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# EIAR Volume 4: Offshore Infrastructure Technical Appendices
# Appendix 4.3.4-1
# Technical Baseline Report - Fish and Shellfish Ecology

Kish Offshore Wind Ltd

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# Dublin Array Offshore Wind Farm

## Environmental Impact Assessment Report

### Volume 4, Appendix 4.3.4-1: Technical Baseline Report - Fish and Shellfish Ecology

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# Glossary

| Term | Definition |
|---|---|
| Array area | The area within which the WTGs and OSP's will be located offshore |
| Benthic | Relating to or occurring on the seabed. |
| Bony fish | Any species with skeletons primarily composed of bone tissue; comprises fishes of the superclass Osteichthyes. |
| Cartilaginous fish | Any species with skeletons primarily composed of cartilage; comprises chimaeras and all elasmobranchs. |
| Decapod crustacean | Crustaceans of the order Decapoda, which includes crabs, lobsters, shrimp and prawns. |
| Demersal | Living and feeding on or near the seabed. |
| Diadromous | Migrating between fresh and saltwater habitats. |
| Elasmobranch | Cartilaginous fish of the subclass Elasmobranchii; comprises sharks, rays and skates. |
| Epibenthic | Living on the seafloor. |
| Flatfishes | Bony fish of the order Pleuronectiformes; includes plaice, soles, flounders, turbot and their relatives. |
| Gadoid | Bony fish of the order Gadiformes; includes cod, haddock, hake and their relatives. |
| Mean High-Water Springs (MHWS) | MHWS is the highest level that spring tides reach on the 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. |
| Nursery grounds | Areas important for the development of juvenile fish and shellfish. |
| Ovigerous | Carrying or bearing eggs. |
| Ovoviviparous | Development of embryo inside eggs within the body and giving birth to live young. |
| Pelagic | Living and feeding in the water column. |
| Shellfish | Shell-bearing aquatic invertebrates used as food; includes various species of crustaceans, bivalves, and gastropods. |
| Spawning grounds | Areas where fish and shellfish aggregate to release their gametes for fertilisation or locations where egg cases are deposited. |
| Viviparous | Development of the embryo inside the body and giving birth to live young. |

| Term | Definition |
|---|---|
| Zone of Influence | The area or 'zone' where impacts from the proposed project may impact upon fish and shellfish receptors. |

## Acronyms

| Term | Definition |
|---|---|
| ABR | Alexandra Basin Redevelopment |
| AEPM | Annual Egg Production Method (AEPM) plankton surveys |
| BIM | Bord Ischagh Maragh |
| BTS | Beam Trawl Survey |
| CFP | Common Fisheries Policy |
| CIEEM | Chartered Institute of Ecology and Environmental Management |
| CO | Conservation Objective |
| CPUE | Catch per unit effort |
| CSTP | Celtic Sea Trout Project |
| dB | Decibel |
| DATRAS | Database of Trawl Surveys |
| DCENR | Department of Communications, Energy and Natural Resources |
| DDV | Drop-Down Video |
| ECC | Export Cable Corridor |
| eDNA | Environmental DNA |
| EEZ | Exclusive Economic Zone |
| EIA | Environmental Impact Assessment |
| EIAR | Environmental Impact Assessment Report |
| EMF | Electro-Magnetic Fields |
| EU | European Union |
| FLO | Fisheries Liaison Officer |
| FU | Functional Unit |
| GES | Good Environmental Status |
| GIS | Geographic Information System |

| Term | Definition |
|---|---|
| IBTS | International Bottom Trawl Survey |
| ICES | International Council for the Exploration of the Sea |
| IFI | Inland Fisheries Ireland |
| INFOMAR | Integrated Mapping for the Sustainable Development of Ireland's Marine Resource |
| IUCN | International Union for the Conservation of Nature |
| LAT | Lowest Astronomical Tide |
| MDO | Maximum Design Option |
| MHWS | Mean High Water Springs |
| MMO | Marine Management Organisation |
| MPA | Marine Protected Area |
| MSFD | Marine Strategy Framework Directive |
| MSY | Maximum Sustainable Yield |
| NIGFS | Northern Irish Ground Fish Survey |
| NINEL | Northern Irish Northeastern Larvae Survey |
| NPWS | National Parks and Wildlife Services |
| O&M | Operations and Maintenance Base |
| OREDP | Offshore Renewable Energy Development Plan |
| OSPAR | The Convention for the Protection of the Marine Environment of the North-East Atlantic (Oslo/Paris convention) |
| OWF | Offshore Wind Farm |
| PSA | Particle Size Analysis |
| SAC | Special Area of Conservation |
| SEA | Strategic Environmental Assessment |
| $SEL_{cum}$ | Cumulative Sound Exposure Level |
| SFPA | Sea Fisheries Protection Agency |
| SPA | Special Protection Area |
| SSB | Spawning-stock biomass |
| UK | United Kingdom |
| UWN | Underwater Noise |
| VER | Valued Ecological Receptor |

| Term | Definition |
|---|---|
| WFD | Water Framework Directive |
| ZoI | Zone of Influence |

# 1 Introduction

## 1.1 Overview

1.1.1 Dublin Array Offshore Wind Farm (Dublin Array) is a proposed offshore wind farm on the Kish and Bray Banks. The Kish and Bray Banks are located approximately 10 km off the east coast of Ireland, immediately south of Dublin city off the coast of counties Dublin and Wicklow. The location of the proposed wind farm site is shown in Figure 1 below. The offshore wind farm will be located within an area of approximately 54 $km^2$ in water depths ranging from 2-50 m lowest astronomical tide (LAT). The project is being developed by two companies, namely Kish Offshore Wind Limited and Bray Offshore Wind Limited (hereafter referred to as the 'Applicant'). A Maritime Area Consent was awarded to Kish Offshore Wind Limited and Bray Offshore Wind Limited by the Minister for the Environment, Climate and Communications in 2022 for the construction and operation of an offshore wind farm and associated infrastructure at the Kish and Bray Banks. The Applicant for development permission is Kish Offshore Wind Limited, on behalf of Kish Offshore Wind Limited and Bray Offshore Wind Limited. This document has been prepared by GoBe Consultants Ltd. (GoBe) to support the Applicant's Environmental Impact Assessment (EIA) for Dublin Array.

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

- Volume 3, Chapter 1: Marine Geology, Oceanography and Physical Processes (hereafter referred to as the Physical Processes chapter): to be referenced for an overview on the surficial sediment properties, suspended sediments and seabed features. This chapter also provides an assessment of the potential impacts of the project upon the marine geology, oceanography and physical processes;

- Volume 4, Appendix 4.3.1-1: Physical processes technical baseline (hereafter referred to the Physical Processes technical baseline): to be referenced for a detailed description of the surficial sediment properties, suspended sediments and seabed features;

- Volume 3, Chapter 2: Marine Water and Sediment Quality (hereafter referred to as the Marine Water and Sediment Quality Chapter): to be referenced for a review of the marine water and sediment quality receiving environment. This chapter also provides an assessment of the potential impacts of the project upon marine water and sediment quality;

- Volume 4, Appendix 4.3.3-1: Benthic Subtidal and Intertidal Ecology Technical Baseline Report (hereafter referred to as the Benthic technical baseline): to be referenced for a detailed description of subtidal and intertidal benthic habitats and seabed features.

- Volume 4, Appendix 4.3.5-7: Underwater Noise Technical Modelling Report (hereafter referred to as the Underwater Noise Technical Modelling Report): to be referenced for a detailed description of the site-specific underwater noise modelling undertaken;

- Volume 4, Appendix 4.3.3-3: Subtidal Survey Report (hereafter referred to as the Subtidal Survey Report): to be referred to for supporting information regarding the subtidal Particle Size Analysis (PSA) survey, in addition to sediment sampling analysis and interpretation; and

- Volume 4, Appendix 4.3.9-1: Commercial Fisheries Technical Baseline Report (hereafter referred to as the Commercial Fisheries technical baseline): to be referenced for a detailed description of the commercial fisheries fleets that operate within and adjacent to the Dublin Array.

- Volume 6, Appendix 6.5. 2-1: Technical Baseline Ecology Report (hereafter referred to as the Terrestrial Ecology technical baseline): to be referenced for a description of diadromous fish species in rivers and streams along the onshore export cable route.

## 1.2 Purpose of this report

1.2.1 The purpose of this technical baseline report is to robustly characterise the receiving environment for fish (benthic, pelagic and elasmobranch species), shellfish (molluscs and crustaceans), and marine turtles present within the offshore footprint of the proposed development, which comprises the array area (area containing the wind turbines, Offshore Substation Platform (OSP), associated foundations, inter-array cables, inter-connector cables and associated infrastructure) and offshore Export Cable Corridor (offshore ECC) and surrounding area. This information will inform the EIA.

1.2.2 The characterisation of the receiving environment establishes the following:

- Those species of fish and shellfish in the study area that are of commercial or recreational importance;

- Those species of conservation importance;

- The species of commercial or conservation interest known to have nursery and/or spawning grounds within the study area;

- Species of commercial or conservation interest known to migrate through the study area;

- Species known to be potentially sensitive to the specific impacts of offshore wind farm development, for example elasmobranch species that are known to be sensitive to electro-magnetic fields (EMF) generated by subsea electricity cables, fish species considered to be hearing specialists that may be disturbed by noise resulting from the offshore wind farm development process, or species that spawn on the seabed (demersal spawners) that may be sensitive to habitat disturbance or loss as a result of the development of the Project; and
- Fish and shellfish species of commercial or conservation interest that have a generally restricted geographical distribution but are considered to be locally abundant.

## 1.3 Report structure

1.3.1 This report is structured as follows:

- Section 1 introduces the report and outlines its aims;
- Section 2 presents the methodology and data sources applied to characterise the receiving environment;
- Section 3 presents the characterisation of the existing receiving environment for the fish and shellfish topic;
- Section 3.8 presents the characterisation of the future receiving environment in the absence of the proposed development;
- Section 5 presents any uncertainties or data gaps which were identified during the baseline characterisation; and
- Section 6 provides a high-level summary of the findings of this report.

# 2 Methodology

## 2.1 Approach

2.1.1 The baseline characterisation for fish and shellfish resources within the Dublin Array fish and shellfish ecology study area (Figure 1) draws on the results of a detailed desk-top review and data collected during site-specific surveys.

2.1.2 Information was reviewed on fish and shellfish ecology in general, and on spawning and nursery behaviour and habitats for key species. A full breakdown of the data utilised to inform this technical baseline is given in Section 2.3.

## 2.2 Study area

2.2.1 The development consent currently being sought includes the following elements within the marine environment:

- Wind turbine generators, offshore substation platform and associated inter-array cabling within the array and offshore export cables and landfall; and
- Operations and Maintenance base (O&M) in Dún Laoghaire Harbour (which includes quayside and marine works).

2.2.2 The extent of the Dublin Array Fish and Shellfish Ecology study area has been determined to capture the greatest extent of potential direct and indirect effects[1] on fish and shellfish receptors within the offshore component of the project. It incorporates the wind farm array area, the intertidal and subtidal areas of the offshore ECC, and the surrounding Zone of Influence (ZoI) (Figure 1). The extent of the ZoI is likely to vary according to the nature of the impact being studied. For the offshore components of the project, the ZoI to assess impacts on fish and shellfish receptors has been defined by the following spatial scales:

[1] For the purpose of this assessment, impacts that occur within the footprint of an activity are termed direct impacts (e.g., physical disturbance to the seabed), while those impacts occurring away from an activity are termed indirect impacts (e.g., dispersal of sediment plumes and associated sediment deposition following the disturbance of the seabed).

- For impacts related to seabed disturbance events that extend beyond the direct footprint of proposed infrastructure, a sedimentary ZoI of 17 km buffering the array area and offshore ECC has been applied. The extent of this ZoI has been determined by reference to the modelled tidal excursion, which describes the maximum distance over which suspended sediments from construction and O&M works may be displaced over a single tidal cycle. Project specific hydrodynamic modelling showed a maximum tidal excursion of approximately 16 km from the point of release during spring tides (Physical Processes Modelling Report: Volume 5, Appendix 5.3.1-4). The results of the modelling also indicate that construction activities would create sediment plumes that would disperse over a maximum distance of 10 km from the point of release. Therefore, a sedimentary ZoI of 17 km is considered to be precautionary and to encapsulate the area within which all of the potential significant indirect effects from sediment plumes and associated sediment deposition on fish and shellfish receptors and their environment might occur.
- A second ZoI (termed underwater noise ZoI) of 30[2] km buffering the array area and offshore ECC[3] has been defined for potential underwater noise effects on sensitive fish and shellfish receptors, acknowledging that underwater noise may have a larger impact range than that associated with sedimentary impacts (as described above). The largest impact ranges of underwater noise are anticipated from piling of foundations in the array area during the construction phase. The area over which the effects from piling noise may arise has been determined through project-specific underwater noise modelling (Dublin Array: Underwater noise Modelling Report Part 1: Volume 4, 4.3.3-1), based on the maximum design option (MDO) and the effect thresholds recommended by Popper *et al.* (2014). For fish, the extent of the underwater noise ZoI has been set to fully encapsulate the modelled maximum impact ranges for the 186 dB re 1 $\mu Pa^2s$ cumulative Sound Exposure Level ($SEL_{cum}$)[4] during pile driving when applied to static receptors[5]. The 186dB re 1 $\mu Pa^2s$ $SEL_{cum}$ represents the recommended exposure threshold for the onset of temporary hearing loss in the most sensitive fish receptors (e.g., herring and cod), as recommended in the Popper *et al.* (2014) guidelines. The results of the modelling indicate that the maximum effect range from

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

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

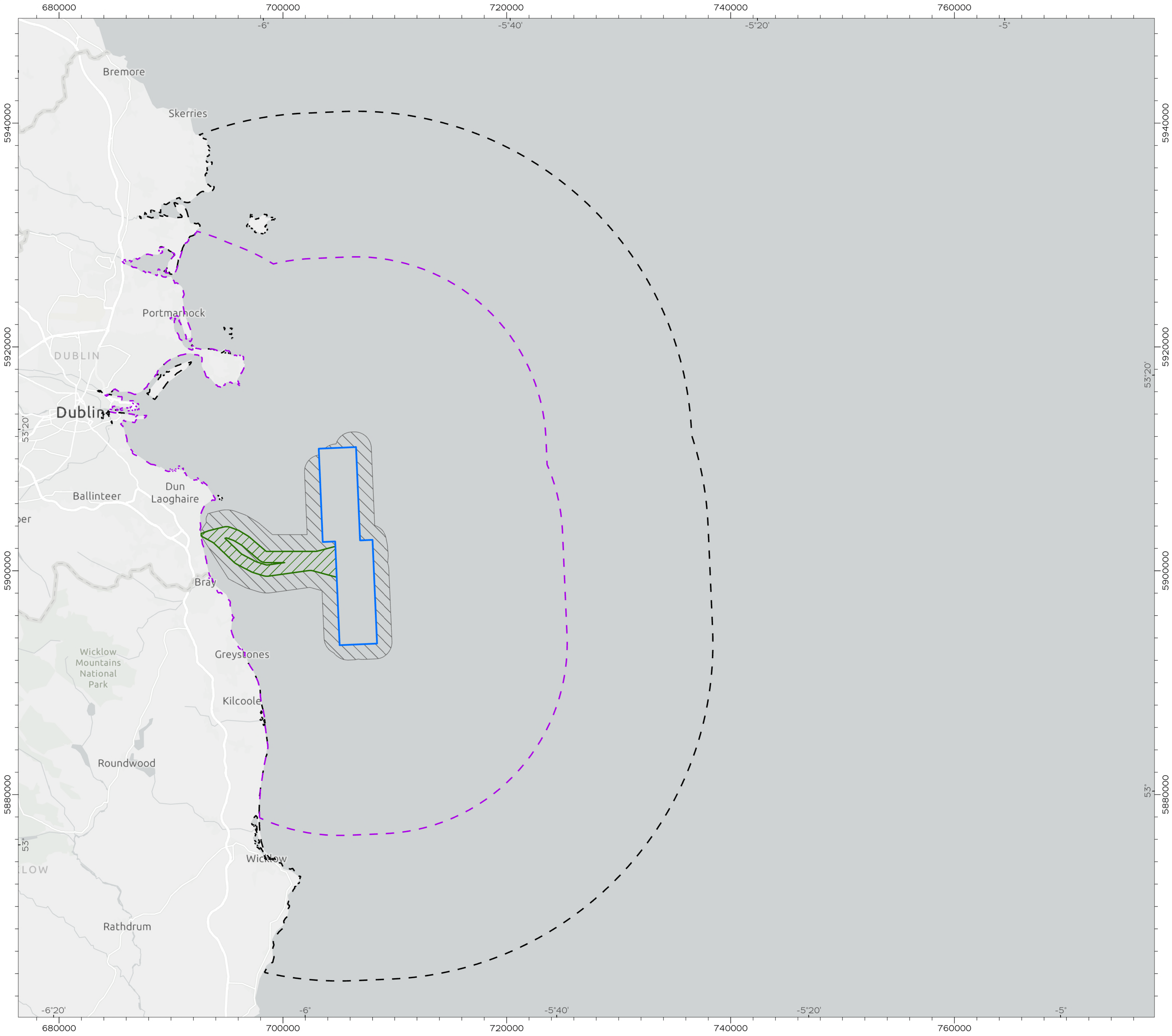
[4] Sound levels are expressed in decibel (dB) with respect to a reference value. For underwater sounds, the reference value is 1 micropascal (μPa). A detailed description of the characteristics of underwater sounds and the effect thresholds applied to define the underwater noise ZoI is included within the Underwater Noise Technical Modelling Report and the UWN and EMF chapter.

[5] Fish were previously assumed to flee noise stimuli at a rate of 1.5 $m\ s^{-1}$; however, recent UK OWF projects have been advised to also consider stationary receptor modelling for some species, such as sandeel and eggs and larvae.

piling noise will extend to 29 km from the array area. Therefore, a precautionary ZoI for underwater noise has been set at 30 km around the array area and offshore ECC.

2.2.3 Collectively the area covered by the array area, offshore ECC and the two ZoIs defined for fish and shellfish receptors is referred to throughout this report as the Dublin Array fish and shellfish study area (hereafter defined as the study area). The study area encompasses the two offshore ECC route options within the offshore ECC up to and including the intertidal zone at the Shanganagh landfall area below Mean High Water Springs (MHWS)[6].

[6] Mean high water springs is the highest level that spring tides reach on the average over a period of time.





- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)

DRAWING STATUS

**FINAL**

DISCLAIMER



MAP NOTES / DATA SOURCES:



PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Study Area for the Fish and Shellfish Ecology Baseline**

DRAWING NUMBER: 1

PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 3 6 9 12 km

0 1.5 3 4.5 6 nm

N

GRID NORTH

| SCALE | 1:350,000 | PLOT SIZE | A3 |
|---|---|---|---|
| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

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## 2.3 Baseline data

2.3.1 A detailed desktop review has been carried out to inform the baseline characterisation of fish and shellfish resources within the study area. The review draws on regional datasets, scientific literature, commercial fisheries information, and industry-specific survey data collected for infrastructure projects within the wider western Irish Sea region. In addition, site-specific surveys were used together with more recent site-specific trawl data (Aquafact, 2019). Site-specific subtidal grab (Fugro, 2021) and dredge (Aquafact, 2018; Ecoserve, 2008) sample data collected to inform the benthic baseline characterisation have also been used to complement the fish and shellfish baseline and to identify potential suitable spawning grounds for sandeels (*Ammodytes* spp.) and Atlantic herring (*Clupea harengus*). Species of commercial importance were identified through reference to the Commercial Fisheries technical baseline.

2.3.2 To ensure the best available data is utilised, consultation with the Sea Fisheries Protection Agency (SFPA), National Parks and Wildlife Services (NPWS), Inland Fisheries Ireland (IFI), Bord Iaschaigh Maragh (BIM), the Marine Institute, and other relevant statutory consultees has been undertaken. Consultation with the local fishing fleet and the use of a Fisheries Liaison Officer (FLO) have served to verify and obtain up to date fishing activity information. Full details of the consultation effort are provided within the Fish and Shellfish chapter (Volume 3, Chapter 5) and the fishing activity across the study area is detailed in the Commercial Fisheries technical baseline.

2.3.3 The data sources used to inform the fish and shellfish baseline are provided in Table 1 below, alongside their temporal and spatial extents in the context of the project. These have provided coverage across large parts of the Dublin Array fish and shellfish study area and the wider region.

### Site-specific surveys

2.3.4 Site-specific marine ecology baseline characterisation surveys were conducted across the Dublin Array offshore ECC and array area in 2002 (summarised in Ecoserve, 2008). Subsequent dredge surveys were carried out in 2008 (Ecoserve, 2008) and 2017 (Aquafact, 2018) to characterise the benthic environment (Figure 2).

2.3.5 In response to a request from the SFPA, an additional trawl survey was undertaken in 2019 (Aquafact, 2019) to provide additional understanding of the function of the Kish and Bray Banks in relation to the local fisheries resource. Consultation with the SFPA was undertaken on the 12th September 2018 (further information on consultation is provided in the Fish and Shellfish Chapter) to agree the scope and objectives of the survey. The objective of the survey was to provide further data on fish species diversity and abundance of groundfish on the banks, in particular for juveniles. It was noted at the meeting that sufficient shellfish data was available and that additional shellfish surveys were not required to inform this baseline.

2.3.6 The 2019 trawl survey was undertaken on a local fishing vessel, whose skipper had regularly fished the area for more than 30 years. It was agreed with SFPA that a minimum of four trawls should be undertaken over the banks in addition to trawls within two control areas, one to the east and one to the west of the banks. The restrictions regarding water depth and the presence of other fishing gear were acknowledged and as such it was agreed that the final location of the tows would be developed in discussion with the vessel skipper.

2.3.7 As recommended by the SFPA, the survey was undertaken using otter trawls. This sampling method was chosen to target demersal species, but it does not provide a good representation of pelagic species. Four tows on the east and four tows on the west of the banks were conducted in a north/south orientation to cover a representative area of the array area whilst taking into consideration safe working depths and seabed structures. A further two tows were conducted outside the proposed array area for comparison. The timing of the survey in the month of July was agreed in consultation with the SFPA and considered suitable to assess the fisheries resource for the area (Aquafact, 2019).

2.3.8 As recommended by the SFPA, two specifications of otter trawl net were used during the survey (Aquafact, 2019):

- Type 1- net used was 320 mesh, 160 mm with a height of 6 meters and width between the doors ~25 m; and
- Type 2- net used was 450 mesh, 150 mm with a height of 20 m and a distance between trawl doors of 45-50 m.

2.3.9 During each of the tows the vessel trawled at an average speed of four knots for an average duration of two hours with depths varying between the start and end of the trawl. All catch was landed on the deck and sorted into species by members of the crew. Boxes were passed to scientific personnel who analysed the catch recording: species, weight, length and when possible, the sex of individuals. During instances where a large amount of a species was caught a maximum and minimum length were recorded (Aquafact, 2019).

2.3.10 In addition, a site-specific grab and Drop-Down Video (DDV) survey was conducted in 2021 (Fugro, 2021) to inform the benthic baseline characterisation. Full detailed methodologies and results of this and the other site-specific grab and dredge surveys are available within Appendices 3.4-3 and 3.4-4 of Volume 5 and the Benthic technical baseline report. The biological data collected during these surveys were used to complement the fish and shellfish characterisation, while sediment data were analysed to identify potential spawning locations for herring and sandeels.

## Regional and other surveys

2.3.11 To provide additional information about fish and shellfish assemblages within the study area and wider region, findings from regional surveys and site-specific surveys undertaken for other projects overlapping the study area were reviewed. These data were further supplemented by information from monitoring reports and published research.

2.3.12 To identify common fish and elasmobranch species within the wider western Irish Sea region, data collected during the Northern Irish Groundfish Survey (NIGFS) and Offshore Beam Trawl Survey (BTS) programmes were sourced from the DATRAS (Database of Trawl Surveys) data portal (International Council for the Exploration of the Sea (ICES), 2023a,b). Both the NIGFS and BTS are part of the International Bottom Trawl Survey (IBTS) programme coordinated by ICES, which collects data on the size, abundance, and distribution of juvenile and adult ground fish. Surveys conducted as part of the NIGFS have been carried out bi-annually since 1992 using a Rock Hopper otter trawl with sampling stations being stratified by water depth and seabed type (ICES, 2017). Offshore beam trawl surveys in the Irish Sea are carried out annually using a 4 m commercial beam trawl. The main aim of the BTS programme is to provide time-series data for the monitoring of commercial flatfish, and sampling follows a fixed station design with positions primarily chosen in areas fished for European plaice (*Pleuronectes platessa*) and various species of sole (*Soleidae* spp.) (de Boois *et al.*, 2023). NIGFS and BTS data were obtained for the years 2018-2022 covering ICES statistical rectangles 35E3 and 35E4 to characterise assemblages within the array area, offshore ECC and adjacent areas of the sedimentary and underwater noise ZoI (Figure 2). In addition, data from ICES rectangles 34E3, 34E4, 36E3 and 36E4 were used to describe ground fish assemblages within the wider western Irish Sea region.

2.3.13 Biological data collected to inform the application for ongoing maintenance dredging in the Dublin Bay shipping channel (Aquatic Services Unit, 2019, 2020) and for the Alexandra Basin Redevelopment (ABR) Project (RPS, 2014) have been used to provide information on fish and shellfish resources within inshore areas of both ZoIs. Sampling was carried out within the shipping channel and Dublin Bay between 2013 and 2020 and included DDVs and beam trawls to assess the distribution of epibenthic invertebrates and demersal fish.

Table 1 Data sources used to inform the fish and shellfish baseline

| Data source | Type of data | Temporal and spatial coverage |
|---|---|---|
| Site-specific surveys | | |
| Fugro (2021). WPM1, WPM2 & WMP3 - Main Array & ECR - Benthic Ecology Monitoring Report. Dublin Array Offshore Site Investigation (Ireland, Irish Sea). | Biological survey of the array area and Export Cable Search Area in February and March 2021. Grab samples collected from 28 stations using a 0.1m$^2$ mini Hamon Grab for faunal and sediment PSA. DDV collected from 29 sites. DDV data used to inform the fish and shellfish baseline; PSA data used to determine potential for herring and sandeel spawning grounds within the study area. | 2021. Biological grab and DDV survey undertaken across the array area and within the Export Cable Search Area. |
| Aquafact (2019). A Fisheries survey of the Kish and Bray Banks. | Fishing resource data collected from 10 otter trawls carried out within and adjacent to the proposed array boundary. Species recorded, as well as life-stage and abundance data used to build the fish and shellfish baseline. | 2019. Biological trawl survey undertaken within and adjacent to the array area. |
| Aquafact (2018). Marine Ecological Assessment of Dublin Array Wind Farm. | Site-specific biological dredge sampling (rectangular opening 0.5 x 0.25 m with 1 cm mesh bag) used to inform the fish and shellfish baseline and to determine potential for herring and sandeel spawning grounds. | 2017. Biological dredge sampling undertaken within the array area (Kish and Bray Banks) and within the Export Cable Search Area. |
| EcoServe (2008). A marine ecological study of the Kish and Bray Banks for a proposed offshore wind farm development: Re-characterization survey. | Site-specific re-characterisation survey of the Kish and Bray Banks. Biological dredge samples (rectangular opening 0.5 x 0.25 m with 1 cm mesh bag) used to build the fish and shellfish baseline. | 2008. Biological dredge sampling undertaken within the array area (Kish and Bray Banks) and along the Export Cable Search Area. |
| Saorgus Energy Limited (2012). Dublin Array Offshore Wind Farm on the Kish and | Environmental Impact Statement for the Dublin Array Offshore Wind Farm (OWF) including data on the fish and shellfish species recorded during site-specific trawl and dredge surveys at the Kish and Bray sandbanks in 2002. During the 2002 survey, site- specific data were collected through four Agassi | Range of data sources utilised to inform the EIA. Study area was defined as 3 km in the east-west direction and approximately 18 km in |

| Data source | Type of data | Temporal and spatial coverage |
|---|---|---|
| Bray Banks. Environmental Impact Statement | trawls. Fish and shellfish species were also recorded from benthic dredge survey samples. | the north-south direction giving an overall study area in the order of 54 $km^2$, comparable to the one presented in this baseline with information provided on fish and shellfish stocks throughout the Irish Sea and across Kish and Bray Banks and inshore waters. |
| Existing data sources | | |
| Coull *et al*. (1998). Fisheries Sensitivity Maps in British Waters. | Maps of spawning and nursery grounds for commercially important fish species. | Spawning seasonality presented, 1991-1996. Covers UK and Irish waters, including the study area. |
| Ellis *et al.* (2010, 2012). Spawning and nursery grounds of selected fish species in UK waters. Scientific Series Technical Report. | Spawning and nursery ground data of selected fish and elasmobranch species. | Spawning and nursery seasonality presented, 1990-2008. Covers UK and Irish waters, including the study area. |
| Marine Institute data sourced from Ireland's Marine Atlas (Marine Institute, 2016)[7]. | Online maps for spawning and nursery grounds for selected species identified across Irish waters; developed as part of the reporting for the Marine Strategy Framework Directive. | Covers all Irish waters including the study area. |

[7] Data from Ireland's Marine Atlas were obtained in 2023 and 2024. All used data are referenced as Marine Institute (2016).

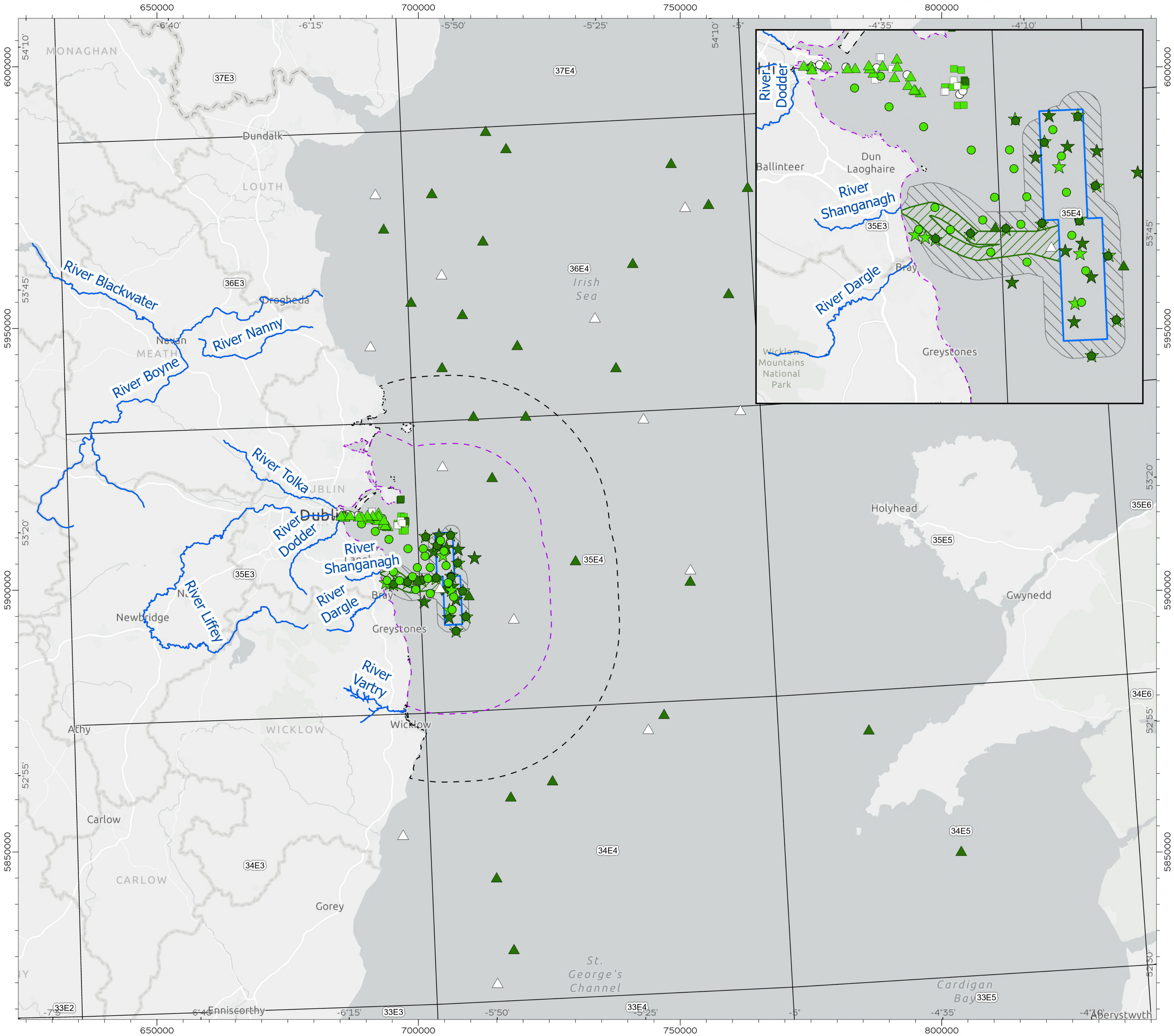
| Data source | Type of data | Temporal and spatial coverage |
| --- | --- | --- |
| Integrated Mapping for the Sustainable Development of Ireland's Marine Resources (INFOMAR) PSA data (2023). | A joint project between the Marine Institute and Geological Survey of Ireland creating integrated seabed mapping products using multibeam echosounder and seabed survey data. PSA dataset used as a proxy to determine potential herring and sandeel spawning grounds. | Broadscale habitat data collected across the Irish Sea from 2006 onwards. |
| European Marine Observation and Data Network (EMODnet) broadscale seabed habitat map of Europe (EUSeaMap, 2021). | Predictive seabed habitat map used to describe seabed substratum types and benthic habitats present in the study area. | Latest data from 2021. Coverage of the entire study area. |
| Cefas (2000). Irish Sea Annual Egg Production Method (AEPM) Plankton Survey. | Abundance and distribution data for zooplankton and fish eggs and larvae. | Data collected in 2000 during the spawning seasons of target species. Data collected across Irish Sea, including the study area. |
| ICES (2023a). Northern Irish Groundfish Survey (NIGFS) (2018-2022). | Annual otter trawl surveys undertaken from 1992 onwards to monitor the distribution of ground fish in the Irish Sea. | 2018-2022. ICES statistical rectangles 34E3, 34E4, 35E3, 35E4, 36E3 and 36E4. |
| ICES (2023b). Offshore Beam Trawl Survey (BTS) (2018-2022). | Annual beam trawl surveys to monitor the distribution of commercially important flatfish. | 2018-2022. ICES statistical rectangles 34E3, 34E4, 35E3, 35E4, 36E3 and 36E4. |
| EIA undertaken to inform the Alexandra Basin Redevelopment (ABR) Capital Dredging project (RPS, 2014) | Beam trawls and two fyke nets deployed in Dublin Bay to build the fish and shellfish baseline for the ABR impact assessment. Documents submitted as part of Foreshore Licence application FS005699. Data has been used to build the fish and shellfish baseline for inshore areas within Dublin Bay. | DDV and trawls undertaken in May and June 2013 in the Dublin shipping channel and Dublin Bay. |

| Data source | Type of data | Temporal and spatial coverage |
|---|---|---|
| Aquatic Services Unit (2019, 2020). Dublin Port Company Maintenance Dredging 2020-2029. | Beam trawls and DDV undertaken within Dublin Bay and the Dublin port shipping channel to build the fish and shellfish baseline for the Dublin Port Maintenance Dredging project. Documents submitted as part of Foreshore Licence applications FS006980 and FS007132. Data has been used to build the fish and shellfish baseline for inshore areas. | Sampling undertaken in between 2016 and 2020. Overlap with the sedimentary and noise ZoI. |
| Marine Institute (2023). The Stock Book 2023: Annual Review of Fish Stocks in 2023 with Management Advice for 2024. | Distribution data on commercially exploited fish stocks of interest to Ireland. | Annual publication. Covers all Irish waters. |
| Marine Institute and Bord Iascaigh Mhara (2023) Shellfish Stocks and Fisheries Review 2023. | An assessment of selected shellfish stocks in Irish waters. | Published 2024. Covers all Irish waters. |
| Gerritsen and Kelly (2019). Atlas of Commercial Fisheries around Ireland. | The atlas reviews the fishing activity of fish stocks of relevance to Ireland that come under the EU Common Fisheries Policy. | Published 2019. Covers all Irish waters. |
| Tully (2017). Atlas of Commercial Fisheries for Shellfish around Ireland. | The atlas reviews the shellfish fishing activity within Irish inshore and territorial waters. | Published 2017. Covers all Irish waters. |
| Celtic Sea Trout Project (CSTP) (2016). | Information on the status, distribution and ecology of sea trout populations in the Irish Sea. | Published 2016. Covers waters around Ireland and western Britain including the Irish Sea. |
| King *et al.* (2011). Ireland Red List No. 5: Amphibians, Reptiles and Freshwater Fish. | Details most up-to-date list of amphibians, reptiles and freshwater fish native and non-native to Ireland, listed from least concern to extinct. | Published 2011. Covers all Irish waters. |

| Data source | Type of data | Temporal and spatial coverage |
|---|---|---|
| Clarke *et al.* (2016). Ireland Red List No. 11: Cartilaginous fish (sharks, skates, rays and chimaeras). | Details most up-to-date list of cartilaginous fish native and non-native to Ireland, listed from least concern to extinct. | Published 2016. Covers all Irish waters. |
| National Parks and Wildlife Service (NPWS). | Information and published resources on protected areas around Ireland. | Various. Ireland wide. |
| Inland Fisheries Ireland (IFI) 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. | 2018-2023. Coverage of Irish rivers draining into the study area. |
| Data sourced from Transitional Water monitoring results for the Water Framework Directive (IFI, 2008-2012) | A combination of beach seines, fyke nets and beam trawls. This data has been used to characterize the fish species present in transitional water bodies. | 2008-2012. Coverage of the Liffey and Tolka estuaries within Dublin Bay. |
| ICES (2022a). ICES Ecosystem Overviews. Celtic Seas ecoregion - Ecosystem Overview. | Overview of the state of the ecosystem in the Celtic Seas ecoregion. | Published 2022. Covers all Irish waters. |
| ICES (2022b). ICES Fisheries Overviews. Celtic Seas ecoregion - fisheries overview. | Overview of all common commercially important fish and shellfish in the region. | Published 2022. Covers all Irish waters. |
| Department of Communications, Energy and Natural Resources | Baseline of fish and shellfish across Irish waters with spawning and nursery grounds of key species. | Published 2010. Covers all Irish waters. |

| Data source | Type of data | Temporal and spatial coverage |
|---|---|---|
| (DCENR) (2010). Strategic Environmental Assessment (SEA) of the Offshore Renewable Energy Development Plan (OREDP) in the Republic of Ireland: Environmental Report Volume 2: Main Report and Appendix F (Commercial Fisheries) in Environmental Report Volume 4: Appendices. | | |
| Department of the Environment, Climate and Communications (2023). Draft OREDP II: Draft SEA Report and Appendix 3 - Updated Baseline Summary Report. | Baseline of fish and shellfish across Irish waters with spawning and nursery grounds of key species. | Draft of OREDP II published 2023. Covers all Irish waters. |
| Marine Protected Area (MPA) Advisory Group (2023). Ecological sensitivity analysis of the western Irish Sea to inform future designation of Marine Protected Areas. | Report to the Irish Government by the MPA Advisory Group to inform the selection of future MPAs in the western Irish Sea. Information within the report and references cited were used to inform the fish and shellfish baseline characterisation. | Published 2023. Covers the western Irish Sea, including the study area. |

| Data source | Type of data | Temporal and spatial coverage |
| --- | --- | --- |
| Consultation undertaken for the commercial fisheries baseline and assessment. | Consultation undertaken for the commercial fisheries baseline and assessment (including consultation captured as part of the Scoping Report for Dublin Array). Meetings and questionnaires circulated to fishing contacts. | 2020/2021 covering all ports that support fishing activity in the vicinity of the Kish and Bray Banks. |





Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)
ICES Statistical Rectangles
Main Rivers

**Sampling Locations**

Ecoserve (2008) (Dredge)
Aquatic Services Unit 2020 (Trawl 2020)
Fugro (2021) (DDV)
ICES NIGFS (2023a) (Otter Trawl)
ICES BTS (2023b) (Beam Trawl)
RPS (2014) (Beam Trawl, Fyke Nets)
Aquafact (2018) (Dredge)
Aquafact (2019) (Otter Trawl)

Aquatic Services Unit 2019

(2019) (Pots)
(2019) (Beam Trawl)
(2020) (Beam Trawl)

DRAWING STATUS

**FINAL**

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MAP NOTES / DATA SOURCES:

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Survey Data Informing the Fish and Shellfish Ecology Baseline**

DRAWING NUMBER: 2

PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 7 14 21 28 km
0 3.5 7 10.5 14 nm

N GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:750,000 | 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

## Fish and elasmobranch spawning and nursery grounds data

2.3.14 An overview of the approach followed to identify fish and elasmobranch spawning and nursery grounds overlapping the study area is provided in paragraph 2.3.15 *et seq.* below. Particular consideration has been given to sandeel and herring owing to the demersal spawning nature of these species, and therefore their increased sensitivity to potential impacts from the proposed development.

### Habitats data analysis

2.3.15 Spawning and nursery grounds overlapping the study area were identified using data from Ellis *et al.* (2010, 2012), Coull *et al.* (1998), and Ireland's Marine Atlas (Marine Institute, 2016). Additional data sourced from the AEPM Plankton Survey (Cefas, 2000) were used to ground-truth the Coull *et al.* (1998) and Ellis *et al.* (2010, 2012) datasets (Table 1).

2.3.16 The Coull *et al.* (1998) dataset shows spawning and nursery grounds for commercially important fish species in waters surrounding the UK and Ireland. Ellis *et al.* (2010, 2012) provide an update to these maps and extend the identification of spawning and nursery locations to ecologically important species, including elasmobranchs. Spawning and nursery areas are categorised by Ellis *et al.* (2010) as either 'high' or 'low' intensity dependent on the level of spawning activity or presence of juveniles recorded in these areas. Coull *et al.* (1998) and data from Ireland's Marine Atlas do not always provide this level of detail, although they delineate more spatially refined areas of potential spawning and nursery grounds.

2.3.17 Some uncertainties are associated with the broad-scale data layers that were used to identify the locations of nursery and spawning grounds and associated spawning and pupping periods. For example, many of the conclusions drawn by Coull *et al.* (1998) are based on historic data and may therefore not account for more recent changes in fish distributions and spawning and nursery behaviour available since its publication. The maps by Ellis *et al.* (2010, 2012) also face some limitations due to the often large spacing of sampling sites used for the annual international larval survey data, which is used as a key data source, consequently resulting in broader scale grids of spawning and nursery grounds than those presented by Coull *et al.* (1998) and the Marine Atlas.

2.3.18 Nonetheless, the spatial extent of the mapped spawning grounds is considered to represent the widest known distribution within which spawning will occur, while the duration of spawning periods indicated in these studies is considered likely to represent the maximum duration of spawning (Coull *et al.*, 1998). Therefore, these maps provide a precautionary basis for assessing impacts on spawning activity.

2.3.19 Spawning and nursery ground locations for key fish and elasmobranch species, as identified in Coull *et al.* (1998), Ellis *et al.* (2010, 2012), and Ireland's Marine Atlas (Marine Institute, 2016), are summarised in Section 3.4 of this report. Active or particularly important spawning grounds for some species may be smaller in extent and spawning periods may be shorter than are indicated by these sources. Therefore, where available, additional research publications and data were reviewed to provide site-specific and contemporary information on fish spawning and nursery behaviour. Information on potential spawning and nursery grounds of fish and elasmobranch species not considered by these studies is, where available, included within the respective species descriptions provided in Section 3.2 and Section 3.3.

## Larval data analysis

2.3.20 AEPM data collected in 2000 were downloaded from the Cefas Data Hub (Cefas, 2000) to provide the most recent available description of larval distribution for herring, Atlantic cod (*Gadus morhua*), whiting (*Merlangius merlangus*) and plaice in the Irish Sea. Point data of larval and egg occurrences were extracted for each species and used to create heat maps using Geographic Information Systems (GIS), following methodologies described by Boyle and New (2018). A radius of approximately 10 km was used to amalgamate the point data and to allow sufficient overlap between them, allowing the extrapolation of the data to provide heat maps covering the full AEPM survey area.

2.3.21 The heat maps show spawning 'hot spots' for herring, cod, whiting and plaice within the study area, thereby providing a data set to support the identification of active spawning grounds for these species, and, in the case of herring, to ground-truth against more recent PSA data collected by the Applicant (Aquafact, 2018; Fugro, 2021). These heat map data are presented alongside the Coull *et al*. (1998) fish sensitivity maps in Section 3.2.

2.3.22 No sandeel larvae data are available for the Irish Sea, and therefore the locations of potential sandeel spawning grounds are based solely on the analysis of PSA data and broadscale marine habitat data, as described in paragraph 2.3.23 *et seq* below.

## Identification of potential sandeel and herring spawning areas

2.3.23 Site-specific PSA data from the most recent benthic baseline characterisation surveys (Aquafact, 2018; Fugro, 2021) together with sediment data from INFOMAR (2023) were analysed to identify areas with seabed substrates suitable to support herring and sandeel spawning within the study area and wider region. The PSA data were processed in accordance with the methodologies described by Reach *et al*. (2013) and Latto *et al*. (2013). Both methodologies are widely accepted by the offshore industry sector and are now routinely used as an approved approach to support EIAs for offshore wind developments in UK waters.

2.3.24 The methodologies detailed by Reach *et al*. (2013) and Latto *et al*. (2013) divide seabed sediments into sediment preference categories for herring and sandeel, respectively, based on the proportions of silts, fine and coarse sands and gravels in surficial sediments. The sediment preference categories are then used to define areas of the seabed with the potential to be used as spawning grounds by herring and sandeel, categorising seabed areas as either "preferred", "marginal" or "unsuitable" for spawning.

2.3.25 The sediment classification and habitat suitability categories derived from these data are used as a proxy to indicate the location of potential spawning grounds for herring and sandeel within the study area. However, it is important to note that while suitable substrates need to be present to support spawning, the sediment composition is not the only parameter that defines suitable spawning habitat. Other environmental (physical, chemical and biotic) parameters, such as sediment oxygenation, siltation rates, micro-scale seabed morphology and the distribution of spawning populations will also contribute to the suitability of seabed environments to be used as spawning grounds. As such the sediment categories assigned alone will over-represent the extent of seabed areas with the potential to support spawning events, therefore ensuring a precautionary approach to the assessment.

2.3.26 The substrate categories used to identify potential herring spawning grounds within the study area are shown in Table 2, and the categories used for sandeel are listed in Table 3. The results of the spawning habitat classifications are presented in Section 3.4 of this report and further interpreted in the Fish and Shellfish Chapter.

Table 2 Herring potential spawning habitat sediment classifications (based on Reach *et al*., 2013)

| Folk Class (Folk, 1954) | Habitat sediment preference | Habitat sediment classification |
|---|---|---|
| Gravel and part sandy Gravel (< 5% mud, > 50% gravel) | Prime | Preferred |
| Part sandy Gravel and part gravelly Sand (< 5% mud, > 25% gravel) | Sub-prime | Preferred |
| Part gravelly Sand (< 5% mud, > 10% gravel) | Suitable | Marginal |
| Everything excluding Gravel, sandy Gravel and part gravelly Sand (> 5% mud, < 10% gravel) | Unsuitable | Unsuitable |

Table 3 Sandeel habitat sediment classifications (based on Latto *et al*., 2013)

| Folk Class (Folk, 1954) | Habitat sediment preference | Habitat sediment classification |
|---|---|---|
| Part Sand, Part slightly gravelly Sand and part gravelly Sand (< 1% muds, > 70% sand) | Prime | Preferred |

| Folk Class (Folk, 1954) | Habitat sediment preference | Habitat sediment classification |
|---|---|---|
| Part Sand, Part slightly gravelly Sand and part gravelly Sand (< 4% muds, > 70% sand) | Sub-prime | Preferred |
| Part Sandy, part gravelly Sand and part sandy Gravel (< 10% muds, > 50% sand) | Suitable | Marginal |
| All others (including part muddy Sand, part slightly gravelly muddy sand, part gravelly muddy Sand, part muddy sandy Gravel and part sandy Gravel) (> 10% muds, < 50% sand). | Unsuitable | Unsuitable |

## Shellfish grounds data

2.3.27 Commercially important shellfish[8] species within the region were identified on account of their landings weight and value (Commercial Fisheries technical report; Tully, 2017) and through consultation with the local commercial fishing industry (Section 3.4). Commercially important shellfish grounds were identified and mapped using data from the Marine Institute (2016). Specifically, the study area was overlayed with inshore fishing ground data showing areas targeted by dredging and potting (Figure 23) and bottom trawl effort data (Figure 24) (Marine Institute, 2016).

[8] For the purpose of this report, shellfish encompass all shell-bearing invertebrates that are harvested as food. This includes crustaceans such as brown crab and European lobster and commercially important molluscs including common whelk and scallops.

## 2.4 Nature conservation

2.4.1 There are several existing legal instruments for the protection of fish and shellfish ecology in Ireland. The European Union (EU) Habitats (92/43/ECC) and Birds (79/409/EEC) Directives list habitats and species for strict protection and include provisions for the designation of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) to protect various features of interest. The Nature Directives are transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) and subsequent amendments. Ireland is also bound to the EU Water Framework Directive (WFD; 2000/60/EC), which provides for an evaluation of fish across lakes, rivers, and transitional water bodies. The WFD also provides for specific provisions for the protection and improvement of freshwater environments capable of supporting salmonids including Atlantic salmon and trout, with important freshwater habitats designated as Salmonid waters. The EU's Marine Strategy Framework Directive (MSFD; 2008/56/EC) aims to achieve Good Environmental Status (GES) of the EU's marine waters. A key component of the MSFD is the designation of Marine Protected Areas (MPAs), which have a primary focus of nature conservation. The Irish Government is committed to expanding Ireland's current network of MPAs to protect at least 30% of the Irish Maritime Area by 2030 to fulfil provisions of existing European Directives and targets set under the EU Biodiversity Strategy (Department of the Taoiseach, 2021). New spatial protection measures may include additional Natura 2000 sites notified under the EU Habitats and Birds Directives as well as new MPAs designated under forthcoming national legislation (Department of Housing, Local Government and Heritage, 2022).

2.4.2 Other international commitments of which Ireland is a signatory include the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention, 1992)[9], which aims to protect marine biodiversity in the north-east Atlantic, and the Bonn Convention (1979)[10], which aims to conserve migratory species throughout their range. The Bonn Convention requires signatories to conserve migratory species and their habitats by providing strict protection for endangered migratory species (Appendix I of the Convention) and also lists migratory species that would benefit from multilateral Agreements for conservation and management (Appendix II of the Convention). Commercial fisheries in the Irish Sea falls under the remit of the EU Commons Fisheries Policy (CFP)[11], which sets out management provisions for the conservation of commercially important fish species, ensuring the protection of fish stocks from fishing pressures.

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[9] https://www.ospar.org/convention

[10] https://www.cms.int/en/legalinstrument/cms

[11] https://oceans-and-fisheries.ec.europa.eu/policy/common-fisheries-policy-cfp_en

2.4.3 At the national level, provisions for the protection and conservation of species and habitats are set out in the Irish Wildlife Act (1976), the Irish Wildlife (Amendment) Act (2000) and subsequent amendments. In addition, Red Lists for Irish waters have been developed in accordance with recommendations by the International Union for Conservation of Nature (IUCN), showing the risk of extinction of fish (King *et al.*, 2011) and elasmobranch (Clarke *et al.*, 2016) species in Irish waters.

2.4.4 The current conservation status of individual fish and shellfish species is discussed in the respective species descriptions provided in Section 3.2 to Section 3.6 of this report. A summary of species of conservation importance that have the potential to occur within the study area is given in Section 3.7.

# 3 Receiving Environment

3.1.1 The seas around Ireland are considered among the most productive and biologically sensitive areas within European waters (Marine Institute, 2022). Information about fish and shellfish species present in the study area and wider western Irish Sea, as identified from survey data and published literature, is provided in the following sections for **fish** (Section 3.2), **elasmobranchs** (Section 3.3) and **shellfish** species (Section 3.4). This includes species accounts for key commercial species and species identified as being of ecological or conservation value. In addition, species with spawning and nursery grounds that overlap the study area are identified, with a summary of spawning and nursery grounds provided in Section 3.4. Any species that are present and known to be particularly sensitive to the impacts from offshore wind farm developments are also identified, for example cod and herring, which are highly sensitive to noise disturbance, and sandeel and herring which are sensitive to seabed disturbances owing to their demersal spawning habits. Finally, any **migratory fish** species and **marine turtles** that have the potential to transit the study area are identified and discussed in Section 3.5 and Section 3.6, respectively.

## 3.2 Fish ecology

### Site-specific surveys

3.2.1 As outlined in Section 2.3, site-specific trawl surveys were conducted across the Kish and Bray Banks in 2002 (Ecoserve, 2004) and 2019 (Aquafact, 2019). In addition, fish species were also recorded during the site-specific benthic baseline characterisation surveys (Aquafact, 2018; Ecoserve, 2008; Fugro, 2021).

3.2.2 During the 2002 trawl survey (as summarised in Ecoserve, 2008), seven species of bony fish were recorded, namely plaice, dab (*Limanda limanda*), lemon sole (*Microstomus kitt*), whiting, grey gurnard (*Eutrigla gurnardus*), lesser weever fish (*Echiichthys vipera*), and butterfish (*Pholis gunnellus*). In addition, two-spotted clingfish (*Diplecogaster bimaculata),* lesser sandeel (*Ammodytes tobianus*), greater sandeel (*Hyperoplus lanceolatus*) and witch flounder (*Glyptocephalus cynoglossus*) were caught in dredge samples.

3.2.3 The demersal fish assemblages sampled by otter trawls across Kish and Bray Banks in 2019 (Aquafact, 2019) were dominated by haddock (*Melanogrammus aeglefinus*) and grey gurnard. Other fish species regularly caught but generally in lower numbers were dab, plaice and tub gurnard (*Cheliodonichthys lucerna*). Less regularly recorded species included cod, lemon sole, John Dory (*Zeus faber*), red mullet (*Mullus surmuletus*), and lesser weaver, and a single record of brill (*Scophthalmus rhombus*), white anglerfish (*Lophius piscatorius*), flounder (*Platichthys flesus*), and dragonet (*Callionymus lyra*). The demersal assemblages recorded on the sandbanks and those sampled in deeper waters outside the array boundary were generally similar in terms of species composition but showed some differences in species densities. For example, whiting and poor cod (*Trisopterus minutus*) were locally abundant in deeper areas surveyed outside the array boundary but less common in the shallower areas sampled across Kish and Bray banks. Pelagic species commonly caught during the survey were Atlantic horse mackerel (*Trachurus trachurus*) and Atlantic mackerel (*Scomber scombrus*) with few records of sprat (*Sprattus sprattus*).

3.2.4 Length frequencies of the specimens caught during the 2019 otter trawl survey suggest that the Kish and Bray Banks are an important nursery ground for juvenile fish such as haddock, cod, plaice and dab (Aquafact, 2019). A similar conclusion was drawn by Atalah *et al.* (2013), who reported high numbers of small juvenile dab, plaice and spotted ray (*Raja montagui*) in beam trawl samples taken on Kish Bank.

## Regional and industry-specific surveys

3.2.5 Demersal fish assemblages sampled within the Dublin Array study area between 2018 and 2022 as part of the NIGFS (ICES, 2023a) and offshore BTS (ICES, 2023b) programmes were generally dominated by whiting, haddock and common dab. Other species regularly caught within the study area, often in higher numbers, were Norway pout (*Trisopterus esmarkii*), poor cod, grey gurnard, common dragonet and plaice. Species often present within the trawl samples but typically in low numbers included Atlantic cod, tub gurnard, sandeels, lemon sole, common sole (*Solea solea*), and thickback sole (*Microchirus variegatus*). Among the many species that were only occasionally recorded between 2018 and 2022 were the common monkfish (*Lophius piscatorius*) and American plaice (*Hippoglossoides platessoides*).

3.2.6 Common pelagic species recorded within the study area during the NIGFS surveys were herring, European sprat (*Sprattus sprattus*), Atlantic mackerel (*Scomber scombrus*) and Atlantic horse mackerel (*Trachurus trachurus*).

3.2.7 Findings from site-specific surveys undertaken for other projects that overlap with the study area for Dublin Array have also been reviewed to provide additional context. 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 and plaice, with sand goby and pipefish also frequently recorded. Other species encountered were 5-bearded rockling (*Ciliata mustela*), scaldfish (*Arnoglossus laterna*), flounder, butterfish, dragonet, whiting.

3.2.8 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 (*Plathichtys flesus*), cod, whiting and butterfish (*Pholis gunnellus*), 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, poor cod, cod, sandeels, gurnard, lesser weever, dragonet, whiting, pipefish, red mullet and herring (Aquatic Services Unit, 2019, 2020).

3.2.9 Fish stock surveys in the Lower Liffey conducted in 2008 and 2010 as part of the WFD transitional water monitoring recorded high numbers of sprat, sand goby (*Pomatoschistus minutus*) 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, pollock 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, pollock, 3-spined stickleback, 3-bearded rockling (*Gaidropsarus vulgaris*), 5-bearded rockling (*Ciliata mustela*), whiting and short-spined sea scorpion also recorded, albeit in lower numbers.

3.2.10 Species records from ICES rectangles 34E3, 34E4, 35E3, 35E4, 36E3 and 36E4 (ICES, 2023a,b) show that the pelagic and demersal fish species recorded across the study area are also present throughout the wider western Irish Sea.

## Fish species of commercial importance

3.2.11 The Irish Sea supports a variety of commercial fisheries for groundfish such as plaice, sole, haddock, anglerfish, and ray species as well as pelagic fisheries of herring and European sprat (*Sprattus sprattus*) (Gerritsen and Kelly, 2019). The main fishing fleets operating in the study area are Irish and Northern Irish demersal otter trawlers targeting nephrops, haddock and mixed demersal species, Irish and Belgian beam trawlers targeting plaice, sole, blonde ray and mixed demersal species, and Irish pelagic trawlers mainly targeting sprat and herring (Commercial Fisheries technical baseline). The main fish and elasmobranch species landed by Irish vessels from the study area (i.e., ICES rectangles 35E3 and 35E4; Figure 2) between 2015 and 2019 were plaice, blonde ray, haddock, lesser-spotted catshark, anglerfish, cod, sole, brill, turbot, pollock and thornback ray (SFPA, 2020, summarised in Commercial Fisheries technical baseline). By comparison with landings across the western Irish Sea, 83% of blonde ray and 66% of plaice were landed from 35E3 and 35E4, highlighting the importance of demersal trawl fisheries in this area (SFPA, 2020, summarised in the Commercial Fisheries technical baseline). The main beam trawl grounds targeting plaice and blonde ray and other mixed demersal species are located to the east of the Kish and Bray Banks, overlapping with the western sections of the underwater noise ZoI (see Figure 22 in the Commercial Fisheries technical baseline).

3.2.12 Pelagic species commercially targeted within the study area are Atlantic herring and European sprat, with fishing grounds mainly located in inshore waters including Dublin Bay and coastal waters off Howth and Wicklow (Commercial Fisheries technical baseline). Further details on the commercial fisheries interests in the Irish Sea and the study area are set out in the Commercial Fisheries technical baseline.

## Species by species distribution

### Atlantic herring

3.2.13 Atlantic herring, also known as herring, are pelagic shoaling fish, which are distributed widely throughout the North Atlantic, typically occurring in continental shelf waters at depths between 0-200 m (Froese and Pauly, 2023). Juveniles are typically found closer inshore, while adults prefer deeper offshore waters (ICES, 1994). Herring mainly feed on copepods (Blaxter and Hunter, 1982), while they in turn are important prey for larger fish like cod and whiting and marine mammals including seals and dolphins (e.g., Patterson, 1985; Sveegaard *et al.*, 2012). Consequently, herring play a key role in marine food webs, transporting energy from lower to higher trophic levels (Blaxter and Hunter, 1982).

3.2.14 Herring are benthic spawners, which deposit adhesive eggs to hard surfaces. Spawning typically occurs in high energy and/or structurally complex environments with good circulation and oxygenation and sufficient surfaces to attach large volumes of eggs (Frost and Diele, 2022). Preferred spawning locations include inshore areas with submerged vegetation and areas with coarse substrates, such as gravel, small rocks, maerl beds, or coarse sand (e.g., Frost and Diele, 2022; Maravelias *et al.*, 2000). Whether such areas are ultimately used by herring for spawning depends on additional factors, including small-scale seabed geomorphology and local wind and flow conditions (Frost and Diele, 2022). As a result, herring spawning beds are typically spatially discrete patches distributed throughout wider areas (spawning grounds) of suitable spawning substrate (O'Sullivan *et al.*, 2013).

3.2.15 Herring are known to display spawning site fidelity, returning to distinct spawning grounds (Frost and Diele, 2022). There was a lack of evidence of herring spawning activity within the study area, as indicated by the absence of spawning ground (Figure 3) and the low count/absence of larvae (Figure 11). The Irish Sea herring stock has historically been divided into two adult spawning populations: (1) the Manx component with spawning grounds located to the east and north of the Isle of Man, and (2) the Mourne component with spawning grounds along coastal areas off County Louth and County Down to the north of the study area (ICES, 1994; Figure 3). A decline in spawning activity of the Mourne herring population was reported by Dickey-Collas *et al.* (2001), who, based on larvae data, estimated that the Mourne spawning stock accounted for about 3% of the total production of Irish Sea herring larvae in the 1990s. More recent larval data collected as part of the annual Northern Irish North-eastern Larvae Survey (NINEL) suggests ongoing spawning activity along the Irish and North Irish coasts over the traditional Mourne herring ground, with the overall contributions of the Mourne herring to the Irish Sea spawning stock remaining low (e.g., ICES, 2021; ICES 2023c,d). The continued operation of a small local (traditional) gillnet fishery on the Mourne herring, aimed at adult fish that spawn off the Northern Irish eastern coast, further confirm the presence of active spawning beds over the traditional Mourne herring ground (ICES, 2023c).

3.2.16 Both Irish Sea herring populations spawn in autumn between September to November (peak spawning occurring in late September or early October), with a small proportion of the spawning stock likely to continue spawning during the winter months until January/February (Dickey-Collas *et al.*, 2001; ICES, 1994). Following spawning, adult herring disperse to offshore feeding grounds across the northern Irish Sea from October/November until the following April/May (ICES, 1994). Tagging studies suggest that some adult herring migrate northwards and join the feeding aggregations on the Scottish west coast (Geffen *et al.*, 2011; ICES, 1994).

3.2.17 Juvenile herring concentrate in inshore areas in the northern Irish Sea (Campenella and van der Kooij, 2021; ICES, 1994). Ellis *et al.* (2010) identified high intensity nursery grounds to the north of Dublin Bay (Figure 4). Maps produced by Coull *et al.* (1998) and the Marine Institute (2016) reinforce this, with herring nursery grounds shown to be located in the north-western Irish Sea (Figure 4). Analyses suggest that herring nursery grounds in the Irish Sea are used by juveniles originating from the Manx and Mourne spawning populations and herring from the Celtic Sea (e.g., Geffen *et al.*, 2011).

3.2.18 Herring were absent from the site-specific trawl samples taken over Kish and Bray Banks (Aquafact, 2019) (noting that the survey used an otter trawl, which is not designed to target pelagic species such as herring). However, herring were recorded in relatively high abundances across the study area and western Irish Sea in the NIGFS surveys (ICES, 2023a). Irish Sea herring stock levels remained low from the mid-1990s to the early 2000s but appeared to have stabilised in recent years, with higher spawning stock biomass observed since the mid-2000s (ICES, 2023c). Seasonal fishing closures are in place across the two main herring spawning areas (i.e., the Mourne ground in the north-east Irish Sea and the main Manx spawning area off the Isle of Man) to protect spawning stocks and aggregations of juveniles (Marine Institute, 2022).

3.2.19 Locations with substrates suitable for herring spawning have been mapped using PSA data from INFOMAR (2023) and site-specific surveys (Aquafact, 2018; Fugro, 2021); the results of this analysis are reported in Section 3.4.

## Sandeel

3.2.20 Sandeel are small, shoaling fish found on continental shelves in the northern hemisphere. There are five species of sandeel found within Irish waters, including the lesser sandeel (*Ammodytes tobianus*), Raitt's lesser sandeel (*A. marinus*), the greater sandeel (*Hyperoplus lanceolatus*) and the smooth sandeel (*Gymnammodytes semisquamatus*) (Nichols *et al.*, 1993).

3.2.21 Sandeel are highly substrate dependent, being demersal spawners and spending large amounts of time buried in the sediment. Consequently, they are more susceptible to seabed disturbance impacts, and as such they are of particular relevance when assessing impacts of offshore wind developments. In addition, sandeels are considered a species of ecological importance in the marine food web being an important prey species for piscivorous fish, seabirds and marine mammals (Green, 2017). As many marine predators rely on sandeels, coupled with their vulnerability to changes in habitat, sandeels are of increasing conservation interest.

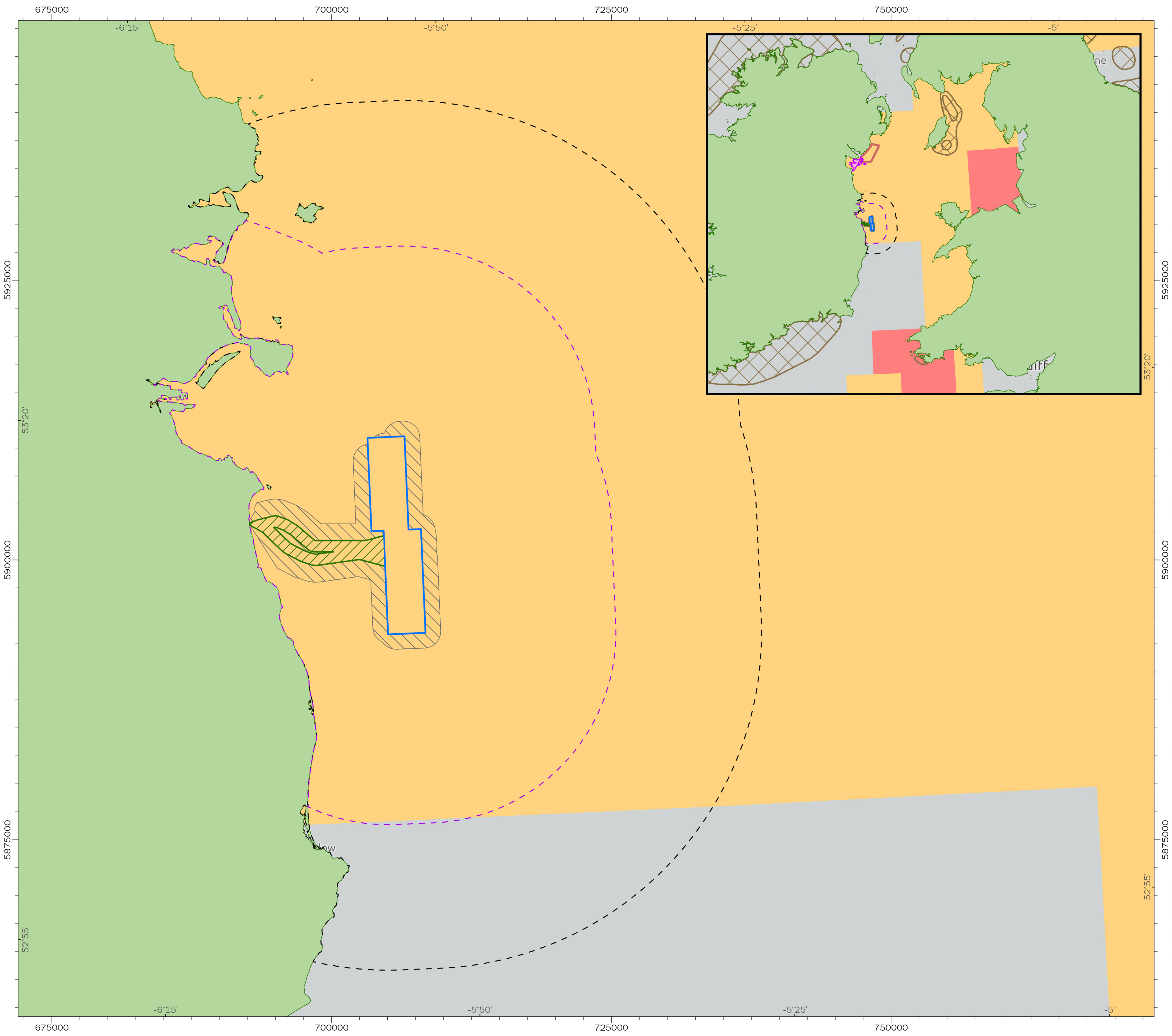
3.2.22 Local distributions of sandeel are largely dependent on the composition of the sediment, with sandeel typically associated with sandy substrates with a high proportion of medium and coarse sand (particle size 0.25-2 mm) (Wright *et al.*, 2000). They rarely occur in sediments where the silt and clay content (particle sizes less than 0.63 µm) is greater than 4%, and they are absent in substrates with a silt content greater than 10% (Holland *et al.*, 2005; Wright *et al.*, 2000)

3.2.23 In the Irish Sea, sandeel spawn either in autumn or between winter and summer, depending on the species (Nichols *et al.*, 1993). The eggs are demersal and are covered with a glutinous secretion that enables them to attach to the seabed (Proctor *et al.*, 1998). After hatching and an initial larval dispersal period of 1-3 months sandeel settle, preferably, on well-oxygenated sandy substrate (Green, 2017). After settlement, sandeel show a high degree of site fidelity (Jensen *et al.*, 2011) and distinct foraging patterns (van Deurs *et al.*, 2011). From September through to March sandeel mostly remain buried within the sediment, only emerging to spawn (Green, 2017). After this overwintering period (i.e., during spring and early summer), sandeel emerge during the day to feed in large schools (van Deurs *et al.*, 2011).

3.2.24 Given their high degree of site fidelity, the settled distribution of adult sandeel is largely reflective of preferred spawning sediments (Jensen *et al.*, 2011). Sandeel spawning locations are known to occur throughout the Irish Sea, with low intensity spawning (Figure 3) and nursery (Figure 4) grounds overlapping with the study area (Ellis *et al.*, 2010, 2012). More recent data suggest that although juvenile sandeel are widespread in the Irish Sea, juvenile hotspots are located in the Central Irish Sea (Campanella and van der Kooij, 2021), including the southern parts of the ZoI.

3.2.25 Sandeel were not recorded during site-specific trawls (Aquafact, 2019) and were caught in low numbers during ICES (2023a,b) trawl surveys. This is most likely due to the sampling gear employed during these surveys, such as the relatively large mesh size (150-160 mm cod end) used during otter trawling (Aquafact, 2019). Sandeels including lesser sandeel and greater sandeel were recorded during the site-specific dredge and DDV surveys, with most records from sites sampled in the shallow areas of the Kish and Bray sandbanks within the array area and few records from the offshore ECC (Aquafact, 2018; Ecoserve, 2008; Fugro, 2021).

3.2.26 Suitable sandeel habitat has been further assessed through analysis of PSA data from INFOMAR and site-specific PSA data (Aquafact, 2018; Fugro, 2021); the results of this analysis are presented in Section 3.4.





Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)
Potential Suitable Herring Spawning Ground (Dundalk Bay) (MPA Advisory Group, 2023)
Traditional Mourne Herring Spawning Area (Dickey-Collas *et al.*, 2001)

Spawning Grounds (Coull *et al.*, 1998)
Atlantic Herring

Spawning Grounds (Intensity) (Ellis *et al.*, 2010)
Sandeel, Low Intensity
Sandeel, High Intensity

DRAWING STATUS
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PROJECT TITLE
**Dublin Array**

DRAWING TITLE
**Sandeel and Atlantic Herring Spawning Grounds (Coull *et al.*, 1998; Ellis *et al.*, 2010)**

DRAWING NUMBER: **3**
PAGE NUMBER: **1 of 1**

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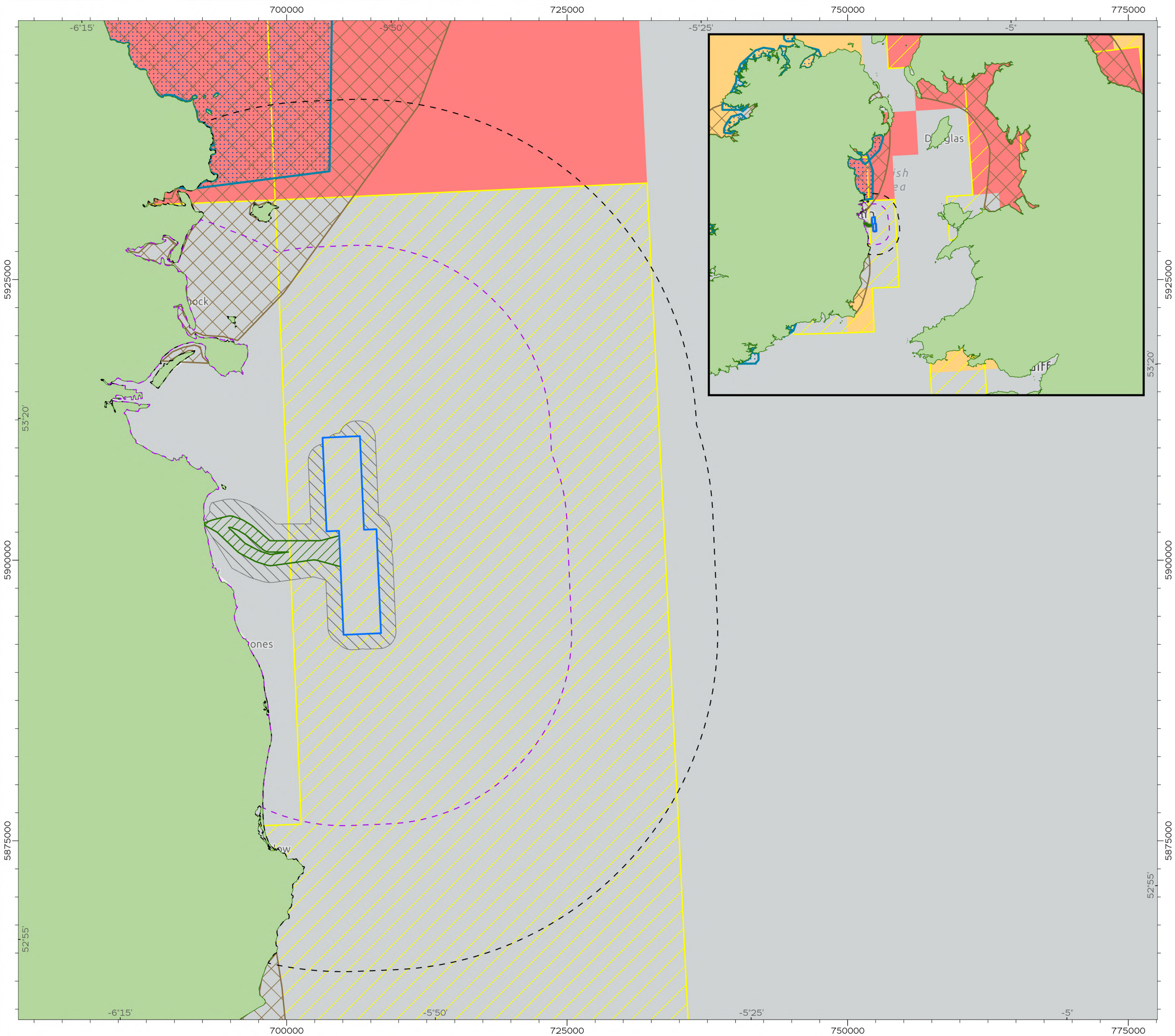
GoBe APEM Group
Dublin Array Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited





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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Sandeel and Atlantic Herring Nursery Grounds (Coull *et al.*, 1998; Ellis *et al.*, 2010)**

DRAWING NUMBER: **4**

PAGE NUMBER: **1 of 1**

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0 1.5 3 4.5 6 nm

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| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

APEM Group

Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

## Whiting

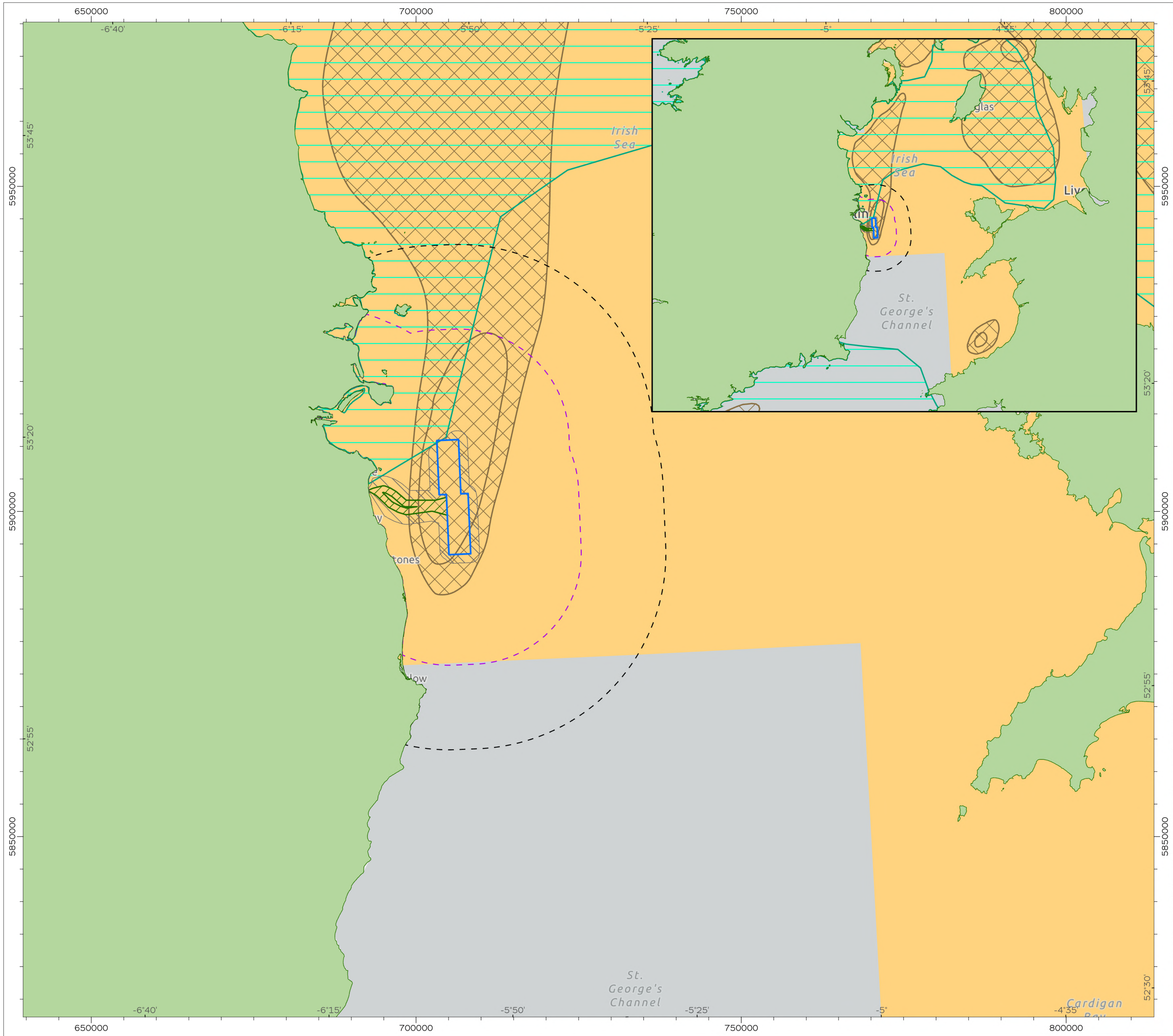
3.2.27 Whiting are a widely distributed demersal codfish found throughout the Eastern North Atlantic over muddy, sandy and coarser grounds. Adult whiting are most common at depths between 30-100 m, but may be found as deep as 200 m (Cohen *et al.*, 1990). Juveniles prefer shallower coastal waters from about 5-30 m (Cohen *et al.*, 1990; Kerby *et al.*, 2013), while adults are found in deeper areas, most commonly over sandy and muddy substrates (Marine Institute, 2023). Whiting move in large shoals and mainly feed on small fish and crustaceans (Marine Institute, 2023).

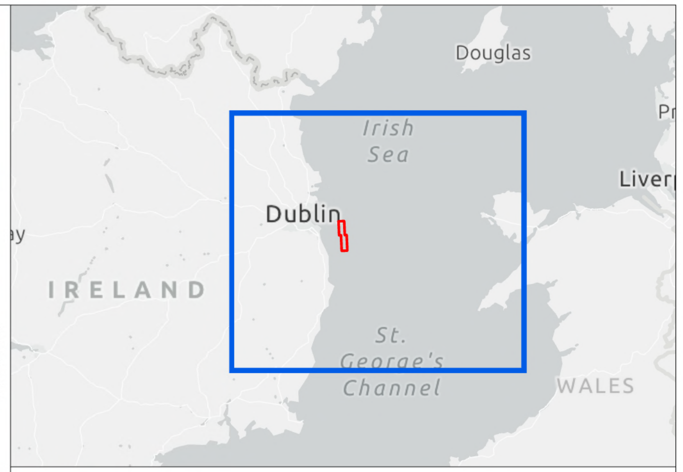
3.2.28 Whiting were one of the most abundant species recorded across the study area and western Irish Sea by the NIGFS and BTS surveys (2018-2022; ICES, 2023a,b). They were also regularly recorded during the site-specific trawl survey (Aquafact, 2019), with highest abundances recorded at the deeper sampling sites to the east and west of the Kish and Bray Banks outside the array area.

3.2.29 Spawning occurs in batches at water depths between 20-150 m (Cohen *et al.*, 1990). The spawning period in the Irish Sea may extend from February to June (Coull *et al.*, 1998), with peak spawning likely to take place in May and April (Nichols *et al.*, 1993). The data analysed by Ellis *et al.* (2010, 2012) indicate low intensity whiting spawning grounds across the majority of the study area, while earlier analyses by Coull *et al.* (1998) suggest the presence of whiting spawning grounds across the array area, offshore ECC and the central section of the ZoIs (Figure 5). The Marine Institute data (Figure 5) confirm the presence of spawning grounds overlapping with the north-western part of the study area. The results of the AEPM survey (Cefas, 2000) suggest that areas of high intensity whiting spawning are located in deeper waters to the east of the sedimentary ZoI (Figure 11), with lower intensity spawning being present within the study area (Figure 5; Figure 11). This is supported by more recent analyses by Campanella and van der Kooij (2021), who identified widespread spawning of whiting in the Irish Sea with higher spawning activity in the central Irish Sea to the east and north-east of the study area.

3.2.30 Juvenile whiting are known to utilise estuarine habitats and other coastal waters as nursery grounds, where they remain up to one year before moving offshore to adult feeding areas (e.g., Cohen *et al.*, 1990; Henderson and Holmes, 1989; Potter *et al*., 1988). High intensity nursery grounds, as mapped by Ellis *et al.* (2010, 2012), extend along the north-east coast of Ireland and overlap with the majority of the study area (Figure 6). The Coull *et al.* (1998) and Marine Institute data (Marine Institute, 2016) indicate the presence of nursery grounds that extend northward from the central to northern section of the study area (Figure 6).

3.2.31 Within the Irish Sea, whiting are mostly caught as bycatch in the nephrops fishery (Marine Institute, 2023). Stock levels in the Irish Sea have been severely depleted since the early 1990s and show no sign of recovery (Marine Institute, 2023).




Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)

Spawning Grounds (Coull *et al.*, 1998)

Whiting

Spawning Grounds (Intensity) (Ellis *et al.*, 2010)

Whiting, Low Intensity

Spawning Grounds (Marine Institute, 2016)

Whiting

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Whiting Spawning Grounds (Coull *et al.* 1998, Ellis *et al.*, 2010)**

DRAWING NUMBER: **5**

PAGE NUMBER: **1 of 1**

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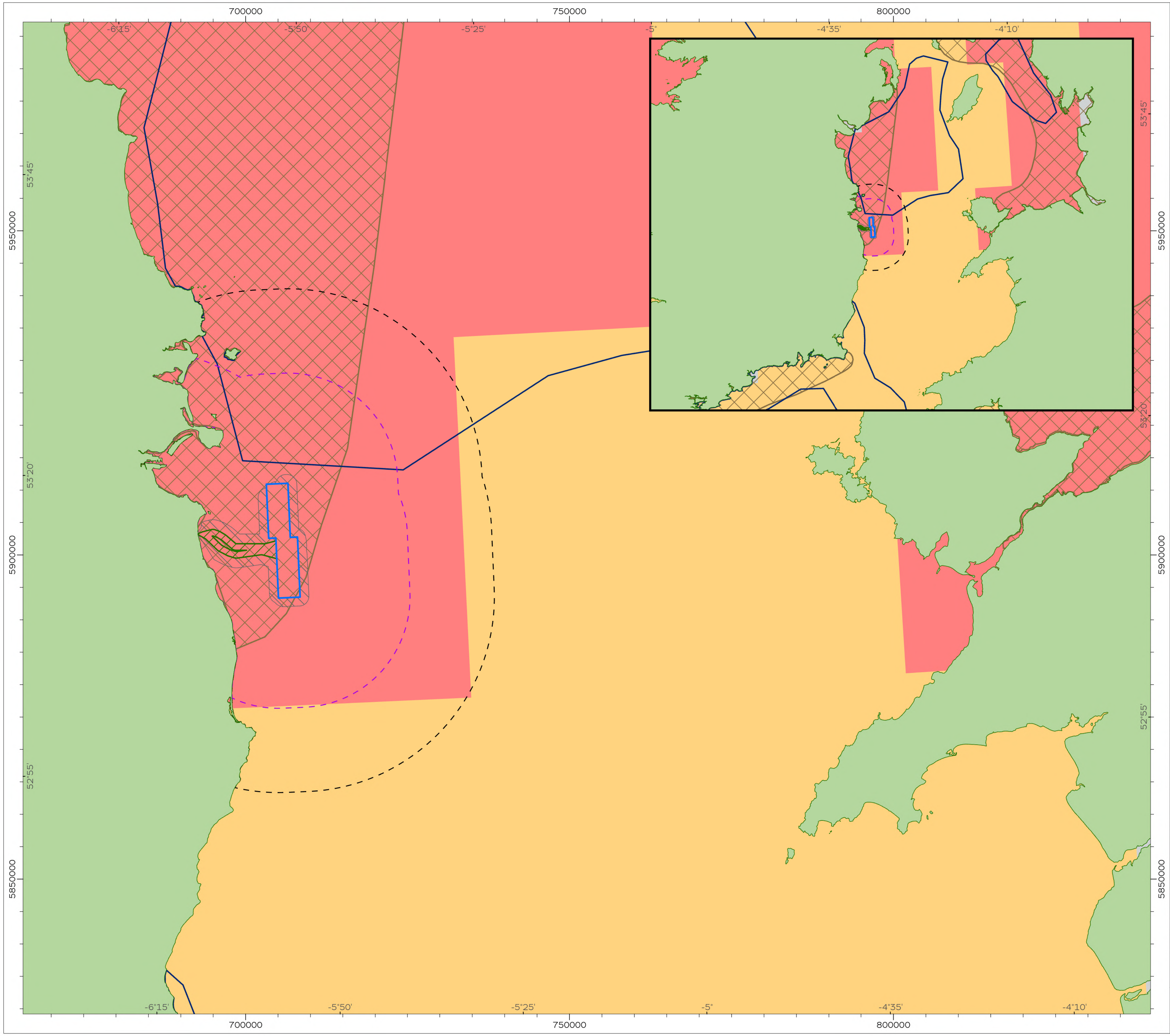
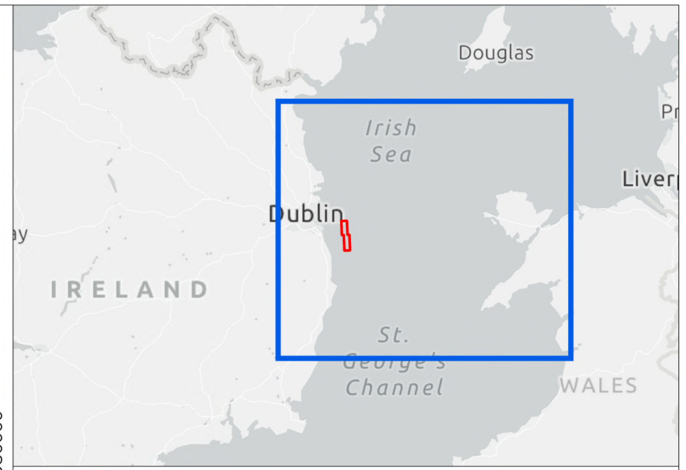
GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited




- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)

Nursery Grounds (Coull *et al.*, 1998)

- Whiting

Nursery Grounds (Intensity) (Ellis *et al.*, 2010)

- Whiting, Low Intensity
- Whiting, High Intensity

Nursery Grounds (Marine Institute, 2016)

- Whiting

DRAWING STATUS

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Whiting Nursery Grounds (Coull *et al.*, 1998; Ellis *et al.*, 2010; Marine Institute, 2016)**

DRAWING NUMBER: 6

PAGE NUMBER: 1 of 1

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| 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

## Atlantic cod

3.2.32 Atlantic cod, also known as cod, are widely distributed on both sides of the North Atlantic Ocean, typically occurring at depths of 150-200 m (Cohen *et al.*, 1990). Cod is a gregarious species that moves in large, size-structured schools between 30-80 m above the seabed during the day (Cohen *et al.*, 1990). Juveniles are more commonly found in shallower waters over more complex bottoms such as gravel, rocky or vegetated habitats (e.g., Froese and Pauly, 2023; Lilley and Unsworth, 2014). Adult cod are opportunistic predators and feed primarily on epibenthic and burrowing crustacea and various species of fish (ICES, 2005).

3.2.33 Cod were recorded in relatively low abundances in all site-specific trawls (Aquafact, 2019), and on a broader scale are distributed across the Irish Sea (ICES, 2023a,b).

3.2.34 Cod are broadcast spawners that release buoyant gametes into the open water. In the Irish Sea, spawning takes place between January and May, with peak spawning occurring from late March to early April mainly in the evening and during the night (ICES, 2005). The planktonic eggs typically hatch over a period of two to three weeks, depending on water temperature (Wright *et al*., 2003). Male cod are known to produce a drumming sound during the spawning season (Fudge and Rose, 2009; Nordeide and Kjellsby, 1999), and it has been suggested that the sounds are used to defend territories and attract females during spawning (Brawn, 1961).

3.2.35 There is strong evidence that cod exhibit spawning site fidelity behaviour, whereby mature individuals migrate in dense shoals to discrete inshore spawning grounds (e.g., ICES, 2005; van Hoeck *et al*., 2023; Zemeckis *et al.*, 2014). This is consistent with the Marine Institute Atlas data that show a coastal spawning band for cod that extends along the east coast of Ireland from south of Wicklow north to Killard (Figure 7). Ellis *et al.* (2010, 2012) predict low intensity cod spawning grounds within the majority of the study area, with areas of high intensity spawning are predicted to overlap with the northern part of the underwater noise ZoI (Figure 7). When considering the datasets discussed above, it is apparent that whilst cod spawning grounds are present across the study area, larval densities (Cefas, 2000) suggest that cod spawning activity is greatest in areas to the north of the study area (Figure 11).

3.2.36 After spawning, juvenile cod move to coastal nursery areas. Coull *et al.* (1998) identified a band of cod nursery grounds in the northern and central Irish Sea extending from Codling Bank to Dundalk peninsula and the coast off Northern Ireland. The mapped nursery grounds overlap the array area, Offshore EEC and the northern parts of the ZoIs (Figure 8). The data analysed by Ellis *et al.* (2010, 2012) indicate cod nursery grounds along the whole western coast of the Irish Sea, with high intensity nursery grounds overlapping with the study area (Figure 8). Similar wide-spread cod nursery grounds are identified by the Marine Institute data and more recent analysis by Campanella and van der Kooij (2021), with the latter analysis also indicating high concentrations of juvenile cod in the study area.

3.2.37 Cod are currently classed as Vulnerable on the IUCN Red List (IUCN, 2023). They are also assessed as being threatened and/or declining across OSPAR region III, on account of significant declines in stocks over the last decades and very low rates of recovery. The most recent stock assessment for cod populations in the Irish Sea suggests that stock biomass in 2023 remained low, with the spawning-stock biomass (SSB) below the estimated maximum sustainable SSB threshold (Marine Institute, 2023).

3.2.38 Historically, landings of cod from the Irish Sea were an important source of revenue to the fishing industry in Ireland and the UK. Landings peaked in the late 1980s and have steadily declined since. As a result, the EU introduced closed areas and seasons in the Irish Sea for cod fishing in 2000. Currently, no direct cod fishery is permitted within the Irish Sea and all allocated catch quota are set exclusively for landings from bycatch (Marine Institute, 2023). In 2021, landings of cod were mainly associated with vessels targeting demersal fish (37%) and nephrops (33%) (Marine Institute, 2022).

## Poor cod

3.2.39 Poor cod are widely distributed throughout Irish waters and waters around the UK (Rogers and Ellis, 2000), where they are considered a common species and important prey species for marine mammals and larger piscivorous fish. In the north-east Atlantic, the species is typically found at water depths from 15-200 m, but they can be found in greater densities in deeper central waters to depths of 400 m (Cohen *et al.*, 1990). Poor cod are gregarious, living in small schools over muddy or sandy grounds (Cohen *et al.*, 1990).

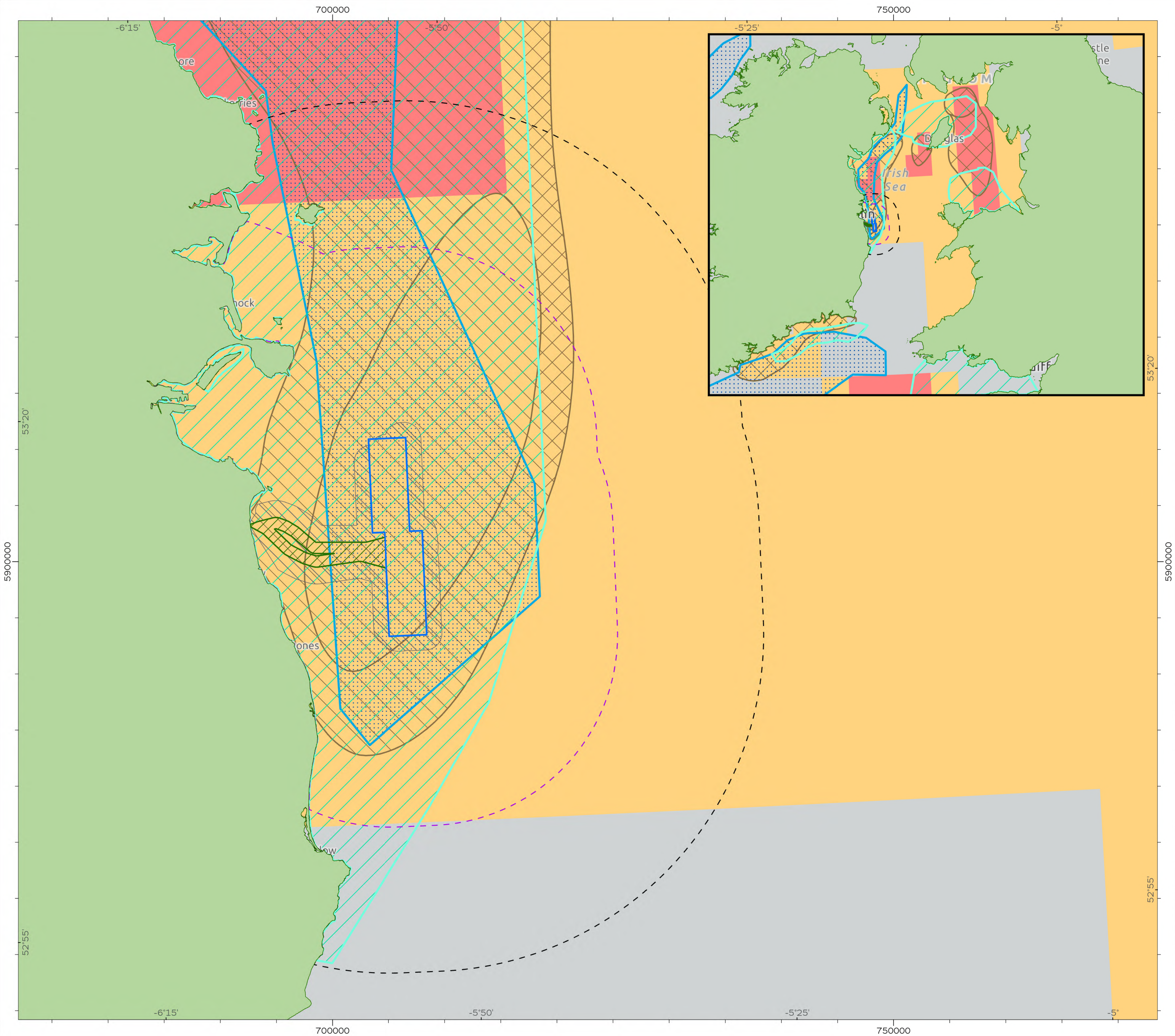
Poor cod were recorded in relatively high numbers in deeper waters to the east and west of the array area during the site-specific trawl survey (Aquafact, 2019). Individuals landed were on average 16 cm in length; adults grow up to 25 cm, suggesting prevalence of juveniles within the area sampled. Poor cod were also regularly recorded in the study area and wider western Irish Sea during the ICES NIGFS and BTS surveys (ICES, 2023a,b).

## Haddock

3.2.40 Haddock are demersal, bottom feeding codfish, which are widely distributed throughout the Eastern and Western North Atlantic (Cohen *et al.*, 1990). The species typically occupies areas near the bottom over rock, sand or gravel at depths of about 10-450 m, with highest densities typically observed in continental shelf waters from 80-200 m (Albert, 1994; Cohen *et al.*, 1990; Marine Institute, 2022). The diet of haddock consists largely of small benthic organisms including molluscs, crustaceans, worms and small fish (Albert, 1994).

3.2.41 Information on the spawning dynamics of haddock in the Irish Sea is relatively sparse. Data from the Marine Institute (2016) show spawning grounds along the western Irish Sea coast, overlapping with the northern and central sections of the study area including the array area and parts of the offshore ECC (). Nursery grounds are found at a similar geographic range but extend further offshore (Coull *et al.*, 1989; Marine Institute 2016;Figure 8). Spawning is likely to take place at some point between February and May, with peak spawning from February to April (Cohen *et al.*, 1990; Coull *et al.*, 1989). Similar to other bentho-pelagic fish species, haddock have a demersal courting period followed by pelagic egg release and planktonic larval phases (Casaretto and Hawkins, 2002). Male haddock are known to produce a variety of sounds during the spawning season, which are thought to play an important role in synchronising the reproductive behaviour of mature male and female haddock (Hawkins and Amorim, 2000).

3.2.42 Haddock are currently classed as Vulnerable on the global IUCN Red List and as of Least Concern on the European Red List (IUCN, 2023). They were one of the most abundant demersal species recorded during the site-specific trawls (Aquafact, 2019) and were also being commonly recorded across the wider study area and western Irish Sea by the NIGFS and BTS surveys (ICES, 2023a,b). The stock size of haddock in the Irish Sea remains high and fishing mortality is low, indicating that the haddock population is in a good state and harvested sustainably (Marine Institute, 2023).





Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)

Spawning Grounds (Coull *et al.*, 1998)

Atlantic Cod

Spawning Grounds (Intensity) (Ellis *et al.*, 2010)

Cod, Low Intensity
Cod, High Intensity

Spawning Grounds (Marine Institute, 2016)

Atlantic Cod
Haddock

DRAWING STATUS

**FINAL**

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Atlantic Cod and Haddock Spawning Grounds (Coull *et al.* 1998; Ellis *et al.*, 2010; Marine Institute, 2016)**

DRAWING NUMBER: **7**

PAGE NUMBER: **1 of 1**

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 3 6 9 12 km
0 1.5 3 4.5 6 nm

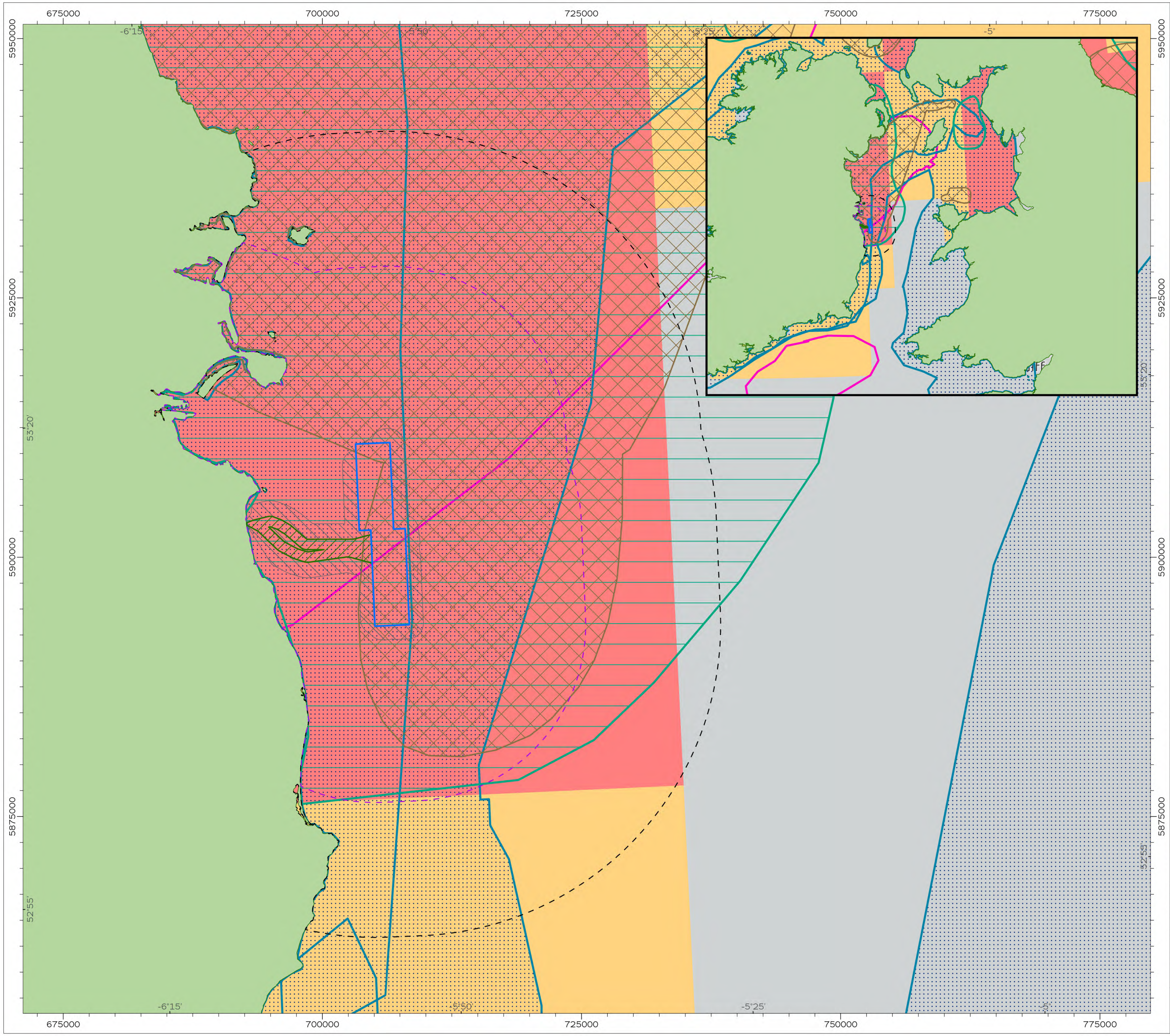
N
GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:350,000 | PLOT SIZE | A3 |
| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

APEM Group

Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited





Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)
Nursery Grounds (Coull *et al.*, 1998)
Haddock
Atlantic Cod
Nursery Grounds (Intensity) (Ellis *et al.*, 2010)
Cod, Low Intensity
Cod, High Intensity
Nursery Grounds (Marine Institute, 2016)
Atlantic Cod
Haddock

DRAWING STATUS
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PROJECT TITLE
**Dublin Array**

DRAWING TITLE
**Atlantic Cod and Haddock Nursery Grounds (Coull *et al.* 1998; Ellis *et al.*, 2010; Marine Institute, 2016)**

DRAWING NUMBER: 8
PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 3 6 9 12 km
0 1.5 3 4.5 6 nm

N
GRID NORTH

| SCALE | 1:375,000 | 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

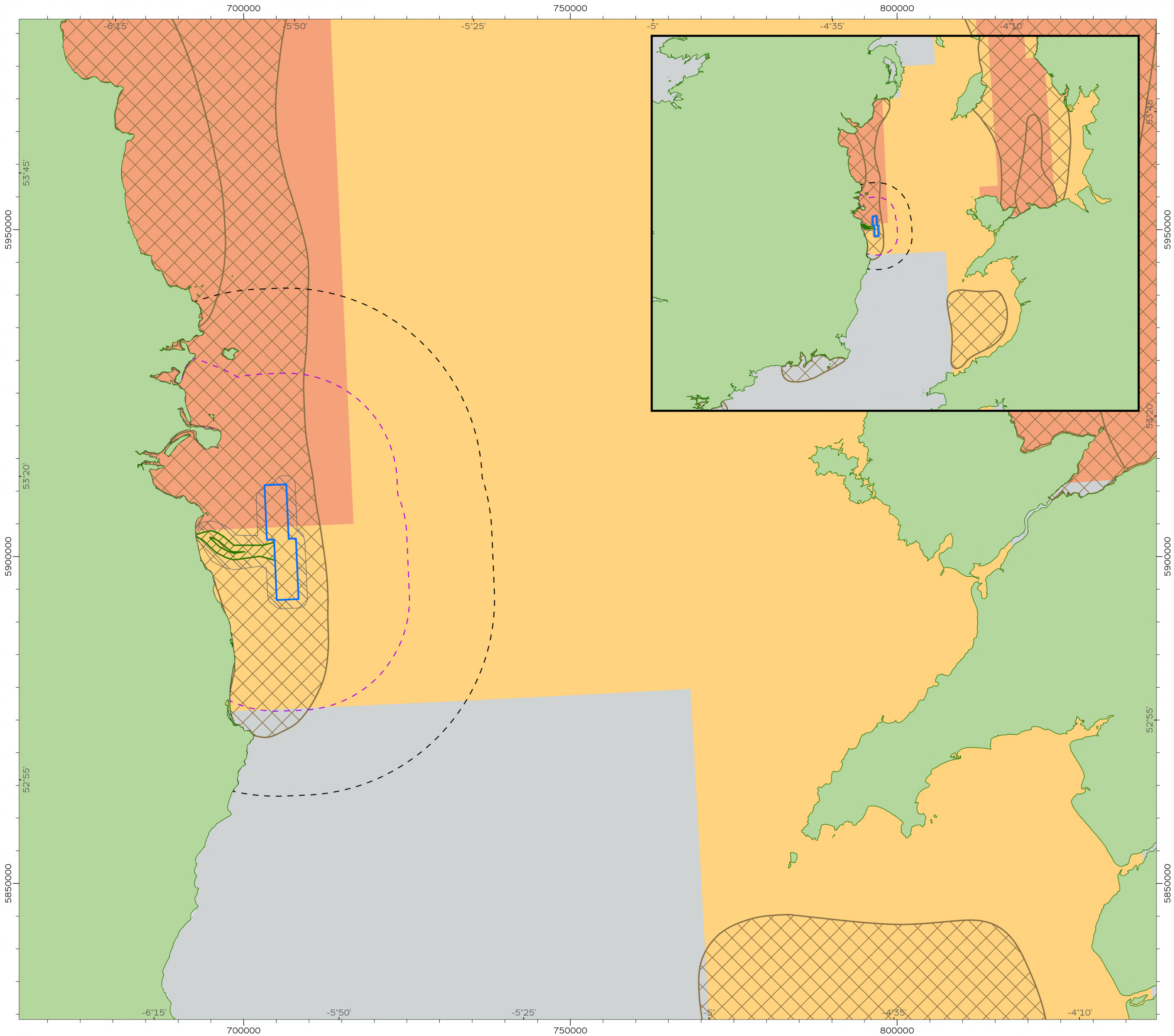
## Plaice

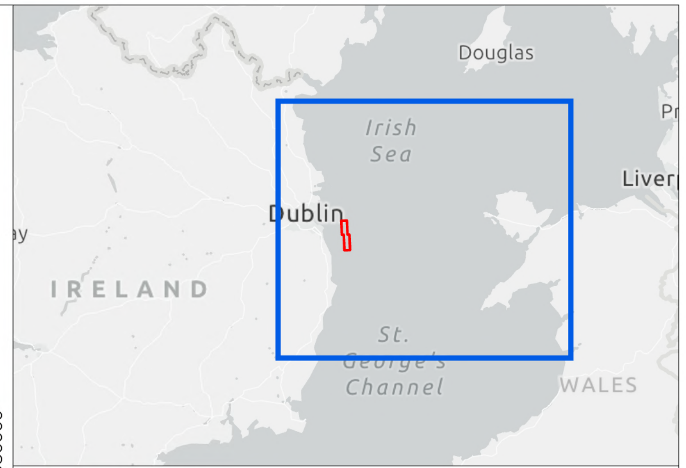
3.2.43 Plaice are widely distributed throughout European waters, including the Irish Sea. The species is typically found in waters less than 100 m depth and most commonly on sandy, muddy or gravel seabeds. Juveniles inhabit mostly shallow waters including intertidal areas, while older fish are found in deeper, more exposed waters (Loots *et al.*, 2010; Marine Institute, 2023).

3.2.44 Irish vessels typically catch plaice as minor bycatch in mixed fisheries targeting nephrops and haddock. Landings in plaice from Irish fleets have decreased in recent years, and fishing mortality of the Irish Sea stock remains below the Maximum Sustainable Yield ($F_{MSY}$) threshold, indicating that the stock is harvested sustainably (Marine Institute, 2023). Plaice were recorded at all sites sampled within the array area during the site-specific trawl survey (Aquafact, 2019) and is also widespread across the wider study area and western Irish Sea (ICES, 2023a,b).

3.2.45 Tagging studies in the North Sea suggest that plaice exhibit strong site fidelity, returning to the same locations to spawn and feed (Hunter *et al.*, 2003). Spawning is controlled by water temperature (Fox *et al.*, 2003; Marine Institute, 2023), and in the Irish Sea is likely to take place between January and April (Coull *et al.*, 1998; ICES, 2005; Nichols *et al.*, 1993). It is typically concentrated across the coastal regions and shallow sandbank features (Fox *et al.*, 2000; Rijnsdorp, 1989). Plaice spawning grounds in the western Irish Sea, as identified by Coull *et al.* (1989), extend from Wicklow Head northward, overlapping with the array area, offshore ECC and the western sections of the sedimentary and noise ZoIs (Figure 9). The analysis by Ellis *et al.* (2010, 2012) indicates high intensity spawning grounds within the northern parts of the study area, including the Kish Bank (Figure 9), and this is confirmed by Cefas (2000) (Figure 11). During spawning pelagic eggs are released in batches and females are likely to produce several batches of eggs during each spawning season (Rijnsdorp, 1989).

3.2.46 Several of the individuals collected on Kish and Bray Banks during the site-specific trawl survey (Aquafact, 2019) were juveniles, suggesting that the area provides a nursery for juvenile plaice. A low intensity nursery ground overlapping the study area is identified by Ellis *et al.* (2010), while Coull *et al.* (1998) shows nursery grounds overlapping with the northern part of the study area (Figure 10). Beam trawl surveys conducted across the Kish, Arklow and Blackwater sandbanks in August 2007 also recorded high numbers of juvenile plaice at Kish Bank, in particular small juveniles; 99% of individuals caught were less than 25 cm long, of which the majority was <15 cm (Atalah *et al.*, 2013).




Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)
Spawning Grounds (Coull *et al.*, 1998)
Plaice
Spawning Grounds (Intensity) (Ellis *et al.*, 2010)
Plaice, Low Intensity
Plaice, High Intensity

DRAWING STATUS

**FINAL**

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Plaice Spawning Grounds (Coull *et al.*, 1998; Ellis *et al.*, 2010)**

DRAWING NUMBER: 9

PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 5.5 11 16.5 22 km
0 3 6 9 12 nm

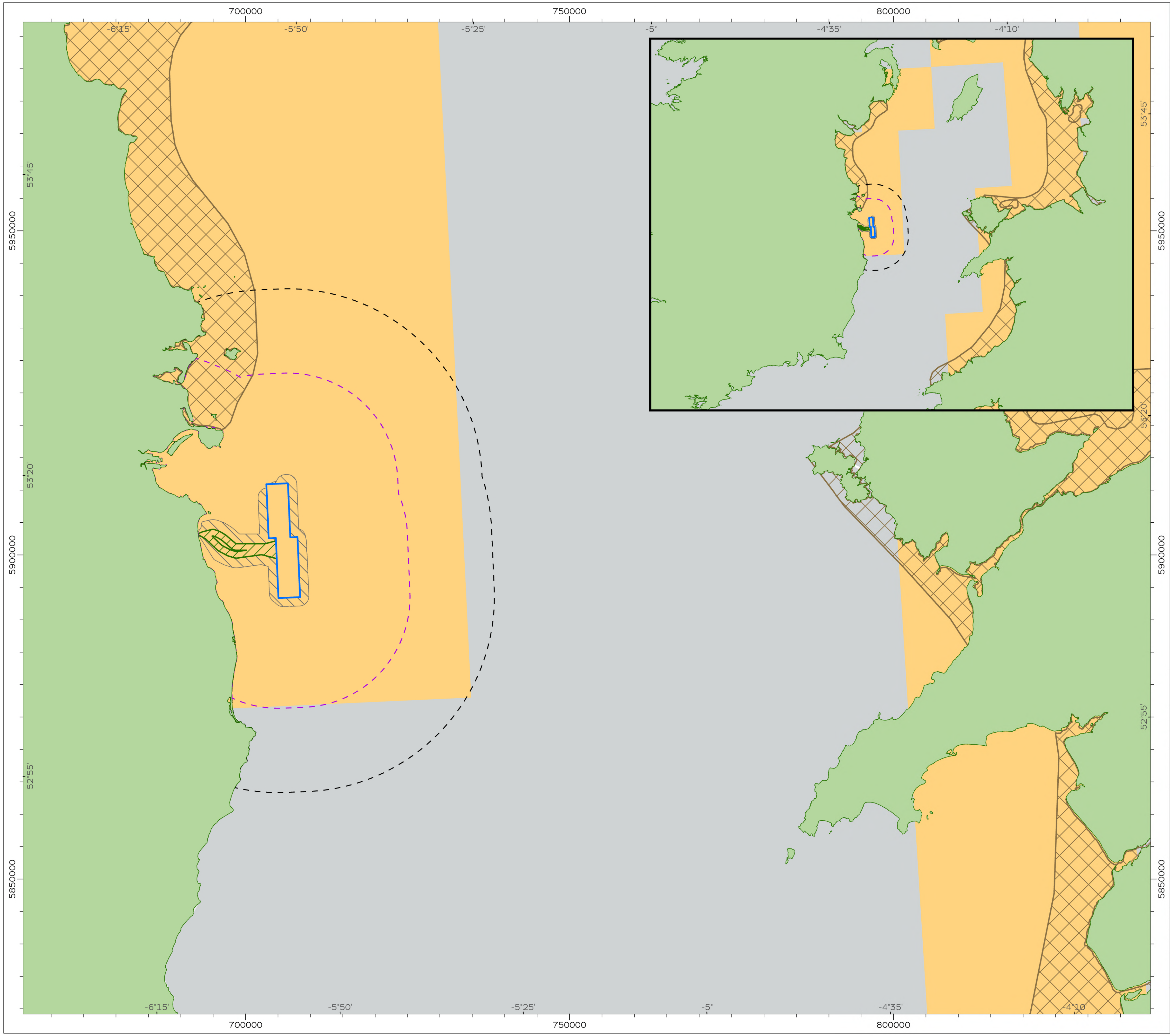
N GRID NORTH

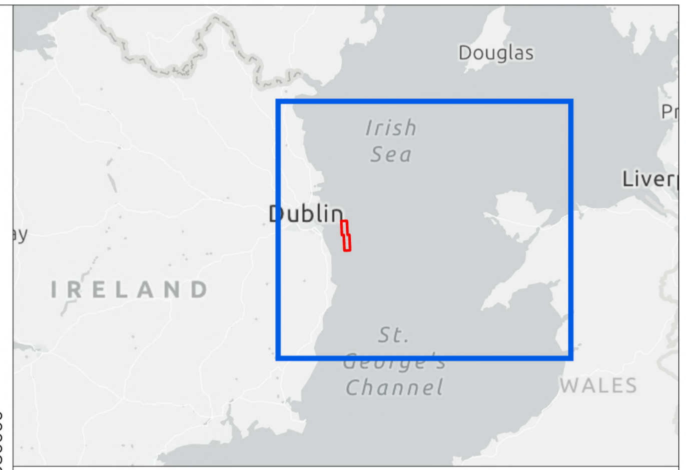
| SCALE | 1:600,000 | PLOT SIZE | A3 |
|---|---|---|---|
| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited




Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)
Nursery Grounds (Coull *et al.*, 1998)
Plaice
Nursery Grounds (Intensity) (Ellis *et al.*, 2010)
Plaice, Low Intensity

DRAWING STATUS
**FINAL**

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PROJECT TITLE
**Dublin Array**

DRAWING TITLE
**Plaice Nursery Grounds (Coull *et al.*, 1998; Ellis *et al.*, 2010)**

DRAWING NUMBER: **10**
PAGE NUMBER: **1 of 1**

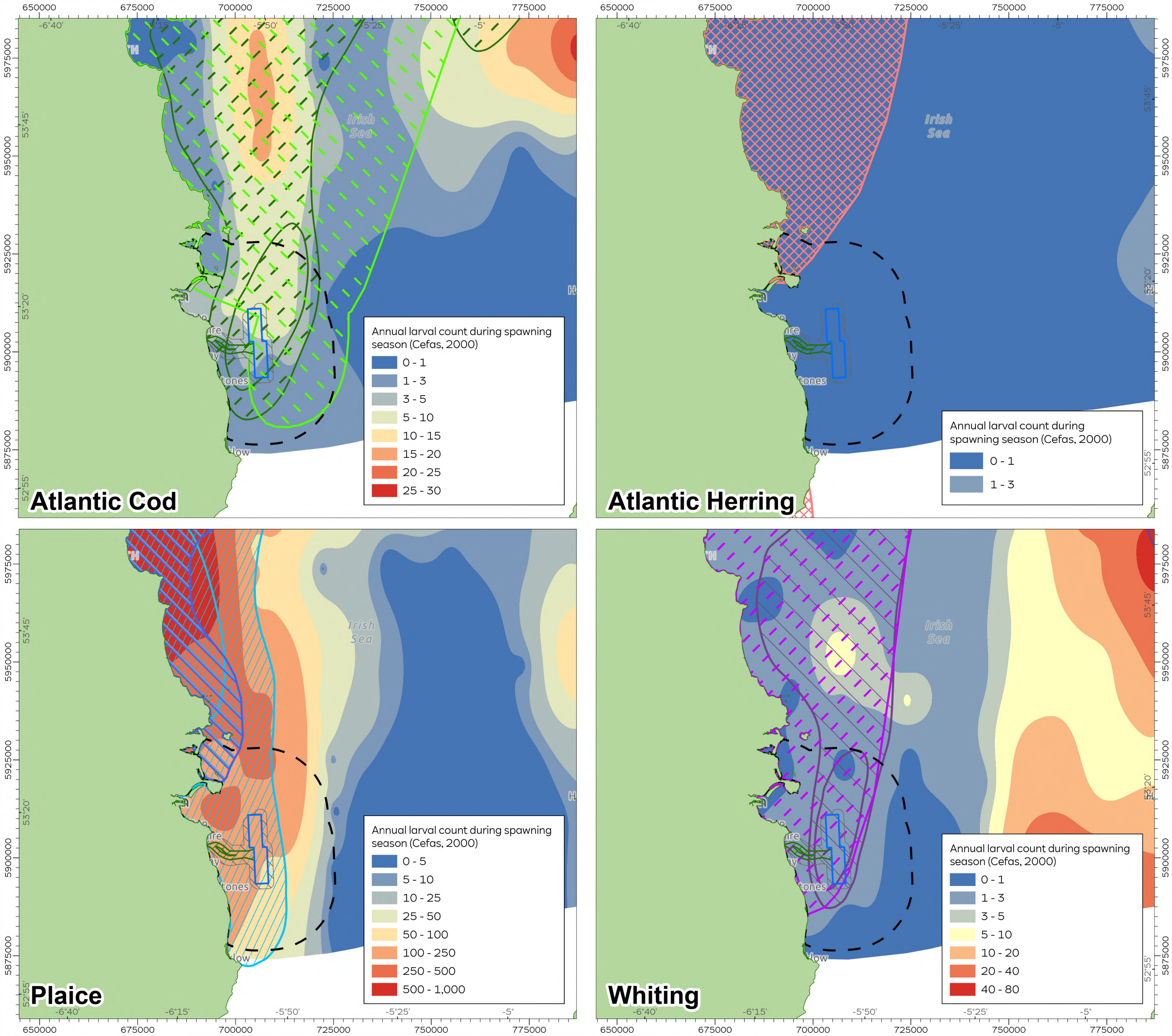
| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 5 10 15 20 km
0 2.5 5 7.5 10 nm

N
GRID NORTH

| SCALE | 1:600,000 | 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





Array Area
Temporary Occupation Area
Export Cable Corridor
Sedimentary ZoI (17km Buffer)

Spawning Grounds (Species) (Coull *et al.*, 1998)

Atlantic Cod
Plaice
Whiting

Nursery Grounds (Species) (Coull *et al.*, 1998)

Atlantic Cod
Atlantic Herring
Plaice
Whiting

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Data Source: Cefas; DOI: http://doi.org/10.14466/CefasDataHub.31

PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Larval Data for Atlantic Cod, Atlantic Herring, Plaice and Whiting (Cefas, 2000) with Spawning and Nursery Grounds (Coull *et al.*, 1998)**

DRAWING NUMBER: 11

PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 9 18 27 36 km
0 5.5 11 16.5 22 nm

N
GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:1,000,000 | 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

## American plaice

3.2.47 The American plaice (*Hippoglossoides platessoides*), also known as long rough dab, is a right-eye flatfish that is widely distributed on soft substratum throughout the eastern and western North Atlantic and adjacent Arctic oceans (Cadrin *et al.*, 2022a; Froese and Pauly, 2023). It has been recorded from the shallows down to water depths of up to 3000 m, being most abundant in shallow waters between 10-400 m water depth (Cadrin *et al.*, 2022a). Batch spawning of pelagic gametes takes place near the seabed (Froese and Pauly, 2023).

3.2.48 The American plaice is currently classed as Endangered on the global IUCN Red List (Cadrin *et al.*, 2022a) and as of Least Concern on the European Red List (Monroe *et al.*, 2015a). It is not commercially targeted by the fishing industry in European waters but may be retained as bycatch (Cadrin *et al.*, 2022a).

3.2.49 The western Irish Sea is considered to be an important habitat for American plaice (MPA Advisory Group, 2023). Analysis of IBTS data by the MPA Area Advisory Group (2023) indicate high densities of American plaice in the north-western Irish Sea outside the study area and low densities within the array area and offshore ECC. The site-specific surveys did not record American plaice.

## Witch flounder

3.2.50 The witch flounder, also known as grey sole, is a long-lived, late-maturing, right-eye flatfish, which is widely distributed throughout the eastern and western North Atlantic and adjacent Arctic Ocean from the shallows down to depth of up to 1600 m. Adults are most abundant on the continental shelves and upper continental slopes at depths between about 45-500 m, where they occur on fine substratum including muds and muddy sands. Juveniles are reported to inhabit different depths bands than adult flounders, generally preferring deeper waters (Cadrin *et al.*, 2022b; Cargnelli *et al.*, 1999).

3.2.51 Witch flounder in the western North Atlantic are known to form dense spawning aggregations in colder offshore waters (Cargnelli *et al.*, 1999). Spawning takes place at or near the seabed from March to November, with the exact spawning period depending on geographic location (Cargnelli *et al.*, 1999). The pelagic larval stage can last up to one year (Cadrin *et al.*, 2022b).

3.2.52 Witch flounder is currently classed as Vulnerable on the global IUCN Red List (Cadrin *et al.*, 2022b), but listed as of Least concern on the European Red List (Monroe *et al.*, 2015b). It is not commercially targeted by the fishing industry operating in Irish waters, but it may be retained as bycatch in nephrops and other demersal trawl fisheries (MPA Advisory Group, 2023). No witch flounders were recorded across and adjacent to the Kish and Bray Banks during the site-specific trawl survey (Aquafact, 2019), with an earlier site-specific dredge survey (Ecoserve, 2008) recording the species at one site east of Bray Bank. The species is also only occasionally recorded within the study area during IBTS groundfish surveys (ICES, 2023a,b).

## Common dab

3.2.53 Common dab is a widely distributed flatfish, occurring all round Ireland and Britain. Dab were recorded within the array area (Aquafact, 2019) and in a broader context were recorded in high abundances across the wider study area and western Irish sea (ICES, 2023a,b).

3.2.54 The site-specific trawl survey (Aquafact, 2019) recorded a number of individuals being juveniles and noted the potential for dab nursery grounds across the array area. High occurrences of juvenile dab, in particular of individuals < 15 cm, were also recorded by Atalah *et al.* (2013) over the Kish Bank, supporting the view that the array area overlaps with important dab nursery grounds.

## Common sole

3.2.55 Common sole, also known as black sole or Dover sole, is a demersal flatfish occurring on sandy and muddy sediments (Marine Institute, 2023). Spawning occurs in spring and early summer (Coull *et al.*, 1998; Nichols *et al.*, 1993). The planktonic larvae remain in shallow inshore nursery areas such as estuaries, tidal inlets and shallow sandy bays, moving to join the spawning adult population in deeper waters at two to three years old (Cuveliers *et al.*, 2011; Savina *et al.*, 2010). The juveniles can undertake extensive migrations, although once they reach maturity, they will only carry out seasonal migrations from deeper water to shallower spawning habitats. Data on the distribution of sole nursery grounds within the western Irish Sea are limited; the analysis by Coull *et al.* (1998) indicate that sole spawning grounds are mainly located in the shallow waters of the eastern Irish Sea from Dublin Bay to Dundalk Bay, partly overlapping with the study area (Figure 12). By contrast, Ellis *et al.* (2010, 2012) identified low intensity spawning grounds extending across the majority of the western and central Irish Sea (). Groundfish surveys have recorded juveniles across mapped spawning areas (Ellis *et al.*, 2012), indicating the presence of nursery grounds within the shallower inshore waters of the study area. Sole were not recorded in site-specific surveys, but their presence within the study area is confirmed through records from ICES groundfish surveys (ICES, 2023a,b).

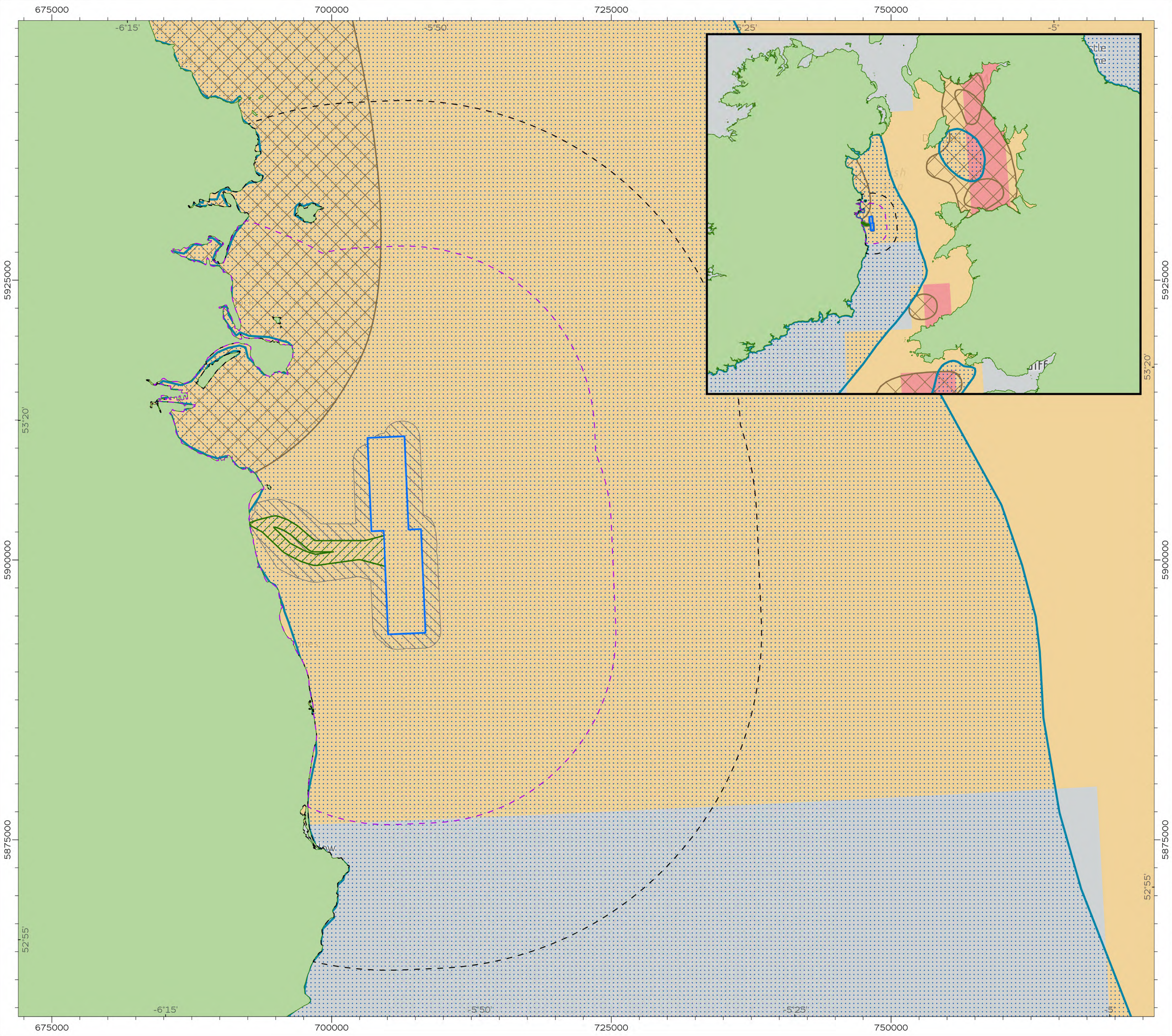
3.2.56 Sole landings from the Irish Sea mainly result from bycatch in mixed fisheries targeting rays and plaice in the St. Georges Channel, and to a lesser extent in the nephrops fishery (Marine Institute, 2023). Most landings are from beam trawlers; however, an increasing proportion of landings are from otter trawl fleets (Marine Institute, 2023). Recent biomass estimates suggest that the Irish Sea stock is currently below levels required to support the maximum sustainable yield, following low recruitment and increasing fishing mortality (Marine Institute, 2023).

## Lemon sole

3.2.57 Lemon sole are found throughout the shelf waters from the Barents Sea to the Bay of Biscay, typically at depth of 50-200 m, though the species has been recorded down to about 1,100 m water depth (Geffen *et al.*, 2021). The species is widely distributed in the Irish Sea and into the Celtic Sea and throughout UK waters, particularly the western English Channel and the western approaches.

3.2.58 Lemon sole are present across the study area, having been recorded in site-specific trawls (Aquafact, 2019) and dredges (Ecoserve, 2008), and on a broader scale were regularly recorded within the study area and wider western Irish Sea during ICES groundfish surveys (ICES, 2023a,b). Data from groundfish surveys in the English Channel suggest that, unlike plaice and sole, lemon sole prefer sandy and gravelly sand substrata in deeper waters (Hinz *et al.*, 2006).

3.2.59 Spawning primarily takes place between April and September (Coull *et al.*, 1998), although evidence exists of spawning through the winter months (Geffen *et al.*, 2021). The study area overlaps with lemon sole spawning (Figure 12) and nursery (Figure 13) grounds, which are likely to extend along the entire east coast of the Irish Sea (Coull *et al.*, 1998).





Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (25km)
Sedimentary ZoI (17km)

Spawning Grounds (Coull *et al.*, 1998)
Lemon Sole
Sole

Spawning Grounds (Intensity) (Ellis *et al.*, 2010)
Sole, Low Intensity
Sole, High Intensity

DRAWING STATUS
**FINAL**



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PROJECT TITLE
**Dublin Array**

DRAWING TITLE
**Sole and Lemon Sole Spawning Grounds (Coull *et al.*, 1998; Ellis *et al.*, 2010)**

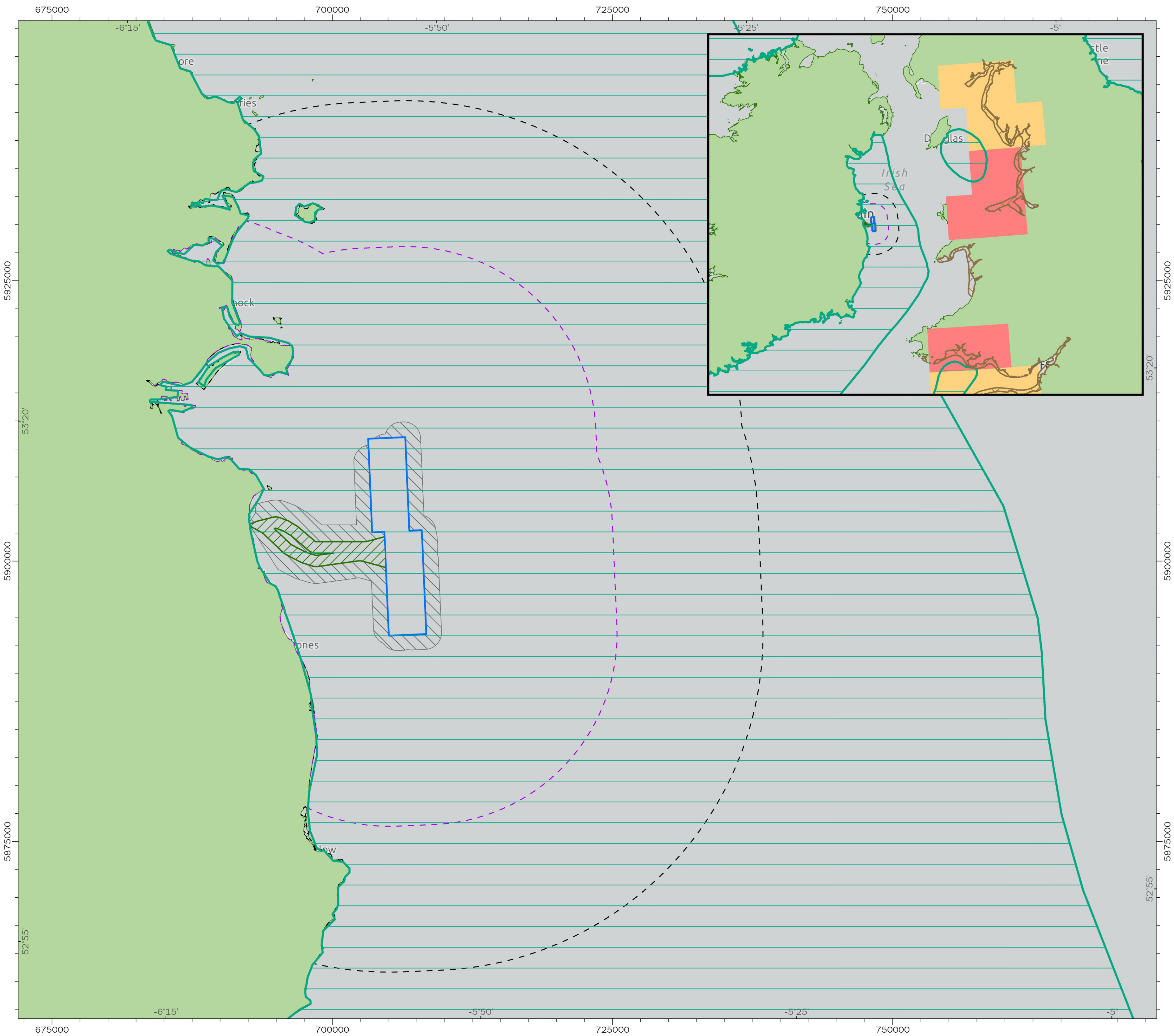
DRAWING NUMBER: 12


| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 3 6 9 12 km
0 1.5 3 4.5 6 nm
N GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:350,000 | 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





Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)
Nursery Grounds (Coull *et al.*, 1998)
Lemon Sole
Sole
Nursery Grounds (Intensity) (Ellis *et al.*, 2010)
Sole, Low Intensity
Sole, High Intensity

DRAWING STATUS

**FINAL**

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Sole and Lemon Sole Nursery Grounds (Coull *et al.*, 1998; Ellis *et al.*, 2010)**

DRAWING NUMBER: 13

PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 3 6 9 12 km

0 1.5 3 4.5 6 nm

N

| SCALE | 1:350,000 | 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

## Hake

3.2.60 Hake are found from the north-west African coast northwards to the Bay of Biscay, further north into Irish, Scottish, and Norwegian Sea waters, and throughout most of the North Sea (Murua, 2010). Hake typically inhabits a water depth of 70-350 m (Barnes, 2008) although has been recorded at 550 m (Maitland and Herdson, 2010). Hake can be found throughout the Irish Sea, preferring muddy and rocky habitats (Maitland and Herdson, 2010).

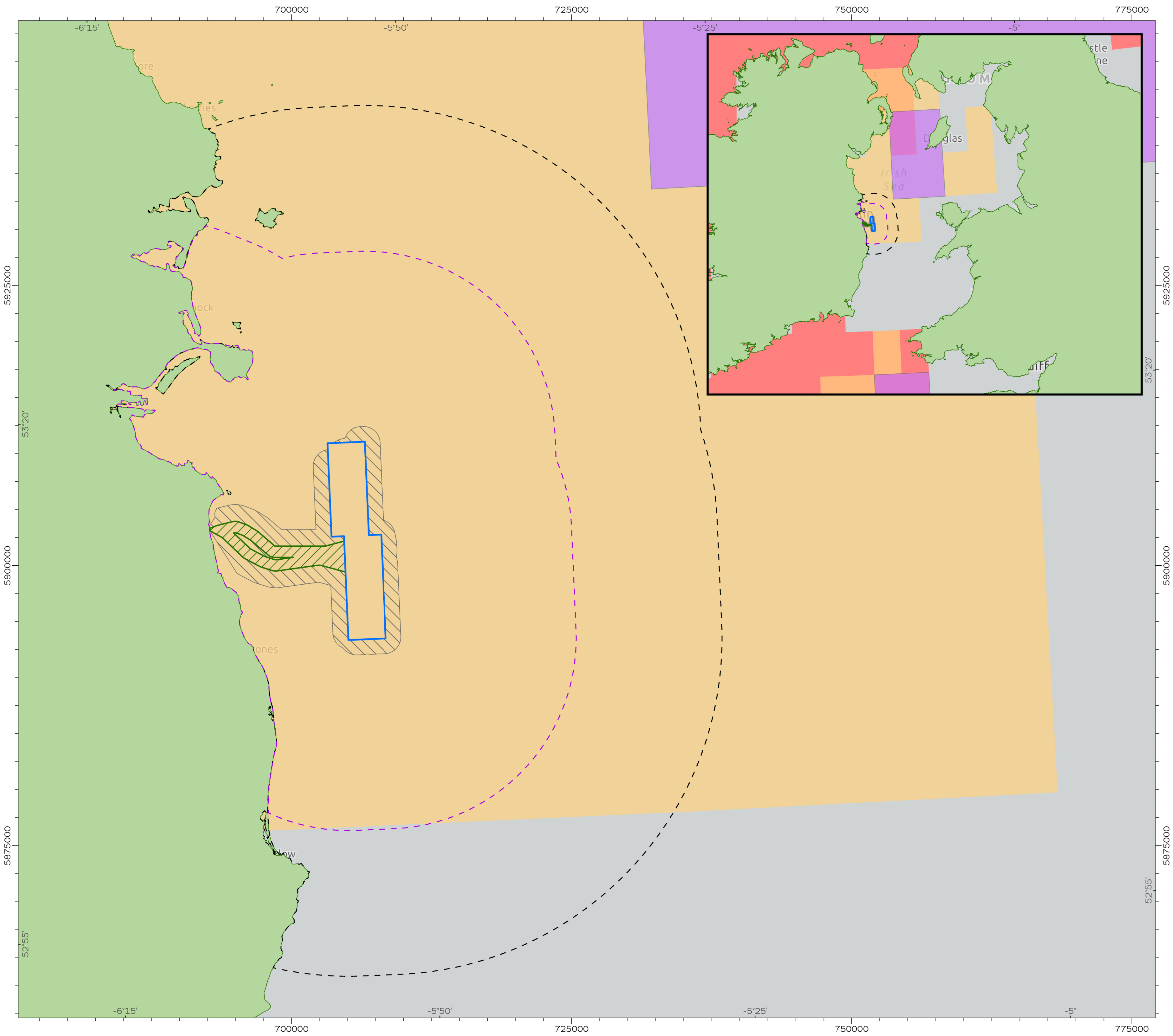
3.2.61 Spawning primarily takes place between February and July (Maitland and Herdson, 2010). The study area does not overlap with hake spawning or nursery grounds, although there is an area of low intensity spawning approximately 5 km to the north-east of the Underwater Noise ZoI (Figure 14; Ellis *et al.*, 2010). The two major spawning areas for hake are the Bay of Biscay and off southern Ireland (Maitland and Herdson, 2010).

3.2.62 Hake stock size is decreasing (Marine Institute, 2023), in part due to discards of juveniles (Maitland and Herdson, 2010). Most Irish trawlers do not target hake but take them as a bycatch in mixed fisheries with anglerfish, megrim, haddock and whiting (Marine Institute, 2023). Hake are of Least Concern on the European Red List (Fernandes *et al.*, 2016).

## Ling

3.2.63 Ling are widely recorded around the British Isles, mainly off the south and west coasts of England, Ireland and west Scotland (Rowley, 2008). Ling is a deep-water species, found at depths of up to 600 m, but can be found in waters as shallow as 10 m (Rowley, 2008), typically inhabiting areas with rocks, crevices and wrecks in deep water (Rowley, 2008).

3.2.64 Spawning primarily takes place between March and August (Rowley, 2008). The majority of the study area overlaps with the low intensity spawning grounds of ling (Figure 14; Ellis *et al.*, 2010).





- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)

Spawning Grounds (Intensity) (Ellis *et al.*, 2010)

- Hake, Low Intensity
- Ling, Low Intensity

Nursery Grounds (Intensity) (Ellis *et al.*, 2010)

- Hake, Low Intensity

DRAWING STATUS

**FINAL**

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Hake and Ling Spawning Grounds and Hake Nursery Grounds (Ellis *et al.*, 2010)**

DRAWING NUMBER: **14**



| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 3 6 9 12 km

0 1.5 3 4.5 6 nm

N GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:350,000 | PLOT SIZE | A3 |
| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

GoBe APEM Group

Dublin Array Generation for generations

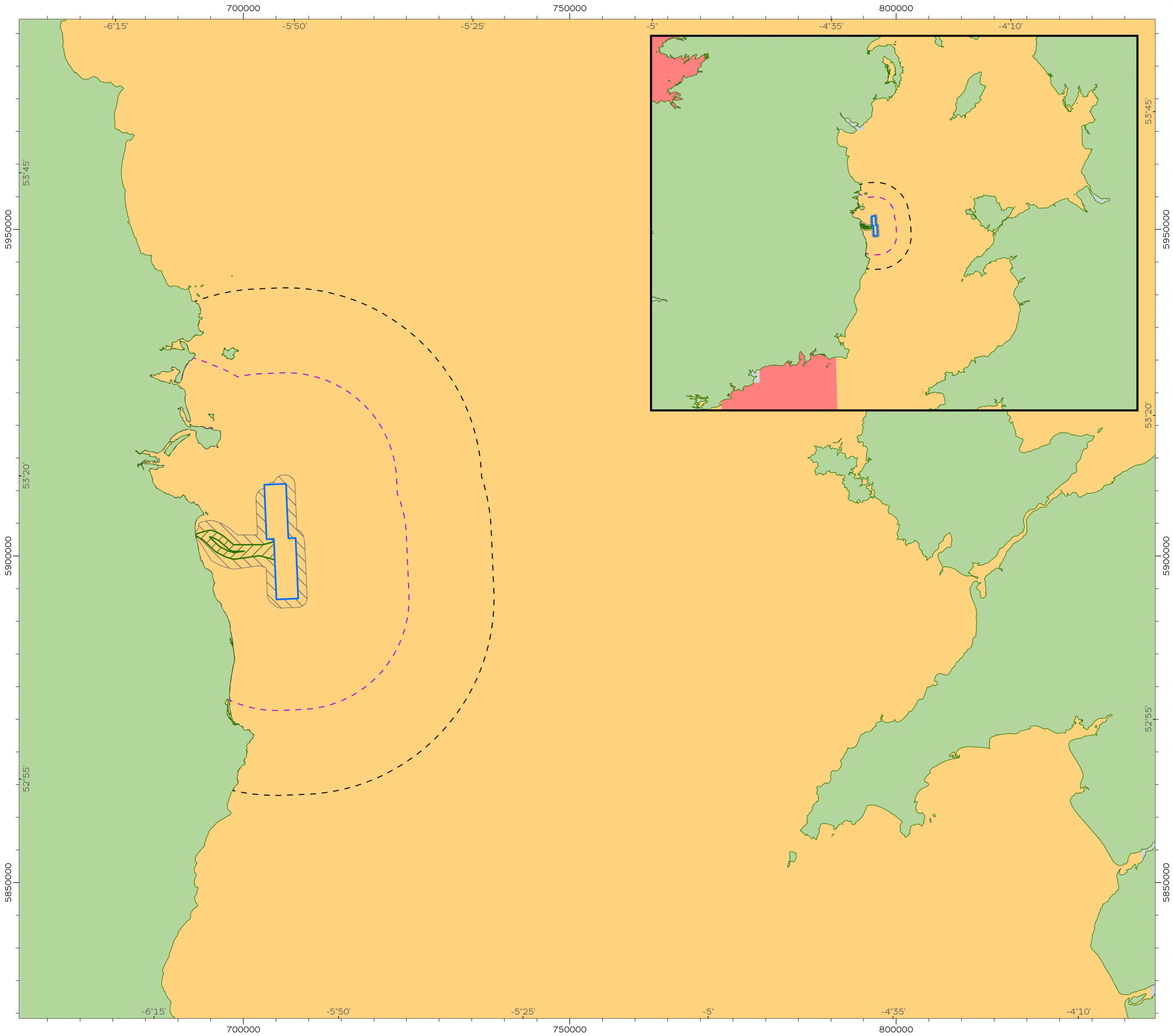
Kish Offshore Wind Limited - Bray Offshore Wind Limited

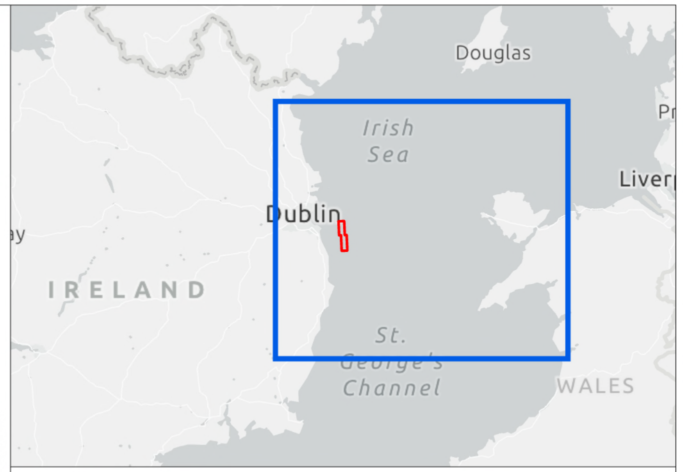
## Anglerfish

3.2.65 Two closely related species of anglerfish are known to occur in Irish waters, the white anglerfish (*Lophius piscatorius*) and the black anglerfish (*L. budegassa*). Fisheries catch data indicate that anglerfish in the Irish Sea are mainly white anglerfish (Marine Institute, 2023).

3.2.66 Anglerfish are demersal species, with white anglerfish being most abundant at water depths of 200-800 m, though they have also been recorded in shallow coastal waters (Marine Institute, 2023; Whitehead *et al.*, 1986), including the study area (Aquafact, 2019; ICES, 2023a,b). They are found mostly on sandy or muddy bottoms but are also present on shell, gravel and occasionally rocky areas. Anglerfish are known to migrate hundreds of kilometres. There are limited data on the spawning behaviour of white anglerfish, but it is hypothesised that they spawn in deeper waters along the edge of the continental slope (reviewed in Ellis *et al.*, 2012). Their planktonic eggs and larvae spent up to four months in the water column, allowing them to be dispersed over large areas (Marine Institute, 2023). Records of juveniles suggest the presence of low intensity nursery ground within the Irish Sea including the study area (Figure 15; Ellis *et al.*, 2010, 2012).

3.2.67 Anglerfish are of commercial importance, a highly valuable demersal fish species, caught almost exclusively by demersal otter trawls. ICES stock assessments for white anglerfish indicate that the stock is currently fished sustainably, with fishing mortality currently below the $F_{MSY}$ threshold for achieving the Maximum Sustainable Yield; the stock size increased since 2004, peaked in 2020, and has been fluctuating around the 2020 stock size since (Marine Institute, 2023). Much of the Irish anglerfish landings come from highly mixed fisheries, where they are caught together with megrim, nephrops, haddock, hake and other species (Marine Institute, 2023). Catches in the Irish Sea are relatively low compared to catches from the Celtic Seas and West of Ireland.




- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)

Nursery Grounds (Intensity) (Ellis *et al.*, 2010)

- Anglerfish, Low Intensity
- Anglerfish, High Intensity

DRAWING STATUS

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Anglerfish Nursery Grounds (Ellis *et al.*, 2010)**

DRAWING NUMBER: **15**

PAGE NUMBER: **1 of 1**

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 5 10 15 20 km
0 3 5 8 10 nm

N
GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:600,000 | PLOT SIZE | A3 |
| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

GoBe APEM Group

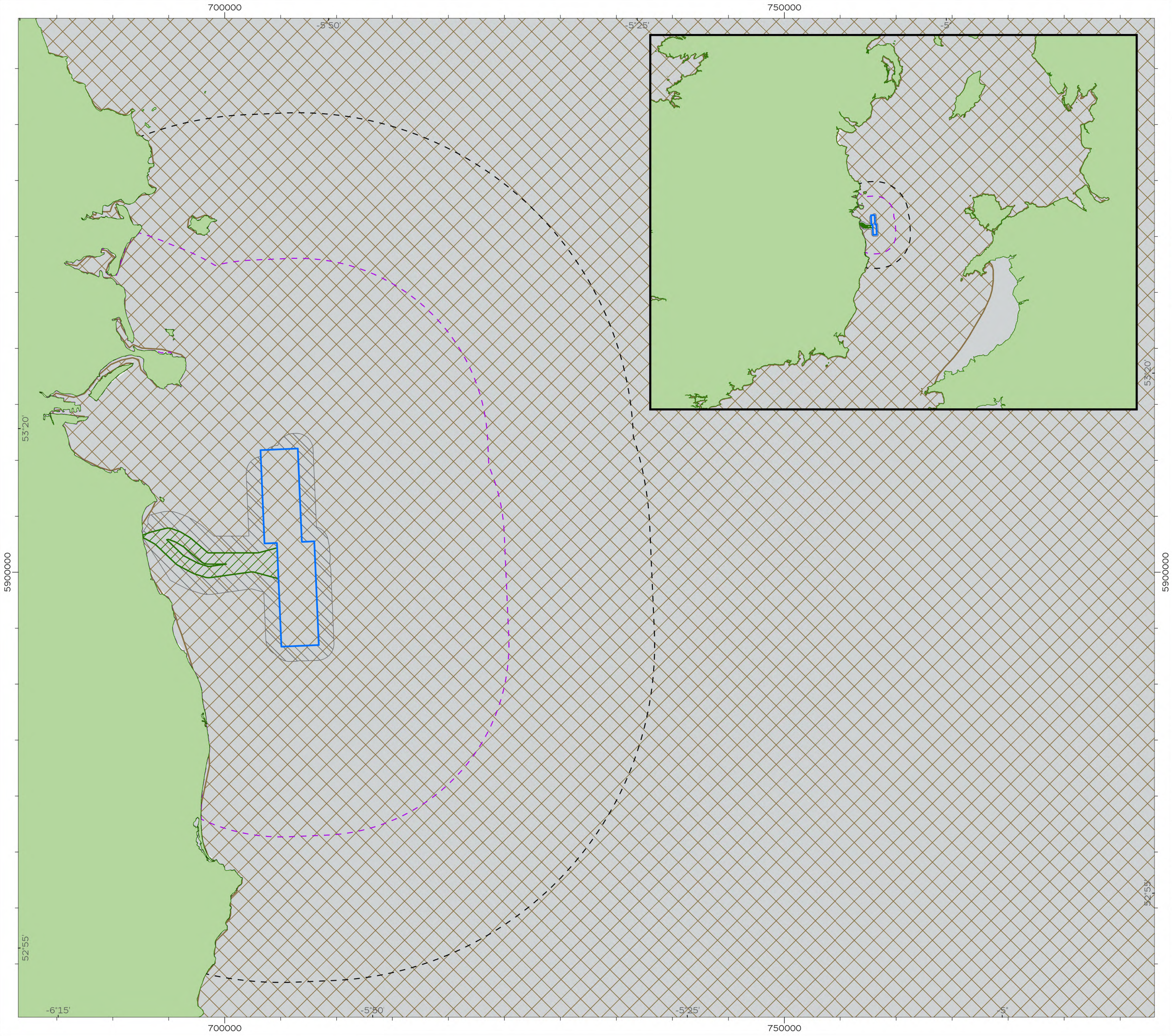
Dublin Array Generation for generations

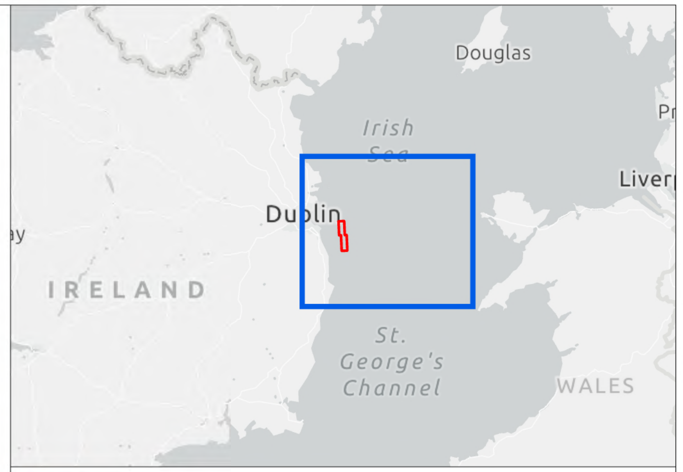
Kish Offshore Wind Limited - Bray Offshore Wind Limited

## Sprat

3.2.68 Sprat is a widely distributed, pelagic schooling species found from Morocco to the south of Norway, with sprat in the Celtic Seas (including the Irish Sea) considered to belong to a single stock (Marine Institute, 2023). Sprat are often found in inshore waters including shallow bays such as Dublin Bay, with juveniles sometime recorded in estuaries (IFI, 2008a; IFI, 2010b; Marine Institute, 2023). They are an important prey resource for a number of marine mammals, sea birds, and piscivorous fish including mackerel, whiting, cod and horse mackerel, in particular in inshore waters (ICES, 2023e).

3.2.69 Sprat are known to migrate seasonally between winter-feeding and summer spawning grounds (Marine Institute, 2023). They do not show homing behaviour (Marine Institute, 2023), and spawning grounds for sprat are extensive, covering both coastal and offshore waters around the UK and Ireland (Figure 16; Coull *et al.*, 1998). Spawning takes places between May to August, with peak spawning occurring between May and June (Coull *et al.*, 1998; ICES, 2023e). Information on the movement patterns of juvenile sprat in the Irish Sea is limited, with nursery areas assumed to overlap with the study area.




Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)
Spawning Grounds (Coull *et al.*, 1998)
Sprat

DRAWING STATUS
**FINAL**

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PROJECT TITLE
**Dublin Array**

DRAWING TITLE
**Sprat Spawning Grounds (Coull *et al.*, 1998)**

DRAWING NUMBER: **16**
PAGE NUMBER: **1 of 1**

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 3 6 9 12 km
0 2 3 5 6 nm

N
GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:350,000 | 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

## Atlantic mackerel

3.2.70 Atlantic mackerel are epi-pelagic and meso-demersal fish found throughout the cold and temperate waters of the North Atlantic Ocean (Collette and Nauen, 1983). They move in dense shoals near the surface and are known to undertake extensive seasonal migrations from their spawning locations in the south to feeding and wintering areas in the north (Iversen, 2002). The diet of mackerel consists mainly of zooplankton (e.g., copepods) and small fish and squids (e.g., Collette and Nauen, 1983; Kvaavik *et al.*, 2019).

3.2.71 Mackerel were recorded within the array area during site-specific trawls (Aquafact, 2019) and are also present within the wider study area (ICES, 2023a). Neither the Marine Institute data nor Coull *et al.* (1998) identify any spawning grounds for mackerel in the Irish Sea, with the main grounds located to the west of Ireland and within the North Sea, consistent with the findings of the 'International mackerel and horse mackerel egg surveys' (e.g., ICES, 2023f). Ellis *et al.* (2010) mapped low intensity mackerel spawning grounds that extend into the north and central Irish Sea, overlapping with the study area (Figure 17), whilst also acknowledging that the primary grounds are located on the continental shelf to the west of Ireland, consistent with the other data sources.

3.2.72 Off the west coast of Ireland, spawning takes place between February and July (Iversen, 2002; Marine Institute, 2023). After spawning, adults disperse and migrate to overwintering areas in cooler, deeper waters (Collette and Nauen, 1983), before migrating back during late winter towards their spawning grounds (Uriarte *et al.*, 2001).

3.2.73 Juvenile mackerel are known to grow rapidly, reaching 30 cm in length after two years, at which point more than half are mature (Marine Institute, 2023). The Marine Institute data show extensive mackerel nursery grounds that extend across Irish waters including the Irish Sea (Figure 18). Ellis *et al*. (2010) also identified low intensity nursery grounds across the northern Irish Sea, which overlap with the northern edge of the study area (Figure 18).

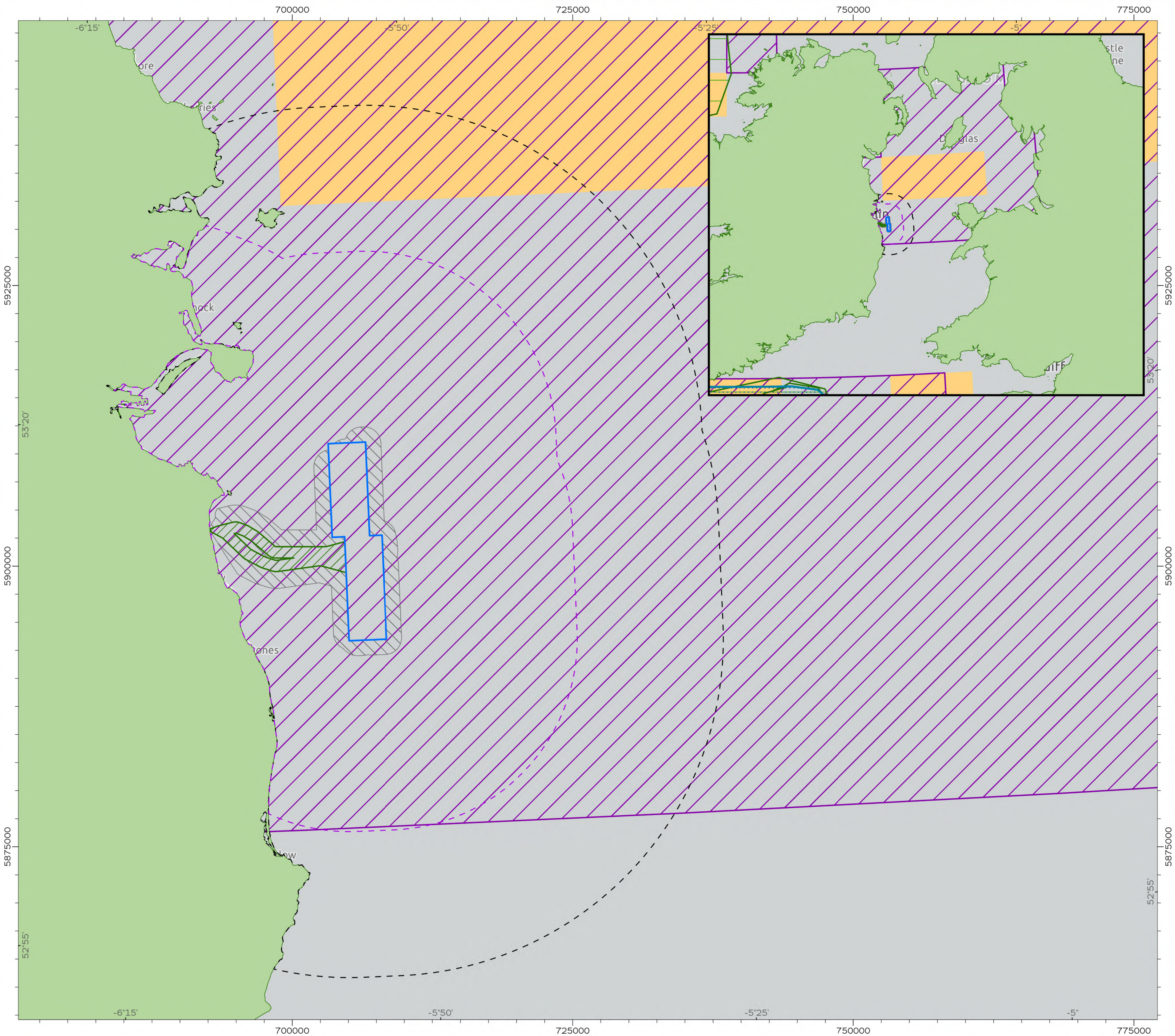
3.2.74 Atlantic mackerel in the Irish Sea are part of the north-east Atlantic stock, which is considered to form a single spawning population (Marine Institute, 2023). The biomass of the stock has been decreasing since 2015, although it remains above the biomass threshold that would trigger amendments to management measures (Marine Institute, 2023).

## Atlantic horse mackerel

3.2.75 Horse mackerel, also referred to as common scad, are pelagic fish that form dense shoals and undergo extensive migration between spawning, feeding and overwintering grounds (Marine Institute, 2023). They are commonly caught in both pelagic and bottom trawl surveys, suggesting they spend some time near the seabed (Marine Institute, 2023). Horse mackerel were recorded across the array area (Aquafact, 2019) and wider study area (ICES, 2023a). These individuals belong to the western horse mackerel stock, which is found from the Bay of Biscay to Norway (Campanella and van der Kooij, 2021).

3.2.76 Horse mackerel eggs surveyed as part of the 'International mackerel and horse mackerel egg surveys' every three years identified the outer continental shelf to the west of Ireland as an important spawning area for the species (e.g., ICES, 2023f). Spawning takes place from December until September, with peak spawning occurring in May/June (Campanella and van der Kooij, 2021). Ellis *et al.* (2010) identified a band of low intensity spawning across the central Irish Sea, overlapping with the northern section of the underwater noise ZoI (Figure 17). Ellis *et al.* (2010) also confirmed juvenile horse mackerel were recorded in a variety of surveys and were distributed widely around the Irish and UK waters. There was no evidence for spatially defined nursery grounds, and so no data layers were provided. Similarly, the Marine Institute (Marine Institute, 2016) identifies nursery grounds across the extent of Irish waters (Figure 18).

3.2.77 Stock levels of Atlantic horse mackerel in Irish waters and the wider north-east Atlantic have been low since the early 2000s, with the current SSB remaining below levels required to support a sustainable fishery (Marine Institute, 2023). Therefore, no direct fishery for Atlantic horse mackerel is currently permitted.





- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)

Spawning Grounds (Intensity) (Ellis *et al.*, 2010)

- Horse Mackerel, Low Intensity
- Mackerel, Low Intensity

Spawning Grounds (Marine Institute, 2016)

- Mackerel
- Horse Mackerel

DRAWING STATUS

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Mackerel and Horse Mackerel Spawning Grounds (Ellis *et al.*, 2010; Marine Institute, 2016)**

DRAWING NUMBER: 17

PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

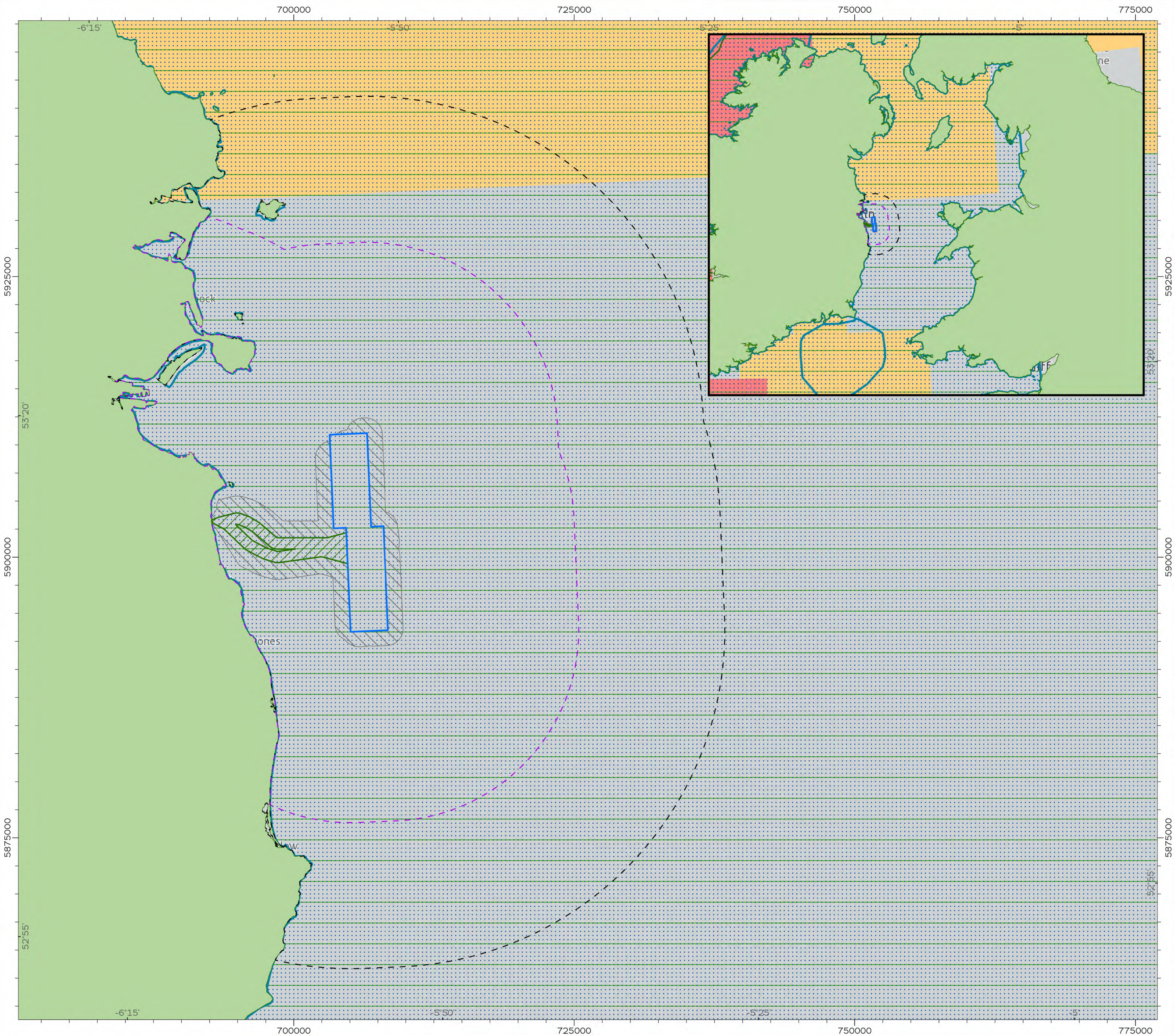
0 3 6 9 12 km
0 1.5 3 4.5 6 nm

N GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:350,000 | 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





Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)

Nursery Grounds (Intensity) (Ellis *et al.*, 2010)

Mackerel, Low Intensity
Mackerel, High Intensity

Nursery Grounds (Marine Institute, 2016)

Horse Mackerel
Mackerel

DRAWING STATUS

**FINAL**



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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Mackerel and Horse Mackerel Nursery Grounds (Ellis *et al.*, 2010; Marine Institute, 2016)**

DRAWING NUMBER: **18**

PAGE NUMBER: **1 of 1**

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 3 6 9 12 km

0 1.5 3 4.5 6 nm

N GRID NORTH

| SCALE | 1:350,000 | 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

## Prey species and food webs

3.2.79 Several of the fish and shellfish species present in the study area are important prey items for top marine predators including elasmobranchs, piscivorous fish, seabirds, and marine mammals (e.g., Cummins *et al.*, 2019; Hernandez-Milian *et al.*, 2015). Small planktivorous species such as sandeel, sprat and herring act as important link between zooplankton and top predators (Frederiksen *et al.*, 2006). Sandeels, for example, constitute an important food source for sea birds, such as tern, puffins, kittiwakes and razorbills. They are also preyed upon by marine mammals, such as seals and harbour porpoise, piscivorous fish, such as herring, cod, whiting, and sea trout. Other fish species important in the diet of marine mammals include whiting, mackerel and various clupeoids (e.g., Hernandez-Milian *et al.*, 2015).

# 3.3 Elasmobranch ecology

3.3.1 Elasmobranchs are cartilaginous fish and include sharks, skates and rays. Elasmobranchs are of interest when considering the effects of offshore wind farm development since many species are of conservation value. In addition, elasmobranchs are considered to be sensitive to EMF effects that might result from the operation of subsea cables since their sensory systems can detect and use EMFs in navigation and hunting (Gill and Desender, 2020).

3.3.2 The elasmobranch assemblages sampled over the Kish and Bray Banks as part of the 2019 site-specific otter trawl survey (Aquafact, 2019) were dominated by lesser-spotted dogfish (*Scyliorhinus canicula*), also known as small-spotted catshark, with starry smooth-hound (*Mustelus asterias*), thornback ray (*Raja clavata*), blonde ray (*Raja brachyura*), and spotted ray also regularly recorded. Less regularly recorded elasmobranchs were tope (*Galeorhinus galeus*), nursehound (*Scyliorhinus stellaris*), and cuckoo ray (*Leucoraja naevus*). Site-specific trawls undertaken across the array area during the 2002 baseline survey (Saorgus Energy Limited, 2012) recorded relatively high abundances of thornback ray. Thornback ray were also 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).

3.3.3 The sites sampled within the study area as part of the annual NIGFS and BTS (ICES, 2023a,b) supported a similar suite of elasmobranch species to the species recorded during the site-specific surveys, with lesser-spotted dogfish typically being the most abundant. In addition to the species observed during the site-specific survey, these surveys also recorded spurdog (*Squalus acanthias*) at several sites within the study area.

3.3.4 Nursehound, tope, starry smooth-hound and skate species are considered to be of particular value to the local recreational angling community, with various elasmobranchs also of commercial value as well as being of conservation interest. The following sections provide summary accounts for these elasmobranch species.

# Elasmobranch species descriptions

## Lesser-spotted dogfish

3.3.5 Lesser-spotted dogfish are a small, slender, bottom-dwelling shark found in the Mediterranean Sea and the north-east and eastern central Atlantic Ocean to depths of about 800 m (Finucci *et al.*, 2021a). They are one of the most abundant elasmobranch species in the north-east Atlantic, including the Irish Sea and study area (Aquafact, 2019), and are found over a variety of substrates including sandy, gravelly and muddy bottoms and coralline algal grounds (Clarke *et al.*, 2016; Ellis *et al.*, 2005; Finucci *et al.*, 2021a). They feed mainly on crustaceans and molluscs, including whelks, scallops and razor shells (Compagno, 1984a). There is growing evidence for philopatry and sex-based differences in behaviour and habitat selection (Martin *et al.*, 2010; Sims *et al.*, 2001).

3.3.6 Lesser-spotted dogfish are oviparous, producing eggs that are deposited in thick-walled cases on macroalgae or sessile erect invertebrates such as sponges, soft corals, and bryozoans (Clarke *et al.*, 2016; Ellis *et al.*, 2005). The egg-laying period is thought to last most of the year (Compagno, 1984a), with peaks observed in summer for lesser-spotted dogfish studied in the Bristol Channel (ICES, 2022c). Data on egg-laying sites and nursery areas in the western Irish Sea are sparse; previous groundfish surveys recorded small numbers of egg cases and juveniles in ICES rectangle 37E4 (Ellis *et al.*, 2005) to the north of the study area, indicating that lesser-spotted dogfish breed within the western Irish Sea region. Egg cases are reported from algal substrates at subtidal water depths and sometimes from the lower intertidal, and the gestation period for eggs can last from 5-11 months (Campagno, 1984a).

3.3.7 The lesser-spotted dogfish is typically not targeted by fisheries, although they are taken as bycatch in mixed bottom fisheries and discarded or used as bait within trap and pot fisheries. They are known to have high discard survival rates of approximately 70% in otter trawls (Rodríguez-Cabello *et al.*, 2005).

3.3.8 Populations of lesser-spotted dogfish in the north-east Atlantic are stable or increasing (Finucci *et al.*, 2021a). Recent stock assessments by ICES based on groundfish survey data have shown an increasing trend in the size of the north-east Atlantic stock from 2004 to 2014 and annual fluctuations around higher stock levels since then (Marine Institute, 2023). The species is currently listed as of Least concern on both the IUCN Red List (Finucci *et al.*, 2021a) and the Ireland Red List (Clarke *et al.*, 2016).

## Nursehound

3.3.9 Nursehound, also known as greater-spotted dogfish or bull huss, are a medium-sized, demersal catshark found throughout the north-east Atlantic Ocean and the Mediterranean Sea (Finucci *et al.*, 2021b). The species occurs mostly in continental shelf waters between about 20-60 m water depth but has also been recorded at water depths of 1-2 m down to about 380 m (Compagno, 1984a; Finucci *et al.*, 2021b). Nursehound favour structurally complex grounds such as rocky substrates, corraline ground and seagrass beds (Clarke *et al.*, 2016; Ellis *et al.*, 2005; Finucci *et al.*, 2021b; Martin *et al.*, 2010). They mainly feed on molluscs, crustaceans and fish including mackerel, flatfish, herring, gurnards and other sharks (Compagno, 1984a).

3.3.10 Like lesser-spotted dogfish, nursehound are oviparous. Data on egg-deposition grounds and nursery areas within the Irish Sea are not available for this species, although it has been suggested that egg-cases may be primarily laid in shallow subtidal or lower intertidal waters attached to macroalgae (Compagno, 1984a; Ellis *et al.*, 2005). Eggs are released in spring and summer and the gestation period is approximately nine months (Compagno, 1984a). Like lesser-spotted dogfish, nursehound have been shown to exhibit refuging behaviour (Sims *et al.*, 2005).

3.3.11 Nursehound is a species of conservation importance, currently listed as Vulnerable on the IUCN Red List (Finucci *et al.*, 2021b), Near threatened on the European Red List (Ellis *et al.*, 2015a), and as of Least concern on the Ireland Red List (Clarke *et al.*, 2016). On a global scale, nursehound populations are thought to have declined between 30-49% over the last five decades (Finucci *et al.*, 2021b). Regional groundfish surveys in the Irish Sea and Bristol Channel show an overall increase in nursehound abundance since the early 1990s (Clarke *et al.*, 2016). This is also evident in ICES stock assessments, which have shown an increasing trend from 2000 to 2020 (Marine Institute, 2023). Nursehound were recorded in low numbers within and adjacent to the array area during site-specific trawls (Aquafact, 2019). ICES groundfish data (ICES, 2023a,b) and IFI tag and release data (MPA Advisory Group, 2023) confirm the presence of nursehound in the study area, including the offshore ECC and outer Dublin Bay. Due consideration has also been given to the species because of its importance to the angling community in the region.

## Tope

3.3.12 Tope, also known as tope shark or school shark, is a medium-sized, bentho-pelagic shark species that is found in shallow waters down to depths of up to 800 m, though it most frequently occurs to water depths of 200 m (Ebert and Stehmann, 2013; Walker *et al.*, 2020). Tope feed on a variety of prey, including small fish, crustaceans, and cephalopods (Barnes, 2008; Ebert and Stehmann, 2013).

3.3.13 Tope was recorded in low numbers within the array area during the site-specific trawl survey (Aquafact, 2019). IFI tag and recapture data also show the presence of tope within the study area including in inshore areas close to the offshore ECC and within outer Dublin Bay (MPA Advisory Group, 2023). In a broader context, tope are globally distributed in temperate waters including the eastern Atlantic, where they range from Iceland and Norway to South Africa and including the Mediterranean Sea (Walker *et al.*, 2020). Tagging data suggest that some adult tope undertake long-distance movements offshore away from the continental shelves and slopes (Walker *et al.*, 2020), while fisheries data indicate spatial differences in the distribution of male and female tope throughout their range (Walker, 1999).

3.3.14 Tope is a species of high conservation importance, being currently listed as Critically endangered on the IUCN Red List (Walker *et al.*, 2020), and as Vulnerable on the Ireland Red List (Clarke *et al.*, 2016). Tope in the Irish Sea are part of the north-east Atlantic tope population (Clarke *et al.*, 2016), which is estimated to have undergone a severe decline of over 75% over the past three generation lengths (i.e., over the past 79 years) (Walker *et al.*, 2020).

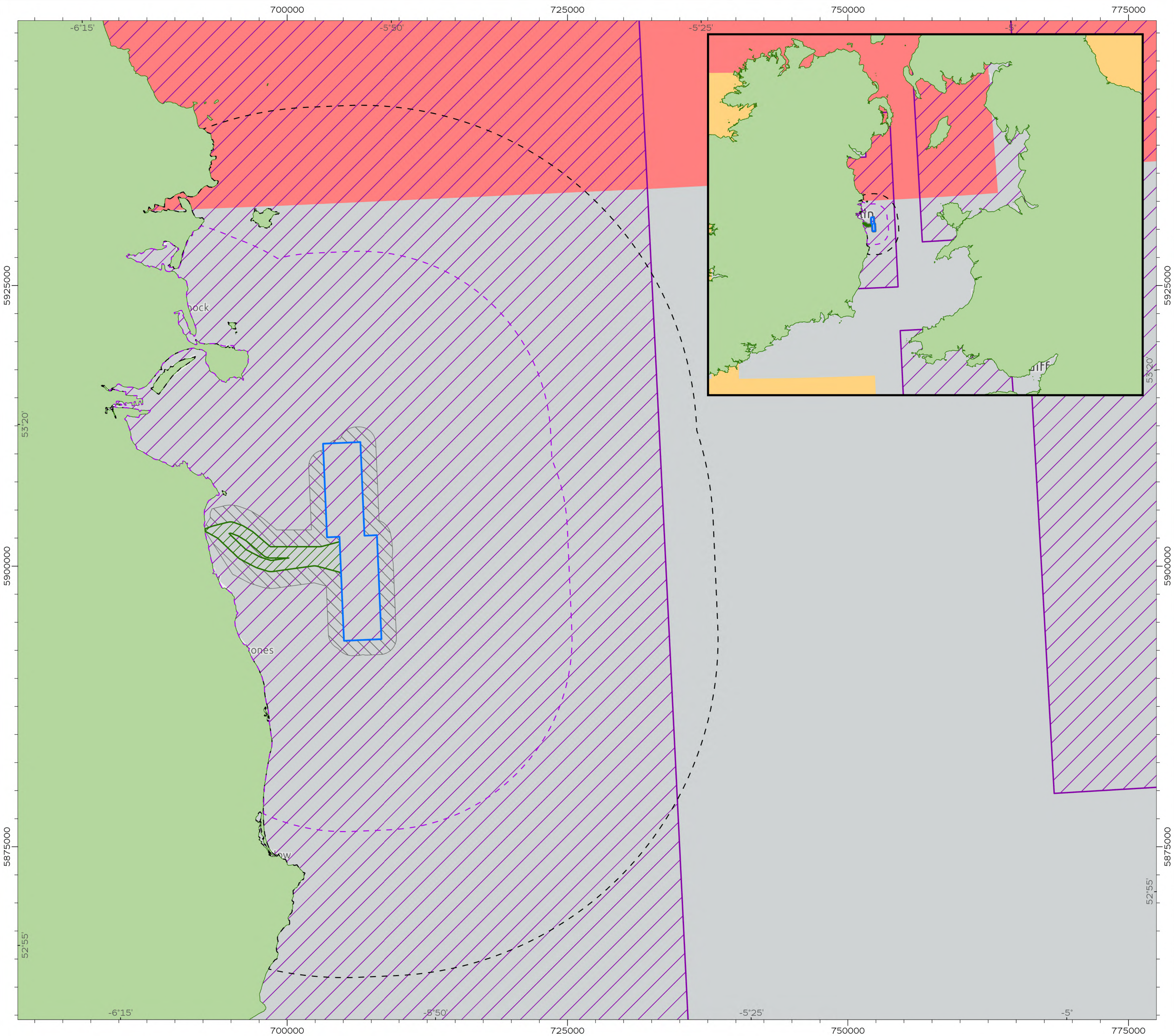
3.3.15 Tope are ovoviviparous with an average litter size of 20-35 pups in most areas (Walker, 1999). However, parturition and nursery locations are poorly known for this species (Ellis *et al.*, 2012). It has been suggested that juvenile tope use shallow, protected estuarine and inshore coastal waters as parturition and nursery grounds, where they can remain for up to two years (Ellis *et al.*, 2012; Walker *et al.*, 2020). Based on the presence of juveniles (< 70 cm total length), Ellis *et al.* (2010, 2012) identified low intensity nursery grounds across the eastern and western Irish Sea, which overlap with the study area (Figure 19). Ovulation and parturition is likely to take place in late spring or early summer and the gestation period of females is about one year (Walker, 1999).

## Spurdog

3.3.16 Spurdog, also known as spiny dogfish, is a small shark species, which is found on or near the bottom in continental shelf waters and near the surface in oceanic waters (Ebert and Stehmann, 2013). The species primarily feeds on bony fish but is also known to target invertebrates including squid, octopuses and crabs. Spurdog were historically widespread in the north-east Atlantic; however, its population has declined significantly due to overfishing and bycatch (Marine Institute, 2022).

3.3.17 Spurdog in the Irish Sea belong to the north-east Atlantic population, which stretches from the Bay of Biscay to the Norwegian Sea (ICES, 2014a). ICES stock assessments have shown an increasing trend of the north-east Atlantic stock since 2004, which has stabilised in recent years (Marine Institute, 2022). Spurdog are currently listed as Vulnerable on the IUCN Red List Status (Finucci *et al.*, 2020), and as Endangered on both the European Red List (Ellis *et al.*, 2015b) and the Ireland Red List (Clarke *et al.*, 2016). The species is also regarded as under threat and/or declining within all OSPAR regions.

3.3.18 Spurdog are viviparous, but data on parturition and nursery locations are not well established for this species (Ellis *et al.*, 2012). High intensity nursery grounds are predicted to be located in the northern Irish Sea (Ellis *et al.*, 2010, 2012), overlapping with the northern part of the underwater noise ZoI (Figure 19).





- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)

Nursery Grounds (Intensity) (Ellis *et al.*, 2010)

- Spurdog, Low Intensity
- Spurdog, High Intensity
- Tope Shark, Low Intensity

DRAWING STATUS

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Spurdog and Tope Nursery Grounds (Ellis *et al.*, 2010)**

DRAWING NUMBER: 19

PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
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| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

GoBe APEM Group

DublinArray Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

## Basking sharks

3.3.19 Basking sharks (*Cetorhinus maximus*) are a large, migratory pelagic species with a circumpolar distribution, which can reach up to 12 m in length (Compagno, 1984b). They are known to migrate through the Irish Sea (Compagno, 2001; Gore *et al.*, 2008; Southall *et al.*, 2005), with known basking shark hotspots located across the central Irish Sea, particularly around the Isle of Man. There are also records of basking sharks across the western Irish Sea, including the study area (e.g., Dolton *et al.*, 2020; Irish Whale and Dolphin Group, 2023). Telemetry data have shown that basking sharks are capable of long-range migrations, moving rapidly between regions over periods of a few weeks, with large variations in migration patterns among individuals (e.g., Sims *et al.*, 2003).

3.3.20 Basking sharks are ram feeders, meaning that they use their gill rakers to filter zooplankton from the water as they swim along (Wilson *et al.*, 2020). They are a long-lived species, with a predicted lifespan of 40-50 years. Defining characteristics of basking shark include slow growth, delayed maturation, long gestation periods, and production of few young. Males are believed to reach sexual maturity between 12-16 years and females in the region of 16-20 years (Wilson *et al.*, 2020). Basking sharks bear live young, and they are thought to breed at the start of summer and offspring gestation takes between one to three and a half years (Compagno, 1984b; Wilson *et al.*, 2020).

3.3.21 The basking shark is a species of conservation importance, being on the OSPAR list of threatened and/or declining species and classed as Endangered by the IUCN in Ireland, Europe and globally (Clarke *et al.*, 2016; Rigby *et al.*, 2021). Since 2022, the species has legal protection within Irish waters under Section 23 of the Irish Wildlife Act (1976) (as amended). Information on current population levels and trends remain limited, but the species is considered to be depleted in the north-east Atlantic (OSPAR, 2021).

3.3.22 Basking sharks have the potential to pass through the study area, but this will likely occur infrequently and in low numbers. Historic sightings include several sightings within the study area (National Biodiversity Data Centre, 2024). Basking sharks concentrate along ocean fronts wherever there is an aggregation of the zooplankton they feed on and can occur anywhere around the Irish coastline during the spring and early autumn. In Irish waters, sightings occur in April through to early October, typically peaking from mid-May to mid-June (Gray *et al.*, 2022; Thornburn *et al.,* 2024). During the winter months, basking sharks are likely to move to feeding grounds in deeper waters off the west coast of Ireland (Sims *et al.*, 2003). Most individuals are sighted in surface waters; however, when relying on sightings from offshore surveys, it is difficult to estimate the number of basking sharks present in the Irish Sea.

## Spotted ray

3.3.23 Spotted ray is a small, bottom-dwelling species that feeds on a variety of prey, including small fish, crustaceans, polychaetes, and molluscs (Gibson-Hall, 2018). In the north-east Atlantic, spotted ray have been recorded in water depths between 8-283 m, being most abundant in water depths less than 100 m (Ellis *et al.*, 2007). Juveniles prefer inshore sandy sediments, with adults also found further offshore on sand and coarse sand and gravel substrates (Ellis *et al.*, 2007).

3.3.24 Spotted ray is listed under OSPAR as threatened and/or declining within the Irish and Celtic Seas and is classed as of Least concern on both the IUCN Red List (Ellis *et al.*, 2007) and the Ireland Red List (Clarke *et al.*, 2016). The species has a wide geographic distribution in the north-east Atlantic and Mediterranean Sea, with ICES recognising two separate stocks around Ireland, one located within the Irish and Celtic Seas and Bristol Channel, and another located north-west and west of Ireland and west of Scotland (ICES, 2014a,b). Catch per unit effort (CPUE) estimates derived from ICES ground surveys indicate an increase in numbers over the last 10-15 years; (ICES, 2014a; ICES, 2022c).

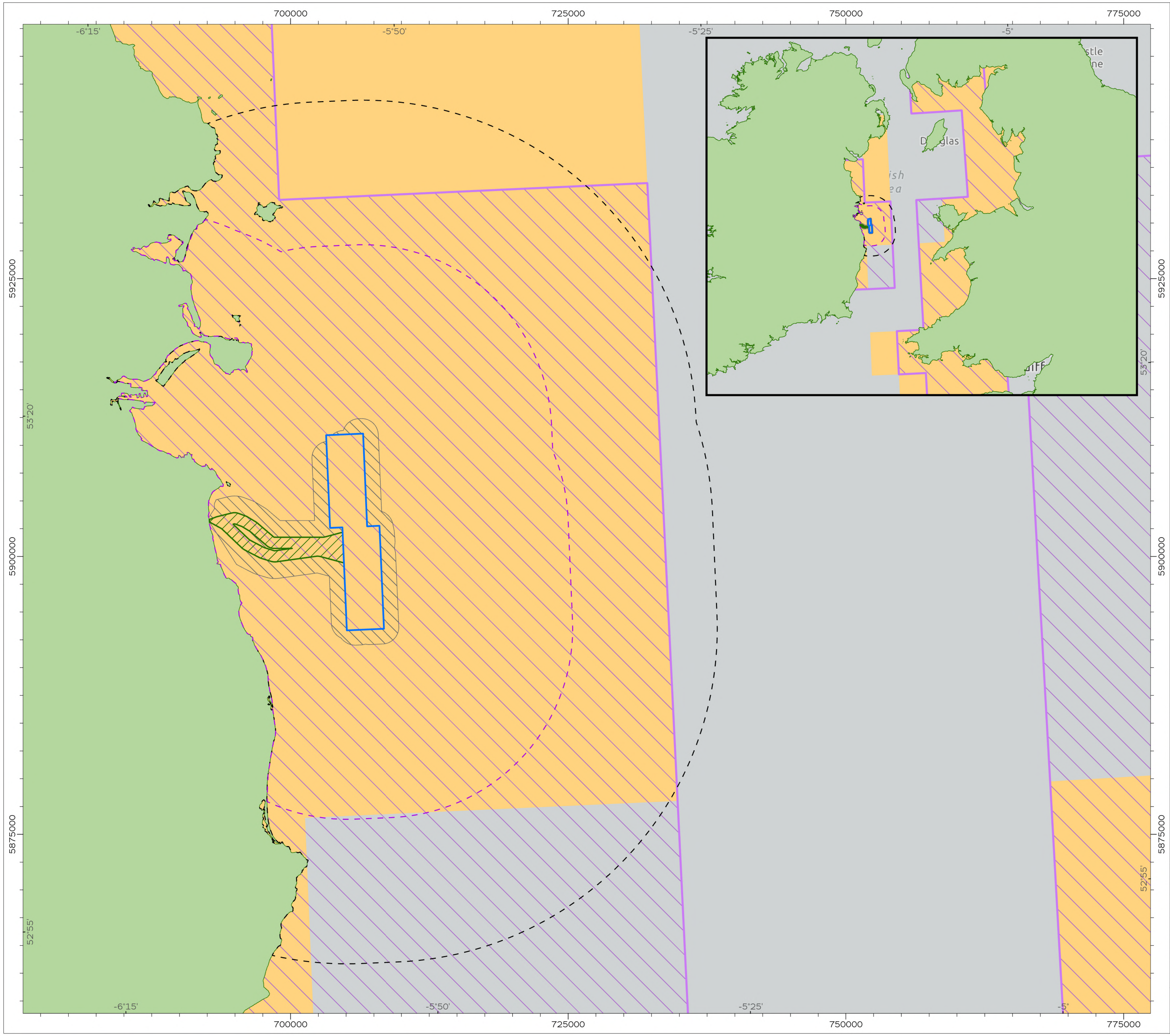
3.3.25 Like all skate species, spotted ray are oviparous. Egg cases and juveniles are often found in sheltered inshore areas (Clarke *et al.*, 2016), and Ellis *et al.* (2012, 2012) predicted low intensity nursery grounds within the study area (Figure 20). A study by Atalah *et al.* (2013) identified a high abundance of juvenile spotted rays across the Kish, Arklow and Blackwater Banks, suggesting the presence of nursery areas across the wider area at suitable habitats along the east coast of Ireland. Spotted ray caught during site-specific trawls within the array area were also mainly small, with the average length per site ranging from 25-38 cm (Aquafact, 2019). By comparison, the length of 50% maturity for male and female spotted ray in the Irish Sea is reported to be > 50 cm (Clarke *et al.*, 2016), which further supports earlier suggestions of potential spotted ray nursery grounds on and around the Kish and Bray Banks.

## Thornback ray

3.3.26 Thornback rays, or roker, are typically found in the coastal waters of the eastern Atlantic, from the Faroe Islands, Iceland, and Norway to South Africa, in the Mediterranean, the Mid-Atlantic Ridge south from Iceland, and in the southwestern Indian Ocean (Stehmann and Bürkel, 1984). They are found over a wide variety of substrates, including mud, sand, shingle, gravel and rock grounds (Ellis, 2016). They are most common at depths of between 10-60 m, but have also been recorded in deeper waters, at depths of up to 300 m (Ellis, 2016). Site-specific (Aquafact, 2019) and regional (ICES, 2023a) trawl survey show the presence of thornback ray within the study area including the array area and offshore ECC.

3.3.27 Thornback ray is a species of conservation importance that is currently listed as Near threatened on the IUCN Red List (Ellis, 2016), although it is listed as Least concern on the Ireland Red List (Clarke *et al.*, 2016). ICES distinguishes three populations around Ireland, one in the Irish Sea, Celtic Sea and Bristol Channel, one off north-west Ireland and West Scotland, and one off western Ireland (Clarke *et al.*, 2016; ICES, 2014a,b). The population size indicator of the Irish and Celtic Seas stock has increased since the early 2000s (ICES, 2022c), following a marked decline in stock size in the 1980s/1990s (MPA Advisory Group, 2023).

3.3.28 Tagging studies suggest that thornback ray exhibit philopatric behaviour, whereby individuals return to specific locations to breed or feed (Hunter *et al.*, 2006). Seasonal migration into shallow inshore feeding and spawning grounds take place in spring and summer, and individuals return to offshore, deeper waters in the autumn and winter (OSPAR, 2008). Eggs are released from February to September, with a peak during late spring/early summer, and the development of embryos within the eggs lasts between 16-21 weeks (Ellis, 2016). No data on spawning grounds in the Irish Sea exists for this species given the absence of data on the distribution of in situ egg cases. However, it is suggested that thornback ray spawning grounds broadly overlap with nursery grounds (Ellis *et al.*, 2012), with the latter being located in shallower, inshore waters (Ellis *et al.*, 2005; MPA Advisory Group, 2023). Low intensity nursery grounds are likely to occur across the study area (Figure 20; Ellis *et al.*, 2010, 2012).





- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)

Nursery Grounds (Intensity) (Ellis *et al.*, 2010)

- Thornback Ray, Low Intensity
- Spotted Ray, Low Intensity

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PROJECT TITLE
**Dublin Array**

DRAWING TITLE
**Thornback Ray and Spotted Ray Nursery Grounds (Ellis *et al.*, 2010)**

DRAWING NUMBER: **20**
PAGE NUMBER: **1 of 1**

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
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| 01 | 2024-05-21 | For Issue | GB | BB | SS |

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0 1.5 3 4.5 6 nm
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| 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

## Blonde ray

3.3.29 Blonde ray is a species of conservation importance that is currently classed as Near threatened on both the IUCN Red list (Ellis *et al.*, 2009) and the Ireland Red List (Clarke *et al.*, 2016).

3.3.30 Blonde ray has a wide geographic distribution in the north-east Atlantic and Mediterranean Sea and is relatively common in the Irish Sea, St George's Channel, Bristol Channel and the English Channel (Ellis *et al.*, 2009). In the north-east Atlantic, blonde ray have been recorded in inshore and shallow shelf waters down to about 150 m water depth (Ellis *et al.*, 2009), where they live mainly on soft substrata such as sandy grounds (Ebert and Stehmann, 2013). Juveniles are thought to feed upon crustaceans, including shrimps and crabs, whilst the main diet of adults consists of fish such as sandeels (Ebert and Stehmann, 2013).

3.3.31 Data on spawning and nursery grounds are not available for this species in the published literature, but it has been suggested that blonde ray prefer shallower, coastal waters (Martin *et al.*, 2010). Reproduction is thought to take place between February and August, with females estimated to produce about 30 eggs per year. The gestation period (i.e., period embryos develop within egg cases) lasts for approximately seven months (Ebert and Stehman, 2013; Ellis *et al.*, 2009).

3.3.32 Blonde ray in the Irish Sea, Celtic Seas and the Bristol Channel are thought to form one stock (ICES, 2022d). Trend information available for juveniles suggest an increase in stocks over time in the Irish Sea (Clarke *et al.*, 2016). However, other data indicate that the population is over-exploited and may have declined during the 20$^{th}$ century (Clarke *et al.*, 2016; Ellis *et al.*, 2009).

3.3.33 Blonde ray is an important commercial species in the study area, with the main fishing grounds located to the east of the Kish and Bray Banks, partly overlapping with the underwater noise ZoI (Commercial Fisheries technical baseline). Fishing effort data analysed by the Irish MPA Advisory Group (2023) show blonde ray landings also from the coastal waters off Howth and Wicklow. During the site-specific trawl survey across the array area (Aquafact, 2019), blonde ray were recorded at five out of ten sites, mainly within the shallower sites sampled across the Kish and Bray Banks. Blonde ray mature at approximately 80-90 cm (Clarke *et al.*, 2016); the average length of blonde ray caught during the site-specific trawl survey was 25-45 cm (Aquafact, 2019), suggesting that the Kish and Bray Banks constitute an important habitat for juvenile blonde ray.

## Cuckoo ray

3.3.34 The cuckoo ray is a small skate species, which is mainly found at water depths between 20-500 m (Ellis *et al.*, 2015c). In the Irish Sea, it can be locally abundant on coarse substrates (e.g., coarse sand and gravel) (Ellis *et al.*, 2015c).

3.3.35 ICES groundfish surveys indicate that cuckoo ray are widespread in Irish waters including the Irish Sea, especially on offshore grounds (ICES, 2022c). Abundance indices are reported to have declined since the 1990s (Clarke *et al.*, 2016), though more recent data show an increase in stock levels, with current fishing pressure on the stock being below the $F_{MSY}$ threshold, indicating that the stock is harvested sustainably (ICES, 2022e).

3.3.36 Data on spawning and nursery grounds is not available for this species in the published literature. Eggs are laid on sandy or muddy substrates, with 70-150 eggs produced per female annually (MPA Advisory Group, 2023; Stehman and Bürkel, 1984).

3.3.37 Cuckoo ray is listed as Least concern on the Global IUCN Red List (Ellis *et al.*, 2015c) and has been classed as Vulnerable on the Ireland Red List (Clarke *et al.*, 2016). The species has also been given due consideration owing to its importance to the angling community.

## 3.4 Summary of fish and elasmobranch spawning and nursery grounds

3.4.1 Many species of fish are known to either spawn or have nursery areas in the Irish Sea (Coull *et al.*, 1998; Ellis *et al.*, 2010, 2012; Marine Institute, 2016). The Marine Institute's Marine Atlas provides the extent of spawning and nursery grounds for several species throughout Irish waters, whereas Coull *et al.* (1998) and Ellis *et al.* (2010, 2012) provide a wider context across UK and Irish waters. These sources, and Figure 3 to Figure 20, detail fish species which have spawning and nursery grounds that overlap with the study area. Spawning periods of fish species in the Irish Sea, known to have spawning habitats in the study area, are presented in Table 4: species include whiting (Coull *et al.,* 1998; Campanella and van der Kooij, 2021), haddock (Coull *et al.,* 1998), Atlantic code (ICES, 2005), plaice (Nichols *et al.,* 1993; Coull *et al.,* 1998; ICES, 2005), common sole (Coull *et al.,* 1998; Nichols *et al.,* 1993), lemon sole (Coull *et al.,* 1998), herring (ICES, 1994), sprat (Coull *et al.,* 1998), horse mackerel (Campanella and van der Kooij, 2021), Atlantic mackerel (Coull *et al.,* 1998; Marine Institute, 2023), sandeel (Nichols *et al.,* 1993), poor cod (Cohen *et al.*, 1990).

Table 4 Summary of fish spawning periods in the Irish Sea. Light blue indicates spawning period, dark blue indicates approximate peak spawning period.

| Species | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Whiting | | | | | | | | | | | | |
| Haddock | | | | | | | | | | | | |
| Atlantic cod | | | | | | | | | | | | |
| Plaice | | | | | | | | | | | | |

| Species | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Common sole | | | | | | | | | | | | |
| Lemon sole | | | | | | | | | | | | |
| Herring | | | | | | | | | | | | |
| Sprat | | | | | | | | | | | | |
| Horse mackerel | | | | | | | | | | | | |
| Atlantic mackerel | | | | | | | | | | | | |
| Sandeel | | | | | | | | | | | | |
| Poor cod | | | | | | | | | | | | |

## Atlantic herring and sandeel spawning habitats

3.4.2 The fish species identified of particular importance in relation to spawning behaviour and sedimentary habitats are herring and sandeel owing to their demersal spawning nature and strong preference for particular sedimentary habitats and areas.

3.4.3 Site-specific PSA data (Aquafact, 2018; Fugro, 2021) and supporting data sources from INFOMAR have been used to determine potentially suitable spawning locations for sandeel and herring, following the methodology described in Section 2.3 of this report.

### Sandeel

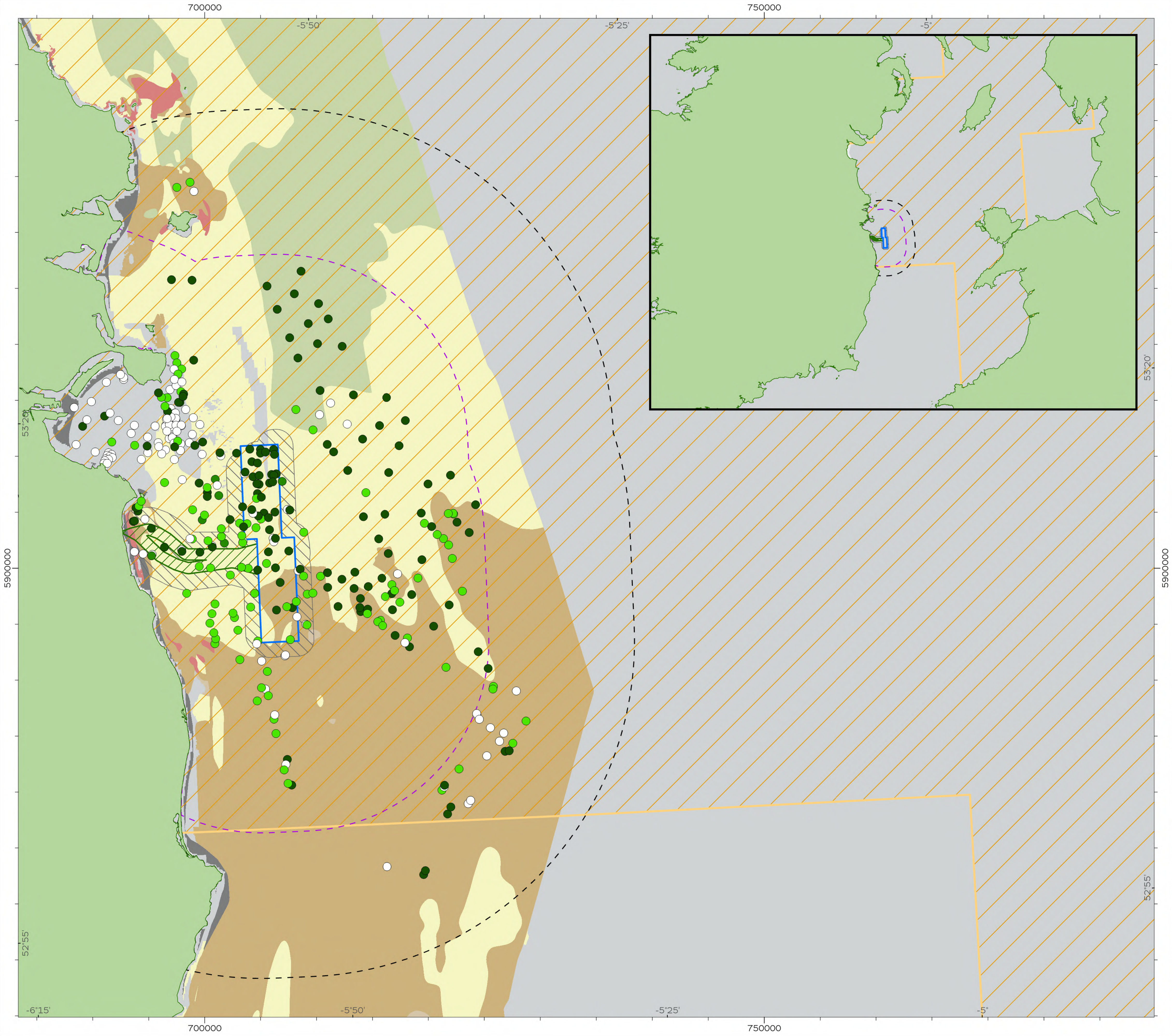
3.4.4 Sandeel spawn throughout the Irish Sea, with low intensity sandeel spawning (Figure 3; Figure 21) and nursery (Figure 4) grounds predicted to overlap with most of the study area (Ellis *et al.*, 2010, 2012). To further refine understanding of the distribution of potential sandeel habitats including spawning grounds within the study area, site-specific (Fugro, 2021) and publicly available (INFOMAR, 2023) PSA data were classified according to the methodology described in Latto *et al.* (2013). The substrate classification derived from these data are used as a proxy to indicate the location of potential suitable sandeel habitat spawning grounds for sandeel, based on known spawning habitat preferences for sandeel species.

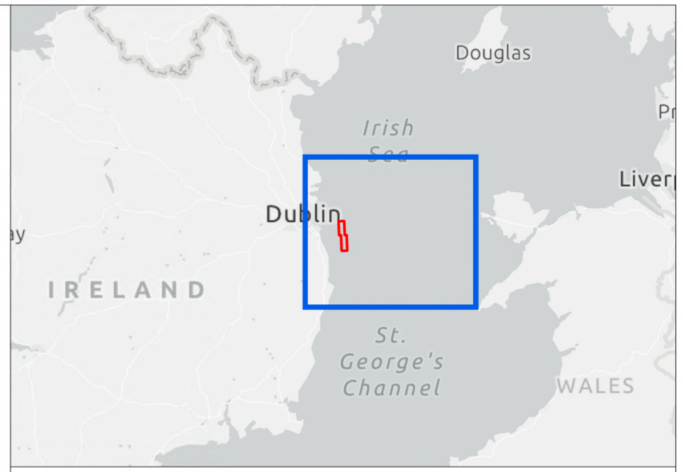
3.4.5 Predictive broadscale seabed substrate maps provided by INFOMAR (2023) indicate that sediments in the northern half of the array area are predominantly composed of sand, while sediments in the southern half of the array area are likely to contain both sands and coarser material (Figure 21). Sediments within the offshore ECC are predicted to contain mainly sands with mixed sediments and rocky substrates present within the inshore sections of the cable routes. Sediment samples collected during site-specific surveys (Aquafact, 2018; Fugro, 2021) are in good agreement with the regional sediment data, showing a predominantly sandy sediment within the array area and offshore ECC. Specifically, sediments sampled in the array area were classified as either 'Sand', 'Gravelly sand' or 'Slightly gravelly sand, and sediments sampled within the offshore ECC were classified as 'Sand' or 'Gravelly sand'.

3.4.6 The substrate classification indicates that 'Prime' sandeel spawning habitats are present within the array area, particularly across the Kish Bank, coinciding with the sandy areas of the bank (Figure 21). Sediments sampled within the northern cable corridor and the inshore sections of the temporary occupation area at Shanganagh are also mainly classed as 'Prime' sandeel habitats, while sediments sampled within the southern cable route are classified as 'Sub-Prime', 'Suitable' and 'Unsuitable' substrate for sandeel.

3.4.7 The PSA data sourced from INFOMAR (2023) indicate 'Prime' and 'Sub-Prime' sandeel habitats, and therefore potential spawning grounds, mainly to the north-east and west of the array area (Figure 21). The seabed to the south of the offshore ECC is dominated by sands that are classified as 'Suitable' substrate for sandeel, while the PSA data collected to the north of the offshore ECC indicate 'Suitable' to 'Prime' and 'Sub-Prime' sandeel substrates. Sediments within Dublin Bay are mainly 'Unsuitable' for sandeel.

3.4.8 When considering the datasets on sandeel habitats and abundances discussed above, it indicates that sandeel habitats, and therefore potential spawning habitats, are present within the array area, particularly across the Kish Bank, coinciding with the sandy areas of the bank.




- Array Area
- Offshore Temporary Works Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)

Spawning Grounds (Intensity) (Ellis *et al.*, 2010)

- Sandeel, Low Intensity

INFOMAR Seabed Substrate

- Rock
- Coarse Sediment
- Mixed Sediment
- Sand
- Mud to Muddy Sand
- Unclassifed Substrate

Sandeel Habitat Suitability (Latto *et al.*, 2013)

- Preferred (Prime)
- Preferred (Sub-Prime)
- Suitable
- Unsuitable

DRAWING STATUS

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Seabed Substrates and Sandeel Habitat Suitability**

DRAWING NUMBER: **21**

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| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

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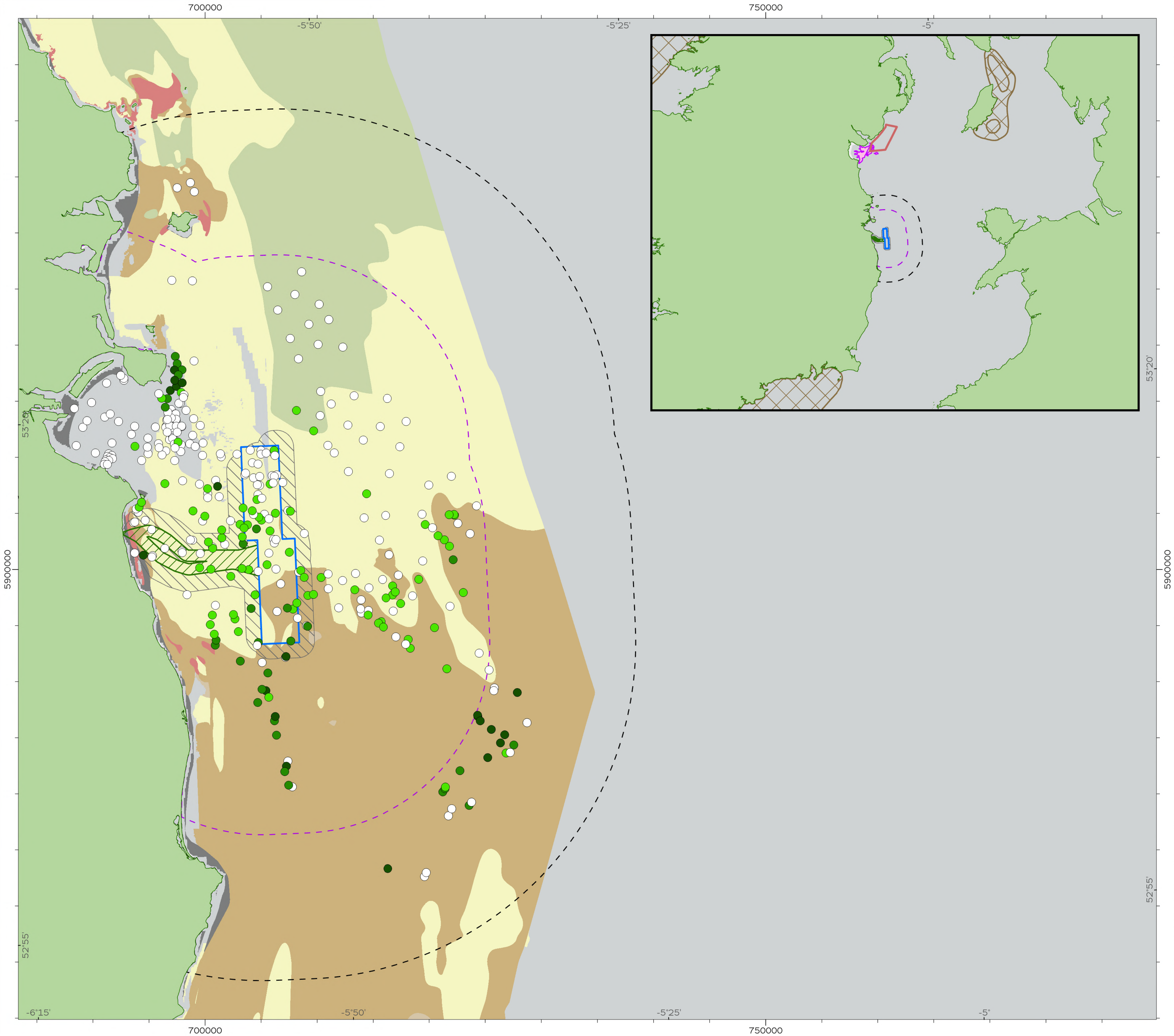
Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

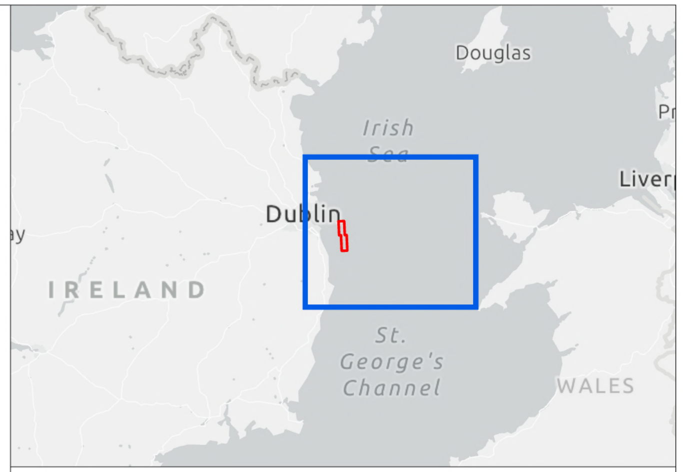
## Atlantic herring

3.4.9 Current evidence suggests that herring nursery grounds are concentrated in the coastal waters of the north Irish Sea, overlapping with the north-western sections of the sedimentary and underwater noise ZoIs (Figure 4; Coull *et al.*, 1998; Ellis *et al.*, 2010, 2012; Marine Institute, 2016) The nearest known active herring spawning ground to the study area, the Mourne herring ground, is located off County Down and the northern sections of County Louth approximately 70 km to the north of the array area (ICES, 1994; Figure 3), with suitable spawning substrate known to also be present across the outer sections of Dundalk Bay located approximately 62 km from the northern boundary of the array area (MPA Advisory Group, 2023; Figure 22). Other known herring spawning beds are concentrated in the eastern Irish Sea along the east coast of the Isle of Man (Coull *et al.*, 1998; Ellis *et al.*, 2010, 2012), approximately 115 km to the north-east of the array area. A report by the Marine Institute (O'Sullivan *et al.*, 2013) identified herring spawning beds and grounds using information collected from fishermen, larval surveys and seabed classification to compare locations of known beds with areas of suitable substrate. This comprehensive study identified beds to the north, west and south of Ireland, outside the Irish Sea.

3.4.10 Potential suitable substrate for herring spawning were also defined using site-specific and publicly available PSA data, following the methodology described by Reach *et al.* (2013). The results of this analysis suggest that large parts of the array area and offshore ECC are unsuitable for herring spawning, based on the seabed being largely dominated by sandy sediments. Coarser sediments containing Gravelly sand are located across part of the array area and offshore ECC and are correspondingly categorised as 'Suitable' or 'Sub-prime' for herring spawning. 'Suitable' to 'Prime' substrates are also present across the coarser sediments in the southern area of the study area and along the coastal areas off Howth (Figure 22).

3.4.11 The datasets on herring habitats and abundances discussed above indicate that sediments suitable for herring spawning are present across the Bray and Kish Banks and within the offshore ECC. However, data from Coull *et al.* (1998) and other sources (e.g., ICES, 1994; O'Sullivan *et al.*, 2013) indicate that these areas are not active spawning grounds. This is further supported by the AEPM larval dataset (Cefas, 2000), which shows a representation of the core larval density area for herring. No hotspots are located within or in the vicinity of the study area, suggesting that whilst there are suitable substrates for spawning within the study area, neither appear to be actively used by herring for spawning (Figure 11).




- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)
- Potential Suitable Herring Spawning Ground (Dundalk Bay) (MPA Advisory Group, 2023)
- Traditional Mourne Herring Spawning Area (Dickey-Collas *et al.*, 2001

Spawning Grounds (Coull *et al.*, 1998)

- Atlantic Herring

INFOMAR Seabed Substrate

- Rock
- Coarse Sediment
- Mixed Sediment
- Sand
- Mud to Muddy Sand
- Unclassifed Substrate

Herring Habitat Suitability (Reach *et al.*, 2013)

- Preferred (Prime)
- Preferred (Sub-Prime)
- Suitable
- Unsuitable

DRAWING STATUS

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PROJECT TITLE

**Dublin Array**

DRAWING TITLE

**Seabed Substrates and Atlantic Herring Habitat Suitability**

DRAWING NUMBER: **22**

PAGE NUMBER: **1 of 1**

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0 1.5 3 4.5 6 nm

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| SCALE | 1:350,000 | PLOT SIZE | A3 |
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| 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

# 3.4 Shellfish ecology

## Site-specific and regional surveys

3.4.1 The site-specific fish (Aquafact, 2019; Ecoserve, 2004) and benthic (Aquafact, 2018; Ecoserve, 2008; Fugro 2021) ecological baseline surveys were not designed to target shellfish species; consequently, only a small number of shellfish and other larger invertebrates were recorded during these surveys. Species typically observed were hermit crabs (*Pagurus* spp.), swimming crabs (*Liocarcinus* spp.), common whelk (*Buccinum undatum*), queen scallop (*Aquipecten opercularis*), and blue mussel (*Mytilus edulis*). Other species recorded include brown crab (*Cancer pagurus*), European lobster (*Hommarus gammarus*), spider crab (*Inachus* sp.), razor shells (*Ensis* spp.), horse mussel (*Modiolus modiolus*), and native oyster (*Ostrea edulis*).

3.4.2 Epibenthic invertebrates present within the trawls undertaken across the Dublin shipping channel and inner Dublin Bay (Aquatic Services Unit, 2019, 2020) included common whelk, 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, hermit crabs, velvet crab (*Necora puber*), and spider crabs (*Majidae*).

3.4.3 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 shells also present (RPS, 2014).

## Shellfish of commercial importance

3.4.4 Commercially important shellfish species within the region on account of their landings weight and value include nephrops (*Nephrops norvegicus*), common whelk, European lobster, brown crab, velvet crab, scallops and razor shells (*Ensis* spp.) (Commercial Fisheries technical report; Tully, 2017). The importance of the whelk fishery in particular was identified through consultation with the local commercial fishing industry, who identified that the Kish and Bray Banks are currently almost exclusively targeted for whelk.

3.4.5 Whelk, brown crab, velvet crab, lobster and brown shrimp are fished using baited traps (pots and creels). Whelks are fished year-round with landings from the study area peaking between January and June, with less fishing activity occurring from July to August (Commercial Fisheries technical baseline). The main potting effort for whelk overlaps with the temporary occupation area, including the array area and offshore ECC (Figure 23).

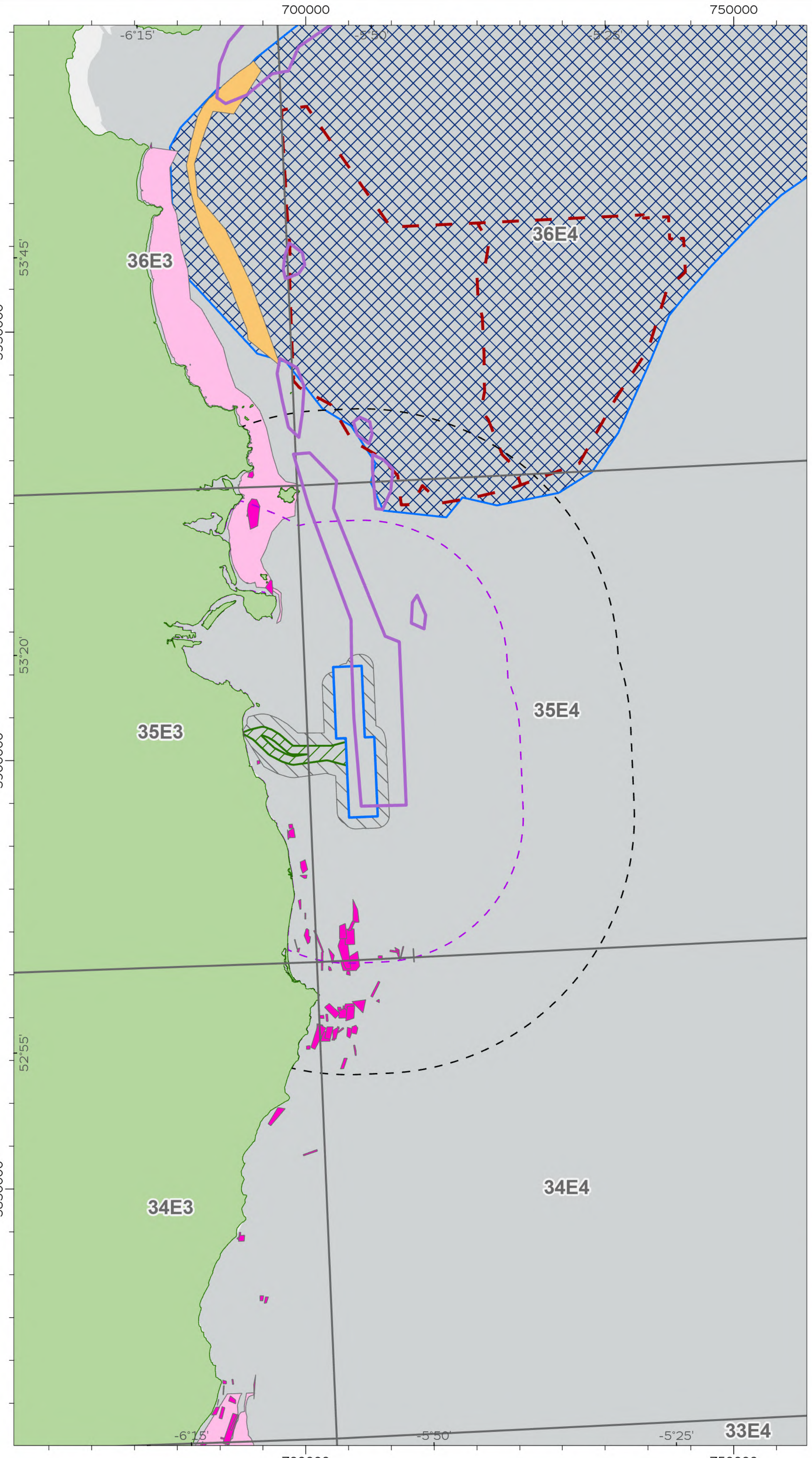
3.4.6 Fishing for crab and lobster takes place all year, with fishing activity for brown crab typically increasing throughout summer and autumn, while landings for lobster peak from late March to early October (Commercial Fisheries Technical baseline; Tully, 2017). Potting vessels targeting brown crab and lobster tend to be more prominent in inshore areas across the offshore ECC, and less prominent within the array area (Commercial Fisheries technical baseline; Figure 23).

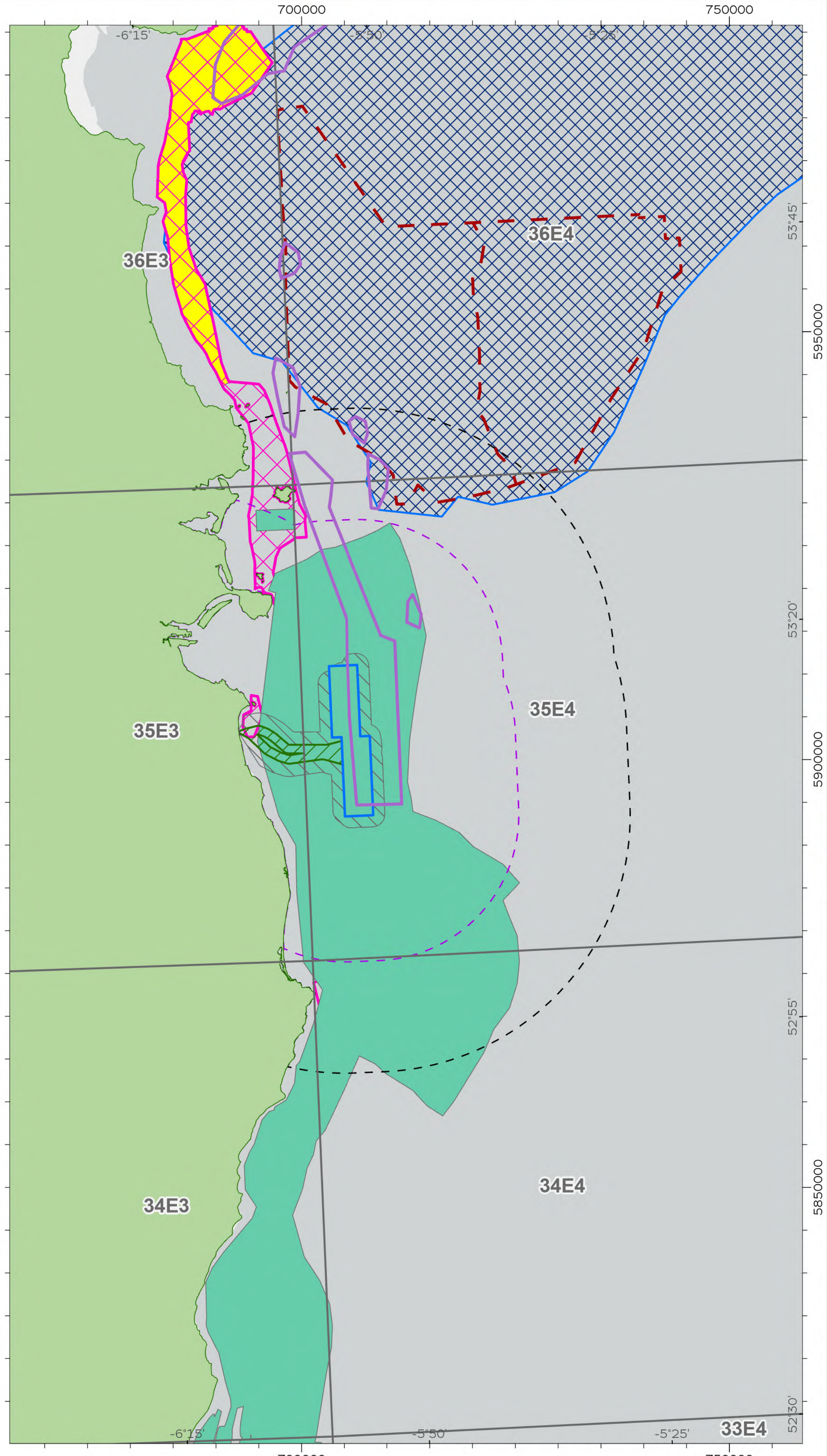
3.4.7 Razor shells and scallops are fished using commercial dredges. Fishing grounds for razor shells are located close to the coast from Portmarnock to north Dundalk Bay in water depths of about 4-14 m (Figure 23; Marine Institute and Bord Iascaigh Mhara, 2023). King scallops are mainly fished by Irish vessels from scallop beds mainly to the east of the Kish Bank, and also occasionally to the west off Bray Head and nearshore close to Shanganagh. Queen scallops are mainly fished by Scottish registered vessels, targeting areas east of the Bray bank (Commercial Fisheries technical baseline; Figure 23).

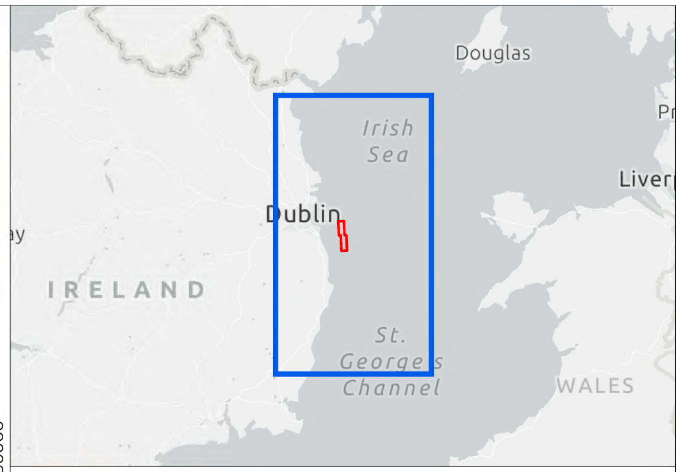
3.4.8 Nephrops are fished using demersal otter trawls; fishing effort is concentrated in ICES rectangles 36E4 and 37E4 to the north of the array area, overlapping with the northern section of the underwater noise ZoI (Figure 24).

3.4.9 In addition to the species commercially fished, juvenile (seed) blue mussels are dredged from licensed beds for use by the aquaculture industry. Current seed mussel beds overlapping the study area are located inshore to the south of the array area and offshore ECC and between Rush and Howth to the north of the offshore ECC (Figure 23).

3.4.10 Further detail on the commercial fisheries interests in the study area and the wider western Irish Sea is included in the Commercial Fisheries technical baseline. Information about the ecology of key commercial species is presented in the following sections.




- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Underwater Noise ZoI (30km)
- Sedimentary ZoI (17km)
- ICES Statistical Rectangles
- Historical King Scallop Fishing grounds (ICES, 2020)

Inshore Dredge Fishing - Target Species (Marine Institute, 2016)

- Razor Clam
- Scallop
- Seed Mussel
- Nephrops Grounds (Marine Institute, 2016)
- Main Nephrops Fishing Grounds (Marine Institute, 2016)

Inshore Pot Fishing - Target Species (Marine Institute, 2016)

- Lobster & Crab
- Shrimp
- Whelk
- Historical King Scallop Fishing grounds (ICES, 2020)
- ICES Statistical Rectangles

DRAWING STATUS

**FINAL**

DISCLAIMER



MAP NOTES / DATA SOURCES:

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PROJECT TITLE

# Dublin Array

DRAWING TITLE

## Inshore Fishing Grounds Targeted by Dredging & Potting (Marine Institute, 2016)

DRAWING NUMBER: 23



| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 5.5 11 16.5 22 km

0 2.5 5 7.5 10 nm

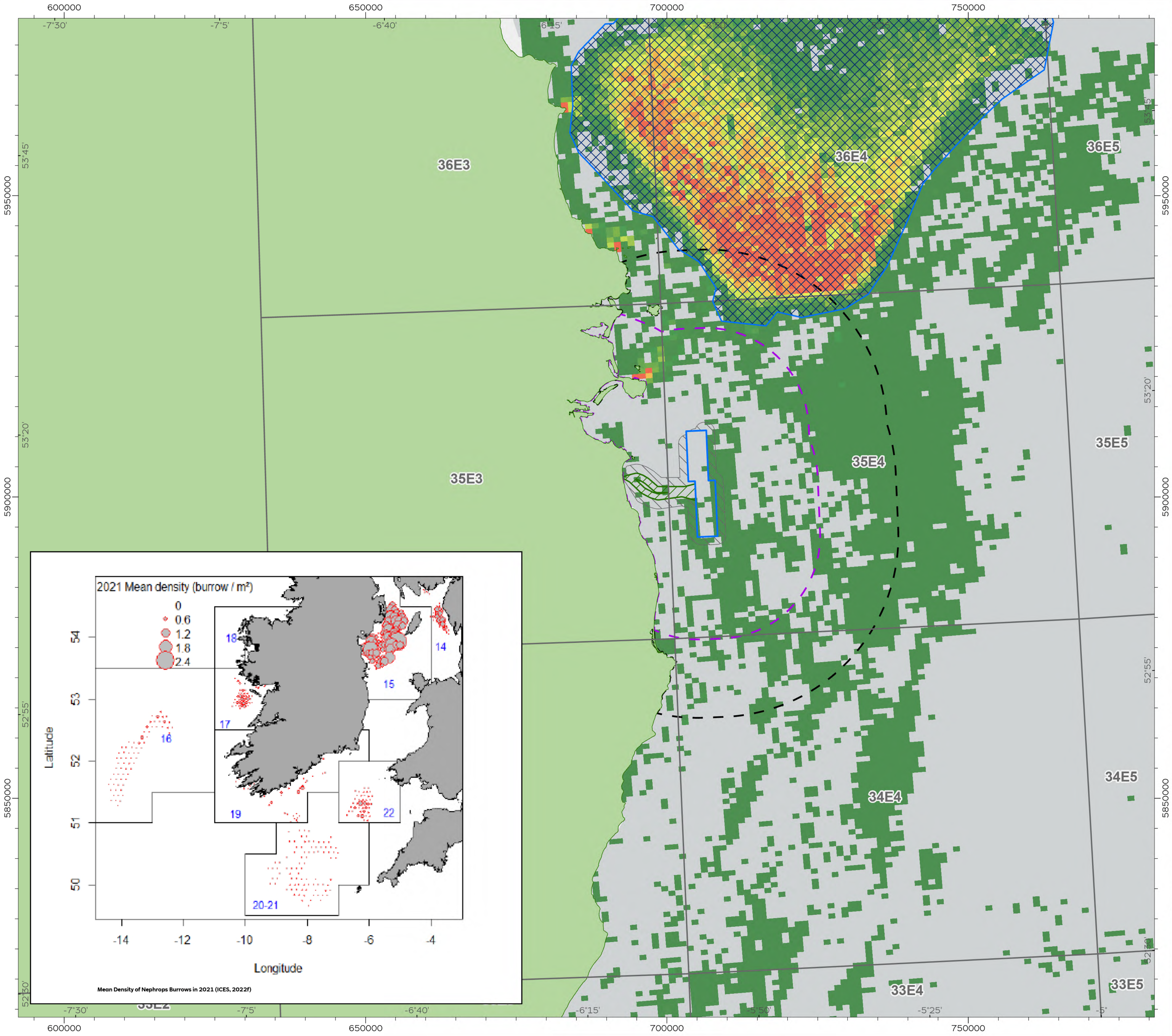
N GRID NORTH

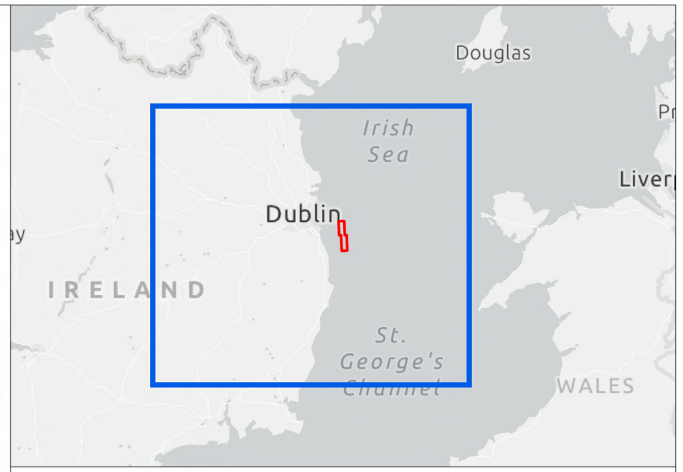
| SCALE | 1:650,000 | PLOT SIZE | A3 |
|---|---|---|---|
| DATUM | WGS 1984 | VERTICAL REF | LAT |
| PRJ | WGS 1984 UTM Zone 29N | | |

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited




Array Area
Temporary Occupation Area
Export Cable Corridor
Underwater Noise ZoI (30km)
Sedimentary ZoI (17km)
ICES Statistical Rectangles
Dublin Bay Prawn Grounds (Marine Institute, 2016)
Irish and EU Bottom Trawl Effort 2014-2018 (Marine Institute, 2016)
High : 45073.3
Low : 0

DRAWING STATUS
**FINAL**



MAP NOTES / DATA SOURCES:
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PROJECT TITLE
**Dublin Array**

DRAWING TITLE
**Dublin Bay Prawn Fishing Grounds in the Western Irish Sea (Marine Institute, 2016)**

DRAWING NUMBER: 24
PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 5.5 11 16.5 22 km
0 3 5 8 10 nm
N GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:650,000 | 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

## Shellfish species descriptions

### Common whelk

3.4.11 The common whelk is a large, epibenthic gastropod that is found from the shallow subtidal down to the continental slope at water depths up to 1200 m, being most common at depths shallower than 50 m (Ager, 2008; Tully, 2017). The species has been recorded from a wide variety of hard and soft substrates including rock, cobbles, and gravel as well as coarse and muddy sands.

3.4.12 Whelks do not release pelagic eggs; instead eggs are laid in large clumps onto hard substrates (Hancock, 1967). In the Irish Sea, breeding and egg deposition is thought to occur from autumn to mid-winter, and hatching of fully formed juveniles takes place between April and early May, three to five months after spawning (Kideys *et al.*, 1993; Smith and Thatje, 2013). The distribution of juvenile whelks tends to be limited to areas close to the adult stock (Lockwood, 2005) due to the absence of a pelagic dispersal stage, and therefore populations are likely to be locally discrete with limited connectivity (Tully, 2017; Valentinsson, 2002).

3.4.13 Tagging experiments have shown little movement of adult whelk, suggesting that they exhibit strong site fidelity (Hancock, 1963). Wider movements may be excepted during the breeding season when female whelk search for suitable egg-deposition sites on hard surfaces (Valentinsson, 2002).

3.4.14 Data on whelk spawning and nursery grounds in the Irish Sea are limited. Monitoring of the whelk fishery across the south-western Irish Sea (Fahy *et al.*, 2000) showed that the length and age frequencies of whelk are most variable in specimens caught around the Dublin Bay area. In addition, whelks landed from the Dublin sector contain a large proportion of larger individuals, indicating that various age classes are present (Fahy *et al.*, 2000). By comparison, Codling Bank (located to the south of the array area) is known to support a large proportion of small, young whelks (Fahy *et al.*, 2000), and it has been suggested that the substratum across Codling Bank might be a particularly productive nursery and possibly spawning ground for whelk (Fahy *et al.*, 2002). Consultation with the fishing industry also suggests that whelk within the study area spawn between Codling and Bray Banks due to the average size of whelk increasing with distance from Codling Bank (Commercial Fisheries technical baseline).

3.4.15 Common whelk are identified as a species of high commercial importance in the study area and south-west Irish Sea region (e.g. Fahy *et al.*, 2002), with landings of the species increasing considerably in the last few years. The array area is understood to be almost exclusively targeted by the whelk potting fishery (Commercial Fisheries technical baseline; Tully, 2017) as part of a fishery that extends over a large area off the east coast of Ireland from Howth to Wexford (Figure 23). A lower level of whelk fishing occurs inshore and across the offshore ECC. Based on the fisheries landings data, the whelk fisheries within the study area has been assessed to be of regional importance (Commercial Fisheries technical baseline).

3.4.16 Whelk stocks in Irish waters are managed by a minimum landing size, but no catch limits or quotas are currently in place (Marine Institute and Bord Iascaigh Mhara, 2023). The long-term sustainability of the Irish whelk fishery remains unclear; several populations are subject to high fishing mortality and the current minimum landing size is well below the size at which whelk mature, suggesting that the reproductive potential of the stock may not be sufficiently protected (Marine Institute and Bord Iascaigh Mhara, 2023).

## Brown crab

3.4.17 Brown crab, also known as edible crab, are large decapod crustaceans that are typically recorded along the lower shore and in subtidal waters at depths of up to 200 m (Brown and Bennett, 1980; Tully, 2017). Juvenile brown crabs prefer intertidal and shallow inshore waters, while adults typically inhabit deeper areas (Mesquita *et al.*, 2021). Brown crab are often associated with rocky reefs but also inhabit mixed coarse grounds and soft sediments particularly offshore (Neal and Wilson, 2008).

3.4.18 Mature female crabs are known to undertake long-distance, seasonal migrations to offshore overwintering grounds following the mating season in spring and summer (e.g., Bennett, 1995; Fahy and Carroll, 2008; Ungfors *et al*., 2007). Sperm is temporary stored by female crabs before fertilisation takes place in late autumn or early winter (Bennett, 1995). The fertilised eggs are then carried by the females for 6-9 months before the pelagic larvae are released in spring to early summer (Brown and Bennett, 1980; Thompson *et al.*, 1995).

3.4.19 Berried females are thought to exhibit a largely sedentary lifestyle during the overwintering period whilst brooding their eggs. During this time, they do not feed and are thought to remain buried in sand and gravel substrates (Neal and Wilson, 2008; Thompson *et al.*, 1995). However, larval distribution data suggest that hatching of eggs may not be confined to the overwintering sites, but instead may occur over a wider area and range of substrates (Thompson *et al.*, 1995). The movements of male brown crabs are typically less directed and cover shorter distances (Bennett, 1995; Ungfors *et al.*, 2007).

3.4.20 The status of brown crab in the Irish Sea has long been considered stable (based on catch rates and recruitment), with their spawning potential considered to be largely protected by the minimum landing size of 140 mm carapace width (Tully, 2017). However, recent stock assessments (Marine Institute and Bord Iascaigh Mhara, 2023) indicate overall declines in crab biomass and landings for stocks off the north-western and south-western Irish Coast in more recent years. Data on the current state of the Irish Sea stock were not available.

3.4.21 The Commercial Fisheries technical baseline identifies potting vessels targeting brown crab across the temporary occupation area, being more prominent across the offshore ECC than the array area, particularly across the inshore waters that overlap with the Northern and Southern Corridors. This baited pot fishery occurs all year, but mainly from March to November.

## Lobster

3.4.22 European lobster are widely distributed in the Eastern Atlantic from Norway south to the Azores and the Atlantic coast of Morocco (Holthius, 1991). They are typically found on coarser ground and rocky reefs from the sublittoral fringe to water depths up to 150 m, although most commonly they are found at depths < 50 m (Holthius, 1991; Pawson, 1995).

3.4.23 Lobster are predominantly nocturnal and rely on suitable shelter throughout their life cycle (e.g., Paille *et al.*, 2002; Smith *et al.*, 1998). Juvenile lobsters are particularly sedentary and known to remain within their burrows to feed, while older individuals forage outside their burrows and generally prefer less complex habitats (Prodöhl *et al.* 2007; Smith *et al.*, 1998). Unlike edible crabs, lobsters are not thought to undertake extensive migrations and will move only a few kilometres away from shelter to find suitable foraging grounds (Pawson, 1995; Skerrit *et al.*, 2015; Smith *et al*., 2001).

3.4.24 Female lobster spawn annually or bi-annually during summer (Pawson, 1995; Prodöhl *et al.* 2007). Fertilised eggs are carried by the females for 10 to 12 months (Holthius, 1991), and hatching takes place in spring and early summer (Pawson, 1995). Unlike edible crabs, berried female lobsters do not typically exhibit a sedentary overwintering behaviour (Pawson, 1995).

3.4.25 The status of European Lobster is considered generally stable in the Irish Sea, with minimum landing size (MLS), maximum landing size and v-notching safeguarding against stock decline (Marine Institute and Bord Iascaigh Mhara, 2023).

3.4.26 Lobsters are mainly targeted to the north of Dublin Array in inshore waters (Marine Institute and Bord Iascaigh Mhara, 2022; Figure 23). The Commercial Fisheries technical baseline identifies potting vessels targeting lobsters across the study area, being more prominent across the offshore ECC than the array area. particularly the very close inshore waters that overlap with the Northern and Southern Corridors.

## King scallop

3.4.27 King scallop (*Pecten maximus*), also known as great scallop, are found along the eastern coasts of the North Atlantic from Norway south to the Iberian Peninsula, where they have been recorded from the low water mark down to 183 m water depth (Brand, 2016). They are most abundant between 20 to 45 m water depth and prefer areas of clean firm sand, fine gravel or sandy gravel exposed to water currents, which provide good feeding conditions (Brand, 2016; Marshall and Wilson, 2008). Adults are largely sedentary and usually found recessed in sediment (Szostek *et al.*, 2013). King scallop can live up to 20 years and reach reproductive maturity at 3-5 years at a size of 6 cm; the average maximum size is 16 cm (Marshall and Wilson, 2008).

3.4.28 The timing of spawning varies between stocks, with spawning typically occurring in spring (April to May) or early autumn (end of August to September (ICES, 2016; Marshall and Wilson, 2008). A bi-modal spawning pattern has been recorded for some stocks, such as in Manx waters, where 'spring spawning' and 'autumns spawning' has been observed (Marshall and Wilson, 2008). The duration of the planktonic larval phase is strongly dependent on water temperature, lasting typically 21 days in warm waters and more than 50 days under colder conditions (Hold *et al.*, 2021). Recruitment can be highly variable as it depends not only on successful spawning and larval production but also on larval retention and the transport of larvae to areas suitable for settlement. As a consequence, scallop beds frequently show a patchy distribution with spatial differences in age structure and recruitment mechanisms (Marshall and Wilson, 2008).

3.4.29 Across the study area, notable king scallops beds are located along the eastern edge of the array area (known as the Bray Offshore bed) and inshore between Bray Head and Dalkey (known as the Bray Inshore bed) (Marine Institute and Bord Iascaigh Mhara, 2023). The scallop ground located along the eastern edge of the array area was surveyed by the Marine Institute in 2023; the presence of scallops was confirmed by the survey and correlates with the areas identified as being targeted by the dredge fishery (Marine Institute and Bord Iascaigh Mhara, 2023). The distribution of scallops in the study area as indicated by fishing data is corroborated by the results of the site-specific dredge surveys, with scallops recorded to the east of the Kish and Bray Banks and along the offshore ECC in areas of gravelly sand and mixed sediments (Aquafact, 2018; Ecoserve 2008). The fishing pattern is periodic depending on the abundance of scallops at any given time. There may be years when only a few days are spent fishing in the area, and others when the area is targeted for two to three months.

3.4.30 Scallop in the Irish Sea represent spatially discrete stocks, though some stocks can be interconnected through larval dispersal. Larval dispersal simulations show connectivity between the south Irish Sea and north-east Celtic Sea, but limited east-to-west connectivity across the south Irish Sea between stocks in Cardigan Bay and off the Irish coast. There is also a general separation of stocks in the Northern Irish Sea and around the Isle of Man from stocks further south (Marine Institute and Bord Iascaigh Mhara, 2022).

## Queen scallop

3.4.31 Queen scallop (*Aequipecten opercularis*), occupy a similar geographic and depth range to King scallop, and both species are often found on the same grounds (Brand, 2016). However, unlike King scallop, Queen scallop do not usually recess into the seabed, and therefore they can also live on harder grounds such as gravel and shelly bottoms (Brand, 2016). They can live up to 8-10 years and reach a maximum size of 9 cm (Brand, 2000).

3.4.32 The species is fished commercially around Ireland and the UK, with particularly important commercial grounds around the Isle of Man. Within the study area and wider western Irish Sea region, queen scallop are typically fished during winter from December to the end of February (based on Marine Management Organisation (MMO) 2020 monthly landings statistics, see Commercial Fisheries technical baseline). Consultation with Scottish based scallop dredgers and MMO landing statistics indicate significant catches of queen scallop from the eastern edge of the Bray and Kish Banks, particularly east of Bray Bank (Commercial Fisheries technical baseline). The distribution of scallops in the study area as indicated by fishing data is corroborated by the results of the site-specific dredge surveys, with Queen scallops recorded to the east of the Kish and Bray Banks and along the Offshore ECC in areas of gravelly sand and mixed sediments (Aquafact, 2018; Ecoserve 2008).

## Razor shells

3.4.33 Razor shells (*Ensis* spp.) are elongated, suspension-feeding bivalves that inhabit vertical burrows in sand and muddy sediments from the intertidal to water depths of up to 40-60 m (Cross *et al.*, 2014; Fraser *et al.*, 2018). In the waters surrounding Ireland, three species of Ensis are of particular interest due to their commercial importance, namely the common razor shell (*Ensis ensis*), the curved razor shell (*E. magnus*) and the sword razor shell (*E. siliqua*) (Fahy and Gaffney, 2001; Fraser *et al.*, 2018). Of these, *E. siliqua* makes up the majority of landings from the study area (Marine Institute and Bord Iascaigh Mhara, 2023).

3.4.34 Razor shells breed annually, with the development of the gonads taking place throughout winter (Fraser *et al.*, 2018). Spawning typically occurs during spring and summer, and larvae settle onto the seabed after spending approximately one month in the water column (da Costa *et al.*, 2010; Fraser *et al.*, 2018). However, successful recruitment of razor shells has been shown to be irregular and sporadic (Fraser *et al.*, 2018). The size distribution of razor shells across intertidal beds has been found to vary spatially, with the largest clams typically found at greater depths (Fraser *et al.*, 2018). This indicates the possibility of post settlement movement of juvenile and possibly adult clams into deeper areas following their initial settlement in shallower areas (Marine Institute and Bord Iascaigh Mhara, 2023).

3.4.35 *E. siliqua* prefers clean fine sand (Fraser *et al.*, 2018) and is most commonly found in shallow subtidal waters at 3-7 m water depth (Cross *et al.*, 2014). The current fishery for *E. siliqua* in the western Irish Sea operates in about 4-14 m water depth (Figure 23), and it is thought that no large beds occur outside of those areas commercially fished (Marine Institute and Bord Iascaigh Mhara, 2023). During the site-specific survey, few razor shells were recorded within the study area including the offshore ECC (Aquafact, 2018; Ecoserve, 2008).

3.4.36 The stocks of *E. siliqua* in the northern Irish Sea are currently managed by a minimum landing size (125 mm shell length) and weekly quotas with the fishery closed on Sundays and in June during peak spawning (Marine Institute and Bord Iascaigh Mhara, 2023). Monitoring data indicate that large size classes were reduced between 2017-2018 but were stable or increasing between 2018 and 2021 (Marine Institute and Bord Iascaigh Mhara, 2022). Data on stock structure are limited, but larval dispersal and the movement of juveniles suggest relatively strong connectivity between beds along the east coast of the north Irish Sea, with the likelihood of self-recruiting beds assessed as being low (Marine Institute and Bord Iascaigh Mhara, 2023).

## Nephrops

3.4.37 Nephrops, also known as the Norway lobster and Dublin bay prawn is a small burrowing decapod crustacean, which is widely distributed throughout the north-east Atlantic and Mediterranean Sea at water depths of between 20-800 m (Hill and Sabatini, 2008). They are mainly found on fine cohesive muddy substrates that are stable enough to support the construction of complex burrow systems (Chapman, 1980). The burrows are typically up to 20-30 cm deep and can be up to 10 cm in diameter and over a metre long (Hill and Sabatini, 2008).

3.4.38 Nephrops in shallow waters (<50 m) usually stay within their burrows during the day (Chiesa *et al.*, 2010), probably to avoid predation (Chapman, 1980). At night they emerge to forage, feeding primarily on other crustaceans as well as sediment-dwelling molluscs, echinoderms, and polychaetes (Hill and Sabatini, 2008). In deeper water, a reversed feeding pattern has been observed with individuals being more active by day.

3.4.39 Juvenile and adult nephrops exhibit a high degree of site fidelity and show no evidence of migration (Hill and Sabatini, 2008). Tagging studies, for instance, have demonstrated that individuals stay close to their burrows during their adult life, while laboratory studies have shown territorial behaviour, particularly among adult males (Hill and Sabatini, 2008).

3.4.40 Nephrops in the Irish Sea spawn annually with the fertilisation of eggs typically occurring throughout August and September (Farmer, 1974). Fertilised eggs are incubated by the females under their abdomen for about 8-9 months. During this time, female nephrops tend to remain within their burrows, re-emerging in late March to July for the larvae to hatch (Dickey-Collas *et al.*, 2000; Farmer, 1974; Hill *et al.*, 1996). The planktonic larvae then spend several weeks in the water column before settling out, with suitable settlement areas being confined to muddy substrates (Dickey-Collas *et al.*, 2000; White *et al.*, 1988).

3.4.41 Nephrops populations are highly discontinuous with at least 30 populations occurring in European waters (Bell *et al.*, 2006, cited in O'Sullivan *et al.*, 2014). Nephrops within the study area are part of the western Irish Sea nephrops population, which inhabits the fine sediments of the Western Irish Sea Mud Belt from about 54.5°N in the north to 53.5°N in the south (Figure 3 21). Sediment deposition across the mud belt is high, driven by a low energy tidal regime and resulting in a substrate favourable for both juvenile and adult nephrops (Hill *et al.*, 1996). Burrow densities across the western Irish Sea nephrops ground are amongst the highest recorded for north-east Atlantic stocks, reaching an average density of up to one burrow per square metre (Lundy *et al.*, 2019). By contrast, the average size of adult individuals is comparatively small, which has been linked to high recruitment rates and/or suppressed growth due to competition (Johnson *et al.*, 2013).

3.4.42 The western Irish Sea nephrops population is believed to be stable, though isolated from surrounding populations with limited imports of larvae from outside the Irish Sea (O'Sullivan *et al.*, 2014; McGeady *et al.*, 2022). Across the western Irish Sea, larval dispersal is thought to be influenced by the Irish Sea gyre, a seasonal water circulation feature that forms above the western Irish Sea mud belt in spring and summer, partly coinciding with the nephrops larval dispersal period (Hill *et al.*, 1996). It has been suggested that the gyre promotes the retention of resident larvae and thus may provide an important mechanism to maintain the western Irish Sea nephrops population (Hill *et al.*, 1996).

3.4.43 Nephrops is commercially exploited throughout its geographic range. The western Irish Sea stock (assessed and managed as Functional Unit (FU) 15) supports one of the most productive nephrops fisheries in Irish waters, yielding landings of 5,000-10,000 tonnes annually over the last two decades (ICES, 2022f). nephrops is the main demersal species landed within the Irish Sea mixed fisheries from otter trawls. The focus of otter trawl fishing activity is located in ICES rectangle 36E4, with the main fishing grounds overlapping with the northern part of the underwater noise ZoI (Figure 24; Commercial Fisheries technical baseline; Marine Institute, 2016). Current stock abundance estimates for FU15 are well above the MSY reference trigger point, indicating that the western Irish Sea nephrops population is in a good state and harvested sustainably (ICES, 2022g; McGeady *et al.*, 2022).

## Blue mussel

3.4.44 Blue mussels are gregarious, suspension-feeding bivalves, which are common around European coasts from the high intertidal to the shallow subtidal down to about 30 m water depth (Knights, 2012; Seed and Suchanek, 1992). They can be found on any substratum providing a secure anchorage ranging from littoral estuarine sand and mudflats and sublittoral sediments to gravel, pebble and rocky shores and artificial structures such as piers and offshore oil platforms (Tyler-Walters, 2008).

3.4.45 . Blue mussels can form dense beds on both hard and soft substrate, creating a multi-layered framework of mussels where individuals remain connected through their byssus threads. Such beds can completely cover the substratum, or they consist of a mosaic of smaller mussel patches of various size and shape separated by open spaces (Seed and Suchanek, 1992). Spawning occurs in early summer, with a pelagic larval dispersal phase (Tully, 2017).

3.4.46 Stocks of blue mussels in the western Irish Sea consist mainly of seed mussel, which settle in spring on suitable substrates (Marine Institute and Bord Iascaigh Mhara, 2023). Seed mussel beds are thought to be ephemeral features that are washed out or predated on prior to the mussels maturing. Stock biomass changes seasonally and is mainly driven by recruitment and growth in spring and summer and mortality during winter (Marine Institute and Bord Iascaigh Mhara, 2023). Some sub-tidal mussel beds in the Irish Sea may, however, contribute significantly to larval production in some years. Given the ubiquitous distribution of blue mussel around the Irish coast and the planktonic larval dispersal phase of mussels blue mussels in the south Irish Sea (i.e., off Wicklow and Wexford) are likely to form one stock but may be separated from beds in the north Irish Sea owing to the different hydrodynamic regimes in these two areas (Marine Institute and Bord Iascaigh Mhara, 2023).

3.4.47 Wild mussel seed is dredged from the Irish Sea and other areas for growing in aquaculture sites licenced for the culture of bottom grown mussels (Tully, 2017). The current focus of the seed mussel fishery activity within the study area lies in inshore waters off Wicklow to the south of the temporary occupation area (Figure 23). Consultation with BIM (phone call 6th February, 2020) confirmed the absence of seed mussel beds on the Kish and Bray Banks as the sediment is considered too mobile across the banks for the establishment of mussel beds. Surveys have recorded beds close to the Shanganagh Waste Water Treatment Plant outfall, but these are not considered extensive enough to be of commercial value. Consultation with BIM further suggested that seed mussel beds are migrating south and that there remain only a few seed beds north of Wicklow. The historic seed site in Dalkey Sound (south of Dublin city) is now closed.

3.4.48 During the Dublin Array site-specific dredge and DDV surveys, blue mussels (including juveniles) were recorded in low numbers within the study area including the array area and the inshore sections of the offshore ECC, but there was no indication of mussel aggregations to be present at the surveyed sites (Aquafact, 2018; Ecoserve, 2008; Fugro, 2021).

## 3.5 Diadromous species

3.5.1 Diadromous fish are species that spend part of their lives in freshwater and part in saltwater, migrating between freshwater and marine environments at points in their life cycle. A classic example is the Atlantic salmon, which leave their natal rivers and enter the marine environment as juveniles (smolts) but return on a yearly basis to spawn in their natal rivers.

3.5.2 Diadromous species are not generally present in the study area for much of their life cycle. Nonetheless, they can be present at times when migrating to and from rivers and transitional waters bodies in the area, and they may therefore be affected by impacts arising from the development process as they transit the study area.

3.5.3 Diadromous fishes that may occur in the study area are Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*), European eel (*Anguilla Anguilla*), twaite shad (*Alosa fallax*) and lamprey species.

## Atlantic salmon

3.5.4 Atlantic salmon are of great biological, conservation and economic importance. During the life history of most populations, individuals begin their life in freshwater and then migrating to sea to feed and grow, before periodically returning to their home rivers to spawn. The strong homing behaviour of Atlantic salmon has resulted in a vast amount of genetically distinct salmon stocks across their distributional range (Gilbey *et al.*, 2021).

3.5.5 Atlantic salmon are listed on Annex II of the Habitats Directive as species whose conservation requires the designation of SACs. The nearest SACs designated for Atlantic salmon to the study area are the River Boyne and River Blackwater SAC and the Slaney River Valley SAC, which the estuaries of the respective rivers located 43 km to the north-west and 96 km to the south of the array area, respectively (Figure 26Figure 25). The Slaney River Valley SAC is also designated for the freshwater pearl mussel (*Margaritifera margaritifera*), which is closely linked with salmon populations, with pearl mussel larvae depending on juvenile Atlantic salmon as hosts (Taeubert and Geist, 2017; Skinner *et al.,* 2003).

3.5.6 Atlantic salmon are also classed as being under threat and/or in decline by OSPAR, and the IUCN has recently assessed Atlantic salmon as Near threatened at global scale (Darwall, 2023) on account of global declines in population densities. The species is listed as Vulnerable in both Irish (King *et al.*, 2011) and European (Freyhof, 2014) waters. The nearest rivers designated as Salmonid waters under the Salmonid River Regulations are the River Boyne and the River Dargle, the latter entering the Irish Sea at Bray approximately 2.5 km to the south of the offshore ECC (Figure 2).

3.5.7 In addition to the River Dargle, Atlantic salmon are known to be present within several rivers flowing into the study area, including the Rivers Varty, Liffey, Dodder and Tolka (IFI, 2018, 2022; Millane *et al.*, 2023; O'Connor, 2006; Figure 2), with the latter three rivers flowing into Dublin Bay about 19 to 20 km to the north-west of the array area.

3.5.8 The marine phase of Atlantic salmon begins between spring and early summer when large numbers of young salmon (smolts) leave Irish rivers to migrate into the rich feeding grounds of the Norwegian Sea and the greater expanse of the north-east Atlantic Ocean (e.g., Gilbey *et al.*, 2021; Holm *et al.*, 2000). On leaving natal rivers, it has been reported that salmon undertake a rapid and active migration away from their river of origin, as, for example, reported by Martin and Mitchell (1985) who caught post-smolts tagged in Scottish rivers in the Faroese fishery within 6 months of leaving freshwater. The return migration of salmon into their native rivers mainly takes place during spring and summer, and spawning occurs during the following autumn and winter (Finstad *et al.*, 2005).

3.5.9 A review of monthly fish counter returns on the Liffey shows that while salmon can run into the 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). However, since the 1980's the number of wild salmon returning to their natal Irish rivers has decreased from 15-20% to approximately 5%, indicating a decrease in salmon survival in the marine environment (Millane *et al.*, 2023). Analysis of data from fish counters indicate that salmon stocks within the Rivers Liffey, Boyne and Slaney are currently below river-specific conservation limits (Millane *et al.*, 2023).

3.5.10 The migratory routes of Atlantic Salmon away from coastal waters to their oceanic feeding grounds are generally poorly understood. Experimental post-smolt trawls in the Norwegian sea and Western Scotland have provided evidence for a northerly migration route for Irish salmon stocks in the early months of their long migration. Recent acoustic telemetry data suggest that young salmon (smolts) from the River Boyne and other rivers along the east coast of Ireland move north upon leaving their home rivers (Barry *et al.*, 2020). The tracking data further suggest that on leaving their natal rivers, smolts move rapidly away from the coast towards the deep waters of the Irish Sea, possibly to take advantage of the northwards flowing surface currents, which can assist their journey to the oceanic feeding grounds in the north-east Atlantic (Barry *et al.*, 2020). There is therefore potential that migratory smolts pass through the study area upon leaving their natal rivers. No information is available on the movement patterns of returning salmon; however, a similar pathway to that of outward moving smolts may be assumed.

3.5.11 Tracking data further suggest that salmon smolts within the south-east coast of Ireland (where the river Slaney is located) head in a south-westerly direction upon leaving the estuary (Rikardsen, *et al.*, 2021), suggesting that they do not migrate through the study area to reach their oceanic feeding grounds.

3.5.12 Atlantic salmon were not recorded during the site-specific trawl surveys (Aquafact, 2019; Saorgus Energy Limited, 2012). However, the evidence suggests that there is the potential for salmon smolt and adult salmon to pass through the study area during outward and return migrations.

## Sea trout

3.5.13 Sea/brown trout begins its life in freshwater (Celtic Sea Trout Project (CSTP), 2016). Juveniles may spend their entire life in natal streams or they may migrate to the sea; anadromous individuals are commonly referred to as sea trout (CSTP, 2016). Netting and tracking data for post-smolt sea trout provide evidence supporting relatively local movement along the coast for the first couple of months at sea (Finstad *et al.*, 2005). This is supported by more recent data (Barry *et al.*, 2020; CSTP, 2016), which indicate that a large proportion of sea trout remain relatively close to their river of origin, with those individuals undertaking longer distance migrations being strongly influenced by the prevailing currents of the area.

3.5.14 In contrast to Atlantic salmon, sea trout often return to freshwater to overwinter as well as to spawn. Spawning occurs in late autumn to early spring in river channels with suitable gradient over cobbly and gravelly substratum (King *et al.*, 2011).

3.5.15 Sea trout are widespread in all major rivers and lakes systems of Ireland, including the Boyne, Nanny, Dargle, and Varty (Cocoran *et al.*, 2022; CSTP, 2016; IFI, 2022). River systems flowing into Dublin Bay (i.e., Liffey, Tolka and Dodder) also support sea trout (CSTP, 2016; Holmes *et al.*, 2018). Environmental DNA (eDNA) samples collected upstream in rivers surrounding the onshore export cable route showed the presence of brown/sea trout within the Shanganagh River, the Carrickmines Stream and the Kill of The Grange River, confirming the wide distribution of trout in rivers draining into the study area (Terrestrial Ecology technical baseline). Of note is that the lower Shanganagh River is known to support anadromous sea trout; being unusual for an urban watercourse (Terrestrial Ecology technical baseline). On account of their wide distribution, sea trout are currently classed as of Least concern on the Global and Irish Red lists (Freyhof, 2011a; King *et al.*, 2011).

3.5.16 During site-specific trawls, sea trout were not recorded (Aquafact, 2019; Saorgus Energy Limited, 2012), but it is assumed that sea trout may be present in the coastal regions of the study area for at least a proportion of the year.

## European eel

3.5.17 European eel are demersal fish that are widely distributed across most European inland waters from Norway to the Mediterranean Sea down to the North African coastline (Pike *et al.*, 2020). It is a species of high conservation importance, being classed as Critically endangered on the Irish (King *et al.*, 2011), European (IUCN, 2023) and Global (Pike *et al.*, 2020) IUCN Red Lists. European eel are also listed as threatened and/or declining within the Celtic Seas OSPAR region, with its status remaining poor in all OSPAR regions where the species is present (OSPAR, 2022).

3.5.18 European eels have a complex life cycle. Adult eel spawn in the Sargasso Sea in the West Central Atlantic throughout late winter and early spring. The larvae then drift back towards Europe and North Africa within the North Atlantic Current and metamorphose into young (glass) eels. Many juvenile eels re-enter their home rivers and migrate upstream as glass eels or elvers, although some individuals remain in estuarine or coastal waters. After several years in fresh or coastal waters (yellow eel stage), eels metamorphose into silver eels and then return to the Sargasso to spawn after which they die (Arai *et al.*, 2006; Pike *et al.*, 2020).

3.5.19 European eel are present in many rivers on the east coast of Ireland including the Tolka, Dodder and Liffey river systems, which flow into Dublin Bay (e.g., IFI, 2008a,b; IFI 2010a,b). They have also been recorded in the rivers, Dargle, Varty, Avoca, Broad Meadow, Nanny, and Boyne (IFI, 2015; Technical Expert Group on Eel, 2021). eDNA samples collected upstream in rivers surrounding the onshore export cable route showed the presence of eel within the Shanganagh River, the Carrickmines Stream and the Kill-O-The-Grange River (Terrestrial Ecology technical baseline). No records of European eel were made during the site-specific trawls for Dublin Array, (Aquafact, 2019; Saorgus Energy Limited, 2012), but it is assumed that eel may be present in the study area for at least a proportion of the year.

3.5.20 Tagging studies suggests that European eels begin their oceanic migration from their home rivers to the spawning grounds in the Sargasso Sea between August and December (Righton *et al.*, 2016). Data collected from elver traps within the River Liffey showed inwardly migrating glass eels and elvers, with peak upstream movements of glass eels observed in April and May, while elver migration mainly occurred from May to July with an occasional year migration extending into August (Aquatic Services Unit, 2020).

3.5.21 Based on the critical status of European eel, no catches neither recreational nor commercial are currently allowed (ICES, 2022g). Eel populations in European waters are strictly managed under the European Eel Regulations (EC/1100/2007)[12], with an Irish Eel Management Plan in place since 2009 (Technical Expert Group on Eel, 2021).

## Lamprey species

3.5.22 There are three species of lamprey native to Ireland, the sea lamprey (*Petromyzon marinus*), the river lamprey (*Lampetra fluviatilis*) and the brook lamprey (*L. planeri*) (Kelly and King, 2001). Both river and sea lamprey are mainly anadromous, migrating from their marine feeding areas to freshwater to reproduce. The young larvae, known as ammocoetes, spend several years buried in freshwater sediments before undergoing metamorphosis into free-swimming adults. The young post-larval lampreys travel downstream to the sea, where they live for several years to mature before returning to riverine spawning grounds (Kelly and King, 2001; Kurz and Costello, 1999). Brook lamprey reside permanently in freshwater, inhabiting rivers and occasionally lakes (Maitland, 2003).

[12] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32007R1100

3.5.23 On the east coast of Ireland, river lamprey have been reported from the Rivers Boyne, Liffey, Dodder, Aughrim, and Avoca (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). In the south-eastern coastal regions, important spawning populations of river and sea lamprey are present within the Rivers Slaney, Barrow, Nore, Suir, and Munster Blackwater (Kelly and King, 2001; King and Linnane, 2004; King, 2006; Kurz and Costello, 1999).

3.5.24 In northwest Europe, the upstream spawning migration of mature sea lamprey into rivers occurs throughout spring and early summer, one or two months before the onset of spawning (Kelly and King, 2001; Maitland, 2003), while the seaward movement of newly metamorphosed young adults takes place during autumn and early winter (Kelly and King, 2001). The upstream migration of mature river lampreys from the sea to freshwater spawning streams typically begins in late summer and autumn (Kelly and King, 2001), and spawning takes place the following spring throughout March and April (Maitland, 2003). Newly metamorphosed young adults migrate downstream into estuaries between summer and late autumn/early winter (Kelly and King, 2001; Maitland, 2003).

3.5.25 The Lower Liffey is a known migratory corridor for river lamprey, and fish counter data suggest that migration takes place between September and April with peak periods in October to November and March to April (Aquatic Services Unit, 2020). Recent surveys of the Liffey confirmed the occurrence of juvenile lamprey within the river catchment (Triturus, 2020). These could be either brook or river lamprey, but because the two species are indistinguishable at the juvenile stage they are treated as paired species.

3.5.26 Most research on lamprey species has focussed on the freshwater portion of their life cycle, while the distribution and habitat requirements of lampreys at sea is poorly documented. River lampreys are reported to typically remain in estuarine areas during their marine stage, where they spend about one to two years feeding on a variety of fishes including herring, sprat, smelt and flounder (Kelly and King, 2001; Maitland, 2003). Adult sea lamprey have been recorded in both shallow coastal and deep offshore waters, with sightings as deep as 4,000 m (Kelly and King, 2001). The parasitic feeding phase of sea lamprey at sea is estimated to last between 18-30 months (King *et al.*, 2011; Silva *et al.*, 2013), and targeted hosts include basking sharks, cetaceans, and a variety of pelagic and demersal fishes such as herring, mackerel, cod, haddock and salmon (Kelly and King, 2001; Waldmann *et al.*, 2008).

3.5.27 All species of lamprey are protected as Annex II species under the EU Habitats Directive on account of dramatic population declines observed across Europe over the last decades (Kelly and King, 2001). The nearest SACs designated for river lamprey to the study area is the River Boyne and River Blackwater SAC, located inland 51.6 km to the north-west of the array area and 53.8 km to the north of the offshore ECC (Figure 26). There are no designated Natura 2000 sites for sea lamprey within or in the vicinity of the study area, with the nearest SAC protected for sea lamprey being the Slaney River Valley SAC, which is located approximately 96 km from the array area and offshore ECC (Figure 26). Sea lamprey are currently classed as threatened and/or declining within the Celtic Seas OSPAR region (OSPAR region III) and as Near threatened on the Ireland Red List (King *et al.*, 2011) and as of Least concern on a European scale (Freyhof, 2010). River lamprey are considered to be of Least concern in Ireland (King *et al.*, 2011) and on a global scale (Freyhof, 2011b).

### Twaite shad

3.5.28 The twaite shad is an anadromous species found in the north-east Atlantic Ocean, including the Irish Sea. The freshwater habitat requirements of twaite shad are not fully understood, but they are known to spawn at night in shallow areas near deeper pools, with their eggs sinking into the spaces between coarse gravel and cobble substrates (JNCC, 2021). Mature individuals start to migrate from the sea into suitable spawning rivers in early summer (April and May) and spawning takes place from May to July (King *et al.*, 2011; Maitland and Hatton-Ellis, 2003).

3.5.29 The distribution and habitat requirements of twaite shad while at sea are also poorly documented. The species is reported to prefer shallow waters at depths of 10-20 m, although it has also been recorded in deeper waters of up to 300 m (Maitland and Hatton-Ellis, 2003).

3.5.30 Twaite shad are protected under Annex II of the EU Habitats Directive, and the nearest SACs designated for the species is the Slaney River Valley SAC to the south of the study area (Figure 26). The species is currently classed as Vulnerable in Irish waters (King *et al.*, 2011)

## 3.6 Marine turtles

3.6.1 Five species of marine turtles have been recorded in Irish waters including leatherback turtle (*Dermochelys coriacea*), loggerhead turtle (*Caretta caretta)* and Kemp's Ridley turtle (*Lepidochelys kempii)* (King and Berrow, 2009). Of these, leatherback turtle is the most regularly reported around the coast of Ireland, accounting for just over 80% of all records (King and Berrow, 2009). Rare vagrant species to southern Irish waters include hawksbill turtle (*Eretmochelys imbricata*) and green turtle (*Chelonia mydas*) (King and Berrow, 2009).

3.6.2 Leatherback sea turtles are a migratory species that use the temperate waters of the North Atlantic to feed (Doyle, 2007). Sightings in the wider region are concentrated off the south and west coasts of Ireland, the southwest of England and the west coast of Wales; however, there are also records of leatherback turtles along the east coast of Ireland including the study area (King and Berrow, 2009; Penrose *et al.*, 2022). Most sightings in Irish waters occur in the summer months, with some records made during autumn (Penrose *et al.*, 2021). Leatherbacks are more likely to be found off the south and west coasts of Ireland because of their facing aspects, with a greater probability of leatherback occurrence in areas where food sources (jellyfish) regularly occur in high concentrations (Doyle, 2007). Irish oceanic waters may also support appreciable densities of foraging leatherbacks because of the high abundance of gelatinous zooplankton located there. Sightings and strandings of leatherback turtles have declined in recent years, which may be a result of several causes such as decreasing population abundances, changes to prey availability, increasing anthropogenic threats and reduced reporting effort (Botterell *et al.*, 2020).

3.6.3 Hard-shell turtle species including loggerhead and Kemp's Ridley turtles have also been identified as a migratory species that are occasionally sighted in Irish waters (Botterell *et al.*, 2020); however, most sightings, strandings and captures tend to occur on the western facing aspects of Ireland, with records decreasing with increasing latitude (Botterell *et al.*, 2020).

3.6.4 All five species of marine turtles recorded in Irish waters are included on the IUCN global Red List of Threatened Species, with leatherback and loggerhead turtle currently classed as Vulnerable, green turtle considered Endangered, and Kemp's Ridley turtle and hawksbill turtle assessed as being Critically endangered (IUCN, 2023). The sub-population of leatherback turtle that visits Irish coastal waters may well be what is termed the north-west Atlantic sub-population in the IUCN Red List (IUCN, 2023).

## 3.7 Species of conservation importance and designated sites

3.7.1 Species of conservation importance that have the potential to be present within the study area are listed in Table 6 below and shown in Figure 25 and Figure 26. Among the listed species, four are Annex II species under the EU Habitats Directive: river lamprey, sea lamprey, twaite shad and Atlantic salmon. European eel, listed on the Ireland Red List as Critically Endangered, also have the potential to occur within the study area. These species are all diadromous and have been considered further in Section 3.5 of this report.

3.7.2 The nearest Natura 2000 site to the study area with relevance to fish is the River Boyne and River Blackwater SAC, which is located inland 51.6 km to the north-west of the array area (Figure 26). The River Boyne estuary lies 43 km to the north-west of the array area and 42 km to the north-west of the offshore ECC. The site is designated for river lamprey and Atlantic salmon (NPWS, 2021). Along the south-east coast of Ireland, migrating fish species are afforded protection in the Slaney River Valley SAC (Figure 26). This site lies approximately 96 km to the south of the array area and offshore ECC and is designated for sea lamprey, brook lamprey, river lamprey, twaite shad and Atlantic salmon (NPWS, 2011). Whilst both SACs lie outside of the study area, they have been given due consideration due to the migratory nature of the protected features, and therefore the potential for the features to transit the study area.

3.7.3 Another SAC relevant to the protection of fish species is the Rockabill to Dalkey Island SAC, whose southern boundary marginally overlaps with the offshore ECC (Figure 25). The Conservation Objectives (COs) for this site include to provision to maintain the favourable conservation condition of harbour porpoise (*Phocoena phocoena*). Any human activities should occur at levels that do not adversely affect the harbour porpoise community at the site (NPWS, 2013a), which includes any activities and operations that may result in the deterioration of key resources upon which harbour porpoise depend, such as key prey stocks for feeding. Similarly, the Lambay Island SAC (Figure 25), designated for harbour porpoise, grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*), provides for the protection against activities that may affect key resources for feeding (NPWS, 2013b). Moreover, several SPAs designated for ornithology features including the South Dublin Bay and River Tolka Estuary SPA (NPWS, 2015), the Rockabill SPA (NPWS, 2013c), the North-west Irish Sea SPA (NPWS, 2023), Lambay Island SPA (NPWS, 2024a), Dalkey Islands SPA (NPWS, 2024b) and The Murrough SPA (NPWS, 2024c) (Figure 25) include COs that provide for the protection of key bird foraging grounds and prey species such as sandeel. Table 5 summarises the Natura 2000 sites that were identified to be of relevance to fish and shellfish ecology.

3.7.4 Cartilaginous fish species listed under the Ireland Red List No. 11 (Clarke *et al.*, 2016) with the potential to occur within the study area include basking shark, tope, spurdog, cuckoo ray, blonde ray, nursehound, spotted ray, thornback ray, starry smooth-hound and lesser-spotted dogfish (see Section 3.3). These species will be considered further in the EIAR due to their potential sensitivity to changes in electromagnetic fields, which could result from cable installation. Since 2021, basking sharks are also protected under Irish law by the Wildlife Act (1976) (as amended). Eel populations in European waters are strictly managed under the European Eel Regulations, with an Irish Eel Management Plans in place since 2009 (Technical Expert Group on Eel, 2021).

Table 5 Natura 2000 sites relevant to fish and shellfish receptors

| Site code | Site name | Relative location to the temporary occupation area | Qualifying/supporting fish and shellfish features | Relevance for fish and shellfish receptors |
|---|---|---|---|---|
| SACs | | | | |
| 002299 | River Boyne and River Blackwater SAC | Located inland; the mouth of the River Boyne is located 43 km from the array area and 42 km from the offshore ECC | River lamprey and Atlantic salmon | COs provide protection of features. |
| 000781 | Slaney River Valley SAC | The Slaney estuary is located 96 km from the array area and offshore ECC | Twaite shad, river lamprey, Brook lamprey, sea lamprey, Atlantic salmon, freshwater pearl mussel | COs provide protection of features. |
| 003000 | Rockabill to Dalkey Island SAC | Overlaps with the offshore ECC and is located 1.8 km east of the array area | Harbour porpoise | COs provide for the protection against activities that have the potential to adversely affect the harbour porpoise community at the site, which includes activities that may affect key fish prey resources. |
| 000204 | Lambay Island SAC | Located 18.4 km north of the offshore ECC and 19.2 km north of the array area. | Harbour porpoise, grey seal, harbour seal | COs provide for the protection against activities that have the potential to adversely affect the harbour porpoise and seal communities at the site, which includes activities that may affect key resources (e.g., water quality and feeding). |
| 003015 | Codling Fault Zone SAC | Located 14.5 km south of the array area and 18.3 km south of the offshore ECC. | Harbour porpoise | No COs published for the harbour porpoise qualifying interest. |
| SPAs | | | | |

| Site code | Site name | Relative location to the temporary occupation area | Qualifying/supporting fish and shellfish features | Relevance for fish and shellfish receptors |
|---|---|---|---|---|
| 004024 | South Dublin Bay and River Tolka Estuary SPA | Located 5.9 km from the offshore ECC and 12.1 km from the array area | Designated for ornithology features, including roseate tern (*Sterna dougallii*), common tern (*S. hirundo*), and Arctic tern (*S. paradisaea*) | COs provide for the protection of prey biomass, with key prey items including crustaceans and small fish, mainly clupeids, sandeel and gadoids. |
| 004236 | North-west Irish Sea SPA | Located 3.4 km to the north of the array area and 10.5 km from the offshore ECC | Designated for several ornithology features | COs provide for the protection of foraging grounds and forage biomass of species the protected bird species rely on as prey, which include fish and crustaceans. |
| 004014 | Rockabill SPA | Located 28.5 km from the array area and 35.3 km from the offshore ECC | Designated for ornithology features, including roseate tern, common tern and Arctic tern | COs provide for the protection of prey biomass, with key prey items including crustaceans and small fish, mainly clupeids, sandeel and gadoids. |
| 004069 | Lambay Island SPA | Located 18.4 km north of the offshore ECC and 19.2 km north of the array area. | Designated for ornithology features, including kittiwake (*Rissa tridactyla*) and puffin (*Fratercula arctica*) | COs provide for the protection of prey biomass, with key prey items including fish of families Ammodytidae (sandeels), Gadidae, Clupeidae, Cottidae and Labridae. |
| 004172 | Dalkey Islands SPA | Located 2.2 km north of the offshore ECC and 8.6 km west of the array area | Designated for ornithology features, including roseate tern, common tern and Arctic tern | COs provide for the protection of prey biomass, with key prey items including crustaceans and small fish, mainly clupeids, sandeel and gadoids. |
| 004186 | The Murrough SPA | Located 11.3 km south of the offshore ECC and | Designated for ornithology features, including little tern. | COs provide for the protection of prey biomass, with key prey items including |

| Site code | Site name | Relative location to the temporary occupation area | Qualifying/supporting fish and shellfish features | Relevance for fish and shellfish receptors |
|---|---|---|---|---|
| | | 8.5 km south of the array area | | crustaceans and small fish, mainly clupeids, sandeel and gadoids. |

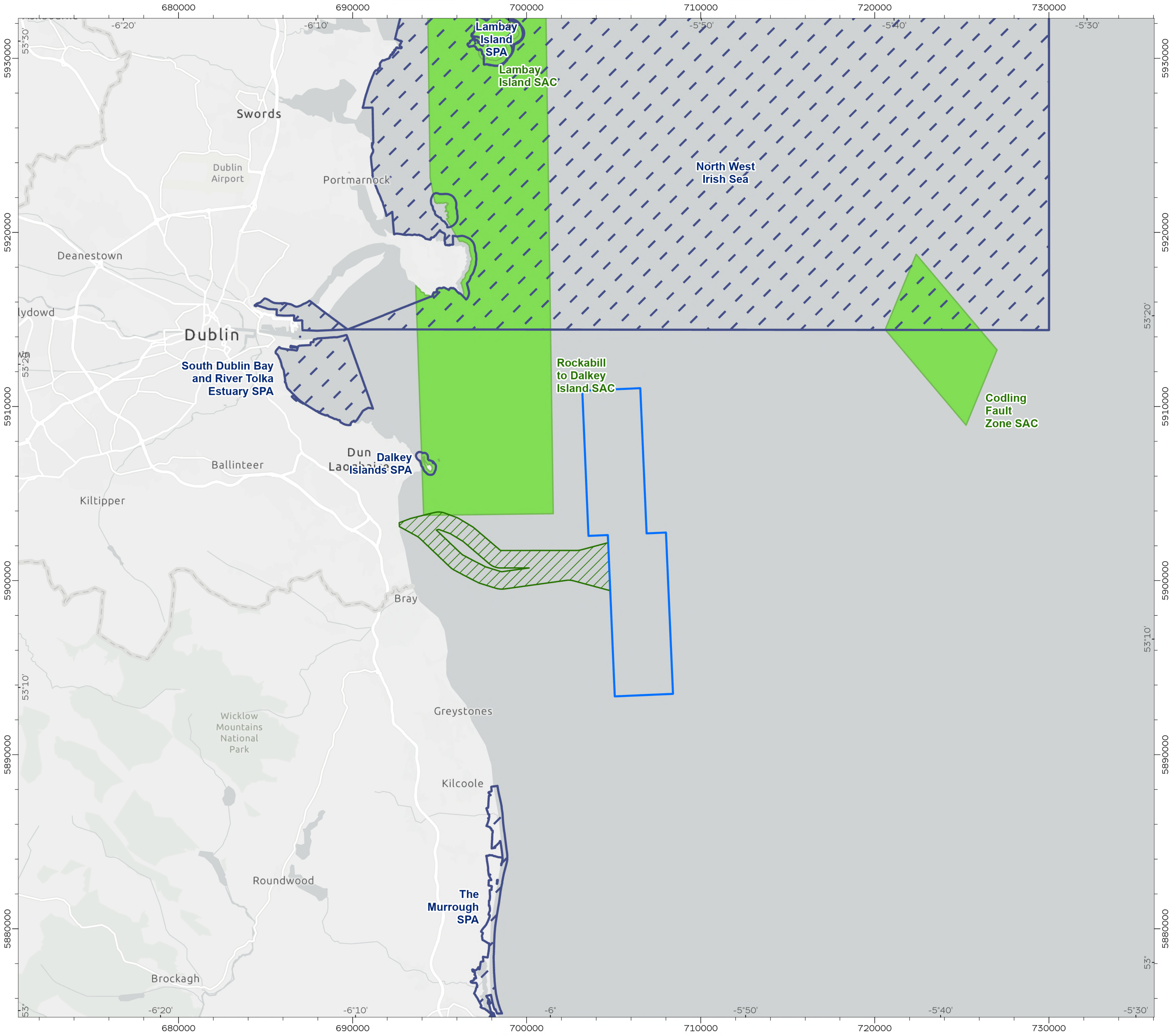
Table 6 Species of conservation importance with the potential to occur within the study area

| Species | European Habitats Directive | Ireland Red List (King *et al.*,2011; Clarke *et al.*, 2016) | IUCN Red List of Threatened Species (2023) | Bonn Convention (1979) | OSPAR List of Threatened and/or declining species and habitats[13] |
|---|---|---|---|---|---|
| River Lamprey | II, V | Least concern | Least concern | N/A | N/A |
| Sea Lamprey | II | Near threatened | Least concern | N/A | X |
| Atlantic Salmon | II, V | Vulnerable | Near threatened | N/A | X |
| European Eel | N/A | Critically endangered | Critically endangered | II | X |
| Twaite shad | II | Vulnerable | Least concern | N/A | N/A |
| Atlantic cod | N/A | N/A | Vulnerable | N/A | X |
| Basking shark | N/A | Endangered | Endangered | I, II | X |
| Tope | N/A | Vulnerable | Critically endangered | II | N/A |
| Spurdog | N/A | Endangered | Vulnerable | II | X |
| Nursehound | N/A | Least concern | Vulnerable | N/A | N/A |
| Cuckoo ray | N/A | Vulnerable | Least concern | N/A | N/A |
| Blonde ray | N/A | Near threatened | Near threatened | N/A | N/A |
| Spotted ray | N/A | Least concern | Least concern | N/A | X |

[13] Listed as threatened and/ or declining in OSPAR Region III (the Celtic Seas), which includes the Irish Sea.

| Species | European Habitats Directive | Ireland Red List (King *et al.*,2011; Clarke *et al.*, 2016) | IUCN Red List of Threatened Species (2023) | Bonn Convention (1979) | OSPAR List of Threatened and/or declining species and habitats[13] |
|---|---|---|---|---|---|
| Thornback ray | N/A | Least concern | Near threatened | N/A | N/A[14] |
| Starry smooth-hound | N/A | Least concern | Near threatened | N/A | N/A |
| lesser-spotted dogfish | N/A | Least concern | Least concern | N/A | N/A |
| Leatherback turtle | N/A | N/A | Vulnerable | I, II | X |
| Loggerhead turtle | N/A | N/A | Vulnerable | I, II | N/A |
| Kemp's Ridley turtle | N/A | N/A | Critically endangered | I, II | N/A |
| Hawksbill turtle | N/A | N/A | Critically endangered | I, II | N/A |
| Green turtle | N/A | N/A | Endangered | I, II | N/A |

[14] Thornback ray are on the OSPAR list of threatened and/or declining species, but are currently considered to be under threat only in OSPAR region II (North Sea). https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats/fish/thornback-ray





- Array Area
- Export Cable Corridor
- Special Area of Conservation
- Special Protection Area

DRAWING STATUS

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PROJECT TITLE

## Dublin Array

DRAWING TITLE

## Designated Natura 2000 Sites Relative to the Study Area

DRAWING NUMBER: 25

PAGE NUMBER: 1 of 1

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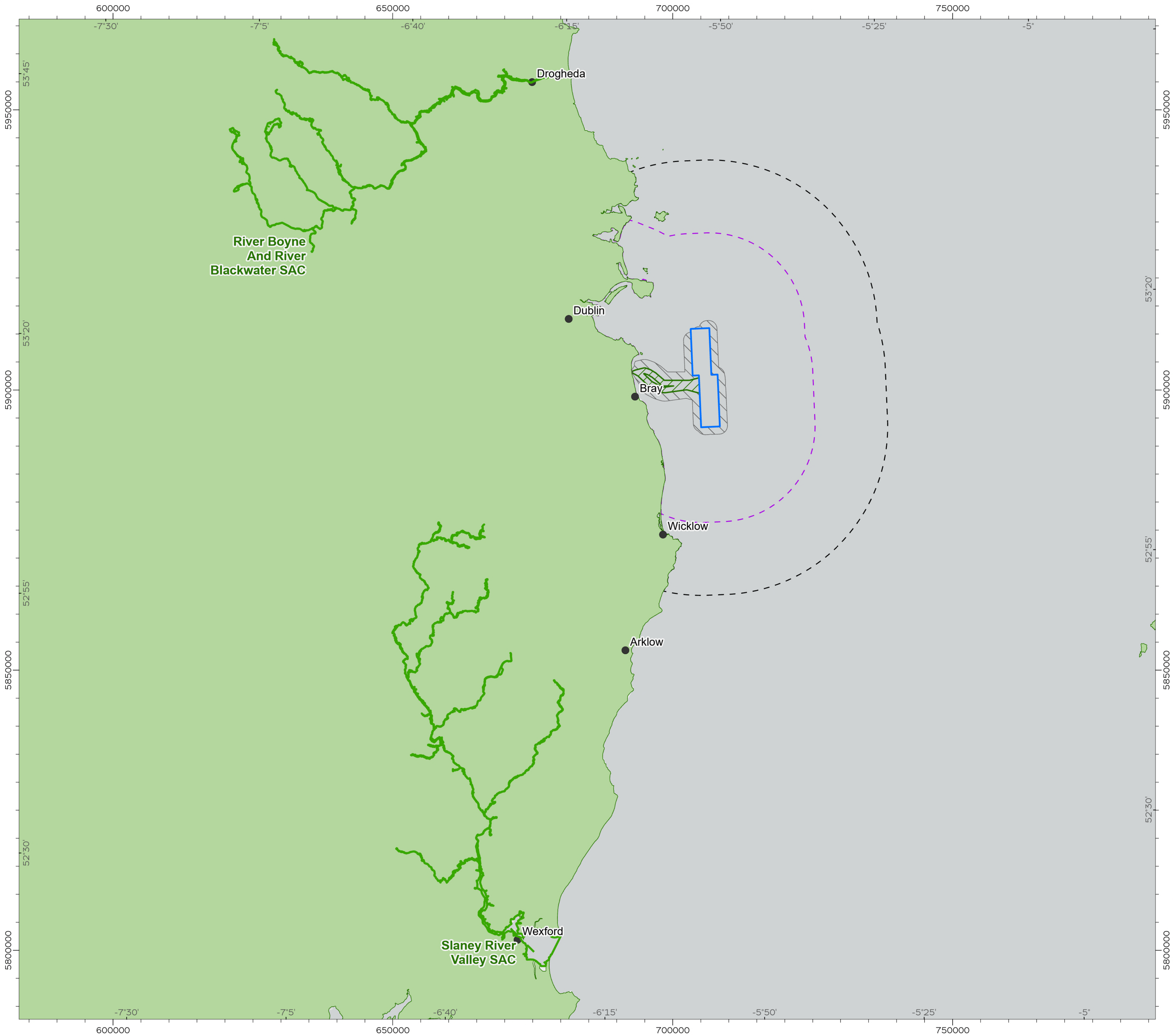
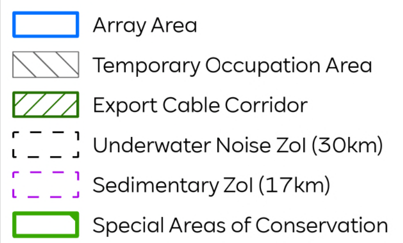
GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited





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PROJECT TITLE

# Dublin Array

DRAWING TITLE

## Designated Natura 2000 Sites for Diadromous Fish Relative to the Study Area

DRAWING NUMBER: 26

PAGE NUMBER: 1 of 1

| VER | DATE | REMARKS | DRAW | CHEK | APRD |
|---|---|---|---|---|---|
| 01 | 2024-05-21 | For Issue | GB | BB | SS |

0 6 12 18 24 km
0 3 6 9 12 nm

N
GRID NORTH

| | | | |
|---|---|---|---|
| SCALE | 1:700,000 | 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

## 3.8 Valued ecological receptors

3.8.1 The impact assessment for fish and shellfish species has taken a Valued Ecological Receptor (VER) approach to determine which species to take forward to the impact assessment stage. This allows the assessment to focus on important ecological features that might be affected by the proposed development (Chartered Institute of Ecology and Environmental Management (CIEEM), 2018). The value of ecological features is dependent upon a range of factors, including their biodiversity, social and economic value within a geographic framework of appropriate reference (CIEEM, 2018). The most straightforward context for assessing ecological value is to identify those species and habitats that have a specific biodiversity importance recognised through international or national legislation or through local, regional or national conservation plans (e.g., species listed on the IUCN Red List of Threatened Species, on Ireland's Red List and those species protected under the European Habitats Directive). The evaluation of value has also assessed the receptor the potential for migratory species to transit the study area and the importance of the study area to support key life stages, such as spawning and nursery periods.. The criteria used to inform the selection of VERs are listed in Table 7 below.

Table 7 Categories used to inform the valuation of ecological receptors in the Dublin Array fish and shellfish study area

| VER Value | VER criteria used to define value |
|---|---|
| International | Species protected under international law (i.e., Bonn Convention Appendix II species). Species classed as threatened and/or declining within the Celtic Seas OSPAR region. Species listed as Critically Endangered or Endangered on the IUCN Red List. |
| National | Species protected under national law (i.e., Annex II species listed as features of SACs) within the National Site Network. Annex II species which are not listed as features of SACs in the study area. Species that have spawning or nursery areas within the study area that are important nationally (e.g., may be primary spawning/nursery area for that species). Species listed as Critically Endangered or Endangered on the Ireland Red List. |
| Regional | Species that have regionally important populations within study area (are locally widespread and/or abundant). Species of commercial importance to fisheries in the study area and wider western Irish Sea region. Species of ecological importance, i.e., species that are an important prey for other species) of conservation or commercial value and that are key components of the assemblages in the study area. Species that have spawning or nursery area within the study area that are regionally important. |
| Local | Species of commercial importance that do not form a key component of the assemblages within the study area. The spawning/nursery area for the species is located outside of the study area. The species is common |

| VER Value | VER criteria used to define value |
|---|---|
| | throughout Ireland but forms a component of the assemblages in the study area. |

3.8.2 With consideration of each receptor's distribution and presence, spawning and nursery activity, as well as their commercial, conservation and ecological importance, an assessment of the value of each of these receptors within the defined study area, and therefore those species considered valued ecological receptors (VERs) has been provided in Table 8.

Table 8 Summary of fish and shellfish VERs and their value/importance within the Dublin Array fish and shellfish study area

| VER | Valuation | Justification |
|---|---|---|
| Demersal VERs | | |
| Plaice | Regional | Study area overlaps high intensity spawning and low intensity nursery grounds. Plaice was regularly caught in site-specific surveys and was also abundant in regional surveys. A species of commercial importance in the study area. |
| Common dab | Regional | Dab was regularly caught in site specific surveys and was also recorded in regional surveys. The array area is likely to overlap with important dab nursery grounds. |
| Common sole | Regional | Study area overlaps with spawning grounds. Recorded in low numbers during regional surveys. A species of commercial importance in the study area. |
| Lemon sole | Regional | Study area overlaps spawning and nursery grounds. Lemon sole was also recorded in site-specific and regional surveys. |
| Atlantic cod | International | Study area overlaps low and high intensity spawning grounds and high intensity nursery grounds. Cod was also recorded in site-specific and regional surveys. A species of conservation importance listed on the OSPAR list of threatened and/or declining species and as Vulnerable on the IUCN Red List. |
| Whiting | Regional | Study area overlaps low intensity spawning and high intensity nursery grounds. Whiting was also recorded in site-specific surveys and was abundant in regional surveys. |
| Haddock | Regional | Study area overlaps spawning and nursery grounds. Haddock was also abundant in site-specific and regional surveys. A species of commercial importance in the study |

| VER | Valuation | Justification |
|---|---|---|
| | | area. A species of conservation importance listed as Vulnerable on the global IUCN Red List. |
| Poor cod | Regional | Recorded in site-specific and regional surveys. Study area likely to overlap with spawning and nursery grounds. |
| Anglerfish | Regional | Recorded in low numbers during site-specific and regional surveys. Study area is likely to overlap nursery grounds. A species of commercial importance in the study area. |
| Pelagic VERs | | |
| Sprat | Regional | Study area overlaps spawning grounds. Sprat was also recorded in site-specific surveys and was abundant in regional surveys. |
| Atlantic mackerel | Regional | Study area overlaps low intensity spawning and low intensity nursery grounds. Mackerel was also recorded in site-specific and regional surveys. |
| Atlantic horse mackerel | Regional | Study area overlaps spawning and nursery grounds. Atlantic horse mackerel was also recorded in site-specific and regional surveys. A species of commercial importance. |
| Substrate-spawning VERs | | |
| Atlantic herring | Regional | Study area overlaps nursery grounds. Herring was recorded in regional surveys. Important prey species for larger fish, birds and marine mammals. |
| Sandeel | Regional | Study area overlaps low intensity spawning and nursery grounds. Sandeel was also recorded in site-specific and regional surveys. Important prey species for fish, birds and marine mammals. |
| Diadromous VERs | | |
| European eel | International | A species of conservation importance listed on the OSPAR list of threatened and/or declining species, in Appendix I of the Bonn Convention, and as Critically endangered on the Ireland and IUCN Red Lists. Protected under the Irish Eel Management Plan. Potential for this species to transit the study area. |
| Atlantic salmon | International | A species of conservation importance listed as EU Habitats Directive Annex II and V species, on the OSPAR list of threatened and/or declining species, and as Vulnerable on the Ireland Red List and as Near threatened on the IUCN Red List. Potential for this species to migrate through the study area. |
| Sea lamprey | International | A species of conservation importance listed within the EU Habitats Directive Annex II species, on the OSPAR list of |

| VER | Valuation | Justification |
|---|---|---|
| | | threatened and/or declining species and as Near threatened on the Ireland Red List. Potential for this species to be present within the study area. |
| River lamprey | National | A species of conservation importance listed as EU Habitats Directive Annex II and V species. Potential for this species to be present within the study area. |
| Sea trout | Regional | Potential for this species to be present within the study area. |
| Twaite shad | National | A species of conservation importance listed as EU Habitats Directive Annex II species. Potential for this species to transit the study area. |
| Elasmobranch VERs | | |
| Basking shark | International | A species of conservation importance listed on the OSPAR list of threatened and/or declining species, in Appendices I and II of the Bonn Convention, and as Endangered on the Ireland and IUCN Red Lists. Protected under the Irish Wildlife Act. |
| Lesser-spotted dogfish | Regional | Study area may overlap with breeding and nursery grounds. Lesser-spotted dogfish was abundant in site-specific and regional surveys. A species of commercial importance. |
| Nursehound (bull huss) | Regional | Nursehound was recorded in site-specific and regional surveys. A species of conservation importance listed as Vulnerable on the IUCN Red List and as Least concern on the Ireland Red List. |
| Spurdog | International | Spurdog were recorded in regional surveys. Study area overlaps with nursery grounds. A species of conservation importance listed on the OSPAR list of threatened and/or declining species, on Appendix II of the Bonn Convention, and as Endangered on the Ireland and European IUCN Red Lists and as Vulnerable on the global IUCN Red List. |
| Tope | International | Study area is likely to overlap with nursery grounds. Tope was also recorded in site-specific and regional surveys. A species of conservation importance listed on Appendix II of the Bonn Convention, and as Vulnerable on the Ireland Red List and as Critically endangered on the IUCN Red Lists. |
| Starry smooth-hound | Regional | Starry smooth-hound was recorded regularly in site-specific and regional surveys. A species of conservation importance listed as Near threatened on the IUCN Red List. |

| VER | Valuation | Justification |
|---|---|---|
| Thornback ray | Regional | Study area overlaps nursery grounds. Thornback rays were regularly recorded in site-specific and regional surveys. A species of commercial importance. A species of conservation importance listed as Near threatened on the IUCN Red List. |
| Spotted ray | International | Study area overlaps nursery grounds. Spotted rays were observed in site-specific and regional surveys. A species of conservation importance listed on the OSPAR list of threatened and/or declining species. |
| Blonde ray | Regional | Blonde ray was recorded in site-specific and regional surveys. A species of commercial importance in the study area. A species of conservation importance listed as Near threatened on the Ireland and IUCN Red Lists. |
| Cuckoo ray | Regional | Cuckoo rays were observed in site-specific and regional surveys. A species of conservation importance listed as Vulnerable on the Ireland Red List. |
| Shellfish VERs | | |
| Common whelk | Regional | A species of commercial importance in the study area. |
| Brown crab | Regional | A species of commercial importance in the study area. |
| European lobster | Regional | A species of commercial importance in the study area. |
| King and Queen scallop | Regional | A species of commercial importance in the study area. |
| Razor shells | Regional | A species of commercial importance in the study area. |
| Nephrops | Regional | A species of commercial importance in the study area. |
| Blue mussels | Regional | A species of commercial importance in the study area. |
| Marine turtle VERs | | |
| Leatherback turtle, loggerhead turtle, Kemp’s Ridley turtle, hawksbill turtle, green turtle | International | All five species are of conservation importance listed on Appendix I and II of the Bonn Convention, with leatherback turtle also considered under threat and/or declining within the Celtic Seas OSPAR region. Potential for these species to transit the study area. |

# 4 Future receiving environment

4.1.1 Rising sea temperatures, ocean acidification, ocean deoxygenation and rising sea levels have been identified as four of the key stressors impacting the state of the world's oceans and coastal environments (EPA, 2020). Recent and projected future changes in the temperature and chemistry of marine waters around Ireland are having, and will in the future have, effects on the phenology, productivity and distribution of marine fish and shellfish (Heath *et al.*, 2012). However, the overall consequences are still hard to predict because fish behaviour, genetic adaptation, habitat dependency and the impacts of fishing on species, result in complex species' responses that may be only partially explained by simple climate envelope predictions.

4.1.2 There is a broad body of evidence to suggest that climatic fluctuations and associated changes in ocean chemistry are playing an important role in changing fish distributions, abundances and community composition in the north-east Atlantic region (e.g., Heath *et al.*, 2012; Townhill *et al.*, 2023). Fish and shellfish play a pivotal role in the transfer of energy from some of the lowest to the highest trophic levels within the ecosystem and serve to recycle nutrients from higher levels through the consumption of detritus. Consequently, their populations will be determined by both top-down factors, such as ocean climate and plankton abundance, and bottom-up factors, such as predation.

4.1.3 Climate effects may influence fish and shellfish species in a variety of ways, from changes in species distributions and community composition, growth rates, recruitment, behaviour, survival to alterations in food web structures. For example, ocean warming has caused many species to move northward or into deeper, colder waters (Simpson *et al.*, 2013), a trend that is predicted to continue in the future (e.g. Townhill *et al.*, 2023). The Celtic Seas ecoregion (which incorporates the Irish Sea) is at the edge of the geographical range of several species, potentially making these species more susceptible to environmental variation (ICES, 2022a).

4.1.4 Sandeel are one species identified of concern as they are less likely to be able to adapt to increasing temperatures; declining recruitment in sandeel in parts of the UK has been linked to changes in their copepod prey, which in turn has been linked to increasing temperature (Heath *et al.*, 2012; Regnier *et al.*, 2019).

4.1.5 Climate change may also affect key life history stages of fish and shellfish species, including the timing of spawning migrations (BEIS, 2016). Fish may also be affected by climate indirectly, in particular through changes in the availability of prey species. However, climate change effects on marine fish populations are difficult to predict and the evidence is not easy to interpret, and therefore it is difficult to make accurate estimations of the future baseline scenario for the entire lifetime of the proposed development.

4.1.6 In addition to climate change, overfishing subjects the populations of many fish species to considerable pressure, reducing the biomass of commercially valuable species, and non-target species. Overfishing can reduce the resilience of fish and shellfish populations to other pressures, including climate change and other anthropogenic impacts. For example, a study on cod in an area where trawl fishing has been banned in the North Sea since 1932 indicated that this population was significantly more resilient to environmental change (including climate change) than populations in neighbouring fished areas (Lindegren *et al.* 2010).

4.1.7 The 2023 Stock Book (Marine Institute, 2023) reports that of the commercial stocks fished around the Irish coast 51% are considered to be sustainably fished (i.e., 38 out of 74 fish stocks assessed), while 24% of stocks are currently considered to be overfished. Overall, the stock assessment data show a long-term increase in the number of stocks sustainably harvested.

4.1.8 ICES's recent ecosystem overview of the Celtic Sea (ICES, 2022a), which includes a large part of the Irish Exclusive Economic Zone (EEZ), found that overall fishing pressure on the commercial fish and shellfish stocks in the Celtic Sea ecoregion has decreased since its peak in 1998. Overall biomass of commercial fish and shellfish stocks in the Celtic Sea has increased since the late 1990s. The fishing footprint and the average number of times the seabed is trawled per year have reduced. However, there are still a number of species with very low spawning stocks in some areas, particularly cod and sole in the Irish Sea (ICES, 2022a,b).

4.1.9 The fish and shellfish baseline characterisation described in the preceding sections represents a 'snapshot' of the fish and shellfish assemblages of the Irish Sea, within a gradual and continuously changing environment. Any changes that may occur during the lifetime of the project (i.e., construction, operation and decommissioning) should be considered in the context of the natural variability and other existing anthropogenic effects, including climate change, overfishing and other environmental impacts.

# 5 Data gaps or uncertainties

## 5.1 Data limitations

5.1.1 Mobile species such as fish, by their nature, exhibit varying spatial and temporal patterns, and their distribution and standing stocks may vary considerably both seasonally and annually. The data collected during the site-specific surveys, therefore, inevitably represents 'snapshots' of the fish and shellfish assemblages within the Dublin Array at the time of sampling.

5.1.2 Furthermore, the efficiency at collecting certain species will vary depending on the sampling gear deployed. For example, the semi-pelagic otter trawl would not collect pelagic species (e.g. herring and sprat) as efficiently as a pelagic trawl, and a 2 m scientific beam trawl will not be as efficient at collecting sandeel and shellfish species as other methods used commercially in the study area (e.g. sandeel or shrimp trawls and shellfish creels).

5.1.3 To account for these limitations, the characterisation of fish and shellfish resources has not relied solely on site-specific survey data but was also informed by historic regional and industry-specific data and information from the scientific literature.

5.1.4 Some uncertainties are also associated with the broad-scale data layers that were used to identify the locations of nursery and spawning grounds and associated spawning and pupping periods (Coull *et al.*, 1998; Ellis *et al.*, 2010, 2012). Many of the conclusions drawn by Coull *et al.* (1998) are based on historic data and may therefore not account for more recent changes in fish distributions and spawning behaviour available since its publication. The maps by Ellis *et al*. (2010, 2012) also face some limitations due to the often large spacing of sampling sites used for the annual international larval survey data, which is used as a key data source, consequently resulting in broader scale grids of spawning and nursery grounds than those presented by Coull *et al.* (1998).

5.1.5 Nonetheless, the spatial extents of the spawning grounds mapped by Coull *et al.* (1998), Ellis *et al.* (2010, 2012) and the Marine Atlas (Marine Institute, 2016) are considered to represent the widest known distribution within which spawning will occur, while the duration of spawning periods indicated in these studies is considered likely to represent the maximum duration of spawning (Coull *et al.*, 1998). Therefore, these maps provide a precautionary basis for assessing impacts on spawning activity.

5.1.6 Active or particularly important spawning grounds for some species may be smaller in extent and spawning periods may be shorter than are indicated by the Coull *et al.* (1998), Ellis *et al.* (2010; 2012) and Marine Institute data. Therefore, where available, additional research publications and data were reviewed to provide the best, most contemporary and site-specific information on fish and shellfish spawning and nursery behaviour.

5.1.7 When considering demersal spawners that display substrate dependency (herring and sandeel), site specific PSA data from recent grab (Fugro, 2021) and dredge surveys (Aquafact, 2018) were analysed to ground-truth the Coull *et al.* (1998) and Ellis *et al.* (2010) datasets. In addition, INFOMAR (2023) broadscale marine habitat maps were used to support the identification of preferred sandeel and herring spawning grounds within the study area. It should be acknowledged, however, that these predictive maps are limited by the broadscale nature of their underlying data and do not account for small-scale, localised differences in seabed sediments, unlike the data obtained from site-specific surveys. Nevertheless, it is important to review all available datasets to develop a clear overview of potential sandeel and herring spawning grounds.

5.1.8 Despite their limitations, the data presented in this report are considered to provide a robust and sufficient evidence base to inform the fish and shellfish baseline characterisation and underpin the impact assessment process.

# 6 Summary

6.1.1 This study has described the key attributes of the fish, shellfish and marine turtle communities in the study area and identified valuable features including the distribution of key fish and shellfish species, spawning and nursery activity, diadromous species and species of commercial and conservation importance. This section provides a summary of each of the fish and shellfish receptors that have the potential to be impacted by the Dublin Array offshore windfarm and therefore require consideration in the EIAR.

6.1.2 The fish and shellfish resources within the study area were found to be typical of the assemblages known to occur across the Irish Sea, with many commercially important fish and shellfish species, species protected under conservation legislation and ecologically important species recorded during site-specific and regional surveys.

6.1.3 Whelk are known to be the most important commercial shellfish species in the study area, with whelk being almost exclusively targeted within the array area, and nephrops having a large fishery located to the north of the site, partly overlapping with the ZoIs. European lobster and brown crab were both found to have regional importance, although both species have larger and more productive fisheries located off the south, west and northwest coasts of Ireland.

6.1.4 No Natura sites designated for fish and shellfish species overlap with the study area; however, there is potential for migratory species of international / national (Atlantic salmon, sea lamprey, river lamprey, European eel, twaite shad) or regional importance (sea trout) to be present within the study area during migratory periods or while living at sea.

6.1.5 Various fish and elasmobranch species were identified that have spawning and/ or nursery grounds within the study area. For example, high intensity plaice spawning grounds, and low intensity sandeel spawning grounds overlap with the study area; in addition to this, high intensity cod, herring and whiting nursery grounds are also located across the site. The review of existing information and site-specific data suggests that the Kish and Bray Banks are an important nursery ground for juvenile fish and elasmobranchs such as haddock, cod, plaice, dab and spotted ray. Several elasmobranch species including lesser-spotted dogfish, nursehound, tope, spurdog, thornback ray, blonde ray and spotted ray are present within the study area. In addition, basking sharks and marine turtles have the potential to transit the study area during their long-distance migrations.

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