Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume III, Appendix 10.1: Fish, Shellfish and Sea Turtle Ecology Technical Report

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Appendix 10.1: Fish, Shellfish and Sea Turtle Ecology Technical Report

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Statement of Authority

Experts	Qualifications	Relevant Experience
APEM: Edward Rickard Author	MRes Marine Biology, University of Plymouth (2018). BSc (Hons) Marine Biology, Swansea University (2017).	Edward Rickard is a Senior Consultant at APEM, with over 5 years of experience in the consultancy industry. He has a strong background working on a diverse range of marine fisheries projects, including Fish and Shellfish Scoping and EIA chapters, pre and post construction surveys of fish, shellfish and benthic assemblages, shellfish stock assessment surveys, desk based acoustic tracking data analysis / reporting and port sampling of commercial fish and shellfish catches.
APEM: Nicola Teague Technical reviewer	MSc Marine Resource Development and Protection, Heriot-Watt University (2003). BSc (Hons) Zoology, University of Sheffield (2002).	Nicola is a Sector Director at APEM responsible for APEMs fisheries division. She has extensive experience of undertaking all types of environmental assessment including EIA's, HRA's and SEA's. She has been involved in such assessments for numerous large developments in the UK including Willington Power Station, Hinkley Power Station, Mersey Tidal Power Study and Argyll Array offshore windfarm. Additionally, she advises on conservation measures for the protection of fish species and other areas of aquatic ecology and is actively involved in the process of condition assessment monitoring including the development of new sampling techniques and management measures.
Ruth Peters-Grundy (HiDef)	M.Sc. Wildlife Biology and Conservation, Edinburgh Napier University (2019) B.Sc. (Hons) Biology with Applied Environmental Science, Keele University (2014)	Ruth Peters-Grundy is Senior Ecological Consultant at HiDef Aerial Surveying Ltd. Ruth has 5 years of experience in Offshore Environmental Consultancy, focused on marine mammals and marine ornithology. She has worked on multiple large offshore wind projects, including undertaking Environmental Impact Assessment and Habitats Regulation Assessment/Appraisal, as well as conducting a variety of external and internal research and development projects.

Glossary

Term	Meaning
Arklow Bank Wind Park 2 (ABWP2) – Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent.
Array Area	The Array Area is the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter-array and interconnector cabling) and foundations will be installed.
Benthic	Live on or near the sea bottom, irrespective of the depth of the sea.
Benthopelagic	Benthopelagic fish usually float in the water column just above the sea floor and can occupy either shallow coastal waters or deep waters offshore.
Cable Corridor and Working Area	The Cable Corridor and Working Area is the area within which export, inter-array and interconnector cabling will be installed. This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.
Demersal	Fish species that live close to the sea floor.
Diadromous	Fish which move between the sea and freshwater at different stages of their life cycle.
Elasmobranchs	Elasmobranchs include sharks, rays and skates and have a skeleton composed entirely of cartilage.
Environmental Impact Assessment Report (EIAR)	An Environmental Impact Assessment Report (EIAR) is a report of the effects, if any, which the proposed project, if carried out, would have on the environment. It is prepared by the developer to inform the EIA process.
Pelagic	Fish species that inhabit open water.
Ray-finned fish	Fish with a bony skeleton.
Sensitive Receptor	Physical or natural resource, special interest or viewer group that may experience an impact.
Fish, Shellfish and Sea Turtle Ecology Study Area	Defined as the area encompassing the Array Area, the Cable Corridor and Working Area and the surrounding area (delineated as one tidal excursion from the Array Area and Cable Corridor and Working Area).

Acronyms

Term	Meaning
CEFAS	Centre for the Environment, Fisheries and Aquaculture Science
CIEEM	Chartered Institute of Ecology and Environmental Management
CL	Conservation limits
CMS	Conservation of Migratory Species
CSTP	Celtic Sea Trout Project
DAHG	Department of Arts, Heritage and the Gaeltacht
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EU	European Union
ICES	International Council for the Exploration of the Sea
IEF	Important Ecological Features
IFI	Inland Fisheries Ireland
IUCN	International Union for Conservation of Nature
MMO	Marine Management Organisation
MSY	Maximum Sustainable Yield
NPWS	National Parks and Wildlife Service
SAC	Special Area of Conservation
UNCLOS	United Nations Convention of the Law of the Sea

Units

Unit	Description
km	kilometre
m	metre

1. Introduction

This Fish, Shellfish and Sea Turtle Technical Report provides a comprehensive characterisation of the fish, shellfish and sea turtle communities for Arklow Bank Wind Park 2 Offshore Infrastructure (herein referred to as the Proposed Development), which has been used to identify receptors for assessment in the Environmental Impact Assessment Report (EIAR).

2. Study Area

For the purposes of the EIAR and the technical report herein, three study areas have been defined (Figure 10.1.1):

- **The Fish, Shellfish and Sea Turtle Ecology Study Area**. Defined as the area encompassing the Array Area, Cable Corridor and Working Area and the surrounding area (delineated as one tidal excursion from the Array Area and Cable Corridor and Working Area to capture the maximum extent of sediment plumes); and
- **Western Irish Sea Fish, Shellfish and Sea Turtle Study Area**. To provide wider context and inform assessments of larger scale impacts.
- **Underwater Noise Study Area**. Defined as area encompassing Array Area and 50 km buffer zone.

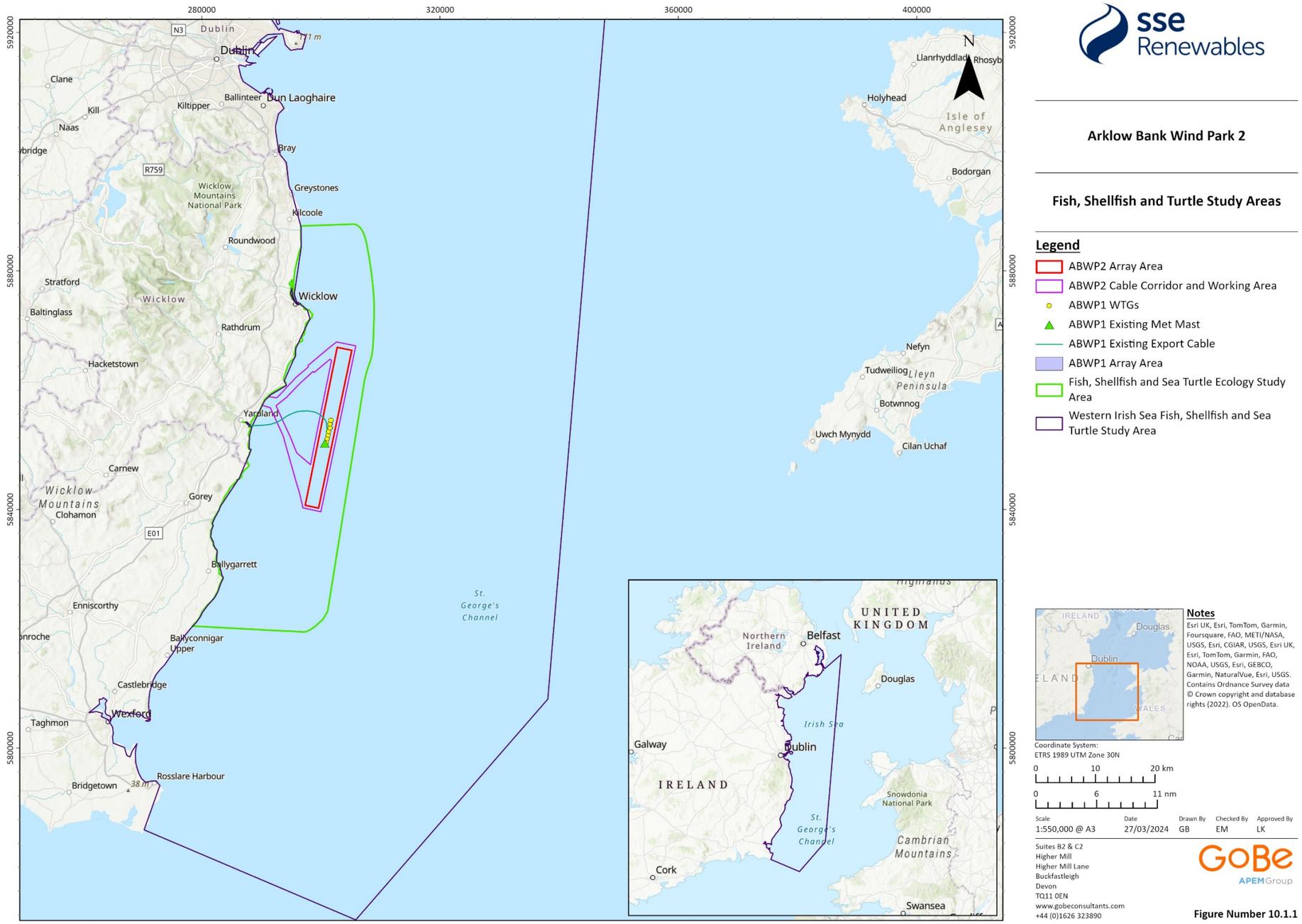

Figure Reference: Ark_001_StudyAreasFig10.1.1

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Arklow Bank Wind Park 2

Fish, Shellfish and Turtle Study Areas

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area
- Fish, Shellfish and Sea Turtle Ecology Study Area
- Western Irish Sea Fish, Shellfish and Sea Turtle Study Area

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue, Esri, USGS. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 10 20 km

0 6 11 nm

Scale	Date	Drawn By	Checked By	Approved By
1:550,000 @ A3	27/03/2024	GB	EM	LK

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Figure Number 10.1.1

Figure 10.1.1. The Fish, Shellfish and Sea Turtle Ecology Study Area and Western Irish Sea Fish, Shellfish and Sea Turtle Study Area.

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3. Methodology

3.1 Desktop Review

A detailed desktop review of existing studies and datasets was conducted to characterise the receiving environment and provide information on fish, shellfish and sea turtle ecology within the Western Irish Sea Fish, Shellfish, Sea Turtle Study Area and the Fish, Shellfish and Sea Turtle Ecology Study Area and the Underwater Noise Study Area. The desktop studies and datasets are summarised in Table 10.1.1 below.

Table 10.1.1. Desktop studies and datasets used to characterise the baseline environment.

Title	Source	Year	Author
Biodiversity maps	National portal that compiles biodiversity data from multiple sources	Various	The National Biodiversity Data Centre
FishBase species accounts	Biology of different species of fish	Various	FishBase
International Council for the Exploration of the Sea (ICES)Division VIIa technical reports series	Various scientific reports on fish and shellfish ecology from surveys undertaken in the Irish Sea	Various	Cefas
Inland Fisheries Ireland (IFI) monitoring report	Various monitoring reports on diadromous fish species across Ireland	Various	IFI
National Parks and Wildlife Service (NPWS) protected sites	Online resources showing location and citation features of protected areas around the coast of Ireland	2011	NPWS
Data product derived from Northeast Atlantic groundfish data from scientific trawl surveys	Spatially explicit data set on the distribution of fish and shellfish from scientific beam and otter trawl surveys	2022	Lynam and Ribeiro

Title	Source	Year	Author
National Programme: Habitats Directive and Red Data Book Fish Species	Summary reports of monitoring undertaken by IFI in relation to threatened fish species (e.g. lamprey, shad)	2022	Gallagher *et al*.
Shellfish Stocks and Fisheries Review 2022	Status of selected shellfish stocks in Ireland	2022	Marine Institute and Bord Iascaig Mhara
UK sea fisheries annual statistics report 2020	UK landing statistics from 2016 to 2020 by ICES rectangle	2021	Marine Management Organisation (MMO)
Long-term insights into marine turtle sightings, strandings and captures around the UK and Ireland (1910– 2018)	Sea turtle locations from sightings, strandings and captures in the Irish Sea	2020	Botterell *et al.*
European Marine Observation and Data Network (EMODnet) broad-scale seabed habitat map for Europe.	EMODnet	2019	EMODnet
Celtic Seas ecoregion fisheries overview	Summary of commercial fisheries in the Celtic Sea	2018	ICES
Long-term satellite tracking reveals variable seasonal migration strategies of basking sharks in the north-east Atlantic	Tracking information of basking sharks across the UK, including Irish Sea	2017	Doherty *et al.*
Celtic Sea Trout Project (CSTP)	Status, distribution, genetics and ecology of sea trout populations in the Irish Sea	2016	CSTP
Ireland Red List (No. 11)	Red List of cartilaginous fish species for Ireland	2016	Clarke *et al.*

Title	Source	Year	Author
The distribution of blue whiting west of the British Isles and Ireland	Temporal and spatial patterns of northeast Atlantic blue whiting stock between 2006 and 2014	2016	Gastauer *et al.*
Geology of the seabed and shallow subsurface: The Irish Sea.	Geology of the Irish Sea	2015	Mellet *et al.*
Slaney River Valley Special Area of Conservation (SAC). Site Synopsis (Site Code: 000781)	SAC site selection details	2015	Department of Arts, Heritage and the Gaeltacht (DAHG)
Diversity of demersal and megafaunal assemblages inhabiting sandbanks of the Irish Sea	Analyses of demersal communities at three sandbanks in the Irish Sea, including the Arklow sandbank, Blackwater Bank (south of Arklow) and Kish Bank (north of Arklow)	2013	Atalah *et al.*
An Inventory of Irish Herring Spawning Grounds	Herring spawning grounds around the coast of Ireland	2013	O'Sullivan *et al.*
Spawning and nursery grounds of selected fish species in UK Waters	Spawning and nursery areas for key fish species including within the Irish Sea in 2010	2012	Ellis *et al.*
An Offshore Wind Farm on the Kish and Bray Banks, Environmental Impact Statement, Section 8: Marine Ecology	Marine ecology baseline and impact assessment	2012	Dublin Array Offshore Wind Farm Ltd
Ireland Red List No. 5: Amphibians, Reptiles and Freshwater Fish	Red List of reptiles and freshwater fish species for Ireland	2011	King *et al*.

Title	Source	Year	Author
Marine turtles in Irish waters	Ecology of marine turtles found in Irish waters and marine turtle recording	2009	King and Berrow
Spatial distribution patterns of basking sharks on the European shelf: preliminary comparison of satellite-tag geolocation, survey and public sightings data	Basking shark locations within the Irish Sea from tag geolocation, survey sightings and public sightings	2005	Southall *et al*.
The distribution of chondrichthyan fishes around the British Isles and implications for conservation	Distribution of elasmobranchs across the UK, including the Irish Sea	2005	Ellis *et al.*
Distribution and relative abundance of demersal fishes from beam trawl surveys in the Irish Sea (ICES Division VIIa) 1993–2001	Catch composition of fish caught during beam trawls in the Irish Sea	2004	Parker-Humphreys
Offshore Wind Farm at Codling Bank, Non-Technical Summary	Non-technical summary including fish and shellfish baseline and impact assessment	2002	Codling Wind Park Ltd.
Demersal assemblages in the Irish Sea, St George's Channel and Bristol Channel	Description of macro-benthic invertebrate and demersal fish assemblages from 101 beam trawl stations within the Irish Sea	2000	Ellis *et al.*
Fisheries Sensitivity Maps in British Waters	Spawning and nursery areas for key fish species including within the Irish Sea	1998	Coull *et al.*

3.2 Site-specific Surveys

Existing data from the desktop study was sufficient for the Proposed Development due to the presence of a number of recent beam and otter trawl data sets (e.g. Atalah *et al*., 2013 and Lynam and Ribeiro, 2022 – see Table 10.1.1) and as such, site-specific fish and shellfish surveys were not considered necessary. However, site specific data collected as part of benthic surveys for Arklow Bank Wind Park 1 (ABWP1) and the Proposed Development provide further information on the fish and shellfish ecology of the area. Relevant site-specific surveys are summarised in Table 10.1.2 below.

Table 10.1.2. Site specific surveys relevant to the characterisation of the fish and shellfish baseline environment.

Data source	Method	Date	Extent
Digital aerial marine mammal and bird surveys (ABWP2)	Aerial	March 2018 to April 2020	Array Area plus 4 km buffer
GE Wind Energy. Post-construction surveys (ABWP1)	Anchor dredge Beam trawl	June 2010 to September 2021	Lease and surrounding area
Arklow Energy Ltd (2010). Post-construction survey (ABWP1)	Anchor dredge Beam trawl	June 2009	Lease and surrounding area
HydroServ Projects Ltd. Post-construction surveys (ABWP1)	Anchor dredge Beam trawl	June 2004 to May 2008	Lease and surrounding area
EcoServe (2001). Baseline/pre-construction survey (ABWP1).	Anchor dredge Agassiz trawl	April 2001	Lease and surrounding area
EcoServe (2001). Baseline/pre-construction survey (ABWP1).	Anchor dredge Otter trawl	September 2000	Lease and surrounding area
EcoServe (2001). Baseline/pre-construction survey (ABWP1).	Anchor dredge	June 2000	Lease and surrounding area

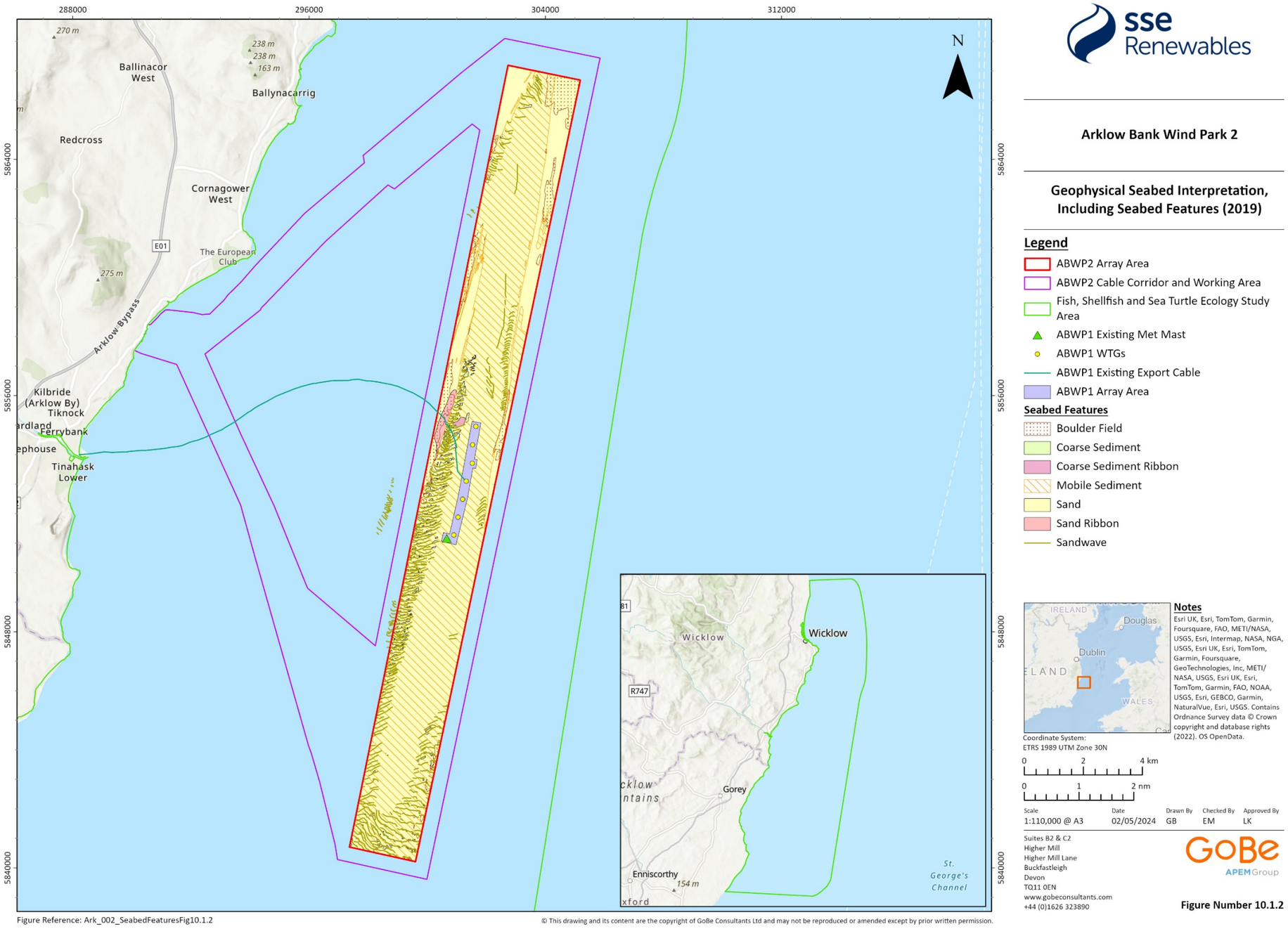
4. Baseline Environment

The Irish Sea is characterised by a deep channel (the Western Channel) running north to south in the western Irish Sea, and extending north into the North Channel, between Northern Ireland and Scotland and south into St George's Channel, between Ireland and Wales (Mellet *et al*., 2015). The Western Channel is considered to be an important feature in shaping the fish and shellfish assemblages (Parker-Humphreys, 2004). At its deepest point the channel is 230 m deep with an extensive area of relatively flat, shallow (< 60 m depth) seabed (the Eastern Platform) and a narrow shelf of shallow water to the west (the Western Trough) (Mellet *et al*., 2015).

The sediments of the Irish Sea can be subdivided into three broad regions: two 'mudbelts' comprising of soft muds which occupy the eastern and western inshore areas separated by a central 'gravel belt' which comprises coarser sediment and hard substrate (Mellet *et al*., 2015). The western Irish Sea is known for its muddy sediments that support one of the most valuable fisheries for the Norway lobster *Nephrops norvegicus* (herein referred to as *Nephrops*) (Parker-Humphreys, 2004).

The Proposed Development is sited on a large, shallow sandbank, known as Arklow Bank. Arklow Bank lies parallel with the coast and lies off the county of Wicklow, between 6 km at its northern end and 15 km at its middle section and southern end. The sandbank measures approximately 25 km long by 2.5 km wide at the widest point and runs in an approximate north-south orientation parallel to the southeast coast of Ireland (Appendix 6.1: Coastal Processes Technical Report). Water depths on the bank range from 0.6 m to 25 m relative to lowest astronomical tide, and the bank is exposed to strong currents, sediment transport and wave action (Atalah *et al*., 2013). The general direction of current flow is towards north northeast during flood and south-southwest during ebb. Breaking waves are often present on parts of the bank, even during low swell conditions, due to the shallow water depths in some areas.

The substrate of the sandbank is dominated by sand and gravel with mobile surface sediments (GE Wind Energy, 2022). To the west, north and south of the sandbank the substrate is comprised of sandy shell to gravel, whilst in the east the substrate is dominated by coarse shell and gravel and some rock (Figure 10.1.2). Inshore, along the Cable Corridor and Working Area, the substrate grades to finer sands and mud. The substrate is an important environmental variable in determining the composition and abundance of fish and shellfish communities in the region.



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Arklow Bank Wind Park 2

Geophysical Seabed Interpretation, Including Seabed Features (2019)

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- Fish, Shellfish and Sea Turtle Ecology Study Area
- ABWP1 Existing Met Mast
- ABWP1 WTGs
- ABWP1 Existing Export Cable
- ABWP1 Array Area

Seabed Features

- Boulder Field
- Coarse Sediment
- Coarse Sediment Ribbon
- Mobile Sediment
- Sand
- Sand Ribbon
- Sandwave

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, Intermap, NASA, NGA, USGS, Esri UK, Esri, TomTom, Garmin, Foursquare, GeoTechnologies, Inc, METI/ NASA, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue, Esri, USGS. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

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Figure Number 10.1.2

Figure 10.1.2. Sediment types observed throughout the Array Area (UHC, 2019).

4.1 Ray-finned Fish

4.1.1 Western Irish Sea Fish, Shellfish and Sea Turtle Study Area

Ray-finned fish communities in the Western Irish Sea are dominated by a diversity of benthic and demersal fish species including various species of flatfish and gadoid. Particularly abundant flatfish species within the Irish Sea include dab *Limanda limanda*, plaice *Pleuronectes platessa*, solenette *Buglossidium luteum* and sole *Solea solea*. Abundant gadoid species include poor cod *Trisopterus minutus*, whiting *Merlangius merlangus* and cod *Gadus morhua* (Ellis *et al*., 2000; Parker-Humphreys, 2004; Lynam and Ribeiro, 2022). Additionally, Atlantic herring *Clupea harengus*, hake *Merluccius merluccius*, blue whiting *Micromesistius poutassou* and Atlantic mackerel *Scomber scombrus* are common, particularly in the pelagic and benthopelagic zones of the Irish Sea.

Ellis *et al*., (2000) described the demersal assemblages in the Irish Sea in relation to sediment type from beam trawls conducted across the Irish Sea in September 1998. They found substrate type to be a strong driver in the alteration of demersal fish assemblages within the Irish Sea, with fine sediments being dominated by a mixed flatfish community (plaice, dab, sole), offshore coarse sediments being dominated by thickback sole *Microchirus variegatus* and muddy sediments being characterised by witch *Glyptocephalus cynoglossus*.

Beam trawls conducted throughout the Irish Sea between 1993 and 2001 identified plaice as being the species that accounted for the largest proportion of caught biomass, accounting for 24.44% of total biomass and 16.63% of the total abundance (Parker-Humphreys, 2004). Additionally, plaice accounted for 4.5% of the UK landed weight by beam trawlers for the ICES rectangles that intersect the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area between 2016 and 2020 (MMO, 2021). Plaice is a widespread and common species throughout European waters and shows a preference for sandy sediments in depths between 10 and 50 m, although they can occur between 0 and 200 m deep (FishBase, 2023a). Tagging studies show that individuals have strong site fidelity, returning to the same location to spawn and feed (Hunter *et al*., 2003). Plaice make use of tidal currents in various life stages. For example, moving downstream with the tide in mid-water during seasonal migrations between spawning and feeding grounds. Their preferred diet is polychaete worms, small crustaceans, siphons of bivalve molluscs and brittle stars (Thompson *et al*., 2020).

Dab are widespread throughout European waters and were identified as the most abundant species (28.04% of total abundance) during beam trawl surveys in the Irish Sea (Parker-Humphreys, 2004). Dab occur on sandy sediments, often in cohabitation with plaice and sole (Ellis *et al*., 2000), in waters from 20 – 150 m (FishBase, 2023b), and feed on crustaceans, worms and small fishes (Thompson *et al*., 2020).

Sole are widespread throughout European waters, occurring in sandy and muddy sediments in waters from the shoreline to 150 m deep (FishBase, 2023c). Sole contributed 8.62% of total

biomass and 4.30% of total abundance during beam trawl surveys in the Irish Sea (Parker-Humphreys, 2004) and 33.2% of the UK landed weight by beam trawlers for the ICES rectangles that intersect the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area between 2016 and 2020 (MMO, 2021). As juveniles, this species spends the first year in shallow coastal waters and estuaries, migrating to deeper waters offshore after this period, although they are largely restricted to depths of < 50 m. In March to May they return to inshore waters to spawn with spawning migrations occurring at night (Kruuk, 1963). Sole is a nocturnal and olfactorial feeder, which makes use of sensory organs to detect prey. They feed on polychaete worms, small echinoderms, worms and molluscs (Thompson *et al*., 2020).

Atlantic herring is a commercially important pelagic species and numerically abundant in the North Atlantic. In the northeast Atlantic, they are found from the northern Bay of Biscay to Greenland and into the Barents Sea (Hauser *et al*., 2001). Adult fish are found on the continental sea shelf to depths of 200 m, however they can disperse over the abyssal plains during feeding migrations. Juveniles tend to occur in shallower waters, far away from the adults and spawning grounds and move into deeper waters after two years. During the day, herring shoals tend to remain close to the sea bottom or in deep water to a depth of 200 m, and they move towards the surface at dusk and disperse over a wider area during the night (FishBase, 2023d). Herring accounted for 43.9% of the UK landed weight by otter trawlers for the ICES rectangles that intersect the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area between 2016 and 2020 (MMO, 2021).

Hake is focused in the northeast Atlantic as one population and is distributed across the Irish Sea, Celtic Sea, English Channel, Scottish Sea and the North Sea (Lynam and Ribeiro, 2022; FishBase, 2023e). They are relatively fast growing with males maturing at round 35 cm and females at 50 cm. Hake usually occur in depths between 70 and 400 m, with the adults living close to the bottom during the day but moving off the bottom at night (FishBase, 2023e).

Whiting is abundant throughout the northeast Atlantic and is also present in the Mediterranean and European Seas. They are most commonly found in depths of 10 m to 100 m, mainly on mud and gravel bottoms, but also on sand and rock. Year one fish feed primarily on crustaceans such as shrimps and crabs, and on small fish and molluscs. After the first year, whiting move offshore in search of prey (FishBase, 2023f).

Blue whiting is distributed throughout the north Atlantic and are found on continental shelves at depths of 300 m to 400 m but have been found at depths of 3,000 m. They make daily migrations from the surface waters at night to the benthos during the day, where they feed on small crustaceans, but large individuals also prey on small fish and cephalopods (FishBase, 2023g). Blue whiting is also abundant across the northeast Atlantic including throughout the Irish Sea with the highest concentrations in the Rockall area and west of the Hebrides (Gastauer *et al*., 2016).

Atlantic mackerel is abundant and widespread in the cold and temperate shelf areas. This species overwinters in deeper waters but moves closer inshore during spring when water temperatures increase (FishBase, 2023h). Atlantic mackerel in the Irish Sea is part of the

British Isles West stock, with the other being the North Sea stock (ICES, 2010). They are generally a pelagic species, forming large schools near the surface, but their habitat preferences are poorly understood (FishBase, 2023h).

Cod is widely distributed in a variety of habitats. Juveniles typically inhabit shallow sublittoral waters in habitats such as seagrass or coarse substrate (gravel, rocks or boulders). Adults prefer deeper, colder waters; during the day they form large schools which swim just above the bottom, whilst at night they disperse to feed. Cod are known to migrate between spawning, feeding and overwintering areas within the boundaries of their stock. Spawning occurs between winter and start of spring when they congregate in large numbers to spawn. Spawning sites are usually in offshore waters, at or near the bottom at depths of 50 to 200 m (FishBase, 2023i).

4.1.2 The Fish, Shellfish and Sea Turtle Ecology Study Area

Finfish species recorded within the Fish, Shellfish and Sea Turtle Study Area during beam trawls between 2000 and 2021 were typical of the sandy and gravelly seabed of the wider Western Irish Sea (EcoServe, 2001; HydroServ 2004; 2005; 2006; 2007; 2008; Arklow Energy Ltd, 2010; GE Wind Energy, 2010, 2011, 2021). Commonly recorded species included plaice, dab, poor cod, sand eel *Ammodytes tobianus*, common dragonet *Callionymus lyra* and sand goby *Pomatoschistus minutus*, with sand eel and sand goby being particularly abundant in some years. Commercial species noted included whiting, lemon sole *Microstomus kitt*, sole, John dory *Zeus faber* and turbot *Psetta maxima*. Non-commercial species included butterfish *Pholis gunnellus*, lesser weaver *Echiichthys vipera* and black goby *Gobius niger*.

Demersal communities at three offshore sandbanks in the western Irish Sea, including Arklow Bank, were studied by Atalah *et al*. (2013). Species noted included dab, whiting, plaice, sole, poor cod and grey gurnard *Eutrigla gurnardus*. High numbers of juvenile plaice and dab were reported on all the sandbanks suggesting the use of these sandbanks as nursery areas and no significant difference was found between the fish assemblage within the existing Arklow windfarm and the control sites. Additionally, beam trawls conducted between 1994 and 2001 in close proximity to the Cable Corridor and Working Area identified an assemblage similar to that of the wider Western Irish Sea with an abundance of flatfish species, including plaice, dab, sole and flounder *Platichthys flesus* (Lynam and Ribeiro, 2022). Other abundant species included whiting, poor cod, grey gurnard and cod.

4.2 Diadromous Fish

The western Irish Sea is home to several migratory fish species, which move between the marine environment and freshwater at different stages of their life cycle and may migrate through the Fish, Shellfish and Sea Turtle Study Area. Atlantic salmon *Salmo salar* and sea trout *Salmo trutta* are two commercially important migratory fish species found in the Irish

Sea. Sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, and twaite shad *Allosa fallax* are also known to occur in inshore waters off the coast of county Wicklow. Brook lamprey *L. planeri* is also recorded on the east coast of Ireland, although as a purely freshwater species, this species migrates between downstream river habitat to upstream areas to spawn. With the exception of sea trout, all of these migratory fish species are listed on Annex II of the Habitats Directive (Council Directive 92/43/EEC) which makes provision for their protection through designation of SACs. The Slaney River Valley SAC, River Barrow and River Nore SAC, River Boyne and River Blackwater SAC and Lower River Suir SAC have all been designated for the protection of migratory fish species (see section 4.7).

Sea trout (and Atlantic salmon) stocks and population characteristics in the Celtic and Irish Seas have been examined by the CSTP. Favoured rivers used by migratory fish on the east coast of Ireland include the Dargle, just south of Dublin Bay, the Avoca in county Wicklow, and the Slaney to the south of county Wexford (CSTP, 2016; IFI 2022a). The Slaney River is the only site designated as a SAC for Annex II migratory fish off the east coast of Ireland and includes salmon, sea lamprey, river lamprey, brook lamprey and twaite shad as citation features (DAHG, 2015). Slaney River SAC is located 44.5km west of the Array Area. IFI monitor river lamprey in the Avoca as this species is known to migrate to this river and its tributaries to spawn (IFI, 2018a).

In a report on the status of Irish salmon stocks in 2022, IFI estimated that only 59% of Ireland's assessed salmon rivers were exceeding biologically based conservation limits (CL) (Millane *et al.*, 2023). While the overall proportion of rivers with good population status is therefore low, minor improvements were recorded from 2014 to 2017 from the fish counter time series (Inland Fisheries Ireland, 2018b; Millane *et al*., 2023). However, this was proceeded by a downturn from 2020 to 2022 (Millane *et* al., 2023). The exact factors that influenced these temporal changes has not been identified, however a broad range of factors could have contributed, including changes in recruitment, predation of smolts and pollution. The CL applied by these reports was the "Maximum Sustainable Yield" (MSY), described as the stock level that maximises the long-term average surplus.

On the east coast of Ireland, where the rivers feed into the western Irish Sea, counters were installed on the rivers Slaney and Boyne. Results from the Slaney showed the passage of 179 salmon in the spring, 30 salmon in late summer and 700 sea trout in 2022. Results from the Boyne showed the passage of 349 salmon in the spring and 1075 salmon in late summer (IFI, 2022b)). This report indicates that salmon and sea trout are returning to the sea (including in the area around Arklow Bank) and that the main migration occurs in late summer.

European eel *Anguilla anguilla* have also been found to occur within the Rivers Slaney and Boyne (IFI, 2015), and may interact with the area around Arklow Bank during their annual migration out to sea to their spawning grounds. European eel are listed as Annex II species on Convention on International Trade in Endangered Species (CITES) and the Convention on the Conservation of Migratory species (Bonn convention), and are listed as Critically Endangered on Irelands Red List of species (King *et al*., 2011).

4.3 Elasmobranchs

4.3.1 Western Irish Sea Fish, Shellfish and Sea Turtle Study Area

Elasmobranchs are diverse and widespread throughout the Western Irish Sea and include species of ray such as spotted ray *Raja montagui*, blonde ray *Raja brachyura*, thornback ray *Raja clavata* and cuckoo ray *Leucoraja naevus* (Parker-Humphreys, 2004; Lynam and Ribeiro, 2022). Widespread shark species include lesser spotted dogfish *Scyliorhinus canicula*, nursehound *Scyliorhinus stellaris*, spurdog *Squalus acanthias* and stary smooth hound *Mustelus asterias*.

Lesser spotted dogfish are widespread across the northeast Atlantic and are abundant throughout the Irish Sea. They were the most abundant elasmobranch species during beam trawl surveys in the Irish Sea, accounting for 14.33% of total biomass and 1.41% of total abundance (Parker-Humphreys, 2004). Additionally, lesser spotted dogfish accounted for 5.5% of the UK landed weight by otter trawlers for the ICES rectangles that intersect the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area between 2016 and 2020 (MMO, 2021). Lesser spotted dogfish occur across a broad range of habitat types, including sand, gravels, mud and hard substrata, and feed on crustaceans, fish, worms and molluscs (Ellis *et al*., 1996). They are listed as Least Concern on Ireland's Red List for cartilaginous fish (Clarke *et al*., 2016).

Tope *Galeorhinus galeus* are a species of benthopelagic shark which occurs worldwide in temperate waters. Tope spawn once a year, are considered a long-lived species and can undertake large scale migrations (Colloca *et al*., 2019). Tope are well distributed across the Irish Sea, occurring in depths of between 17 and 200 m and feeding on epibenthic and pelagic fish and cephalopods (Ellis *et al*., 1996; Ellis *et al*., 2005). Tope are listed as Vulnerable on Ireland's Red List for cartilaginous fish (Clarke *et al*., 2016).

Spurdog, which are listed as Endangered on Ireland's Red List for cartilaginous fish (Clarke *et al*., 2016), is a species of benthopelagic shark with a global distribution (FishBase, 2023j). Spurdog are well distributed across the UK, including the Irish Sea (Lynam and Ribeiro, 2022), where they occur on a wide range of habitat types (Martin *et al*., 2010, 2012). They feed on fish, crustaceans and molluscs and give birth to multiple live young at a time, with a two year gestation period (Ellis *et al*., 1996; Ellis and Keable, 2008; FishBase, 2023j).

Rays make up an important component of the demersal assemblages within the Irish Sea, with multiple species of ray occurring within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area including spotted ray, blonde ray, thornback ray and cuckoo ray. Cuckoo ray has declined in abundance since the 1990s by approximately 45% and is therefore listed as Vulnerable on the Ireland Red List for cartilaginous fish (Clarke *et al*., 2016). Spotted and Thornback rays are listed as Least Concern and blonde rays are listed as Near Threatened. Other species of ray that occur within the Irish Sea include small eyed ray *Raja microocellata* and undulate ray *Raja undulata*, however records are sparse (Lynman and Ribeiro, 2022). Rays have a varied diet feeding on crustaceans, epibenthic fish, worms and molluscs (Ellis *et al*.,

1996). They can occur on a wide range of sediment types including hard bottoms, muddy sediments, sand and coarse sediments, with habitat preference and diet varying with species (Ellis *et al*., 1996; Martin *et al*., 2010).

Basking shark *Cetorhinus maximus* is a large, filter-feeding species that is predominately solitary but may also occur in aggregations where there is dense zooplankton abundance (Speedie, 1999). Basking sharks migrate through the Irish Sea during spring and summer, with migration routes covering large distances from the north of Scotland to North Africa, and occasionally between the UK and America (Johnston *et al.*, 2019). A tagging study of basking sharks found that half of the tagged sharks entered the Exclusive Economic Zone (EEZ) of Ireland, including the Irish Sea, indicating the importance of this area for overwintering and migration (Doherty *et al*., 2017).

Mating has not been observed in basking sharks and most likely occurs in deep water with courtship-like behaviour as the precursor, particularly where individuals aggregate in food-rich waters (Sims, 2008; Sims *et al*., 2022). Individuals are thought to pair and mate in early summer (Sims *et al*., 2000) and gestation has been estimated to take between 12 to 36 months (Parker and Stott, 1965; Compagno, 1984; Sims *et al*., 2008; 2015). As an ovoviviparous species, basking sharks bear live young, hatched from eggs within the uterus of the female. Basking sharks are a slow-growing species with late maturation (at 12 to 20 years of age) and a relatively low fecundity (producing litters of around six pups; Sund, 1943). These characteristics suggest that basking shark would be vulnerable to environmental changes and the population would be slow to recover from any major losses. Basking shark is listed on the OSPAR list of threatened/declining species including in Region III (Celtic Seas) (OSPAR Commission, 2015), on the International Union for Conservation of Nature (IUCN) Red List as Globally Endangered (Rigby *et al*., 2019) protected under the Wildlife Act 1976 (as amended in 2022) and on Ireland's Red list as Endangered (Clarke *et al*., 2016). In addition, as a highly migratory species, basking shark is protected under various international conventions including Convention on the Conservation of Migratory Species (CMS) (Bonn Convention) and the United Nations Convention of the Law of the Sea (UNCLOS).

4.3.2 The Fish, Shellfish and Sea Turtle Ecology Study Area

Beam trawls conducted between 1994 and 2001 in close proximity to the Cable Corridor and Working Area identified a number of elasmobranch species including lesser spotted dogfish, spotted ray, thornback ray, starry smooth hound and cuckoo ray, with lesser spotted dogfish being particularly abundant (Lynam and Ribeiro, 2022). Additionally, blonde ray, spotted ray and lesser spotted dogfish were noted during trawls at Arklow bank during 2007 (Atalah *et al*., 2013). A high number of juvenile spotted rays were noted during these surveys, suggesting the use of this sandbank as a nursery area (Atalah *et al*., 2013). Additionally, site specific beam trawl surveys conducted between 2000 and 2021 noted lesser spotted dogfish, spotted ray and thornback ray within the Fish, Shellfish and Sea Turtle Ecology Study Area.

While spurdog and tope have not been identified within the Fish, Shellfish and Sea Turtle Study Area, they have been observed 9 and 8 km away, respectively (Lynam and Ribeiro,

2022). Given their broad habitat type preference (Martin *et al*., 2010, 2012) and widespread distribution across the Western Irish Sea, it is likely that both species do occur within the Fish, Shellfish and Sea Turtle Study Area.

No sightings or strandings of basking sharks have been observed by the Irish Whale and Dolphin Group in or around the Fish, Shellfish and Sea Turtle Ecology Study Area, however a single individual was recorded in October 2019 during two years of site-specific aerial surveys of the Array Area plus 4 km buffer. While present in the area of the Proposed Development, the Fish, Shellfish and Sea Turtle Study Area is unlikely to support high numbers of basking sharks (Southall *et al*., 2005).

4.4 Shellfish

4.4.1 Western Irish Sea Fish, Shellfish and Sea Turtle Study Area

Shellfish communities contribute to the biodiversity of the benthic ecosystem and are an important link in the food chain, both as predators and prey. Key commercial species in Irish waters by volume and value of landings are *Nephrops*, king scallop *Pecten maximus*, brown crab *Cancer pagurus*, European lobster *Homarus gammarus*, razor clams *Ensis siliqua* and *E. arcuatus*, whelk *Buccinum undatum* and blue/seed mussel *Mytilus edulis*, with brown crab, lobster, whelk and king scallop constituting the largest estimated value of landings out of the commercial shellfish species in Ireland in 2022 (Marine Institute and Bord Iascaig Mhara, 2022).

Brown crabs are a relatively long-lived species that are distributed through the Irish Sea and are found on all coasts from the intertidal zone down to 100 m. They live on rocky, gravelly substrate which they can either bury into or make use of pre-existing crevices/fissures. Following spawning there is a larval dispersal phase of 30 to 50 days.

The main cockle *Cerastoderma edule* beds in the western Irish Sea are in Dundalk Bay, which has been designated as shellfish waters (the “Dundalk Bay Production Area”) and is under a Natura 2000 site management regime and subject to a fishery Natura plan for cockles. The Dundalk Bay stock is located 110 km to the north of Arklow Bank. Other small-scale cockle stocks are distributed on the northwest coast of Ireland (Marine Institute and Bord Iascaig Mhara, 2022).

Nephrops is widely distributed on muddy substrates across the northeast Atlantic. Around Ireland they are found at depths of 20 m to 600 m; much deeper than their average habitat. *Nephrops* grounds are found 123.5 km south of the Array Area and 62 km north of the Array Area. There is no known overlap of *Nephrops* habitat with Arklow Bank or within theFish, Shellfish and Sea Turtle Ecology Study Area. *Nephrops* create a shallow burrow in muddy sediments which limits their distribution.

Scallops inhabit sand, gravel and mixed sediments and populations (scallop beds) are interconnected throughout the Irish Sea by larval dispersal. There is limited data available for

scallops through opportunistic sampling from a series of annual surveys; these surveys indicate that there are several discrete populations within the western Irish Sea, one of which is just off Wexford and extends close to the south of Arklow Bank (Marine Institute and Bord Iascaig Mhara, 2022).

The whelk is an epibenthic mobile gastropod, inhabiting muddy sand, sand and mixed sediments from depths of 0 m to 50 m. This species is widely distributed from Iceland in the north to the Bay of Biscay, including throughout the Irish Sea and on all Irish and British coasts. Stocks are likely to be locally discrete due to the absence of a pelagic larval phase and therefore whelk in the Irish Sea comprises a number of populations with limited connectivity. Irish landings data between 2016 and 2020 for the ICES rectangles that intersect the Proposed Development identified whelk as the dominant landed species (Appendix 14.1: Commercial Fisheries Technical Report).

4.4.2 The Fish, Shellfish and Sea Turtle Ecology Study Area

Beam trawls conducted between 2000 and 2021 as part of site-specific surveys identified an abundance of pink shrimp *Pandalus montagui*, shrimp *Crangon allmanni*, acorn barnacle *Balanus crenatus*, flying crab *Liocarcinus holsatus* and queen scallop *Aequipecten opercularis*, with the anchor dredge identifying an abundance of wart barnacle *Verruca stoemia*, shiny nut clam *Nucula nucleus* and wrinkled rock borer *Hiatella arctica* (EcoServe, 2001; HydroServ 2004; 2005; 2006; 2007; 2008; Arklow Energy Ltd, 2010; GE Wind Energy, 2010, 2011, 2022). Additional species observed during the beam and dredge surveys included velvet swimming crab *Necora puber*, whelk, mussel *Mytilus edulis*, curled octopus *Eledone cirrhosa* and razor clam.

Beam trawls at Arklow bank during 2007 identified a shellfish community typical of sand banks. Crustacean species identified included common hermit crab *Pagurus bernhardus*, flying crab, brown shrimp *Crangon crangon*, pink shrimp and common prawn *Palaemon serratus* (Atalah *et al*. 2013). Key mollusc species included whelks and razor clams.

Brown crab has been recorded on the South side of Arklow Bank and approx. 800m southwest of the southern fork of the Cable Corridor and Working Area (Atalah *et al*., 2013; Lynam and Ribeiro, 2022), however records are sparse, and abundances were low, with no records from the site-specific benthic surveys. Given the preference of adult European lobsters for rockier sediments and the Fish, Shellfish and Sea Turtle Ecology Study Area consisting mostly of sandy sediment (Sand – Sandy gravel) the area is unlikely to support large populations of European lobster. Irish landings data for the ICES rectangles that intersect the Proposed Development further supports this, with no significant landings of brown crab or European lobster between 2016 and 2020 (Appendix 14.1: Commercial Fisheries Technical Report).

Seed mussel beds occur in inshore areas along the east coast of Ireland with key areas around Wicklow and along the Wexford coastline (Appendix 14.1: Commercial Fisheries Technical Report). A commercial mussel seed farm (the Irish Mussel Seed Company), located between Clogga Bay and Kilmichael Point, near the harbour town of Arklow, Co. Wicklow, gained a

Foreshore Licence in 2018 to collect and harvest rope grown mussel spat, for a period of up to 10 years. The licensed site is located approximately 8.5 km to the south of the Southern extent of the North – South Cable Corridor and Working Area. The sustainability of the natural mussel seed beds and the licensed mussel seed farm are key considerations in the EIAR.

Seed mussels are an important natural resource and harvested by commercial fisheries using dredges and re-laid on commercially leased sites for mussel farming. The main period of mussel larval settlement in Irish waters is in the spring, followed by a less intensive spawning period in the summer (Dare, 1976). Mussel spat settle on hard substrate and consistently settle in the same area every year as a result of both hydrodynamics (Hannan, 1984) and biological and chemical cues (Dobretsov and Wahl, 2001). For example, the presence of conspecifics attracts the spat causing aggregations in dense mussel beds (Seed, 1969; Young, 1983). Blue/seed mussels are often found in the intertidal and shallow subtidal zones of offshore windfarm foundations, whereby they can become established after a year and Super Abundant (on SACFOR scale[1]) after several years (De Mesel *et al.*, 2015).

In Irish waters, a number of areas have been identified as designated shellfish areas which aim to support shellfish life and growth and contribute to the high quality of edible shellfish products. Under Article 5 of the Shellfish Directive (2006/113/EC) and Section 6 of the Quality of Shellfish Waters Regulations (S.I. No. 268 of 2006) these areas require the development of Pollution Reduction Programmes (PRPs) which measure a number of parameters in order to achieve good water quality in compliance with the Directive. The PRPs focus on bivalve and gastropod molluscs including oysters, mussels, cockles, scallops and clams. The closest designated shellfish areas to the Proposed Development are Malahide, 56.5 km to the north, and Wexford Inner Harbour and Wexford Outer Harbour to the south (47.6 km and 44.5 km respectively) (Figure 10.1.3). The cultivation of razor clams is predominant in Malahide whilst mussel cultivation is predominant in Wexford Inner Harbour and Wexford Outer Harbour. Additionally, a number of shellfish production areas exist outside of these designated shellfish areas; Pacific oysters *Crassostrea gigas* in Ballyteigue Bay, razor clam in Rosslare Bay and razor clam in Wexford Bay. Ballyteigue Bay and Rosslare Bay are located south of the Fish, Shellfish and Sea Turtle Ecology Study Area, with Wexford Bay intersecting the Fish, Shellfish and Sea Turtle Ecology Study Area at the southern perimeter.

[1] The SACFOR scale (Superabundant, Abundant, Common, Frequent, Occasional and Rare) is a unified system for recording the abundance of marine benthic flora and fauna in biological surveys.

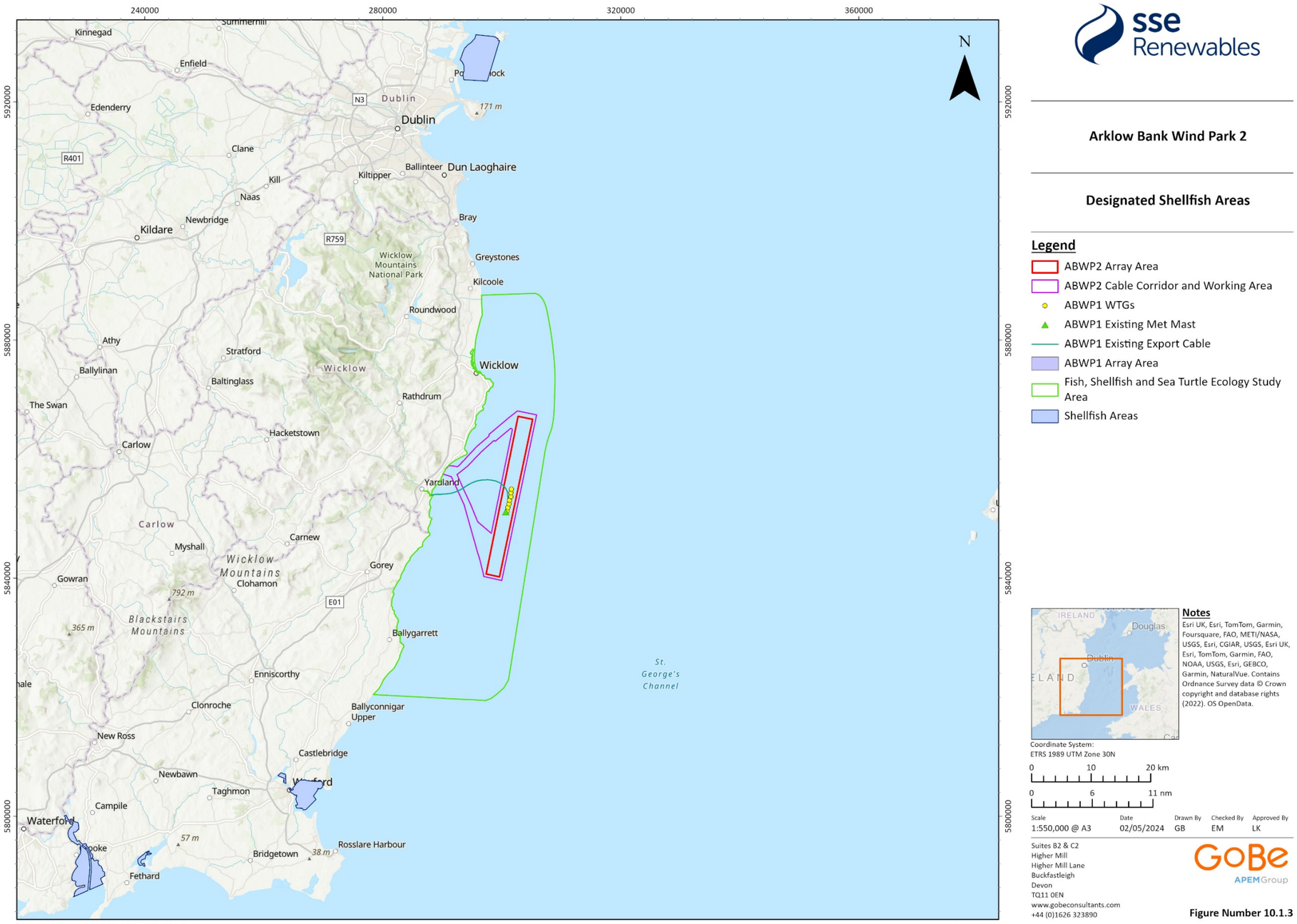

Figure Reference: Ark_003_ShellfishFig10.1.3

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Arklow Bank Wind Park 2

Designated Shellfish Areas

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area
- Fish, Shellfish and Sea Turtle Ecology Study Area
- Shellfish Areas

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 10 20 km

0 6 11 nm

Scale	Date	Drawn By	Checked By	Approved By
1:550,000 @ A3	02/05/2024	GB	EM	LK

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Figure Number 10.1.3

Figure 10.1.3. Designated shellfish waters.

4.5 Sea Turtles

Five species of marine turtles have been recorded in Irish waters including leatherback (or 'leathery') turtle *Dermochelys coriacea*, loggerhead turtle *Caretta caretta*, Kemp's Ridley turtle *Lepidochelys kempii*, Green turtle *Chelonia mydas* and Hawksbill turtle *Eretmochelys imbricata* (King and Berrow, 2009; Botterell *et al*., 2020). Of these, leatherback turtles are the most regularly reported around the coast of Ireland (King and Berrow, 2009; Botterell *et al*., 2020). Only a few records have been found of hawksbill turtle and green turtle, both on the south coast of Ireland, and these are thought to be rare vagrants to Irish waters (King and Berrow, 2009). The majority of sightings captures or strandings have been recorded along the south and west coasts of Ireland, however, there are records of leatherback turtles along the east coast of Ireland suggesting that this species may occur within the Irish Sea. There may be distinct coastal 'jellyfish hotspots' in the Irish Sea representing important foraging areas for leatherback turtle (Houghton *et al*., 2006). This species has a strong seasonal distribution with most sightings in the Irish Sea in the summer months; most likely driven by an increase in the abundance of jellyfish, as their key prey resource.

Leatherback turtle is listed on the OSPAR list of threatened and declining species (OSPAR Commission, 2009), on the IUCN Red List as Globally Vulnerable (Wallace *et al*., 2013) and on Ireland's Red list as Least Concern (King *et al*., 2011). This species is also protected under the Irish Wildlife Acts (1976 and 2000) and on Annex II and IV of the European Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (the 'Habitats Directive'). In addition, as a highly migratory species, leatherback turtle is protected under the CMS (Bonn Convention). No leatherback turtles were recorded during the site-specific aerial surveys however a leatherback turtle was observed in August 2020 as part of the Marine Mammal Observer observations carried during a programme of site investigation activities.

4.6 Spawning and nursery grounds

A number of fish species are known to have spawning and/or nursery areas within the Irish Sea. Data from Cefas (Ellis *et al*., 2012), the Marine Institute (O'Sullivan *et al*., 2013) and fisheries sensitivity maps (Coull *et al*., 1998) provides spatially explicit maps of the nursery/spawning areas for key species.

The Irish Sea supports spawning populations of several commercially important fish species. Species such as whiting, haddock, cod, plaice, mackerel, herring and sandeel sp. spawn within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area (Figure 10.1.4, Figure 10.1.5 and Figure 10.1.6). The Fish, Shellfish and Sea Turtle Ecology Study Area overlaps with spawning grounds for lemon sole, plaice and sprat, of which only the spawning grounds for lemon sole and sprat overlap with the Array Area or Cable Corridor and Working Area (Coull *et al*., 1998). The Fish, Shellfish and Sea Turtle Ecology Study Area also overlaps, across a stretch of 11 km at the northern extent, with spawning grounds for cod, ling, mackerel,

sandeel, sole and whiting. Spawning grounds for these species do not overlap with the Array Area or Cable Corridor and Working Area. The key spawning periods for fish species are shown in Table 10.1.3.

Table 10.1.3. Spawning periods of key fish species (Coull *et al.,* 1998; Ellis *et al*., 2012). Orange denotes spawning period with blue denoting peak spawning period.

Common Name	Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish	*Lophius piscatorius*												
Lemon Sole	*Microstomus kitt*												
Plaice	*Pleuronectes platessa*												
Sand eel	Ammodytidae sp.												
Sole	*Solea solea*												
Whiting	*Merlangius merlangus*												
Cod	*Gadus morhua*												
Haddock	*Melanogrammus aeglefinus*												
Ling	*Molva molva*												
Herring	*Clupea harengus*												
Mackerel	*Scomber scombrus*												
Sprat	*Sprattus sprattus*												
Spotted ray	*Raja montagui*												
Thornback ray	*Raja clavata*												
Spurdog and Tope	*Squalus acanthias* and *Galeorhinus galeus*												

The habitats that are important for supporting juvenile fish (i.e. that provide adequate food resources and shelter) are known as nursery areas. Nursery areas for several species, including herring, mackerel, lemon sole, anglerfish *Lophius piscatorius* haddock, cod and whiting are found within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area (Figure 10.1.4 to Figure 10.1.7). Nursery grounds for anglerfish, plaice, sand eel, haddock, cod, whiting, lemon sole and herring overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area, all assigned as either low intensity or spawning intensity undetermined.

The western Irish Sea (including the Fish, Shellfish and Sea Turtle Ecology Study Area) has been identified as a nursery area for spotted ray, tope and thornback ray (Ellis *et al*., 2012) (Figure 10.1.7). In addition, local fisheries consider that the waters off the coast of County Wicklow are important as a pupping/nursery area for elasmobranch species and over the last ten years the area has become favoured by recreational anglers, targeting mainly elasmobranch species (IFI, pers. Comm.). Spurdog nursery grounds do not overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area, however there are high intensity nursery grounds for this species 65 km north (Ellis *et al*., 2012).

High numbers of juvenile flatfish and elasmobranchs were recorded across the sandbanks studied in the western Irish Sea by Atalah *et al*. (2011), including juvenile spotted ray, plaice and dab, suggesting extensive use of these sandbanks as nursery areas for these species. However, as juveniles found across Arklow Bank were larger but less abundant compared with the other sandbanks studied, this study suggested that at Arklow Bank is unlikely to be one of the sandbanks of highest importance (Atalah *et al*. 2011).

Of the shellfish within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area, *Nephrops* are known to spawn in the region, with spawning areas recorded both to the north and south of the Fish, Shellfish and Sea Turtle Ecology Study Area (Figure 10.1.6). Annually, mating takes place in the spring or winter when the females are in the soft, post-moult state. The ovaries then mature throughout the spring and summer months and egg-laying takes place in later summer or early autumn. Young larvae hatch in late winter or early spring and enter a two-month planktonic phase after which they settle on suitable substrate (soft or silty mud).

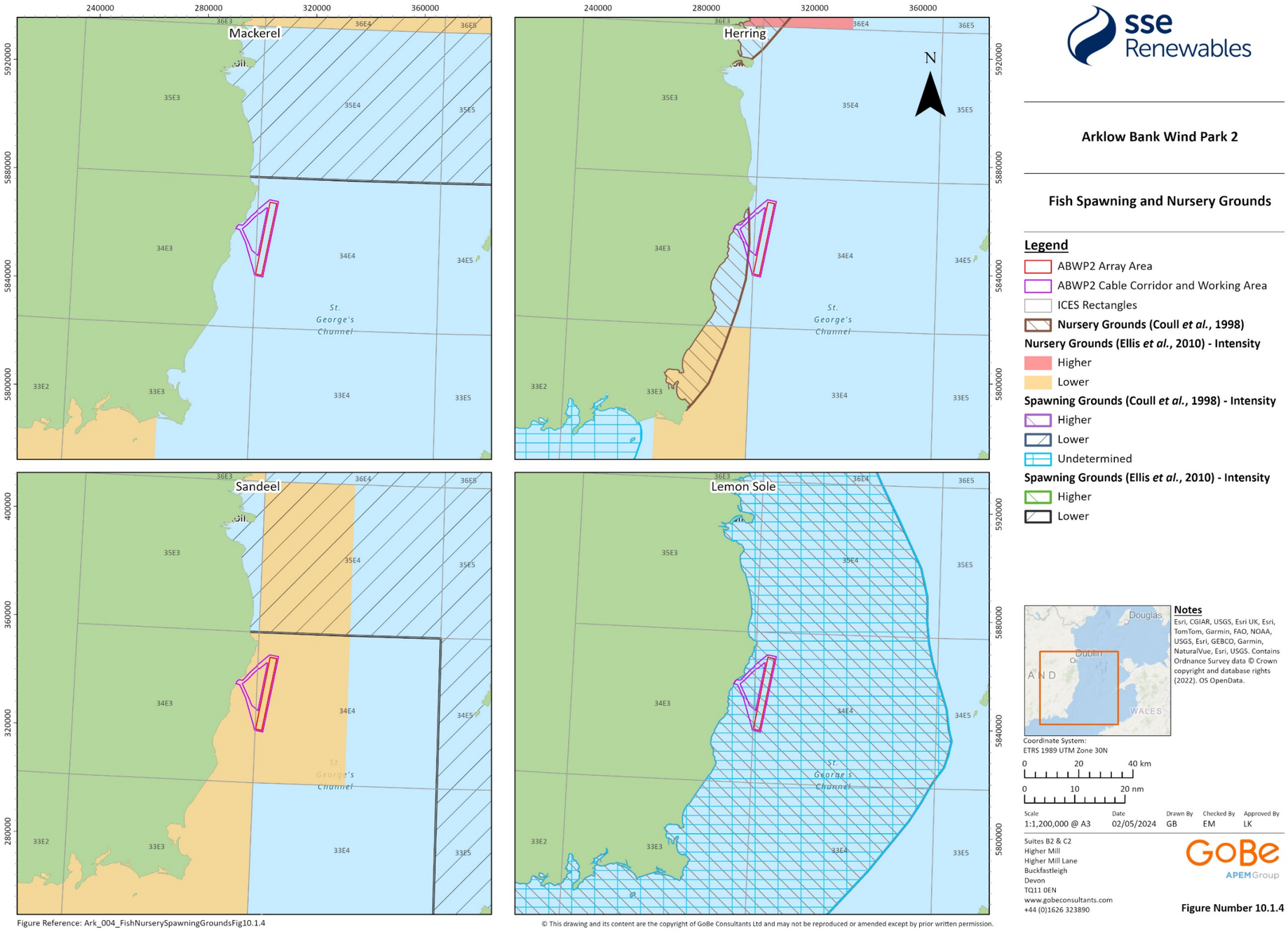

Figure 10.1.4. Spawning and nursery grounds for mackerel, herring, sandeel and lemon sole.

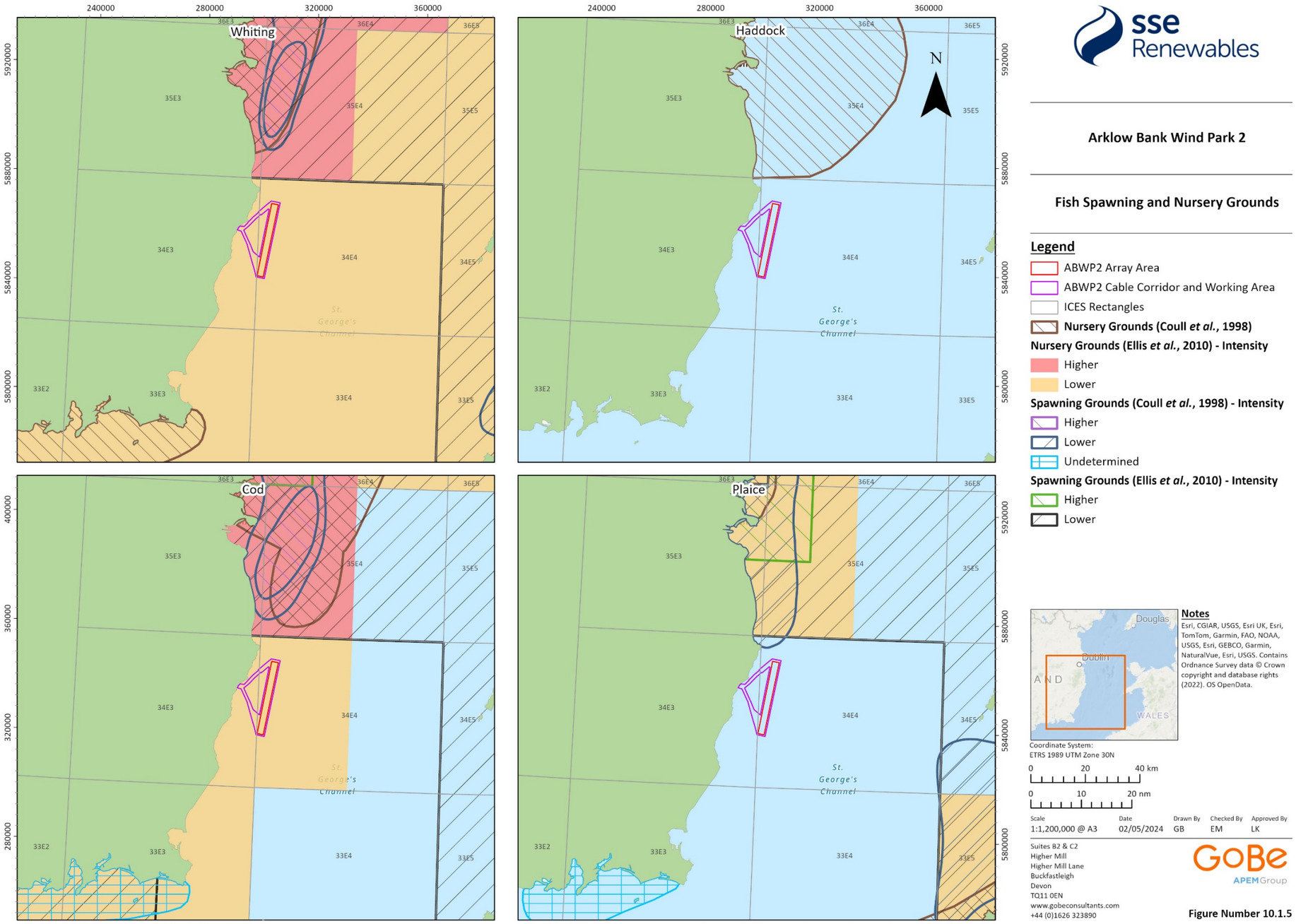

Figure 10.1.5. Spawning and nursery grounds for whiting, haddock, cod and plaice.

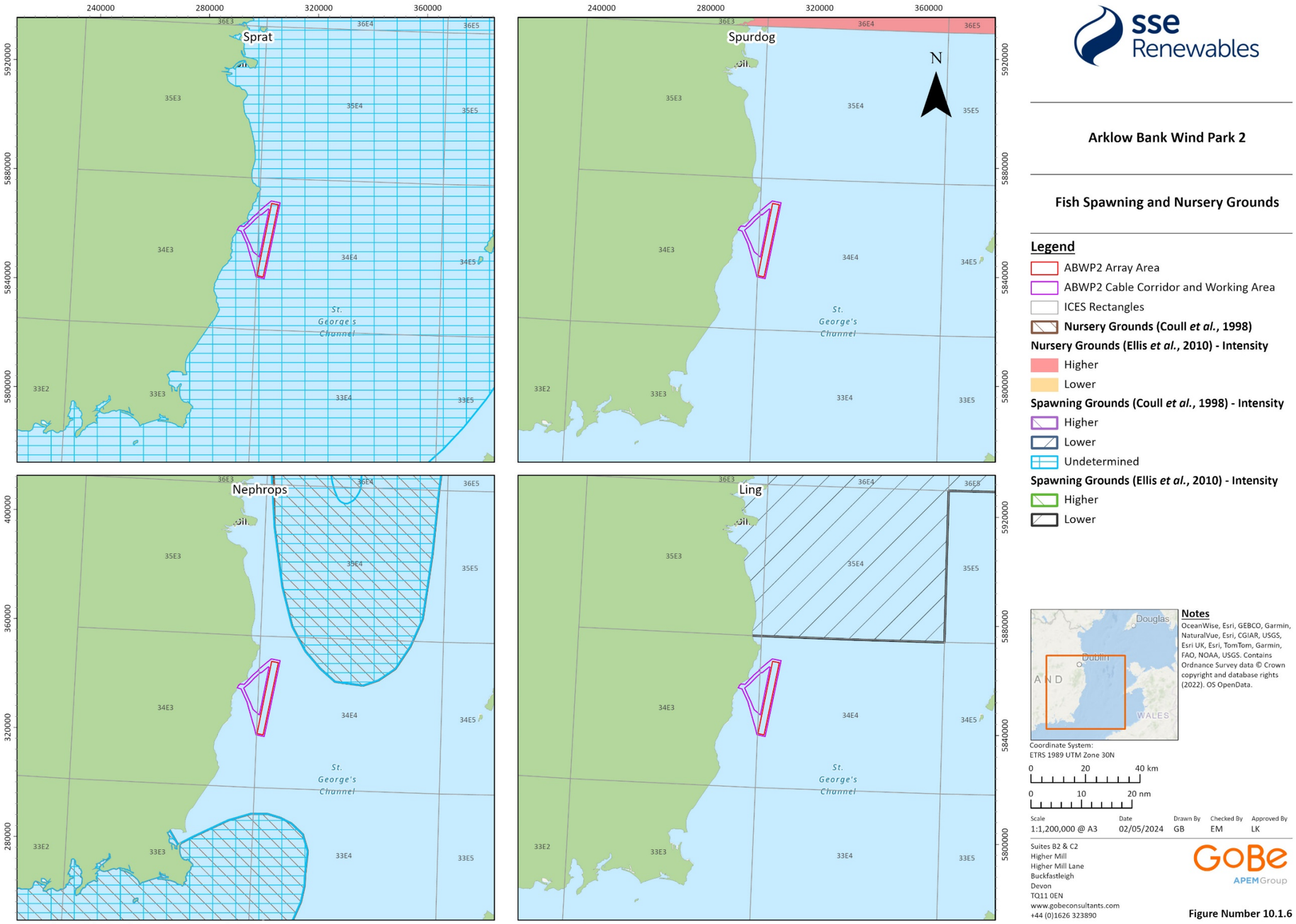

Figure Reference: Ark_006_FishNurserySpawningGroundsFig10.1.6

sse Renewables

Arklow Bank Wind Park 2

Fish Spawning and Nursery Grounds

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ICES Rectangles
- **Nursery Grounds (Coull *et al.*, 1998)**

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

- Higher
- Lower

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

- Higher
- Lower
- Undetermined

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

- Higher
- Lower

Notes

OceanWise, Esri, GEBCO, Garmin, NaturalVue, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 20 40 km

0 10 20 nm

Scale	Date	Drawn By	Checked By	Approved By
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Figure Number 10.1.6

Figure 10.1.6. Spawning and nursery grounds for sprat, spurdog, Nephrops and Ling.

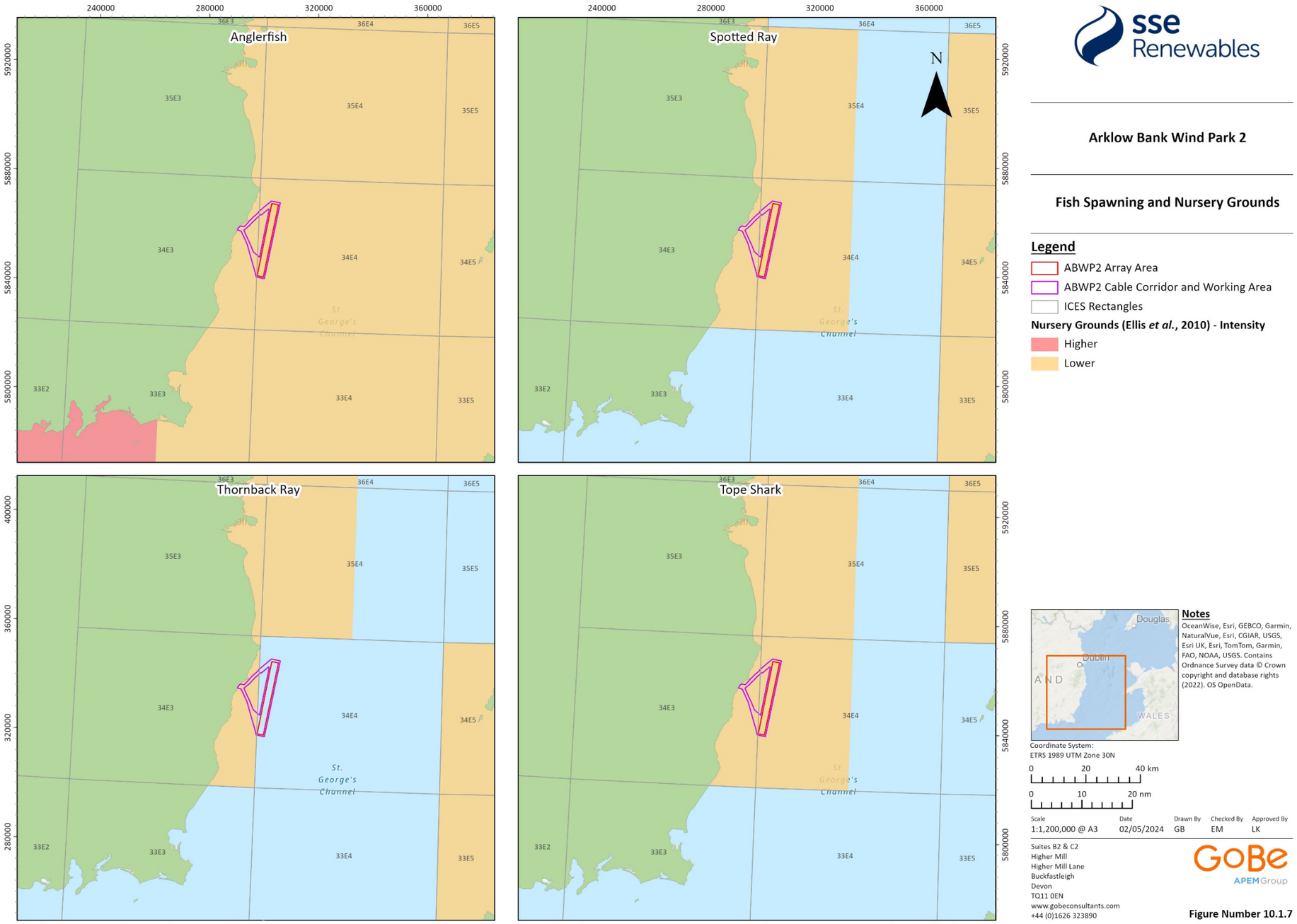

Figure Reference: Ark_007_FishNurserySpawningGroundsFig10.1.7

Figure 10.1.7. Nursery grounds for anglerfish, spotted ray, thornback ray and tope.

4.7 Designated Sites

Sites designated for the protection of fish within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area are illustrated in Figure 10.1.8. The features included are those that inhabit the marine environment at some point in their lifecycle (i.e. not wholly freshwater features).

The designated sites relevant to fish and shellfish within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area are presented in Table 10.1.4. Designated sites with relevant fish citation features within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area.

Table 10.1.4. Designated sites with relevant fish citation features within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area.

Designated site	Closest distance from Array Area (km)	Relevant features of interest
Slaney River Valley SAC (000781)	22.6	Sea Lamprey *Petromyzon marinus* River Lamprey *Lampetra fluviatilis* Twaite Shad *Alosa fallax fallax* Atlantic Salmon *Salmo salar*
River Barrow and River Nore SAC (002162)	54.1	Sea Lamprey *Petromyzon marinus* River Lamprey *Lampetra fluviatilis* Twaite Shad *Alosa fallax fallax* Atlantic Salmon *Salmo salar*
Lower River Suir SAC (002137)	82.0	Sea Lamprey *Petromyzon marinus* River Lamprey *Lampetra fluviatilis* Twaite Shad *Alosa fallax fallax* Atlantic Salmon *Salmo salar*
River Boyne and River Blackwater SAC (002299)	92.7	River Lamprey *Lampetra fluviatilis* Atlantic Salmon *Salmo salar*

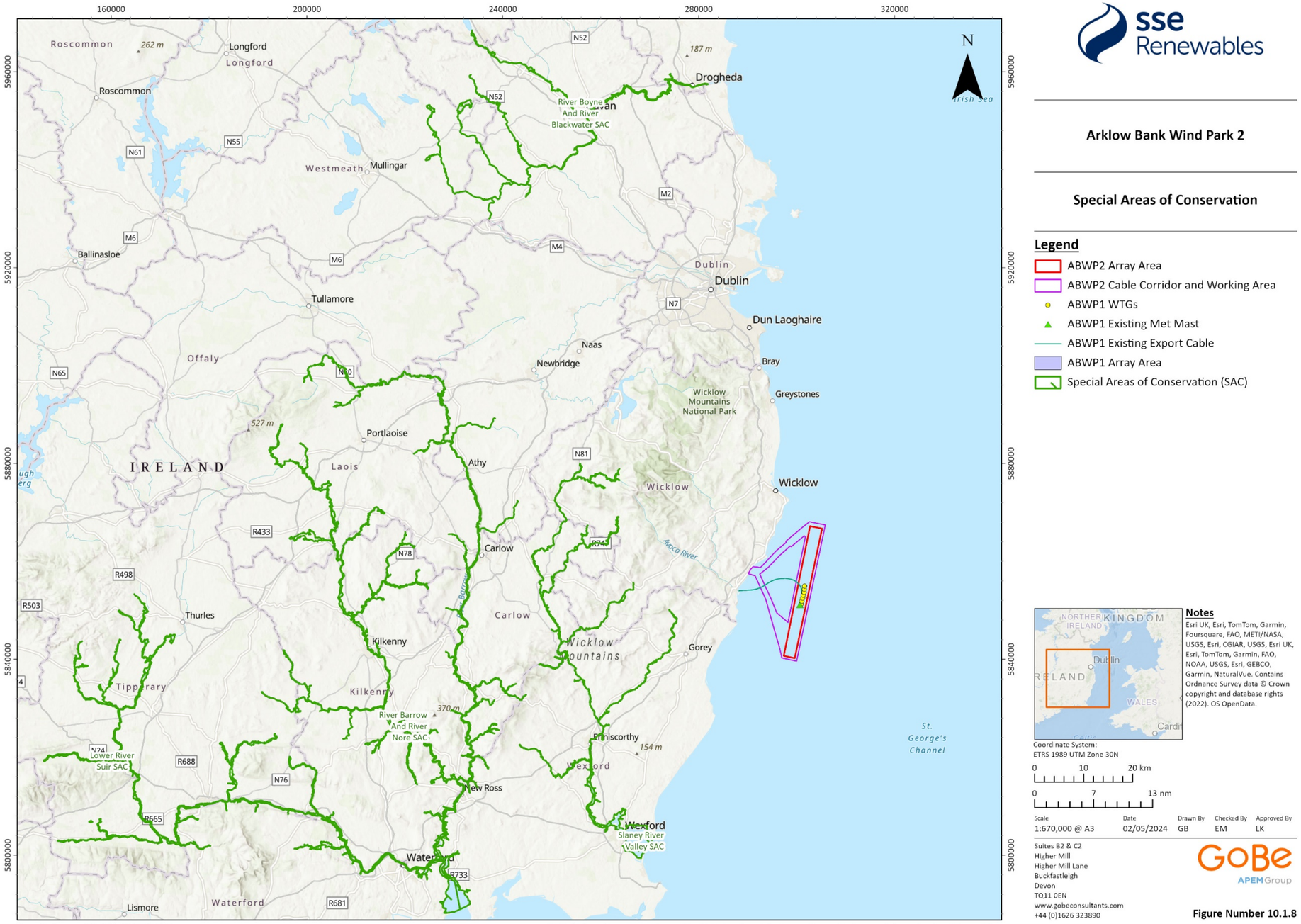

Figure Reference: Ark_008_SACFig10.1.8

sse Renewables

Arklow Bank Wind Park 2

Special Areas of Conservation

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area
- Special Areas of Conservation (SAC)

Notes

Esri UK, Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, GEBCO, Garmin, NaturalVue. Contains Ordnance Survey data © Crown copyright and database rights (2022). OS OpenData.

Coordinate System:
ETRS 1989 UTM Zone 30N

0 10 20 km

0 7 13 nm

Scale	Date	Drawn By	Checked By	Approved By
1:670,000 @ A3	02/05/2024	GB	EM	LK

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Figure Number 10.1.8

Figure 10.1.8. SACs designated for fish species within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area.

4.7.1 Slaney River Valley SAC

The Slaney River Valley SAC encompasses the freshwater stretches of the River Slaney from the coastal waters of Wexford harbour to the inland reaches of the river as far as the Wicklow mountains. Designated for the protection of a number of coastal, estuarine and freshwater habitats listed on Annex I of the European Union (EU) Habitats Directive, this site supports several species listed on Annex II of the Habitats Directive, including salmon, sea lamprey, river lamprey, brook lamprey and twaite shad, and small numbers of freshwater pearl mussel *Margaritifera margaritifera* (DAHG, 2015).

Habitats within the site are thought to provide a suitable environment for spawning or as nursery habitats for juvenile fish. Lamprey species spawn in clean gravels whilst juveniles of these species will burrow in areas of fine sediment in still water. Inland Fisheries Ireland monitor lamprey spawning activity in the Slaney in July (towards the end of the spawning period) in order to record whether the conservation objectives of the SAC are being met (Gallagher *et al.,* 2017). Twaite shad prefers stable gravel substrate for spawning although regular breeding has not been confirmed in the River Slaney (NPWS, 2011). Similarly, salmon spawn in clean gravels and the River Slaney is primarily a spring salmon fishery and is regarded in Ireland as one of the top rivers for early spring fishing (DAHG, 2015).

The conservation objectives for the Slaney River Valley SAC are to maintain the favourable conservation conditions for each of the designated features in the site.

4.7.2 River Barrow and River Nore SAC

The River Barrow and River Nore SAC consists of freshwater stretches of these two river catchments upstream as far as the Slieve Bloom Mountains and also includes estuarine habitats downstream to Creadan Head in Waterford Harbour. This SAC is important for a number of Annex II migratory fish species including sea lamprey, brook lamprey, river lamprey, twaite shad and Atlantic salmon. The freshwater stretches are important as spawning grounds, particularly for twaite shad and Atlantic salmon (DAHG, 2016). The freshwater stretch of the River Nore main channel is designated as a salmonid river and both rivers are mainly fished for grilse. In addition, the smelt *Osmerus eperlanus*, a species listed as 'Rare' in the Irish Red Data Book, occurs in the estuarine stretches of the SAC.

The conservation objectives for the River Barrow and River Nore SAC are to restore/maintain the favourable conservation conditions for each of the designated features in the site.

4.7.3 Lower River Suir SAC

The Lower River Suir SAC consists of the freshwater stretches of the River Suir immediately south of Thurles and the tidal stretches as far as the confluence with the Barrow/Nore immediately east of Cheekpoint in County Waterford. The site is of particular conservation

interest for the presence of a number of Annex II fish species, including Atlantic salmon, twaite shad, sea lamprey, brook lamprey and river lamprey. This river is of particular importance for twaite shad as it is one of only three known spawning grounds in the country for this species (DAHG, 2013).

The conservation objectives for the Lower River Suir SAC are to restore/maintain the favourable conservation conditions for each of the designated features in the site.

4.7.4 River Boyne and River Blackwater SAC

The River Boyne and River Blackwater SAC comprises the freshwater stretches of the River Boyne which drain a considerable area of Meath and Westmeath and smaller areas of Cavan and Louth. The site is designated as a SAC for the Annex II species river lamprey and Atlantic salmon. River lamprey are present in the lower reaches of the Boyne although the distribution of this species is not well known (DAHG, 2014). The Boyne is one of the most important rivers in eastern Ireland for Atlantic salmon and is known to have extensive habitat used as spawning grounds for this species (DAHG, 2014). Atlantic salmon run the Boyne in almost every month of the year with adult fish arriving in February to spawn, smaller spring fish arriving April/May, and a further late run in August.

The conservation objectives for the River Boyne and River Blackwater SAC are to restore/maintain the favourable conservation conditions for each of the designated features in the site (DAHG, 2018).

5. Important Ecological Features

In accordance with the best practice guidelines (Chartered Institute of Ecology and Environmental Management (CIEEM), 2019), Important Ecological Features (IEF) are identified and all potential impacts of a development are assessed against the IEFs to determine whether or not they are significant. The fish, shellfish and sea turtle IEFs are defined as species considered to be important for ecological, commercial and/or conservations reasons. The IEFs that will be assessed within the fish, shellfish and sea turtle EIAR is presented in Table 10.1.5, along with their importance and justification for their inclusion.

Table 10.1.5. Important Ecological Features being taken forward for assessment.

IEF	Scientific name / Representative species	Importance	Justification
Benthic and demersal fish assemblages (Flatfish)	Lemon sole *Microstomus kitt,* Plaice *Pleuronectes platessa*	Regional	Species of commercial importance. Spawning and nursery grounds overlap with study area.
Benthic and demersal fish assemblages (Flatfish)	Turbot *Scophthalmus maximus,* dab *Limanda limanda,* common sole *Solea solea,* thickback sole *Microchirus variegatus*	Local	Flatfish species typical of the Irish Sea. Commercially important.
Benthic and demersal fish assemblages	Sand goby *Pomatoschistus minutus*, *Trisopterus minutus,* pogge *Agonus cataphractus,* dragonet *Callionymus lyra*, black goby *Gobius niger*	Local	Important prey species, with no information available on spawning and nursery grounds and little to no commercial value.
Benthopelagic and pelagic fish assemblages	Atlantic cod *Gadus morhua,* Whiting *Merlagius merlangus,* Atlantic mackerel *Scomber scombrus*, Atlantic herring *Clupea harengus*, Anglerfish Lophiformes spp., Haddock *Melanogrammus aeglefinus,* sandeel *Ammodytes spp.,* Sprat *Sprattus sprattus*	Regional	Species of commercial importance within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area. Nursery and/or spawning grounds for these species overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area.
Benthopelagic and pelagic fish assemblages	Ling *Molva molva*	Local	Species of commercial importance within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area. Spawning grounds for this species overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area.
Benthopelagic and pelagic fish assemblages	European hake *Merluccius merluccius,* blue whiting *Micromesistius poutassou*	Local	Local benthopelagic/ pelagic assemblages that are typical of the wider western Irish Sea region. These species are commercially important but have no known spawning or nursery grounds in the region.
Local shellfish assemblages	Hermit crab *Pagurus prideaux*, brown shrimp *Crangon crangon*, pink shrimp *Pandalus boralis*, common hermit crab *Pagurus bernhardus*, velvet swimming crab *Necora puber*	Local	Local shellfish assemblages that are typical of the wider western Irish Sea region and are important prey species.
Blue mussel and mussel seed beds	*Mytilus edulis*	Regional	The area inshore from Arklow Bank is considered to be of importance for the settlement of mussels and as a seed bed for this commercially important species.
Whelk	*Buccinum undatum*	Regional	Species is a key component of the commercial fisheries within the Fish, Shellfish and Sea Turtle Study Area.
Other commercially important shellfish species	King scallop *Pecten maximus*, queen scallop *Chlamus opercularis*, edible crab *Cancer pagurus*, cockle *Cerastoderma edule*, European lobster *Hommarus gammarus*	Regional	Commercially important shellfish that are abundant within the Fish, Shellfish and Sea Turtle Study Area.

IEF	Scientific name / Representative species	Importance	Justification
Nephrops	*Nephrops norvegicus*	Regional	Spawning areas for *Nephrops* lie to the north and south of the Fish, Shellfish and Sea Turtle Study Area.
Elasmobranchs	Thornback ray *Raja clavata,* Spotted ray *Raja montagui,*	Regional	The Fish, Shellfish and Sea Turtle Study Area overlaps part of the nursery areas for these species. These species are locally abundant and listed as Least Concern on Ireland's Red List for cartilaginous fish.
Elasmobranchs	Tope *Galeorhinus galeus*	Regional	The Fish, Shellfish and Sea Turtle Study Area overlaps part of the nursery areas for this species. Listed as Vulnerable on Ireland's Red List for cartilaginous fish.
Elasmobranchs	Spurdog *Squalus acanthias*	Regional	Endangered on Ireland's Red List for cartilaginous fish. The Fish, Shellfish and Sea Turtle Study Area does not overlap with nursery grounds for this species.
Elasmobranchs	Cuckoo ray Leucor*aja naevus* Lesser spotted dogfish *Scyliorhinus canicula*	Local	Abundant within the Fish, Shellfish and Sea Turtle Study Area. Ireland's Red List includes these species as Vulnerable (cuckoo ray) and Least Concern (lesser spotted dogfish).
Basking shark	*Cetorhinus maximus*	International	Internationally protected species, OSPAR listed species, IUCN Red List (Endangered) and Ireland's Red List species (Endangered). Migrates through the Irish Sea and may pass through the Fish, Shellfish and Sea Turtle Study Area. A single basking shark was recorded in October 2019 during two years of site-specific aerial surveys of the Array Area plus 4 km buffer.
Diadromous species	Atlantic salmon *Salmo salar*, sea trout *Salmo trutta*, sea lamprey *Petromyzon marinus*, river lamprey *L. fluviatilis*, twaite shad *Allosa fallax* and European eel *Anguilla anguilla*.	International	Diadromous fish species are Annex II species and are qualifying interests of SACs within the western Irish Sea; there is potential connectivity between the SACs and the Fish, Shellfish and Sea Turtle Study Area.
Leatherback turtle	*Dermochelys coriacea*	International	Internationally protected species, OSPAR listed species, IUCN Red List (Vulnerable) and Ireland's Red List species (Least Concern). Migrates through the Irish Sea where there are likely to be hotspots for foraging. May pass through the Fish, Shellfish and Sea Turtle Study Area. No leatherback turtles were recorded during the site-specific aerial surveys.

6. Summary

The fish community within the Fish, Shellfish and Sea Turtle Study Area is characteristic of demersal coastal communities of sandbank habitat and inshore fine sands. Demersal benthic species including sand goby, dragonet, poor cod, whiting and sand eel are abundant, and flatfish such as plaice, turbot, lemon sole and flounder are common in the area. Sandbanks are typically favoured by elasmobranchs and site-specific surveys reported spotted ray, thornback ray and dogfish amongst the most commonly recorded demersal fish species. A similar suite of species occurs inshore, with flatfish including plaice, dab and common sole dominating sandy substrates.

Arklow Bank and the surrounding waters also support a diverse shellfish community, some of which are commercially exploited. Whelk is the most commercially important shellfish, with Arklow Bank forming part of the eastern Irish fisheries for this species, which also includes Codling Bank to the north. Mussels are the second most commercially important shellfish. The area inshore from the northern part of Arklow Bank (near Wicklow) is considered to be particularly important as a mussel seed bed and for the settlement of larvae and subsequently, in 2018, a commercial mussel seed farm was licensed to the south of Arklow for the collection and harvesting of mussel seeds.

Fish communities within the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area are dominated by demersal flatfish such as plaice, lemon sole and turbot. Elasmobranchs, including thornback ray, cuckoo ray and spurdogs are also common and widespread. Benthopelagic and pelagic species characterise the offshore environment of the western Irish Sea, with Atlantic cod, Atlantic herring, European hake, whiting and blue whiting typically recorded in the wider region. Commercially important shellfish recorded in the Western Irish Sea Fish, Shellfish and Sea Turtle Study Area included *Nephrops*, king scallop, brown crab, European lobster, razor clam and cockle, however the Fish, Shellfish and Sea Turtle Study Area is unlikely to support large populations of *Nephrops*, brown crab or European lobster.

The western Irish Sea is also home to migratory fish species with Atlantic salmon and sea trout as the two most commercially important species in the region. The rivers Slaney, Boyne, Dargle and Avoca on the east coast of Ireland are key rivers for migratory fish species. Sea lamprey, brook lamprey, river lamprey, and twaite shad are known to occur in inshore waters off the coast of county Wicklow. The Slaney River Valley SAC, River Barrow and River Nore SAC, River Boyne and River Blackwater SAC and Lower River Suir SAC have all been designated for the protection of migratory fish species. These sites provide a suitable habitat both for spawning migratory fish and for juveniles of diadromous species.

Basking shark migrate through the Irish Sea during spring and summer and migration routes cover large distances from the north of Scotland to North Africa. Basking sharks have been recorded moving through the Celtic and Irish seas between March to June.

Sightings and stranding records for marine turtles suggests that the leatherback turtle may occur regularly within the Irish Sea. This species has a strong seasonal distribution with most sightings in the Irish Sea in the summer months; most likely driven by an increase in the abundance of jellyfish, as their key prey resource. Most records are from coastal waters, although it is likely that animals will range widely into offshore waters to forage.

A large portion of the Irish Sea is considered important nursery and spawning grounds for several species of fish and shellfish. Spawning grounds for lemon sole and sprat overlap with the Array Area or Cable Corridor and Working Area. The Fish, Shellfish and Sea Turtle Ecology Study Area also overlaps with spawning grounds for cod, ling, mackerel, sandeel, sole and whiting, however for these species the spawning grounds do not overlap with the Array Area or Cable Corridor and Working Area.

It is considered likely that Arklow Bank is a nursery habitat for several species of elasmobranch. Nursery areas for spotted ray, tope and thornback ray have been mapped overlapping the Fish, Shellfish and Sea Turtle Study Area, whilst spurdog (a species listed as Endangered on Ireland's Red List for cartilaginous fish) has a nursery area to the north of the Array Area (with the southern limit just north of Dublin Bay). Nursery grounds for anglerfish, plaice, sand eel, haddock, cod, whiting, lemon sole and herring overlap with the Fish, Shellfish and Sea Turtle Ecology Study Area. There is no overlap with *Nephrops* nursery grounds or fishing grounds with the Fish, Shellfish and Sea Turtle Ecology Study Area.

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