 0.1 0.1 0.2 0.3 Kilometers
0 0 0 0 0 Miles

N GRID NORTH

SCALE 1:9,000 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

2.10 References

ABPmer (2014) Cruise Berth, Dún Laoghaire Harbour: Wave, Tide and Sediment Plume Modelling. Available at: https://www.pleanala.ie/publicaccess/EIAR-NIS/PA0042-PA0051/EIS%20Volume%203%20Appendices/004.EIS_Appendix_5_4_1_%20Wave_Tide_Sediment_Plume_%20Modelling_Report.pdf (Accessed: 12 July 2024).

ABPmer (2014), 'Explore the ABPMER UK renewables atlas', Atlas of UK Marine Renewable Energy (ABPmer). https://www.renewables-atlas.info/explore-the-atlas/ [Accessed: July 2024].

Aquatic Services Unit (2019), 'Dublin Port Company Maintenance Dredging (2020-2021). Assessment of Potential Benthic and Fisheries Impacts'. https://www.gov.ie/en/foreshore-notice/7a2de-maintenance-dredging-in-dublin-port/ [Accessed: April 2024].

Aquatic Services Unit (2020), 'Dublin Port Company Maintenance Dredging 2022-2029. Benthic and Fisheries Assessment'. https://www.gov.ie/en/foreshore-notice/60147-dublin-port-maintenance-dredging/ [Accessed: April 2024].

Celi, M., Filiciotto, F., Maricchiolo, G., Genovese, L., Quinci, E. M., Maccarrone, V., Mazzola, S., Vazzana, M. and Buscaino, G. (2016), 'Vessel noise pollution as a human threat to fish: assessment of the stress response in gilthead sea bream (Sparus aurata, Linnaeus 1758)', Fish Physiology and Biochemistry, 42: 631-641.

Centre for Environment, Fisheries and Aquatic Science (Cefas) (2016) Suspended Sediment Climatologies around the UK. Available at: https://assets.publishing.service.gov.uk/media/5a80b954e5274a2e8ab51cc7/CEFAS_2016_Suspended_Sediment_Climatologies_around_the_UK.pdf [July 2024]

Centre for Environment, Fisheries and Aquatic Science (Cefas) (2016) Monthly average non-algal Suspended Particulate Matter concentrations. Available at: https://www.cefas.co.uk/data-and-publications/dois/monthly-average-non-algal-supended-particulate-matter-concentrations/ (Accessed 12 January 2025)

Coastal Futures Interactive Map, IHE Delft (2021) Available at: https://www.un-ihe.org/news/coastal-futures-ihe-delft-launches-interactive-tool-showing-how-climate-change-could-affect [July, 2024]

Corcoran, W., Matson, R., McLoone, P., Bateman, A., Cierpial, D., Donovan, R., Duffy, P., Gavin, A., Gordon, P., McCarthy, E., Robson, S., Wightman, G., Roche, W. and Kelly, F. L. (2022), 'Sampling Fish for the Water Framework Directive - Summary Report 2021', National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Coull, K. A., Johnstone, R., and Rogers, S. I. (1998), 'Fisheries Sensitivity Maps in British Waters', UKOOA Ltd. https://www.cefas.co.uk/media/52612/sensi_maps.pdf [Accessed: October 2023].

Cruise Berth, Dún Laoghaire Harbour: Wave Tide Sediment Plume Modelling, ABPmer (2014) Available at: https://www.pleanala.ie/publicaccess/EIAR-NIS/PA0042-PA0051/EIS%20Volume%203%20Appendices/004.EIS_Appendix_5_4_1_%20Wave_Tide_Sediment_Plume_%20Modelling_Report.pdf [July 2024].

CSTP (2016), (Milner, N., McGinnity, P. and Roche, W., eds.), 'Celtic Sea Trout Project - Technical Report to Ireland Wales Territorial Co-operation Programme 2007-2013 (INTERREG 4A)', Dublin, Inland Fisheries Ireland. http://celticseatrout.com/downloads/technical-report/ [Accessed: November 2023].

DCCAE, 2017. Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects.

Department of Housing, Planning and Local Government, 2018, 'Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment', Available online: https://www.housing.gov.ie/sites/default/files/publications/files/guidelines_for_planning_authorities_and_an_bord_pleanala_on_carrying_out_eia_-_august_2018.pdf

Desmond, M.; O'Brien, P. and McGovern, F., (2017), A Summary of the State of Knowledge on Climate Change Impacts for Ireland Report 11 (2010–2016), EPA RESEARCH PROGRAMME 2014–2020, Report No. 223, Available: https://www.epa.ie/pubs/reports/research/climate/EPA%20RR%20223_web.pdf [September 2019]

Dolton, H. R., Gell, F. R., Hall, J., Hall, G., Hawkes, L. A. and Witt, M. J. (2020), 'Assessing the importance of Isle of Man waters for the basking shark Cetorhinus maximus'. Endangered Species Research, 41: 209-223.

Dún Laoghaire Harbour Company (2011). Dún Laoghaire Harbour Masterplan - Environmental Report.

Dún Laoghaire-Rathdown County Council, 2024. Marine Consultancy Services for Dredging Operations. Available at: https://www.dlrcoco.ie [November 2024].

Dunlop, N. (2009), 'A guide to sea angling in the eastern fisheries region', Eastern Regional Fisheries Board, Blackrock, Co. Dublin. https://kilmoreangling.com/wp-content/uploads/2016/11/ERFBseaanglingguide.pdf [Accessed: August 2024].

Ellis, J. R., Milligan, S. P., Readdy, L., South, A., Taylor, N. and Brown, M. (2010), 'MB5301 Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones). Report No. 1: Final Report on development of derived data layers for 40 mobile species considered to be of conservation importance'.

Ellis, J. R., Milligan, S. P., Readdy, L., Taylor, N. and Brown, M. J. (2012), 'Spawning and nursery grounds of selected fish species in UK waters', Science Series Technical Report, 147: 56 pp. Cefas, Lowestoft.

EMODnet (2020), 'European Marine Observation and Data Network (EMODnet) Bathymetry', https://emodnet.ec.europa.eu/geoviewer/ [Accessed: July 2024].

Environmental Protection Agency (EPA). (2022), Water Quality in Ireland 2016 – 2021. Available online: https://www.epa.ie/publications/monitoring--assessment/freshwater--marine/water-quality-in-ireland-2016--2021-.php [July 2024]

Environmental Protection Agency. (2022). Guidelines on the information to be contained in Environmental Impact Assessment Reports. Environmental Protection Agency. Available at: www.epa.ie (Accessed 18 Jul. 2024). ISBN: 978-1-80009-005-7.

European Marine Observation and Data Network (EMODnet) Data Portal, EMODnet (2020) Available at: https://emodnet.ec.europa.eu/en [July 2024].

Fanning, A., Craig, M., Webster, P., Bradley, C., Tierney, D., Wilkes, R., Mannix, A., Treacy, P., Kelly, F., Geoghegan, R., Kent, T., Mageean, M. (2015). Water Quality in Ireland 2010-2015. Environmental Protection Agency. Available at: www.epa.ie (Accessed 18 Jul. 2024). ISBN: 978-1-84095-735-8.

Folk, R.L. (1954) 'The Distinction between Grain Size and Mineral Composition in Sedimentary-Rock Nomenclature', Journal of Geology, 62: 344-359.

Haarsma, R.J. et al. (2016) 'High resolution model intercomparison project (highresmip v1.0) for CMIP6', Geoscientific Model Development, 9(11), pp. 4185–4208. doi:10.5194/gmd-9-4185-2016.

Hagan & Dubsky, 2021 . Short autumn Survey of seagrass (Zostera noltii) in Dublin Bay, October 2021.

Handegard, N. O., Michalsen, K. and Tjøstheim, D. (2003), 'Avoidance behaviour in cod (Gadus morhua) to a bottom-trawling vessel', Aquatic Living Resources, 16(3): 265-270.

https://www.reabic.net/journals/mbi/2023/2/MBI_2023_OShaughnessy_etal.pdf

Hydrographic Services Ltd., 2015. Dún Laoghaire Harbour sediment samples analysis.

Hydrographic Surveys Ltd., 2013. Report of Survey: Dún Laoghaire Bathymetric Survey Sediment Samples & Analysis. INFOMAR., 2016. Integrated Mapping for the Sustainable Development of Ireland's Marine Resource.

IAMMWG. (2023). Review of Management Unit boundaries for cetaceans in UK waters (2023). JNCC Report 734, JNCC, Peterborough, ISSN 0963-8091.
IFI (2008a), 'Sampling Fish for the Water Framework Directive - Transitional Waters 2008 (Liffey Estuary)'. www.wfdfish.ie [Accessed: June 2024].
IFI (2008b), 'Sampling Fish for the Water Framework Directive - Transitional Waters 2008 (Tolka Estuary)'. www.wfdfish.ie [Accessed: June 2024].
IFI (2010a), 'Sampling Fish for the Water Framework Directive - Transitional Waters 2010 (Liffey Estuary)'. www.wfdfish.ie [Accessed: June 2024].
IFI (2010b), 'Sampling Fish for the Water Framework Directive - Transitional Waters 2010 (Tolka Estuary)'. www.wfdfish.ie [Accessed: June 2024].
IFI (2010b), 'Sampling Fish for the Water Framework Directive - Transitional Waters 2010 (Tolka Estuary)'. www.wfdfish.ie [Accessed: June 2024].
IFI (2018), 'The Status of Irish Salmon Stocks in 2017 with Catch Advice for 2018', A Report of the Technical Expert Group on Salmon to the Inland Fisheries Ireland.
IFI (2022), 'Report on Salmon Monitoring Programmes 2021', Funded under the Salmon Conservation Fund, IFI/20221-4590.
Igoe, F., Quigley, D. T. G., Marnell, F., Meskell, E., O'Connor, W. and Byrne, C. (2004), 'The sea lamprey Petromyzon marinus (L.), river lamprey Lampetra fluviatilis (L.) and brook lamprey Lampetra planeri (Bloch) in Ireland: general biology, ecology, distribution and status with recommendations for conservation', Biology and Environment: Proceedings of the Royal Irish Academy, 104(3): 43-56.
INFOMAR (2021). Integrated Mapping for the Sustainable Development of Ireland's Marine Resources. Available at: https://www.marine.ie/Home/site-area/areas-activity/seabed-mapping/infomar
Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) (2016) Available at: https://www.marine.ie/site-area/areas-activity/seabed-mapping/infomar?language=en [July 2024].
Kelly, F. L. and King, J. J. (2001), 'A review of the ecology and distribution of three lamprey species, L. fluviatilis, L. planeri and P. marinus', Biology and Environment Proceedings of the Royal Society B, 101: 165-185.
King J. J. and Linnane, S. M. (2004), 'The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs', Irish Wildlife Manuals, No. 14. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
Laffoley, D.A., Connor, D.W., Tasker, M.L. & Bines, T., 2000. Nationally important seascapes, habitats and species. A recommended approach to their identification, conservation and protection, pp. 17. Peterborough: English Nature.
Lewandowski, J., Luczkovich, J., Cato, D. and Dunlop, R. (2016), 'Summary Report Panel 3: Gap Analysis from the Perspective of Animal Biology: Results of the Panel Discussion from the Third International Conference on the Effects of Noise on Aquatic Life', In Popper A.N. and Hawkins A.D. The effects of noise on aquatic life, II. (pp. 1277-1282). Springer Science+Business Media, New York.
Lowe, J.A., Howard, T., Pardaens, A., Tinker, J., Jenkins, G., Ridley, J., Leake, J., Holt, J., Wakelin, S., Wolf, J., Horsburgh, K., Reeder, T., Milne, G., Bradley, S., and Dye, S., (2009). 'UK Climate Projections Science Report: Marine and Coastal Projections.', Available online: http://cedadocs.ceda.ac.uk/1322/1/marine_and_costal_projections_full_report.pdf
Marine Institute (2016), 'Ireland's Marine Atlas'. https://atlas.marine.ie/ [Accessed: July 2023 to May 2024].
Marine Institute. (2019), Addendum to 2006 Guidelines for the Assessment of Dredged Material in Irish Waters (Cronin et al.). Available online: https://www.epa.ie/publications/licensing--permitting/freshwater--marine/addendum-to-2006-guidelines-for-the-assessment-of-dredged-material-in-irish-waters-marine-institute-2019.php [February 2024]

MERC Consultants (2022). Littoral and sublittoral Reef habitats of Dún Laoghaire Rathdown County Council area. Report to Dún Laoghaire Council. Available at: https://www.dlrcoco.ie/sites/default/files/atoms/files/dlrd_reef_habitats_nov_2022_final_01.pdf

Millane, M., Fitzgerald, C., Kennedy, R., Maxwell, H., McLean, S., Barry J. and Gargan, P. (2023), 'The Status of Irish Salmon Stocks in 2022 with Catch Advice for 2023', Report of the Technical Expert Group on Salmon (TEGOS) to the North-South Standing Scientific Committee for Inland Fisheries. 55 pp.

MPA Advisory Group (2023), 'Ecological sensitivity analysis of the western Irish Sea to inform future designation of Marine Protected Areas (MPAs)', Report for the Department of Housing, Local Government and Heritage, Ireland. https://www.gov.ie/en/publication/e00ec-marine-protected-areas/#ecological-sensitivity-analysis-of-the-western-irish-sea [Accessed: November 2023].

National Biodiversity Data Centre (2024), 'Basking Shark (Cetorhinus maximus)'. https://maps.biodiversityireland.ie/Species/15533 [Accessed: August 2024].

Nedwell, J. and Howell, D. (2004), 'A review of offshore wind farm related underwater noise sources', Report No. 544 R 0308 by Subacoustech Ltd., commissioned by COWRIE on behalf of the Crown Estate. https://tethys.pnnl.gov/sites/default/files/publications/Nedwell-Howell-2004.pdf [Accessed: August 2024].

O'Connor W. (2006), 'A survey of juvenile lamprey populations in the Boyne Catchment', Irish Wildlife Manuals, No. 24. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

O'Shaughnessy KA, Lyons D, Ashelby CW, Counihan R, Pears S, Taylor E, Davies R, Stebbing PD (2023) Rapid assessment of marine non-native species in Irish marinas. Management of Biological Invasions 14(2): 245–267, https://doi.org/10. 3391/mbi.2023.14.2.05

OSPAR (2008b). OSPAR List of Threatened and/or Declining Species and Habitats (Reference Number: 2008-6). OSPAR Convention For The Protection Of The Marine Environment Of The North-East Atlantic. Available from: http://www.jncc.gov.uk/pdf/08-06e_OSPAR List species and habitats.pdf

PINS (2019). Nationally Significant Infrastructure Projects - Advice Note Seventeen: cumulative effects assessment relevant to nationally significant infrastructure projects. Available at: https://www.gov.uk/government/publications/nationally-significant-infrastructure-projects-advice-note-seventeen-cumulative-effects-assessment-relevant-to-nationally-significant-infrastructur

Popper, A. N. and Hawkins, A. D. (2019), 'An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes', Journal of Fish Biology, 94: 692-713. https://doi.org/10.1111/jfb.13948

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J., Coombs, S., Ellison, W. T., Gentry, R. L., Halvorsen, M. B., Løkkeborg, S., Rogers, P. H., Southall, B. L., Zeddies, D. G. and Tavolga, W. N. (2014), 'Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI - Accredited Standards Committee S3/SC1 and registered with ANSI', New York: Springer.

Reine, K. J., Clarke, D. G. and Dickerson, C. (2014), 'Characterization of underwater sounds produced by hydraulic and mechanical dredging operations', The Journal of the Acoustical Society of America, 135(6): 3280-3294.

Renewable UK (2013). Cumulative Impact Assessment Guidelines Guiding Principles For Cumulative Impacts Assessment In Offshore Wind Farms. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Cumulative-Impact-Assessment-Guidelines.pdf

RPS (2014), 'Alexandra Basin Redevelopment Project Environmental Impact Statement'. https://www.gov.ie/en/foreshore-notice/d0b8b-dublin-port-company-alexandra-basin-re-development/ [Accessed: April 2024].

Scally, L., Pfeiffer, N.J., & Hewitt, E. (2020) The monitoring and assessment of six Annex I marine habitats. Irish Wildlife Manuals, No. 118. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland. Available at: https://www.npws.ie/sites/default/files/publications/pdf/IWM118.pdf

Sea water temperature Dublin Today: Ireland (no date) SeaTemperature.info. Available at: https://seatemperature.info/dublin-water-temperature.html (Accessed: 10 July 2024).

Soudijn, F. H., van Kooten, T., Slabbekoorn, H. and de Roos, A. M. (2020), 'Population-level effects of acoustic disturbance in Atlantic cod: a size-structured analysis based on energy budgets', Proceedings of the Royal Society B, 287(1929): 20200490.

Southall, E. J., Sims, D. W., Metcalfe, J. D., Doyle, J. I., Fanshawe, S., Lacey, C., Shrimpton, J., Solandt, J. L. and Speedie, C. D. (2005), 'Spatial distribution patterns of basking sharks on the European shelf: preliminary comparison of satellite-tag geolocation, survey and public sightings data', JMBA - Journal of the Marine Biological Association of the United Kingdom, 85/5: 1083-1088.

Stephen Little & Associates (2015). Proposed Cruise Berth Facility, Dún Laoghaire Harbour Environmental Impact Statement. Report to Dún Laoghaire Harbour Company. https://www.pleanala.ie/en-ie/case/pa0042 [Accessed: August 2024].

Tillin, H. & Tyler-Walters, H., 2014. Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 2 Report – Literature review and sensitivity assessments for ecological groups for circalittoral and offshore Level 5 biotopes. JNCC Report No. 512B, 260 pp.

Vabø, R., Olsen, K. and Huse, I. (2002), 'The effect of vessel avoidance of wintering Norwegian spring spawning herring', Fisheries Research, 58(1): 59-77.

van der Knaap, I., Ashe, E., Hannay, D., Bergman, A. G., Nielsen, K. A., Lo, C. F. and Williams, R. (2022), 'Behavioural responses of wild Pacific salmon and herring to boat noise', Marine Pollution Bulletin, 174: 113257.

Wysocki, L. E., Dittami, J. P., and Ladich, F. (2006), 'Ship noise and cortisol secretion in European freshwater fishes', Biological Conservation, 128: 501-508.

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