Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume III, Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report

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Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report

COMMERCIAL IN CONFIDENCE

APEM

Date of issue: **May 2024**

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APEM Ltd
Riverview
A17 Embankment Business Park
Heaton Mersey
Stockport
SK4 3GN

Tel: 0161 442 8938
Fax: 0161 432 6083

Registered in England No. 02530851

Report should be cited as:

"APEM (2024). Appendix 9.1: Benthic Subtidal and Intertidal Ecology Technical Report"

Version	Date	Status	Author	Reviewed by	Approved by
1.0	10/05/2024	Final (External)	APEM Ltd	GoBe Consultants	Sure Partners Limited

Statement of Authority

Experts	Qualifications	Relevant Experience
APEM: Connor Markham Author	BSc (Hons), Marine Biology w/ Year in Industry, Swansea University (2018).	Connor is a Senior Consultant with experience in the field of marine consultancy including EIA, HRA and WFD assessment. Throughout the production of these reports, Connor uses his extensive knowledge of marine ecology to assess the potential impacts of anthropogenic activities on a wide range of environmental receptors including benthic habitats and species, fish and marine mammals. Connor has worked on developments for the marine energy, infrastructure and transport (ports and harbours) industries where he has both led and supported on several stages of large-scale projects including environmental scoping to the production of marine ecology ES chapters. Connor is also highly experienced in the management and design of both intertidal and subtidal marine surveys to gather sufficient site characterisation data to inform ecological assessments. This also includes the analysis and interpretation of biological benthic data to characterise biological assemblages at proposed development sites.
APEM: Dr Marc Hubble Document audit	PhD, James Cook University (1998 – 2003). BSc (Hons), Applied Marine Biology, Heriot-Watt University (1994-1997).	Marc has worked in the field of marine ecology research/consultancy for over 18 years during which time he has gained extensive experience managing a diverse range of marine projects. He has an excellent knowledge of protected species and habitats and relevant policy/legislation, and a detailed understanding of the ecology and conservation requirements of biological groups encompassing plankton, macroalgae, angiosperms, invertebrates, finfish/shellfish and associated fisheries, and marine mammals. He has conducted numerous scoping studies and worked on/managed EIAs, SEAs, HRAs, WFD and MCZ assessments for a diversity of marine developments encompassing offshore windfarms, interconnectors, tidal power schemes, outfalls, bridges, tunnels, ports/harbours/marinas, including DCO applications for NSIPs. Many of these assessments have involved application of the most recent guidance criteria and best practice approaches to assess the potential effects of underwater noise and vibration on fish and marine mammals. He has completed assessments for a range of work sectors including energy (nuclear power and renewables); oil and

gas; water industry; flood defence, aggregates, coastal infrastructure developments and public sector projects. He has excellent experience of engaging and consulting with clients, statutory authorities and other stakeholders throughout the EIA process. He has extensive experience of applying his multidisciplinary knowledge to impact assessments in estuarine, coastal and offshore habitats and routinely interprets and applies data from a wide range of published/grey literature sources including water quality, geophysical and oceanographic survey outputs.

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Glossary

Term	Meaning
Abundance	The sum total of individuals from a given species within a given area.
Anoxic	Complete lack of oxygen in a place or environment.
Arklow Bank Wind Park 1 (ABWP1)	Arklow Bank Wind Park 1 consists of seven wind turbines, offshore export cable and inter-array cables. Arklow Bank Wind Park 1 has a capacity of 25.2 MW. Arklow Bank Wind Park 1 was constructed in 2003/04 and is owned and operated by Arklow Energy Limited. It remains the first and only operational offshore wind farm in Ireland.
Arklow Bank Wind Park 2 – Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent.
Arklow Bank Wind Park 2 (ABWP2) (The Project)	Arklow Bank Wind Park 2 (ABWP2) (The Project) is the onshore and offshore infrastructure. This EIAR is being prepared for the Offshore Infrastructure. Consent for the Onshore Grid Infrastructure (Planning Reference 310090) and Operations Maintenance Facility (Planning Reference 211316) has been granted on 26 May 2022 and 20 July 2022, respectively. • Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent. This is the subject of this EIAR and will be referred to as 'the Proposed Development' in the EIAR. • Arklow Bank Wind Park 2 Onshore Grid Infrastructure: This relates to the onshore grid infrastructure for which planning permission has been granted. • Arklow Bank Wind Park 2 Operations and Maintenance Facility (OMF): This includes the onshore and nearshore infrastructure at the OMF, for which planning approval permission has been granted. • Arklow Bank Wind Park 2 EirGrid Upgrade Works: any non-contestable grid upgrade works, consent to be sought and works to be completed by EirGrid
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.
Bathymetry	The measurement of water depth in oceans, seas and lakes.
Benthic Ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Biogenic	Produced or originating from a living organism.
Biotope	A region uniform in environmental conditions and in its populations of animals and plants for which it is the habitat.

Term	Meaning
Bivalve	An aquatic mollusc which has a compressed body enclosed within a hinged shell, such as oysters, mussels, and scallops.
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.
Chartered Institute of Ecology and Environmental Management (CIEEM)	Professional body which represents and supports ecologists and environmental managers in the United Kingdom, Ireland and mainland Europe.
Circalittoral	The area of the continental shelf seabed that lies below the zone of periodic tidal exposure.
Conspicuous	Clearly visible.
Crustacean	An arthropod of the large, mainly aquatic group Crustacea, such as a crab, lobster, shrimp, or barnacle.
Echinoderm	A marine invertebrate of the phylum Echinodermata, such as a starfish, sea urchin, or sea cucumber.
Enumerate	Establish the number of.
EIA	An Environmental Impact Assessment (EIA) is a statutory process by which certain planned Projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU of the European Parliament and of the Council (EIA Directive) and the regulations transposing the EIA Directive (EIA Regulations).
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.
Ephemeral	Lasting a very short time.
EirGrid	State-owned electric power transmission system operator (TSO) in Ireland and Transmission Asset Owner (TAO) for the Project's transmission assets.
Facies	The character of a rock expressed by its formation, composition, and fossil content.
Fauna	The animals of a particular region, habitat, or geological period.
Flora	The plants of a particular region, habitat, or geological period.
Geophysical	A branch of earth science dealing with the physical processes and phenomena occurring especially in the earth and in its vicinity.
Global Navigation Satellite System	A network of satellites that provide geo-spatial positioning to many devices autonomously.
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

Term	Meaning
Heterogenous	Consisting of dissimilar or diverse constituents.
Important Ecological Features (IEF)	The IEFs of an area are those that are considered to be important and potentially affected by the Proposed Development.
Impoverished	Poor in quality.
Infaunal	The animals living in the sediments of the ocean floor, river or lake beds.
Intertidal	The area between the high water mark (HWM) and the low water mark (LWM).
Intertidal Phase I Walkover Survey	Survey methodology with the aim of identifying habitat types.
Landfall	The area in which the offshore export cables make landfall and is the transitional area between the offshore cabling and the onshore cabling
Lowest Astronomical Tide (LAT)	The lowest tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.
Low Water Mark (LWM)	The level reached by the sea at low tide.
Macrofauna	Animals large enough to be seen by the naked eye.
Mollusc	An invertebrate of a large phylum which includes snails, slugs, mussels, and octopuses.
Maritime Area Consent (MAC)	A consent to occupy a specific part of the maritime area on a non-exclusive basis for the purpose of carrying out a Permitted Maritime Usage strictly in accordance with the conditions attached to the MAC granted on 22 December 2022 with reference number 2022-MAC-002.
Natura 2000	A European network of important ecological sites.
Polychaete	A marine annelid worm of the class Polychaeta
Proposed Development	Arklow Bank Wind Park 2 Offshore Infrastructure.
Sandwaves	A sedimentary structure that forms across from tidal currents.
Scour	A process in which the continuous movement of water gradually degrades sediment and structures.
Special Areas of Conservation (SAC)	A site that protects natural habitats and/or species of European interest.
Species Density	A measure of the number of species in a given area.
Species Diversity	A measurement of biological diversity to be found in a specific ecological community.
Species Richness	The number of different species represented in an ecological community, landscape or region.
Subtidal	Below the low water mark.
Taxa	A taxonomic group of any rank, such as a species, family, or class.
The Benthic Subtidal and Intertidal Ecology Study Area	Defined as the area encompassing the Array Area, the Cabel Corridor and Working Area and the surrounding area (delineated as one tidal excursion from the Array Area).
Tidal Excursion	The net horizontal distance over which a water particle moves during one tidal cycle of flood and ebb.
Turbulence	Strong sudden movements within air or water.

Term	Meaning
Venerid Bivalves	Family of marine bivalve molluscs.
Wind Turbine Generator (WTG)	A device that converts the kinetic energy of wind into electrical energy.

Acronyms

Term	Meaning
ABWP1	Arklow Bank Wind Park 1
ABWP2	Arklow Bank Wind Park 2
AL	Action Level
ASU	Aquatic Services Unit
BIOMOR	Benthic Biodiversity in the Southern Irish Sea Project
CIEEM	Chartered Institute of Ecology and Environmental Management
DBT	Dibutylin
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMODnet	European Marine Observation and Data Network
EU	European Union
EUNIS	European Nature Information System
GNSS	Global Navigation Satellite System
HABMAP	Habitat Mapping for Conservation and Management of the Southern Irish Sea
IEF	Important Ecological Features
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LWM	Low Water Mark
HWM	High Water Mark
NPWS	National Parks and Wildlife Service
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
OWF	Offshore Windfarm
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
SAC	Special Area of Conservation
SSC	Suspended Sediment Concentration
SWISS	Southwest Irish Sea Survey
TBT	Tributylin
TEH	Total Extractable Hydrocarbons
UHRS	Ultra-High Resolution Survey
WTG	Wind Turbine Generator

Units

Unit	Description
cm	Metres
km	Kilometres
km^2	Kilometres squared
m	Metres
mg/kg	Milligrams per kilogram
MW	Megawatt

1. Benthic Subtidal and Intertidal Ecology Technical Report

1.1 Introduction

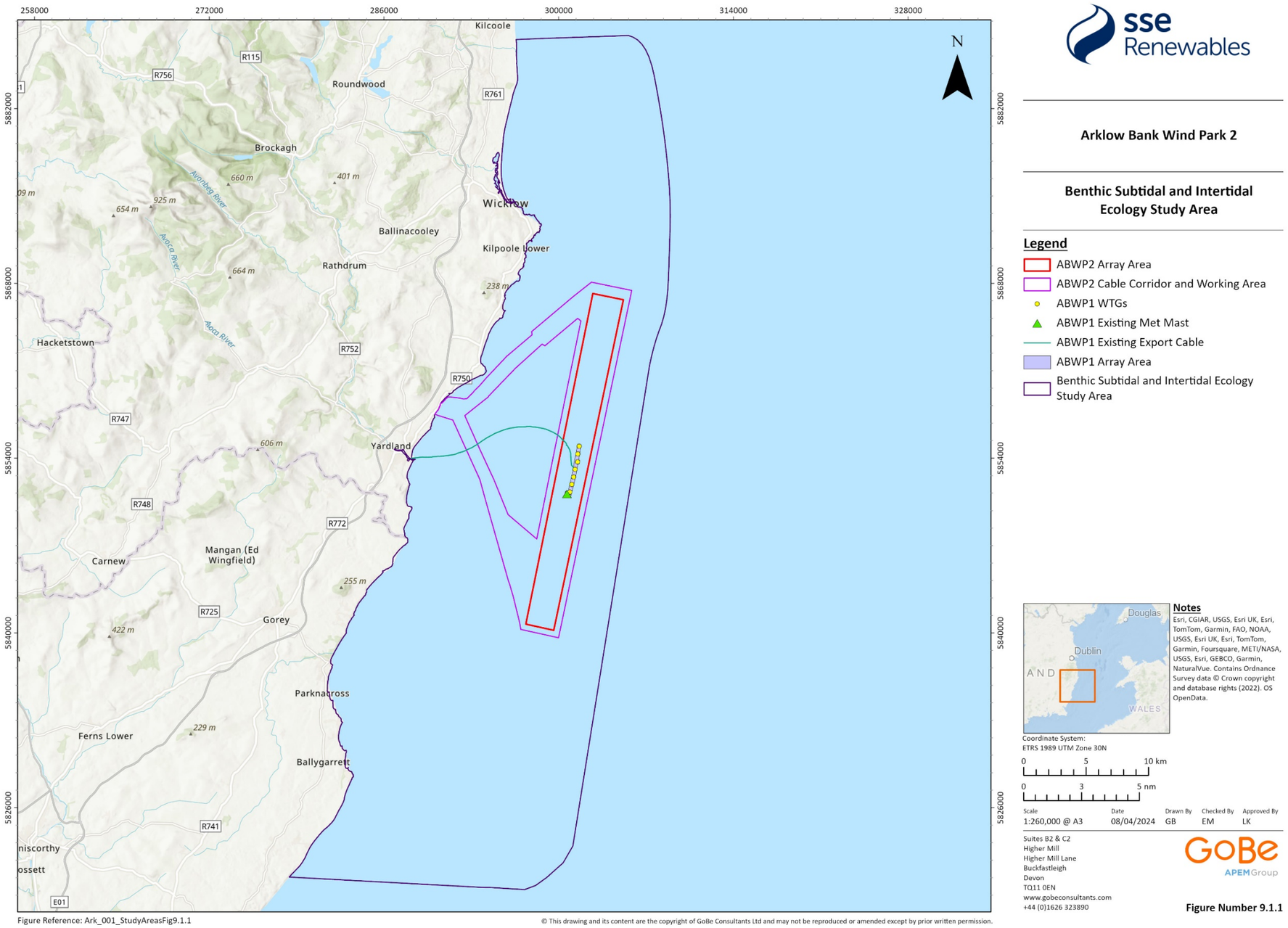
This Benthic Subtidal and Intertidal Ecology Technical Report provides an up-to-date benthic ecology subtidal and intertidal baseline characterisation for the Arklow Bank Wind Park 2 (ABWP2) Offshore Infrastructure ('the Proposed Development') and surrounding area to inform the Environmental Impact Assessment Report (EIAR), using the most recent desktop data and site-specific survey data. This report is structured as follows:

- Location of the study area;
- Methodology including details of desk-based review data sources and site-specific survey data;
- Baseline characterisation of benthic subtidal and intertidal ecology from those data sources outlined above; and
- Summary including identification of Important Ecological Features (IEF).

1.2 Study Area

The Proposed Development is located approximately 6 to 15 km off the east coast of Ireland. The Array Area covers an area approximately 63.4 km^2 and the area for the entire development covers up to 139.4 km^2 Figure 9.1.1. The Maritime Area Consent (MAC) provides consent for up to two offshore export cables. The Cable Corridor and Working Area will connect the Array Area to the mainland, via a cable landfall Figure 9.1.1 located to the south of Ennereilly Beach, approximately 4.5 km north of Arklow Figure 9.1.1.

For the purposes of the benthic subtidal and intertidal ecology assessments, the Benthic Subtidal Study Area is defined as the area encompassing the Array Area, Cable Corridor and Working Area, and surrounding area (delineated as one tidal excursion from the Proposed Development which is the maximum extent to which secondary impacts associated with sediment mobilisation (i.e. Increased Suspended Sediment Concentrations (SSC) and associated deposition) could occur), (See Volume III, Appendix 6.1: Marine Physical Processes Numerical Modelling), Figure 9.1.1. The Benthic Intertidal Ecology Study Area is defined by the intertidal habitats up to the High Water Mark (HWM) mark within the Cable Corridor and Working Area. To provide a wider context, the desktop review has also considered the benthic subtidal and intertidal habitats, communities and species present within the wider southwest Irish Sea (i.e. Regional Benthic Ecology Study Area).



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Arklow Bank Wind Park 2

Benthic Subtidal and Intertidal Ecology Study Area

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area
- Benthic Subtidal and Intertidal Ecology Study Area

Notes

Esri, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri UK, Esri, TomTom, Garmin, Foursquare, METI/NASA, 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 5 10 km

0 3 5 nm

Scale	Date	Drawn By	Checked By	Approved By
1:260,000 @ A3	08/04/2024	GB	EM	LK

Suites B2 & C2
Higher Mill
Higher Mill Lane
Buckfastleigh
Devon
TQ11 0EN
www.gobeconsultants.com
+44 (0)1626 323890

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Figure Number 9.1.1

Figure Reference: Ark_001_StudyAreasFig9.1.1

Figure 9.1.1 Benthic Subtidal and Intertidal Ecology Study Area.

1.3 Methodology

1.3.1 Desktop Review

A desktop review has been undertaken to inform the baseline for benthic subtidal and intertidal ecology, including a review of a number of academic reports, datasets, reports from surveys undertaken to support other project consents and surveys to support the designation of Special Areas of Conservations (SAC) for offshore habitats located in the vicinity of Arklow Bank (Table 9.1.1 and Table 9.1.2). These provide further context to the site-specific surveys (Table 9.1.2).

1.3.2 Benthic Subtidal Surveys

Several benthic subtidal surveys have been conducted across the Benthic Subtidal and Intertidal Ecology Study Area between 2000 and 2021. These included pre-construction baseline surveys (prior to construction for the Arklow Bank Park 1 (ABWP1) wind turbine generators (WTG)) undertaken in 2000 and 2001, a series of post-construction monitoring surveys undertaken over a period of eight years (2004 to 2011, inclusive) and a subtidal benthic ecology survey, conducted as part of the post-construction monitoring programme for ABWP1 in 2021. These site-specific monitoring surveys were focussed primarily on Arklow Bank and the area inshore, although some sampling was also undertaken to the east of Arklow Bank. Samples were taken in approximately the same locations every year (Figure 9.1.2). The labelled numbers in Figure 9.1.2 represent the dredge and trawl sample numbers used during the 2021 site-specific survey.

In addition, site-specific geophysical surveys for the Proposed Development were also undertaken across the Array Area and Cable Corridor and Working Area in 2019 and 2022. These data provide further characterisation information, including seabed feature and sediment types, which were considered alongside the ecological datasets.

The results of these surveys have been reviewed and summarised and all site-specific data sources are detailed in Table 9.1.1 and Table 9.1.2 below. Whilst the sampling methods were not identical across all surveys, these datasets provide benthic ecology data over a long time series and therefore represent a robust characterisation of the benthic subtidal ecology assemblages across the study area to inform the Benthic Subtidal and Intertidal Ecology EIAR chapter (Volume II, Chapter 6: Benthic Subtidal and Intertidal Ecology).

1.3.3 Benthic Intertidal Surveys

An intertidal Phase I walkover survey and on-site dig-over sediment sampling of the landfall site, located to the south of Ennereilly Beach, was conducted in June 2019 (Figure 9.1.3). The survey was conducted following guidance outlined in Davies *et al*. (2001) and Wyn *et al*.

(2006), while habitats/biotopes were classified in accordance with Connor *et al*. (2004). For the purposes of this report, EUNIS codes have also been provided (EEA, 2019).

The Phase I walkover survey was conducted along transect lines extending from the upper shore to the lower intertidal. Field notes were made on the shore type, wave exposure, sediments/ substrate present, descriptions of habitats / biotopes/ species present and the spatial relationships between them. Biotopes present were identified, and their extents determined with the aid of aerial and on-site photography and using hand-held Global Navigation Satellite System (GNSS) recorders.

On-site dig-over sediment sampling and analysis was undertaken in soft sediment habitats, which involved approximately 0.02 m^2 of sediment dug to a depth of 20 cm to 25 cm and sieved through a 0.5 mm mesh. The aim of dig-over sediment sampling was to identify and enumerate conspicuous fauna and determine sediment physical characteristics (including sediment type, deposition layers, sediment mobility, presence and depth of hypoxic/anoxic layers, etc.).

During the survey, sections of the landfall were not accessible due to the steep cliff terrain. However, adjacent areas of the landfall were sampled, to the north and south. The inaccessible sections of the intertidal study area were visually assessed from vantage points on the backing cliffs.

The results of this survey have provided a robust and up-to date baseline characterisation of the benthic intertidal ecology study area to inform the Benthic Subtidal and Intertidal Ecology EIAR chapter (volume II, chapter 9: Benthic Subtidal and Intertidal Ecology).

Table 9.1.1. Summary of key desktop reports and data sources.

Title	Source	Year	Author
EUSeaMap 2021: European Marine Observation and Data Network (EMODnet) broad-scale seabed habitat map for Europe	EMODnet	2021 (accessed 27/07/2023)	EMODnet
Wicklow Reef SAC – Conservation objectives	NPWS	2013 (accessed 27/07/2023)	NPWS
Wicklow Reef SAC – Site Synopsis	NPWS	2014 (accessed 27/07/2023)	NPWS
Blackwater Bank SAC – Conservation objectives	NPWS	2023 (accessed 27/07/2023)	NPWS
Blackwater Bank SAC – Site Synopsis	NPWS	2014 (accessed 27/07/2023)	NPWS
Seabed Habitats of the Southern Irish Sea. In 'Seafloor Geomorphology as Benthic Habitat'.	Scientific publication – Seafloor Geomorphology as Benthic Habitat	2012 (accessed 27/07/2023)	Robinson *et al.*
Diversity of demersal and megafaunal assemblages inhabiting sandbanks of the Irish Sea	Scientific publication – Marine Biodiversity	2013 (accessed 27/07/2023)	Atalah *et al.*
Littoral and Benthic Investigations on the South Coast of Ireland: II. The Macrobenthic Fauna of Carnsore Point.	Scientific publication – Proceedings of the Royal Irish Academy	1987 (accessed 27/07/2023)	Keegan *et al.*
Seabed mapping in the southern Irish Sea: Predicting benthic biological communities based on	Scientific publication – Hydrobiologica	2008 (accessed 27/07/2023)	McBreen *et al.*

Title	Source	Year	Author
sediment characteristics			
Benthic surveys of sandbanks in the Irish Sea	Scientific publication – (NPWS, Department of Environment, Heritage and Local Government	2007 (accessed 27/07/2023)	Roche *et al.*
Proposed Dredge Disposal Sites for Arklow Harbour Commissioner	Survey of proposed dredge sites around Arklow Harbour	2008 (accessed 27/07/2023)	Aquafact International Services Ltd.
Ecological sensitivity analysis of the western Irish Sea to inform future designation of Marine Protected Areas (MPAs)	Marine Protected Area Advisory Group	2023 (accessed 27/07/2023)	Marine Protected Area Advisory Group
ABWP1 baseline survey	Survey of anchor dredge sites for ABWP1	2000 (accessed 27/07/2023)	EcoServe
	Survey of anchor dredge sites and otter trawls for ABWP1	2000 (accessed 27/07/2023)	
	Survey of anchor dredge sites and agassiz trawls for ABWP1	2001 (accessed 27/07/2023)	
ABWP1 post-construction survey.	Survey of anchor dredge sites and beam trawls for ABWP1	2004 (accessed 27/07/2023)	HydroServ Projects Ltd.
ABWP1 post-construction survey.		2004 (accessed 27/07/2023)	HydroServ Projects Ltd.
ABWP1 post-construction survey.		2005 (accessed 27/07/2023)	HydroServ Projects Ltd.
ABWP1 post-construction survey.		2005 (accessed 27/07/2023)	HydroServ Projects Ltd.
ABWP1 post-construction survey.		2006 (accessed 27/07/2023)	HydroServ Projects Ltd.
ABWP1 post-construction survey.		2007 (accessed 27/07/2023)	HydroServ Projects Ltd.

Title	Source	Year	Author
ABWP1 post-construction survey.		2008 (accessed 27/07/2023)	HydroServ Projects Ltd.
ABWP1 post-construction survey.		2009 (accessed 27/07/2023)	HydroServ Projects Ltd.
ABWP1 post-construction survey.		2010 (accessed 27/07/2023)	GE Wind Energy
ABWP1 post-construction survey.		2011 (accessed 27/07/2023)	GE Wind Energy
ABWP1 post-construction survey.		2021 (accessed 27/07/2023)	GE Wind Energy
Proposed Dredge Disposal Sites for Arklow Harbour Commissioner.	Dive survey using corers for benthic infauna, particle size analysis and organic carbon.	2007 (accessed 27/07/2023)	Aqua-fact International Services Ltd.
Diversity of demersal and megafaunal assemblages inhabiting sandbanks of the Irish Sea.	Beam trawls (demersal fish and megafaunal invertebrates).	2013 (accessed 27/07/2023)	Atalah *et al*.
Sediment chemistry sampling to support dredge dumping as sea permit application for ABWP1	Van Veen grabs for sediment chemistry.	2016 (accessed 27/07/2023)	Aquatic Services Unit

Table 9.1.2. Summary of site-specific subtidal benthic ecology surveys for the Proposed Development.

Data Source	Date(s) of survey	Survey Methodology
RPS (2019). ABWP2 Intertidal Phase I walkover survey and on-site dig-over sediment sampling of the Landfall site.	June 2019	• Phase I walkover survey and on-site digging.
Ultrabeam Ltd. (2019) Site-specific geophysical surveys of the ABWP2 Array Area and Cable Corridor and Working Area.	July/August 2019	• Multibeam echo sounder, sidescan sonar, sub-bottom profiler and magnetometer sampling.
Green Rebel (2022) Site-specific geophysical and hydrographic surveys of the ABWP2 Array Area and Cable Corridor and Working Area.	August to November 2022	• Sub-bottom profiler, Ultra High Resolution Survey (UHRS), sidescan sonar and magnetometer, multi-beam bathymetry and backscatter.

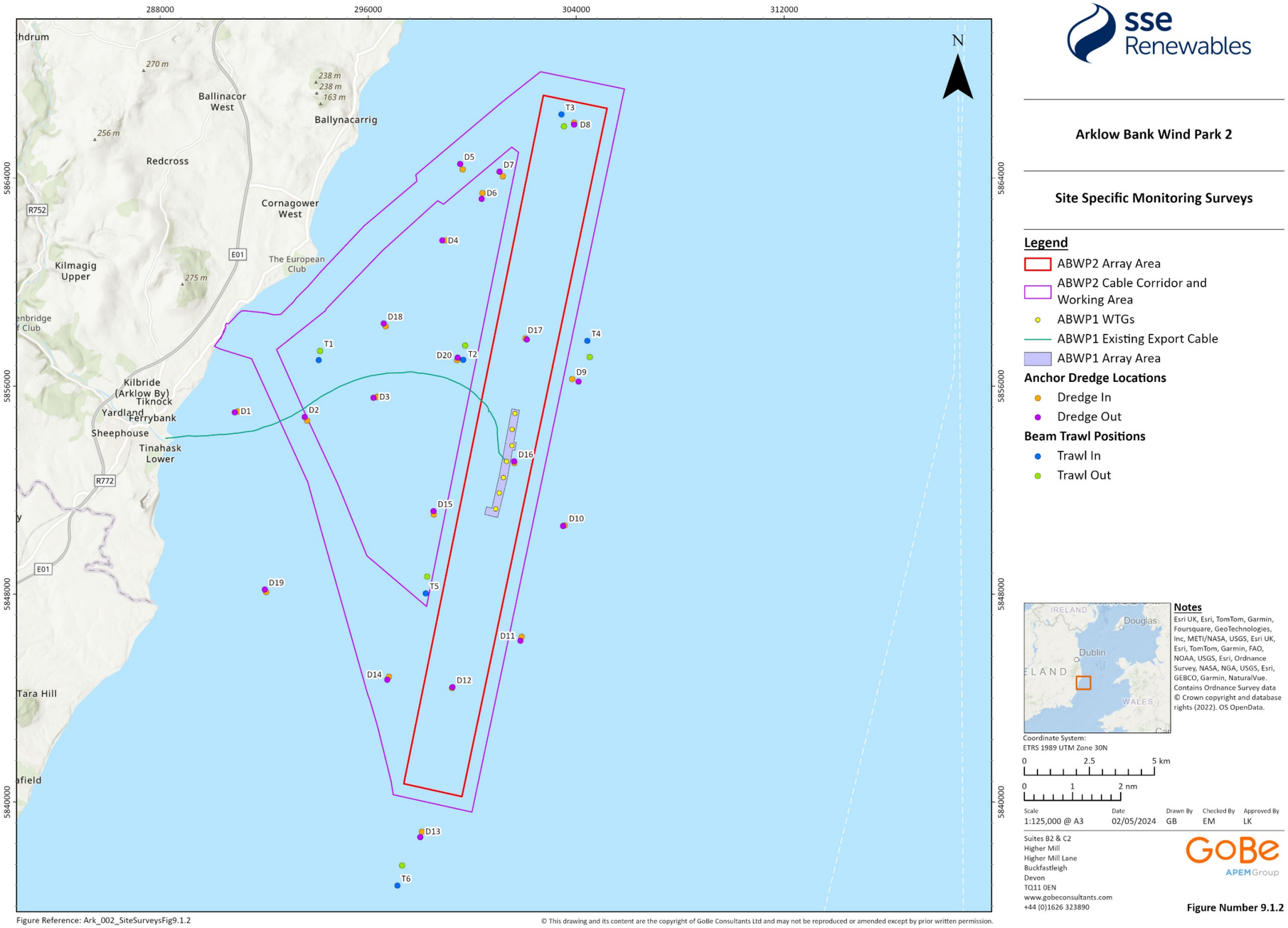

Figure 9.1.2. Dredge and trawl locations for the existing Arklow Bank Wind Park 1 site-specific benthic surveys.

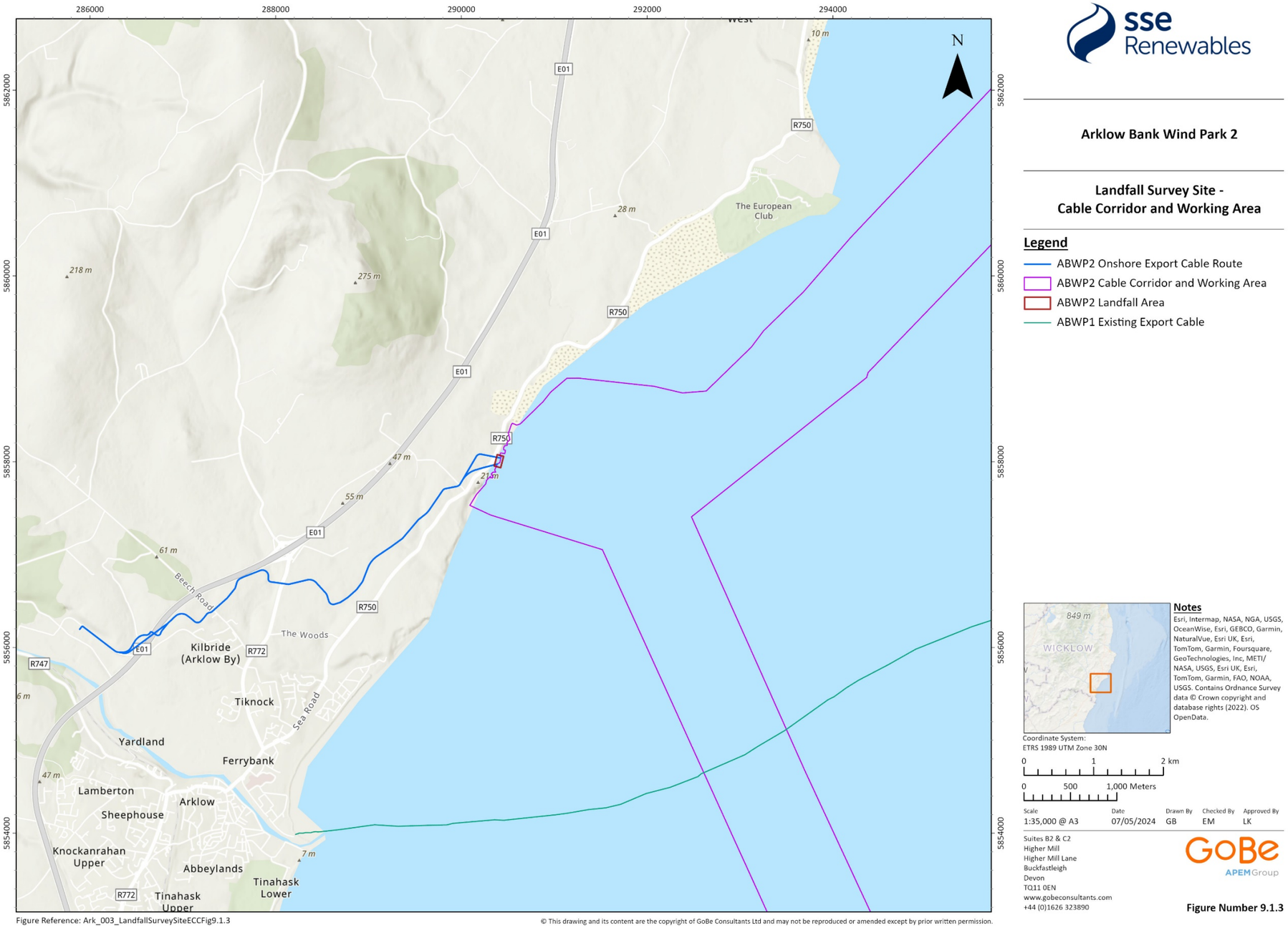

Figure 9.1.3. Arklow Bank Wind Park 2 landfall location.

1.4 Baseline Environment

1.4.1 Subtidal Ecology Desktop Data

1.4.1.1 Seabed Sediments

The seabed of the western Irish Sea comprises current swept coarse sediments which consist of compact sand with gravel, shell and/or cobbles in varying proportions. The EMODnet (European Marine Observation and Data Network) broad-scale seabed habitat map for Europe (EUSeaMap, 2021) presents the European Nature Information System (EUNIS) habitat classifications for the southern Irish Sea which primarily consists of circalittoral coarse sediment, circalittoral sand and circalittoral mixed sediments. Analysis of HABMAP (Habitat Mapping for Conservation and Management of the Southern Irish Sea), BIOMOR (Benthic Biodiversity in the Southern Irish Sea Project) and SWISS (South West Irish Sea Survey) project data also identified that the most common sediment type in the southern Irish Sea is sand, followed by sandy gravel, gravelly sand and muddy sand (McBreen *et al*., 2008).

Offshore sediments near Arklow Bank, within the Array Area, consists of an upper highly mobile layer of infralittoral, circalittoral and offshore circalittoral sand, ranging from medium to coarse sandy sediment (Creane *et al.* 2023; EUSeaMap, 2021; Marine Protected Area Advisory Group, 2023). Sand habitat and cobbles with shells/pebbles are present at the northern end of the Bank and fine sand at the southern end (Fehily Timoney & Co 2001; Panigrahi *et al.* 2009). Circalittoral fine sand or circalittoral muddy sands are also present in association with Arklow Bank itself and circalittoral/deep circalittoral coarse sediment in the areas to the east and to the west (i.e. inshore) of the sandbank (EUSeaMap, 2021). Keegan *et al*. (1987) studied the seabed and benthic fauna off Carnsore Point, approximately 70 km to the southwest of the Proposed Development using dredge trawls. Keegan *et al*. (1987) described the seabed around Arklow Bank as comprising of current swept coarse sediments which consist of compact sand, with gravel, shell and/or cobbles in varying proportions. The proportion of samples classified as sandy sediments increased northwards towards Wexford Harbour (Keegan *et al*. 1987).

The most inshore sediments near Arklow town are indicated to be a combination of circalittoral fine sand or circalittoral muddy sand and, to a lesser extent, circalittoral sandy mud (EUSeaMap, 2021; Marine Protected Area Advisory Group, 2023). These predictions from Keegan *et al*. (1987) are consistent with the results of the site-specific sampling surveys which are discussed further in Section 4.2.

1.4.1.2 Benthic Ecology

The infaunal communities associated with the soft-sediment communities of the western Irish Sea are described in Keegan *et al*. (1987) as being typically impoverished. This is reflective of the mobile nature of the sediments in this area, as a result of exposure to strong currents and weather-induced turbulence. The epifaunal communities are described by Keegan *et al*. (1987) as being characterised by erect hydroids (typically *Hydrallmania falcata*, *Sertularia argentea*, *Nemertesia* spp.) that attach to cobbles or shell, with the bryozoan *Flustra foliacea* abundant on bedrock exposed to strong currents and sand scour. The sandy seabed communities, found to the north of Carnsore Point, towards Arklow, were impoverished but included the polychaetes *Nephtys cirrosa* and *Ophelia borealis*. Other habitats in this region include banks of cobbles and coarse sands characterised by the polychaetes *N. cirrosa*, *O. borealis* and *Lanice conchilega*, and the bivalves *Spisula elliptica* and *Abra alba*.

Robinson *et al*. (2012), using a combination of HABMAP, BIOMOR and SWISS project data, identified that species-rich gravelly plains were present throughout St George's Channel and were generally classified as the biotope '*Mediomastus fragilis*, *Lumbrineris* spp., and venerid bivalves in circalittoral coarse sand or gravel' (JNCC code: SS.SCS.CCS.MedLumVen; EUNIS code: MC3212). The fine sands of the Blackwater Bank, to the south of Arklow Bank, were characterised as resembling the 'Infralittoral mobile clean sand with sparse fauna' (JNCC code: SS.SSa.IfiSa.ImoSA; EUNIS code: MB5231) or '*Nephtys cirrosa* and *Bathyporeia* spp. In infralittoral sand' (JNCC code: SS.Ssa.IfiSa.NcirBat; EUNIS code: MB5233) biotopes (Roche *et al*., 2007; Robinson *et al*., 2012). The same surveys at Kish Bank, to the north of Arklow Bank, revealed sandy substrate with medium to very-fine sand. The sediments here were characterised by four biotopes: '*Glycera lapidum* in impoverished infralittoral mobile gravel and sand' (JNCC code: SS.SCS.ICS.Glap; EUNIS code: MB3235); '*Abra prismatica*, *Bathyporeia elegans* and polychaete spp. In circalittoral fine sand' (JNCC code: SS.SSA.CfiSa.ApriBatPo; EUNIS code: MC5212); '*Nephtys cirrosa* and *Bathyporeia* spp. In infralittoral sand' (JNCC code: SS.SSA.IfiSa.NcirBat; EUNIS code: MB5233) and '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' (JNCC code: SS.SSA.CmuSa.AalbNuc; EUNIS code: MC5214), (Roche *et al.*, 2007; Robinson *et al.*, 2012).

Beam trawls undertaken by Atalah *et al*. (2013) at three locations on the sandbank of Arklow Bank in 2007 (after the construction of existing Arklow Bank Wind Park 1 wind turbine generators), demonstrated that the assemblages recorded were typical of those commonly found around the east coast of Ireland and were similar in terms of composition and abundance to those identified by previous studies (e.g. Mackie *et al.*, 1995). On Arklow Bank, the hermit crab *Pagurus bernhardus* was the most abundant macrofaunal invertebrate taxon followed by the starfish *Asterias rubens*, the bivalve *S. elliptica* and the crab *Liocarcinus holsatus*. The community present was shown to be comparable to that present at two other

sandbanks in St George's Channel (Kish and Blackwater) although differences were observed which were attributable to changes in the relative abundances of the dominant taxa. Atalah *et al*. (2013), noted that the presence of wind turbines was not associated with any alterations in benthic invertebrate communities, with no significant variation found in response variables such as abundance, number of taxa or Shannon-Weiner index of diversity.

Further inshore, Robinson *et al*. (2012) identified that the communities associated with areas of sandy and gravelly waves off the coast at Arklow resembled the '*Moerella* spp. With venerid bivalves in infralittoral gravelly sand' biotope (i.e. MoeVen) as described in Connor *et al*. (2004). Arklow Harbour Commissioners commissioned Aquafact International Services Ltd. to carry out seabed surveys in 2007 at a proposed dredge disposal site northeast of the town of Arklow (Aqua-fact International Services Ltd., 2008). The surveys found that the area was primarily composed of shelly coarse sand and gravels, reflecting the dynamic environment in this area. The benthic communities characterising these sediments were relatively species poor with 51 species recorded, comprising predominantly polychaetes, crustaceans, molluscs and echinoderms. No organisms were recorded as being rare or unusual and no habitat types were listed in the EU Habitats Directive (Aqua-fact International Services Ltd., 2008).

1.4.2 Site-specific Subtidal Survey Data

1.4.2.1 Seabed Sediments

The results of the latest site-specific survey conducted in 2021 were in line with the findings from previous surveys, indicating that the seabed was predominately sedimentary with little or no fixed hard substrata (GW Wind Energy, 2021). Minor variations were observed in terms of sediment particle size at select locations between the current survey and previous surveys, which is related to the heterogenous nature of sediments across the site. The seabed on Arklow Bank consisted of slightly gravelly sand, with coarser gravelly sands characterising the eastern and western parts of the bank. To the north of Arklow bank, the seabed varied, ranging from sand, gravelly sand and gravel. Seabed to the south of Arklow bank was predominately sandy with areas of gravel and mud.

Site-specific geophysical surveys of the Array Area conducted in 2019 indicate a boulder field near the north east tip of Arklow Bank, sandwaves to the south, and sand habitat across the bank itself (see Figure 9.1.4 for bathymetry data; Figure 9.1.5 for broad habitat mapping based on data interpretation). Very small patches of coarse sediments were recorded near the central section along the western flank (Figure 9.1.5). Water depths across Arklow Bank were typically less than 20 m, with the deepest areas in the northeast (up to 43 m) and southeast of the Array Area (up to 35 m; see Figure 9.1.4).

The 2022 site-specific geophysical survey of the Cable Corridor and Working Area found that the distribution of sediment across the cable routes show predominant facies of medium to coarse sands which coincide with the large presence of sandwaves, megaripples and sediment waves on the approach to Arklow Bank (Figure 9.1.7). Conversely, finer grained facies types such as sandy mud to clay are visible in troughs between sand wave crests (Figure 9.1.7). The water depths gradually increased offshore to a maximum depth of 35 m below Lowest Astronomical Tide (LAT) before decreasing at Arklow Bank (Figure 9.1.6).

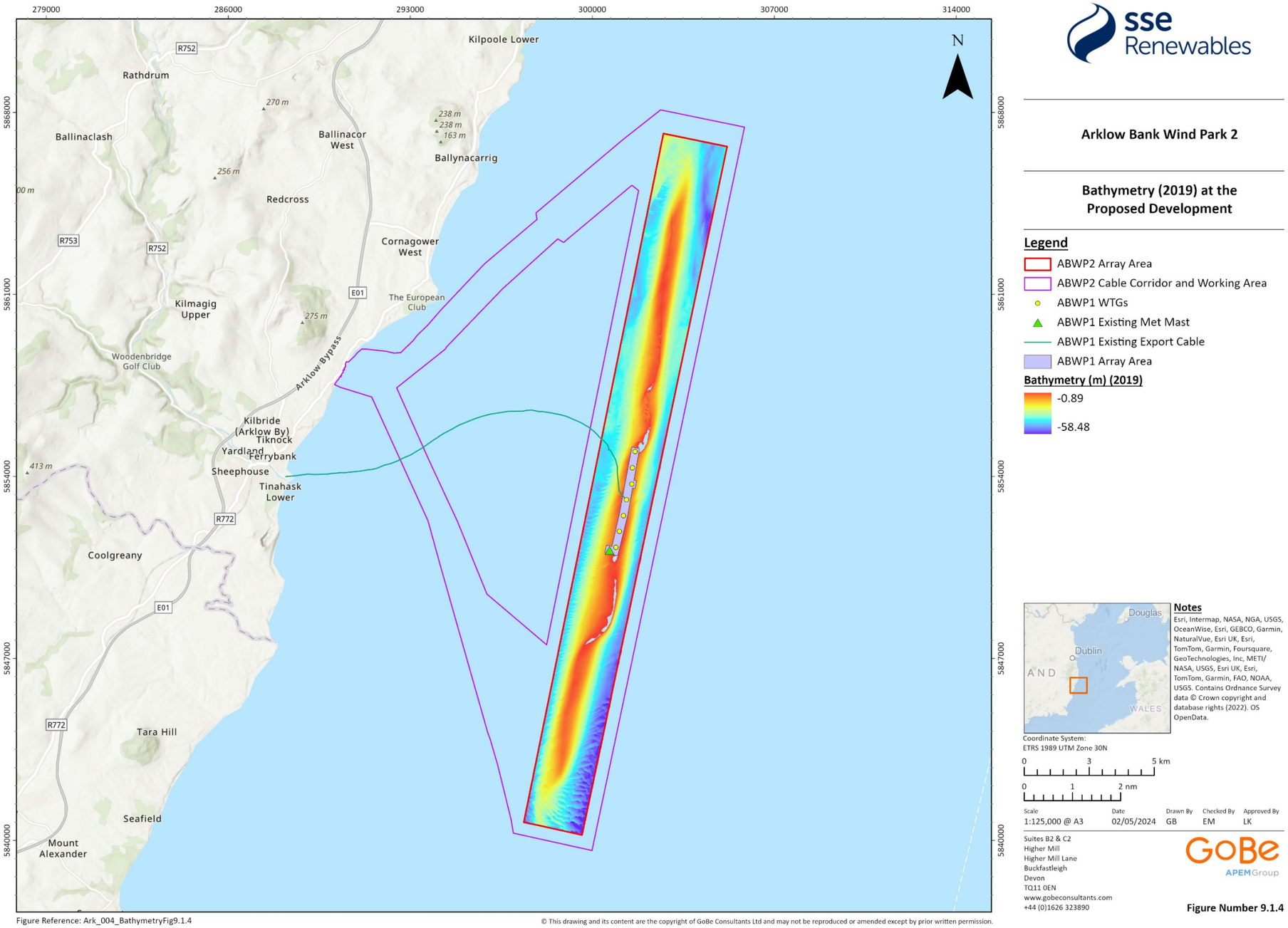

Figure Reference: Ark_004_BathymetryFig9.1.4

sse Renewables

Arklow Bank Wind Park 2

Bathymetry (2019) at the Proposed Development

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area

Bathymetry (m) (2019)

-0.89

-58.48

Notes

Esri, Intermap, NASA, NGA, USGS, OceanWise, Esri, GEBCO, Garmin, NaturalVue, Esri UK, Esri, TomTom, Garmin, Foursquare, GeoTechnologies, Inc, METI/ NASA, 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 3 5 km

0 1 2 nm

Scale	Date	Drawn By	Checked By	Approved By
1:125,000 @ A3	02/05/2024	GB	EM	LK

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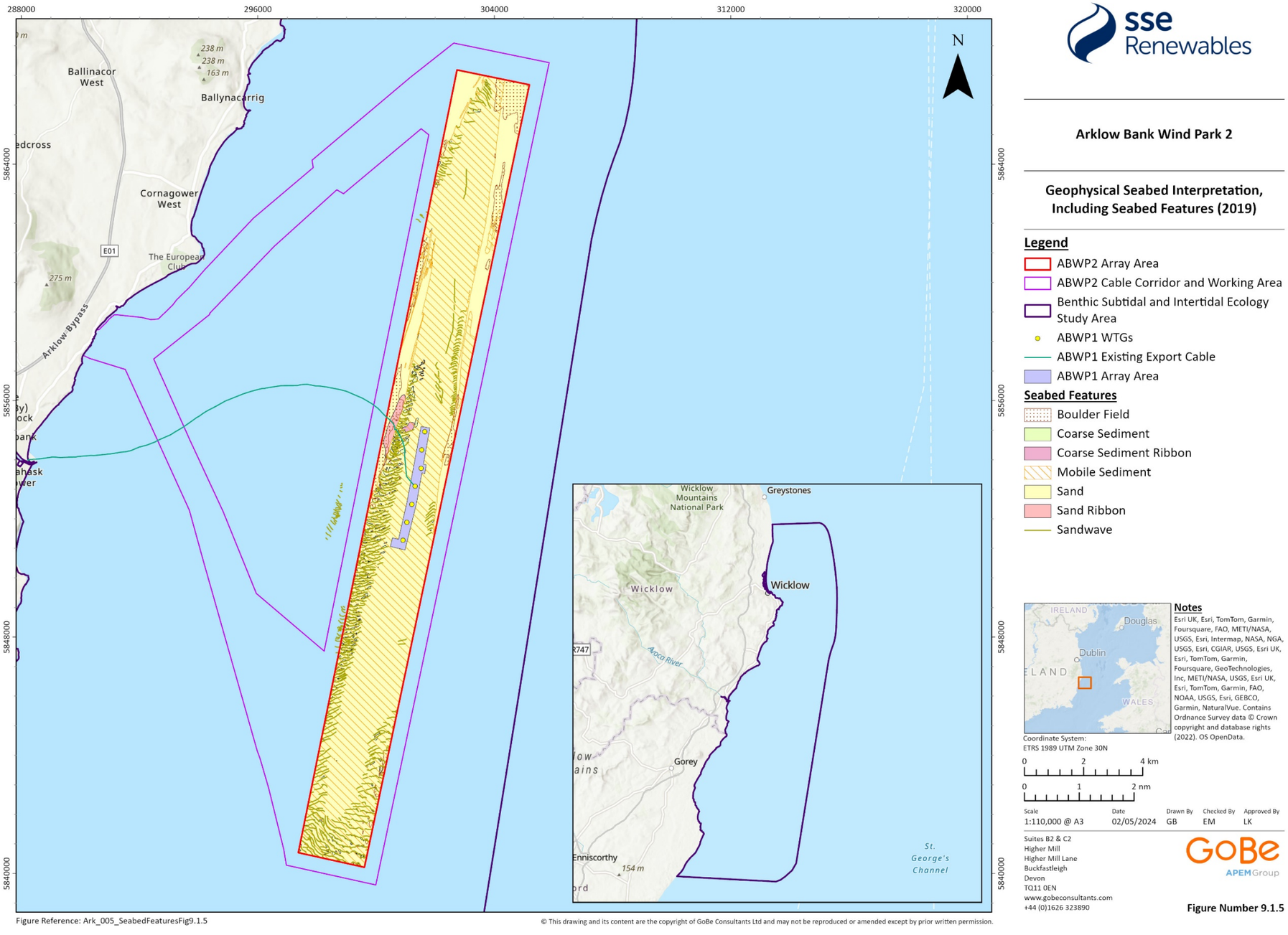
Figure Number 9.1.4

Figure 9.1.4. Seabed bathymetry of the Array Area (Ultrabeam Ltd., 2019).



Arklow Bank Wind Park 2

Geophysical Seabed Interpretation, Including Seabed Features (2019)

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- Benthic Subtidal and Intertidal Ecology Study Area
- 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, CGIAR, USGS, Esri UK, Esri, TomTom, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, 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

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0 1 2 nm

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Devon
TQ11 0EN
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Figure Number 9.1.5

Figure Reference: Ark_005_SeabedFeaturesFig9.1.5

Figure 9.1.5. Seabed interpretation of the Array Area (Ultrabeam Ltd., 2019).

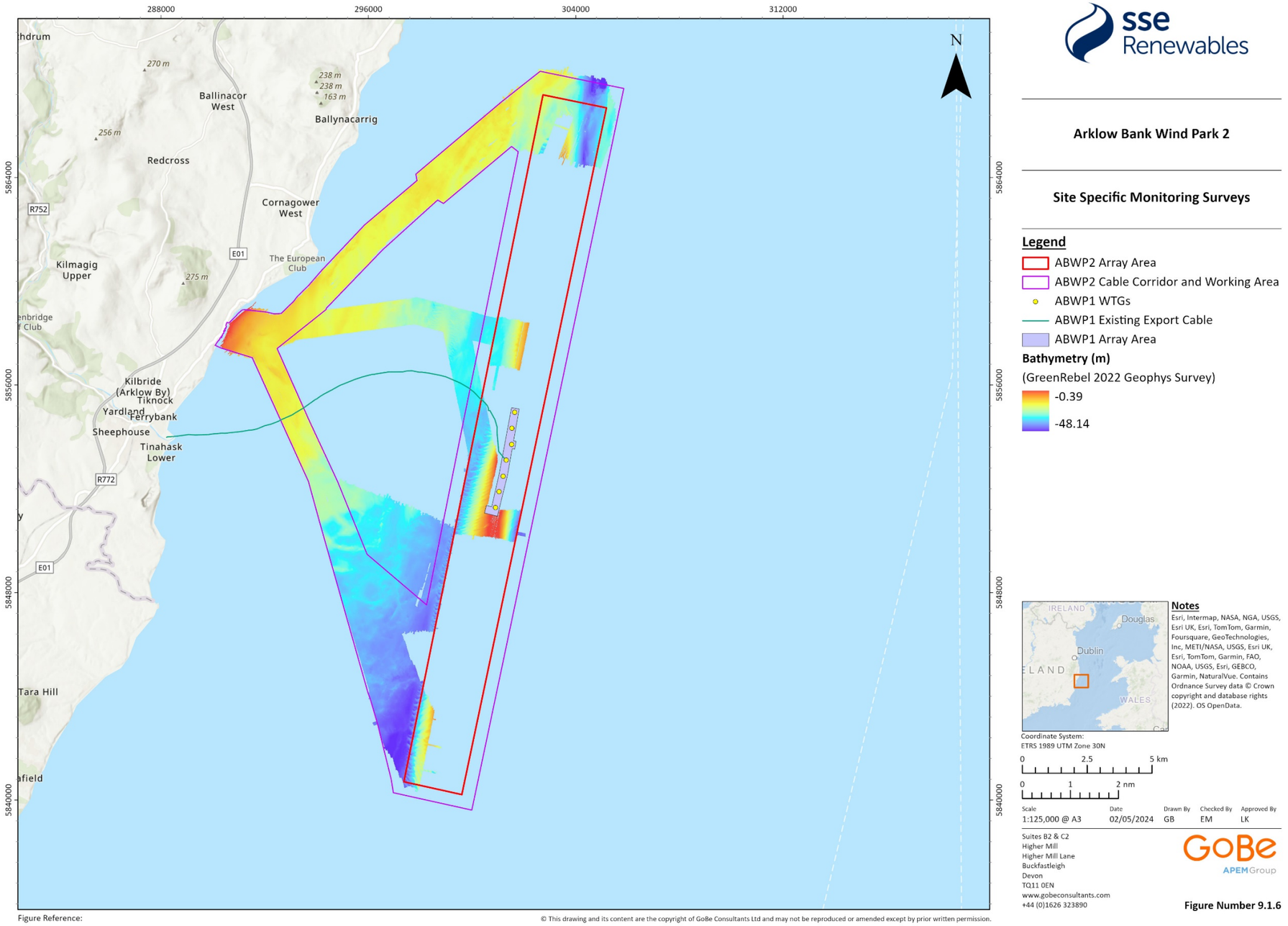


Figure 9.1.6. Seabed bathymetry of the offshore cable routes (Green Rebel, 2022).

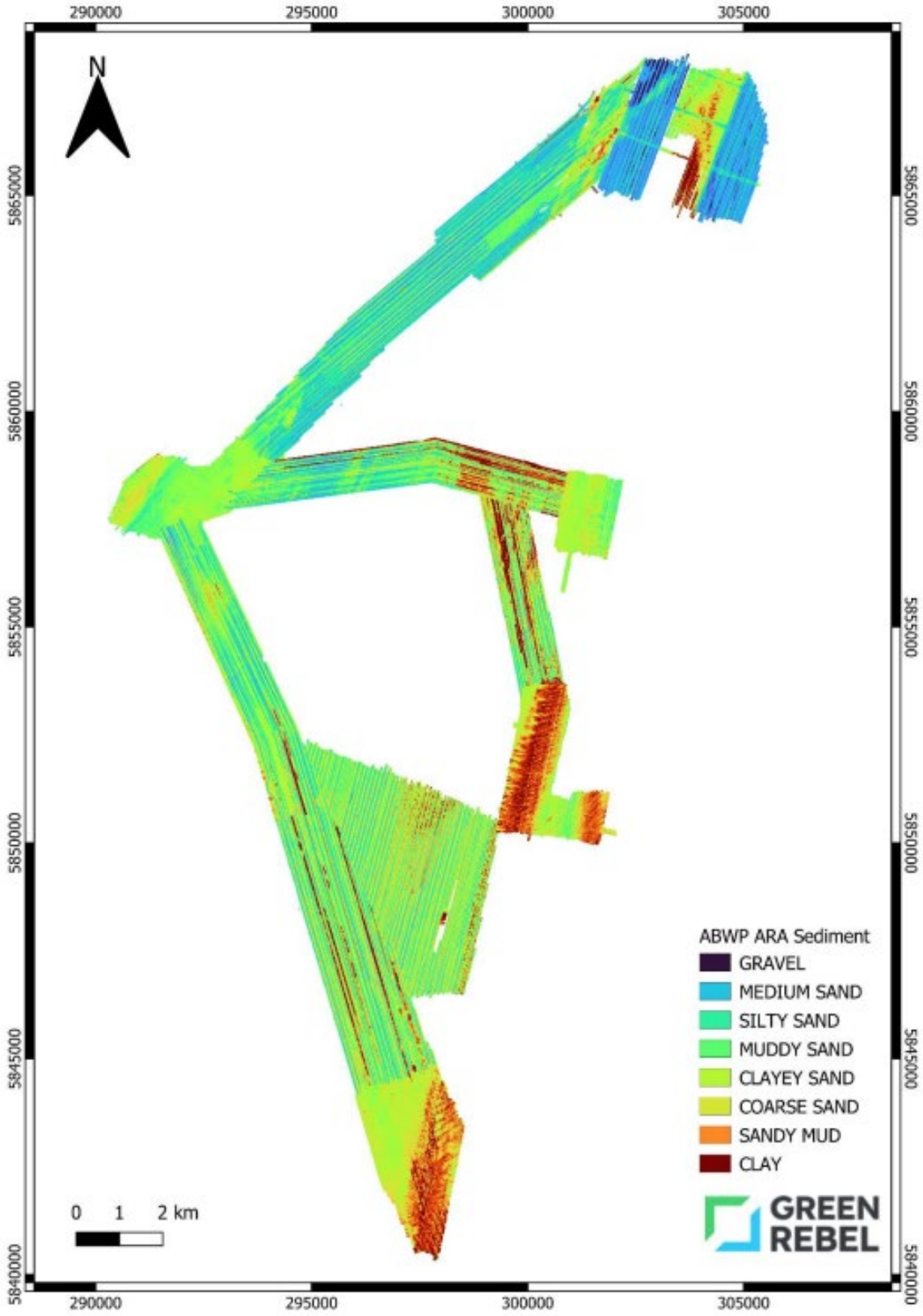


Figure 9.1.7. Seabed interpretation of the offshore cable routes (Green Rebel, 2022).

1.4.2.2 Subtidal Ecology

The benthic subtidal ecology surveys indicated the presence of low diversity communities with little temporal variation. Results of the most recent site-specific survey conducted in 2021 recorded a total of 185 taxa (2,440 individuals) and 238 taxa (6,355 individuals) within beam trawls and anchor dredge samples, respectively. Overall, the number of taxa recorded within beam trawls and anchor dredge samples were in keeping with previous surveys and similar to those identified in surveys between 2007 and 2011.

Species diversity was highest within areas of sandy shell, gravel and cobbles in the northwest, southwest and southeast of Arklow Bank and inshore along the proposed Cable Corridor and Working Area. The communities associated with sandy sediments were extremely species poor in comparison, as would be expected for the more mobile sandy sediments characterising a shallow sandbank. The most abundant species recorded during the 2021 survey were found to be broadly similar to the most abundant species in previous surveys. The species typically recorded were the reef-building worms *Sabellaria alveolata* and *Sabellaria spinulosa*; the polychaetes *Spirobranchus lamarcki*, *Dipolydora coeca*, *Serpulidae* spp. And *Scoloplos armiger*; the molluscs shiny button clam *Nucula nucleus*, wrinkled rock borer *Hiatella arctica* and white furrow shell *Abra alba*; the crustaceans wart barnacle *Verruca stroemia* and long clawed porcelain crab *Pisidia longicornis*; and the tunicates baked bean ascidian *Dendrodoa grossularia* and *Polycarpa fibrosa*. The assemblages and patterns recorded in the site-specific surveys reflect the desktop data, including observations made by Keegan *et al*. (1987) and more recent mapping by the EUSeaMap (2021) and Robinson *et al*. (2012).

Previous site-specific surveys identified several biotopes across the Benthic Subtidal and Intertidal Ecology Study Area, all of which are common to the east coast of Ireland (Table 9.1.3), (EcoServe, 2001). The extent of these habitats relative to the Proposed Development boundaries is indicated in Figure 9.1.8.

Table 9.1.3. Subtidal biotopes identified across the Benthic Subtidal and Intertidal Ecology Study Area (EcoServe, 2001).

Biotope	JNCC code:	EUNIS code:	Historical classification[1]
'Infralittoral mobile clean sand with sparse fauna'	SS.SSa.IFiSa.IMoSa	MB5231	IGS.Mob
'Sertularia cupressina and *Hydrallmania falcata* on tide-swept sublittoral sand with cobbles or pebbles'[2]	SS.SSa.IFiSa.ScupHyd	MB5232	IGS.ScupHyd
'Infralittoral muddy sand'	SS.SSa.IMuSa	MB5	IMS
'Moderate Energy Circalittoral rock'	CR.MCR	MC12	MCR
'Sabellaria spinulosa on stable circalittoral mixed sediment'	SS.SBR.PoR.SspiMx	MC2211	MCR.CSab
'Flustra foliacea and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment'[3]	SS.SMx.CMx.FluHyd	MC4214	MCR.Flu
'Moderate Energy Infralittoral Rock'	IR.MIR	MB12	MIR
'Sparse sponges, *Nemertesia* spp. and *Alcyonidium diaphanum* on circalittoral mixed substrata'	CR.HCR.XFa.SpNemAdia	MC1217	N/A
'Moerella spp. with venerid bivalves in infralittoral gravelly sand'	SS.SCS.ICS.MoeVen	MB3233	IGS.Sel

As indicated in Figure 9.1.8, the three most extensive biotopes across the survey area were SS.SSa.IFiSa.IMoSa (MB5231), SS.SMx.CMx.FluHyd (MC4214) and SS.SSa.IFiSa.ScupHyd (MB5232). The SS.SSa.IFiSa.IMoSa (MB5231) biotope was recorded in association with the sandy/shell sediments of the Arklow Bank feature and also throughout the inshore area to the south of the proposed offshore cable routes. The inshore area through which the

[1] Previous biotope classifications as presented in EcoServe, 2001.

[2] While the historic classification suggests the biotope *Sabellaria spinulosa*, didemnids and other small ascidians on tide-swept moderately wave-exposed circalittoral rock (CR.MCR.CSab.Sspi.As), due to the sediment types characterising the study area (i.e. sands and gravels), the soft sediment biotope SS.SBR.PoR.SspiMx is more likely to be present.

[3] While the historic biotope classification suggests the biotope *Flustra foliacea* on slightly scoured silty circalittoral rock, (CR.MCR.EcCr.FaAlCr.Flu), due to the sediment types characterising the study area (i.e. sands and gravels), the mixed sediments biotope SS.SMx.CMx.FluHyd is more likely to occur.

proposed Cable Corridor and Working Area extend were characterised by the SS.SMx.CMx.FluHyd (MC4214) biotope, with the muddy sands associated with the inshore area in the vicinity of the town of Arklow characterised by the SS.SSa.ImuSa biotope (MB5). The SS.SSa.IFiSa.ScupHyd (MB5232) biotope was recorded in the areas immediately to the east and west of Arklow Bank. These inshore communities are consistent with the communities recorded by Robinson *et al*. (2012) and Aquafact International Services Ltd (2008).

The Array Area is predominantly characterised by the SS.SSa.IfiSa.ImoSa (MB5231) biotope, consistent with the sandbank feature. The site also coincides with more limited areas of SS.SSa.IFiSa.ScupHyd (MB5232) on the edge of the sandbank and wind farm site. The northwest corner of the Array Area is characterised by the SS.SMx.CMx.FluHyd (MC4214) biotope. The Cable Corridor and Working Area to the Landfall location starts at the OWF site in the SS.SSa.IFiSa.IMoSa (MB5231) biotope, then run across the SS.SSa.IFiSa.ScupHyd (MB5232) biotope, and extend into the SS.SMx.CMx.FluHyd (MC4214) biotope to the west of the wind park boundary which continues to the Landfall location (Figure 9.1.8).

Discrete patches of the biotope SS.SBR.PoR.SspiMx (MC2211) were identified to the west of the Array Area, east of Arklow town and towards the north of the Array Area (Figure 9.1.8). Historically these were classified as the MCR.CSab biotope (a rocky substrate biotope), however, due to the mixed sand and gravel sediments characterising the wider region, these areas are more likely to be representative of the *S. spinulosa* on stable circalittoral mixed sediment biotope (JNCC code: SS.SBR.PoR.SspiMx; EUNIS code: MC2211). At the time of writing, full *S. spinulosa* reef assessments have not yet been undertaken, however, both *S. spinulosa* and *S. alveolata* were recorded subtidally. These species were coexisting across the survey area, which is particularly noteworthy given that *S. alveolata* is more generally associated with intertidal areas and areas of variable salinity. The largest number of indicative locations for *S. spinulosa* identified within the survey area was in 2005, when *S. spinulosa* was recorded at a total of ten sites, however, sites were not allocated biotopes (survey reports subsequent to 2005 allocated biotopes to each site). Where the historic MCR.CSab biotope classification (now assumed to be SS.SBR.PoR.SspiMx/MC2211) was recorded, it is not yet determined whether these can be considered indicative locations of potential *S. spinulosa* reef. Four sites with *Sabellaria* spp. biotopes were identified in 2010, three sites in 2009 and 2021, two sites in 2006 and one site in 2007 and 2011 (Figure 9.1.9). No sites with *Sabellaria* spp. biotopes were identified during the 2008 survey. *Sabellaria* spp. are reef forming, with reefs known to be naturally ephemeral habitats and the patchy and variable nature of *Sabellaria* spp. biotopes found within the site-specific surveys reflects this variability.

Site-specific surveys conducted in 2021 identified a total of six biotopes across the Benthic Subtidal and Intertidal Ecology Study Area, all of which are common to the east coast of Ireland (Table 9.1.4).

Table 9.1.4. Subtidal biotopes identified across the Benthic Subtidal and Intertidal Ecology Study Area in 2021.

Biotope	JNCC code:	EUNIS code:	Historical classification[4]
'Infralittoral fine sand'	SS.SSa.IFISa	MB5	IGS.Fas
'Infralittoral mobile clean sand with sparse fauna'	SS.SSa.IFiSa.IMoSa	MB5231	IGS.Mob
'Sabellaria spinulosa on stable circalittoral mixed sediment'[5]	SS.SBR.PoR.SspiMx	MC2211	MCR.CSab
'Flustra foliacea and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment'	SS.SMx.CMx.FluHyd	MC4214	CR.MCR.ByH.Flu.SerHyd
'Moderate energy circalittoral rock'	CR.MCR	MC12	CR.MCR
'Flustra foliacea on slightly scoured silty circalittoral rock'	CR.MCR.EcCr.FaAlCr.Flu	MC12241	CR.MCR.ByH.Flu.Flu

The current distribution of biotopes across the survey area based on results of the 2021 survey is consistent with previous site-specific surveys, including baseline surveys conducted in 2000 and 2001.

The three sites on Arklow Bank were classified as SS.SSa.IFiSa.IMoSa (MB5231), conforming with baseline surveys which identified similar low species diversity sites, consisting of clean mobile sand with shell gravel elements. The only exception to this was a single site to the west of Arklow Bank which had previously been classified as CR.MCR (MC12) in some surveys and SS.SSa.IFISa (MB5) in others. No fauna were recorded at the site during the 2021 survey, and consequently it was classified as SS.SSa.IFiSa.IMoSa (MB5231).

[4] 1997 JNCC classifications as defined by Connor *et al*. 1997, which was used to facilitate comparison between the 2021 survey and baseline survey conducted in 2000 and 2001.

[5] While the historic classification suggests the biotope *Sabellaria spinulosa*, didemnids and other small ascidians on tide-swept moderately wave-exposed circalittoral rock (CR.MCR.CSab.Sspi.As), due to the sediment types characterising the study area (i.e. sands and gravels), the soft sediment biotope SS.SBR.PoR.SspiMx is more likely to be present.

Sites to the eastern edge of Arklow Bank consisted of several biotopes including CR.MCR.EcCr.FaAlCr.Flu (MC12241) which is consistent with surveys since 2007. The biotope CR.MCR (MC12) was also recorded to the east, indicating no change from 2011 and is consistent with the results of surveys between 2006 and 2008.

To the far west of Arklow Bank, a single site had been classified as SS.SSa.IFISa (MB5) during the 2021 survey, which is unchanged from the previous surveys in 2010 and had previously been classified as SS.SSa.IFiSa.ScupHyd (MB5232) in 2009 and 2008. Similarly, a single site to the north of Arklow Bank had been classified as SS.SMx.CMx.FluHyd (MC4214) in 2021 which was different to the CR.MCR (MC12) classification allocated between 2009 and 2011 but was consistent with surveys conducted from 2006 to 2008.

No rare or uncommon species were recorded during subtidal surveys within the Benthic Subtidal and Intertidal Ecology Study Area. All species recorded were found to be common to the east coast of Ireland (Atalah *et al*., 2013; Robinson *et al*., 2012; Aquafact International Services Ltd, 2008). Both *S. alveolata* and *S. spinulosa* were, however, recorded to the northwest and east of Arklow Bank (likely to be the '*S. spinulosa* on stable circalittoral mixed sediment' (SS.SBR.PoR.SspiMx/MC2211) biotope, due to the prevalence of sand and gravelly sediments in the region). Generally, species richness was found to be greatest at locations where *Sabellaria* spp. were recorded. *Sabellaria* spp. are able to form reefs which qualify as Annex I habitat under the Habitats Directive (EC, 2019). There are several characteristics which are used to define *Sabellaria* reefs, including elevation, consolidation, patchiness, density of *Sabellaria* spp., biodiversity and temporal stability (Gubbay, 2007; Hendrick and Foster-Smith, 2006). The simplest definition of *Sabellaria*. reef in the context of the Habitats Directive is considered to be "an area of *Sabellaria* spp. which is elevated from the seabed and has a large spatial extent. Colonies may be patchy within an area defined as reef and show a range of elevations" (Gubbay, 2007). As indicated above, locations where *Sabellaria* spp. were recorded have not yet been assessed for their reef potential using best practice guidelines (Limpenny *et al*., 2010; Gubbay, 2007). If *Sabellaria* spp. individuals were of sufficient abundance, biomass and size at the locations where they were recorded (see Figure 9.1.9) then there is the potential that they may be classed as biogenic reefs that may qualify as Annex I habitat under the Habitats Directive (EC, 2019).

1.4.2.3 Subtidal Sediment Contaminants

In May 2016, the Aquatic Services Unit (ASU) was commissioned to undertake sediment sampling and chemical analysis of sediments from three locations on Arklow Bank to support a permit application to undertake seabed levelling works along Arklow Bank. The seabed levelling was required to facilitate access for maintenance vessels for the existing ABWP1 WTGs, and the associated disposal of material. Levels of contaminants which included a suite of metals, organochlorines, polychlorinated biphenyls (PCBs), tributylin (TBT), dibutylin (DBT) and polycyclic aromatic hydrocarbons (PAHs) were typically low and below the respective lower Irish Action Levels (ALs), (Cronin *et al.,* 2006). The exception being arsenic which was marginally elevated and exceeded the lower Irish Action Level at a single station, although consultation with the Marine Institute confirmed that this was acceptable for the material to be disposed of at sea (Ramboll Environ, 2016).

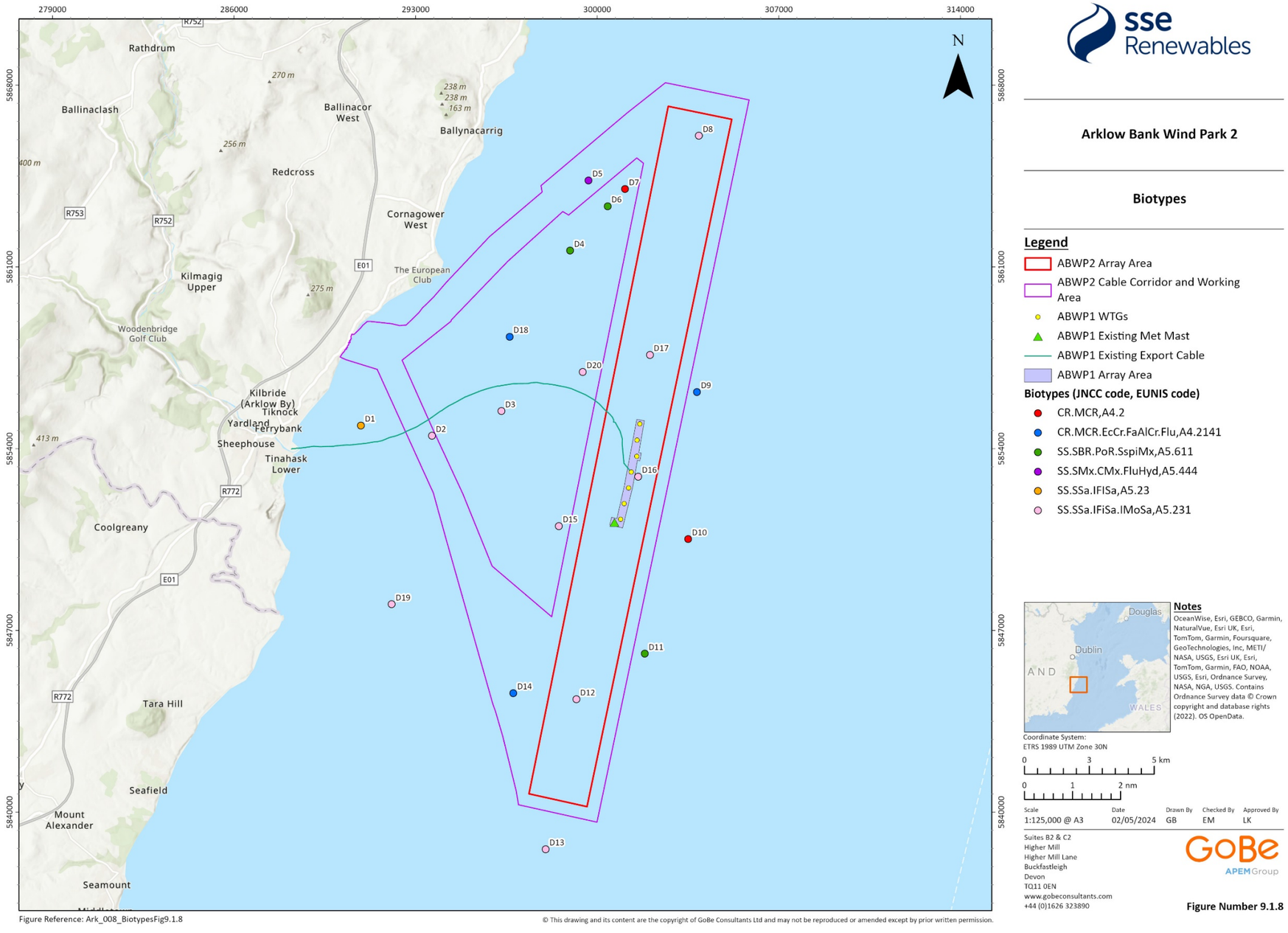
In 2009, Arup Consulting Engineers (Arup) were commissioned by Arklow Harbour Commissioners to prepare an application for the Arklow Port Dredge Disposal Licence Application. Legislative requirements for the disposal of dredge spoil include the undertaking of a full contamination assessment of the sediment. Sediment contamination was found to be higher in the inshore area when compared with sampling results from the offshore area. Of note, the upper ALs were exceeded for copper, zinc, lead and DBT. The lower ALs were exceeded for cadmium, arsenic, PCBs, and TEH. These contaminants are typical of industrial port/harbour sediment and are legacy of historical pollution and it is anticipated that these substances will fall as the sources are reduced (EPA 2016 – 2019). Therefore, as the samples were collected in 2009 and contaminants are characteristic of historical pollution, it is anticipated that volumes have since also reduced.

In a more recent EIAR conducted to support the application of Arklow Wastewater Treatment Plant, the results of borehole investigations with 15 sediment samples taken near the long sea outfall (in Arklow Harbour) were shown in comparison to Irish ALs. In accordance with the older (2006) Irish ALs, the survey found that seven of the samples were classified as 'uncontaminated' where eight of the samples were classified as 'marginally polluted'. However, if the same results are compared with the updated (2019) Irish ALs, only three samples are classified as 'marginally polluted' (Irish Hydrodata Limited, 2018). The Irish ALs take into consideration naturally elevated levels of arsenic that can occur. The three remaining 'marginally polluted' samples were exceeded for one or more of the following metals:

- Arsenic: 20.6 mg/kg, AL 1 Limit 20 mg/kg;
- Copper: 88.9 mg/kg, AL1 limit 40 mg/kg;
- Cadmium: 0.92 mg/kg, AL1 limit 0.7 mg/kg;
- Nickel: 30.5 and 38.8 mg/kg, AL1 limit 21 mg/kg.

Copper and cadmium were both present at only one location and represented as isolated occurrences. The EIAR concluded that the marine sediments were very slightly contaminated at relatively low levels for some specific parameters. Overall, when these results are compared with the earlier survey of Arklow Harbour, the concentration of metal contaminants are substantially lower in volume.

A more recent survey of Dublin Port was conducted in 2020 to support the application of a permit to carry out a Maintenance Dredging Programme at the site (RPS, 2021). The sediment chemistry results displayed low level contamination of arsenic, cadmium, copper, lead, nickel and zinc at select locations within Dublin Harbour. The results also showed some localised, slightly elevated levels of PCBs, Polycyclic Aromatic Hydrocarbons (PAHs), and TEH over the lower ALs at select locations. However, none of the 31 samples they collected exceeded the upper AL and therefore are not classed as heavily contaminated. Whilst Dublin Harbour is a significant distance away from Arklow Harbour, they are both characterised by similar pollution sources and are located adjacently to the Irish sea. Therefore, it is of relevance to compare these more recent results with the survey of Arklow Harbour from 2009. Further, the same report carried out sediment chemistry trend analysis of Dublin Ports navigation channel between 2006 and 2020 and found that metal concentrations have generally reduced, PCBs showed a modest decrease, and PAHs showed a substantial decrease over this timeframe (RPS, 2021).



Arklow Bank Wind Park 2

Biotypes

Legend

- ABWP2 Array Area
- ABWP2 Cable Corridor and Working Area
- ABWP1 WTGs
- ABWP1 Existing Met Mast
- ABWP1 Existing Export Cable
- ABWP1 Array Area

Biotypes (JNCC code, EUNIS code)

- CR.MCR,A4.2
- CR.MCR.EcCr.FaAlCr.Flu,A4.2141
- SS.SBR.PoR.SspiMx,A5.611
- SS.SMx.CMx.FluHyd,A5.444
- SS.SSa.IFlSa,A5.23
- SS.SSa.IFiSa.IMoSa,A5.231

Notes

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

Coordinate System:
ETRS 1989 UTM Zone 30N

0 3 5 km

0 1 2 nm

Scale	Date	Drawn By	Checked By	Approved By
1:125,000 @ A3	02/05/2024	GB	EM	LK

Suites B2 & C2
Higher Mill
Higher Mill Lane
Buckfastleigh
Devon
TQ11 0EN
www.gobeconsultants.com
+44 (0)1626 323890

Figure Number 9.1.8

Figure Reference: Ark_008_BiotypesFig9.1.8

Figure 9.1.8. Subtidal benthic ecology biotopes in the vicinity of the Proposed Development (GE Wind, 2021).

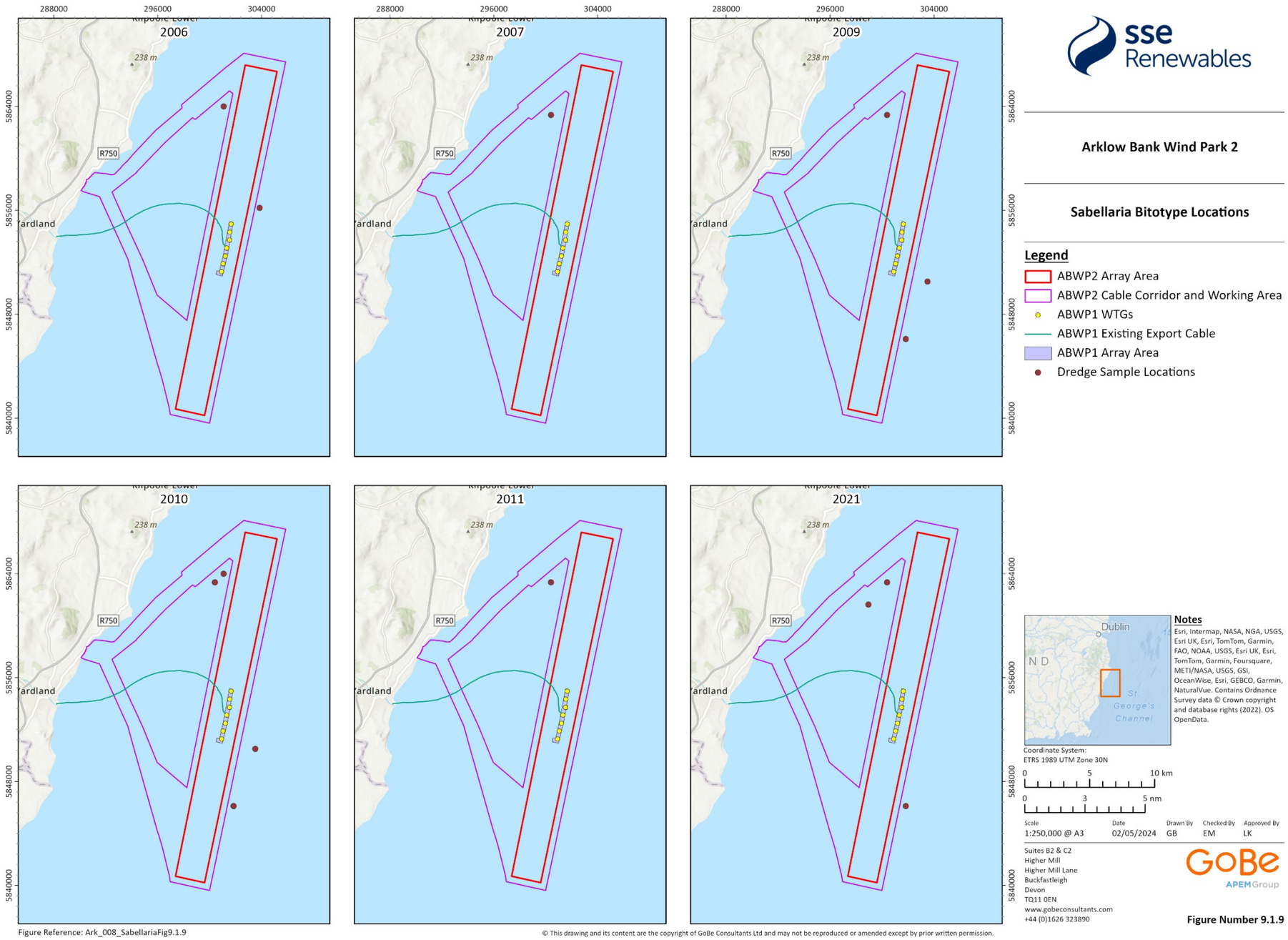


Figure 9.1.9. Dredge locations where *Sabellaria spp*. were found during the ABWP1 post construction benthic monitoring surveys (HydroServ, 2007a, 2007b, 2009, GE Wind, 2011, 2012, 2021).

1.4.3 Intertidal Ecology

The northern-most point of the landfall site is located at Ennereilly Beach, and the southern-most point of the landfall site is located at Johnstown Bay Beach (see Figure 9.1.3). The site consists of a series of coves with narrow beaches separated by steep rocky cliff outcrops with vegetated upper slopes. As mentioned in Section 1.3.3, due to the steep cliff terrain, it was not possible to access parts of these coves to undertake the intertidal survey in 2019. However, sampling was undertaken to the north and south of these coves, and observations of the inaccessible coves from the cliff tops found that these sites were identical to the landfall site in terms of sediment type (i.e. sand and gravels) and environmental conditions (i.e. wave exposure), and therefore biotope classifications would be anticipated to be consistent across the landfall area.

The landfall site consists of a very narrow intertidal area with cliff outcrops of between 1 m and 20 m in height and vegetated slopes above the tide line. Periodically the cliff outcrops extend below the Low Water Mark (LWM) to create a series of small inlets that are backed by low cliffs. The shore in these inlets ranges from gently sloping to steep soft sediment down to LWM with an easterly, moderate to exposed wave exposure.

Along the lower-shore, surface sediments comprised of medium to coarse gravel (Figure 9.1.10). Lower-shore pebble sediments gave way to coarse to fine sand sediments on the mid-shore (Figure 9.1.10). Upper shore sediments comprised a mixture of coarse sand, cobble and native oyster *Ostrea edulis* shell hash with occasional patches of coarse to fine sand sediment. These areas of coarse gravel and cobble sediments were more abundant and extensive adjacent to rock outcrops that extend across the intertidal zone. The coarse pebble and cobble sediments are subject to high degrees of drying between tides and were consequently devoid of fauna with very few species able to survive in this environment. The coarse to fine sand sediments characterising the mid shore area are subject to relatively less drying between tides. Replicate dig-over samples were carried out at two tidal heights (Figure 9.1.11 and Figure 9.1.12). No fauna were recorded in the dig-over samples and the coarse to fine sand sediments were potentially devoid of macrofauna. The surface coarse sediments were generally thin (up to 5 cm to 10 cm) overlying layers of coarse pebbles.

In general, lower- and upper-shore coarse sediments conformed to the Connor *et al*. (2004) habitat 'barren littoral shingle' (JNCC code: LS.LCS.Sh.BarSh; EUNIS code: MA3211), (Figure 9.1.10 and Figure 9.1.13). Sediments characterising the mid-shore, which are mobile due to moderate to high wave exposure at the site, conformed to the habitat 'barren littoral coarse sand' (JNCC code: LS.LSa.MoSa.BarSa; EUNIS code: MA5231) with patches of LS.LCS.Sh.BarSh (MA3211). An intertidal sediment biotope map for the area is presented in Figure 9.1.14.

The outcropping rock platform to the north of the beach and the lower cliff-line along the upper-shore are devoid of attached flora and fauna with the exception of the lower reaches of the cliff outcrops to the north and south of the beach which support low numbers of encrusting barnacles and limpets (*Patella vulgata*) and conform to the habitat *Semibalanus balanoides*, *P. vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock (JNCC code: LR.HLR.MusB.Sem.Sem; EUNIS code: MA12231).

The findings of the 2019 intertidal survey at the landfall site are in line with the findings from the 2001 historic intertidal surveys, with sediments comprising sands to cobbles with some *O. edulis* shell hash. *O. edulis* is listed under Annex V of the OSPAR convention. However, no live specimens were recorded during surveys. The historic surveys also recorded lower shore rocky areas characterised by mussels, limpets, barnacles and algal species, similar to the 2019 survey results.

A B

Figure 9.1.10. (A) Lower-shore sediments at the Landfall site and (B) mid-shore sediments at the Landfall site.

Figure 9.1.11. Surface beach sediments and dig-over samples of typical habitats at the Landfall site.

Figure 9.1.12. Southward long-shore view of typical habitats at the Landfall site showing location of dig-over samples.

Figure 9.1.13. Upper shore sediments and bordering cliff at the Landfall site.

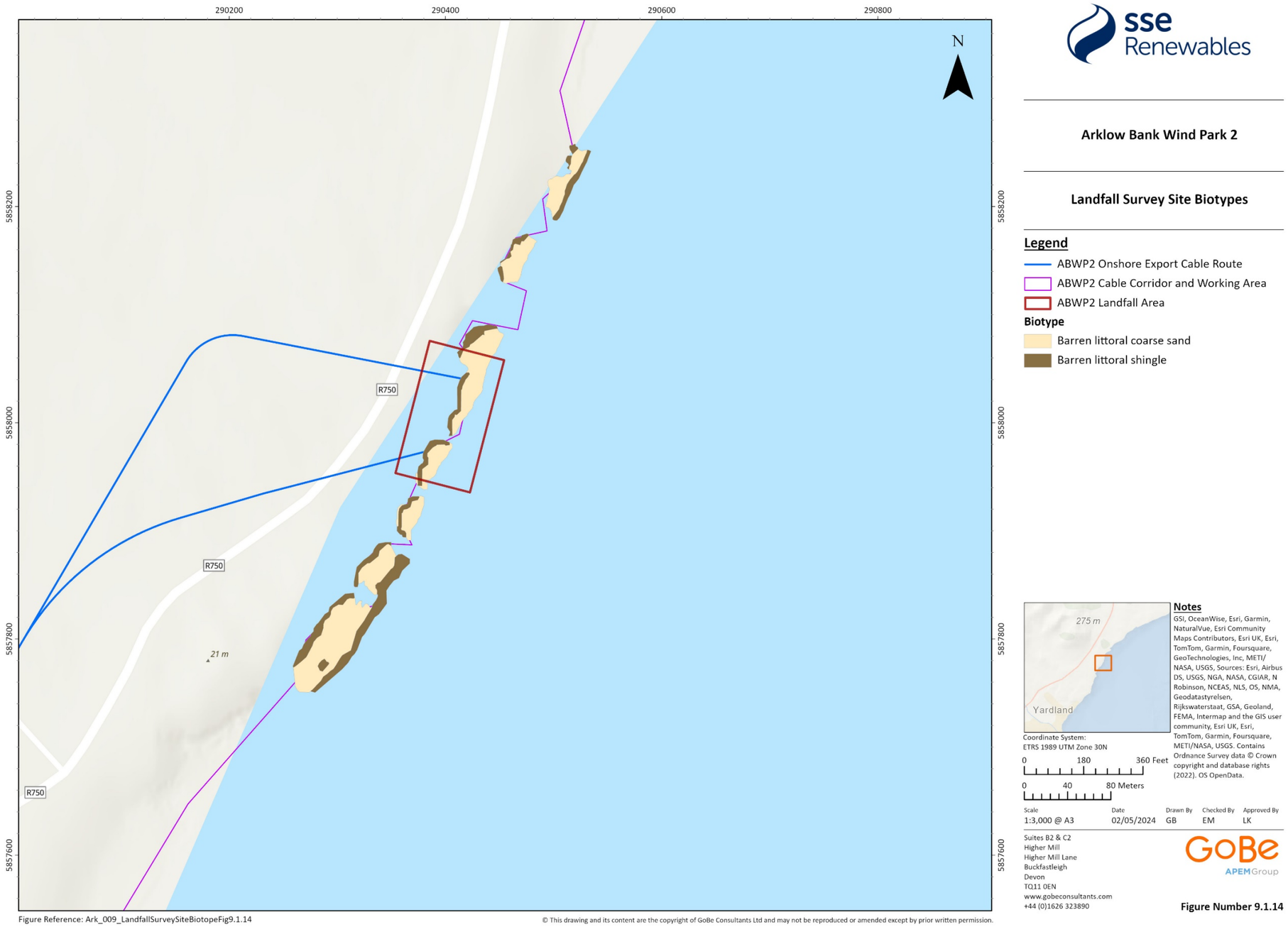


Figure 9.1.14. Intertidal benthic ecology biotopes at the landfall location (RPS, 2019).

1.5 Designated Sites

No sites of nature conservation importance for benthic subtidal or intertidal ecology overlap with the Array Area or Cable Corridor and Working Area (see Figure 9.1.15). The nearest Natura 2000 sites with relevant benthic features are the Wicklow Reef SAC designated for the Annex I habitat 'Reefs' (approximately 4.5 km and 3.6 km to the north of the Array Area and Cable Corridor and Working Area respectively) and the Blackwater Bank SAC (approximately 19.7 km and 19.1 km to the south of the Array Area and Cable Corridor and Working Area respectively) designated for the presence of the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time'.

The Wicklow Reef SAC is located off the north of Wicklow Head and covers an area of 15 km^2. The seabed sediments are a mixture of cobbles, bedrock and sand, and are subject to strong tidal streams. It is designated for the *S. alveolata* reef which occurs at a depth of 12 to 30 m and reaches a thickness of at least 30 to 50 cm. There is a high biodiversity of species associated with the reef including hydroids (e.g. *H. falcata*), a variety of polychaete worms, the snail *Calliostoma zizyphinum*, the bivalves *Musculus discors* and *Mytilus edulis*, other molluscs, bryzoans, barnacles, amphipods, crabs, starfish, brittlestars and sea squirts. Several of the species associated within the reef are rare in Irish waters (NPWS, 2014a). For instance, the bryozoan *Phaeostachys spinifera* is only known from five locations with the majority located on the west coast of Ireland and no records in the Irish sea south of county Antrim; The polychaete *Eulalia ornata* and the amphipod *Unciola crenatipalma* are only known from one and two sites respectively in Ireland (NPWS, 2014a).

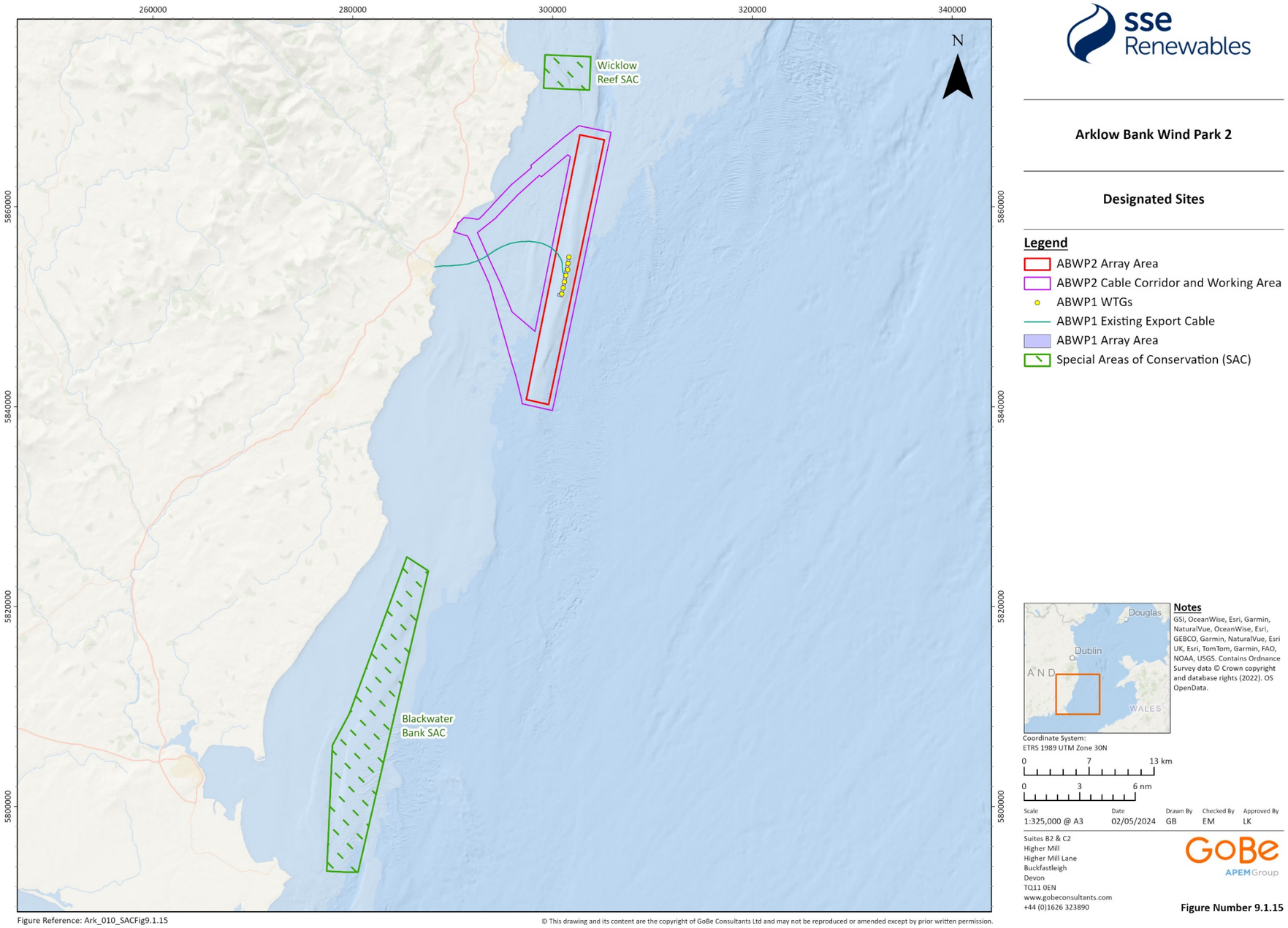
The conservation objectives for Wicklow Reef SAC are to conserve the current swept subtidal reef community complex in its natural condition, to keep the distribution and area of the reef stable or increasing (NPWS, 2013a).

Blackwater Bank SAC is designated for the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' (NPWS, 2013b) and consists of a series of sandbanks running parallel to the eastern Irish coastline. The SAC has a total area of 124 km^2. This site includes Lucifer Bank, Blackwater Bank and Moneyweights Bank. The sandbanks range from 2 to 4 km offshore and may be more than 1 m in height and several metres in width and are generally made up from varying sediment fractions from very fine sand to fine sand with occasional cobbles. The sandbanks in this designated site are between 4 to 8 m below the surface at low tide (NPWS, 2014b).

Previous surveys of the Blackwater Bank SAC have indicated an area of high hydrodynamic activity with strong, tidally induced current speeds which do not allow fine particles and organic matter to settle, therefore such areas are highly mobile and have low species density.

Benthic surveys were undertaken in 2005 (Roche *et al.*, 2007) and in 2012 (Aquafact, 2012 Unpublished.) by the National Parks and Wildlife Service (NPWS) to provide supporting information for the designation of Blackwater Bank SAC (NPWS, 2013b). The species that were recorded in the area are typical of shallow sandy inshore habitats. These surveys revealed that, with the exception of the southeastern margins of the site, the sandbank is dominated by the '*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand' (JNCC code: SS.SSa.IFiSa.NcirBat; EUNIS code: MB5233) biotope. The distinguishing species of this community complex were identified as the polychaetes *N. cirrosa*, *Nephtys* sp., *Nephtys longosetosa* and *Scolelepis squamata* and the amphipods *B. elegans* and *Pontocrates altamarinus*. *B. elegans* was recorded in high abundances on the sandbank itself and also in deeper waters in the northeastern and western margins of the site; elsewhere it occurs in low abundances. *N. cirrosa* occurred in low abundances throughout this community complex. Where fine sand was the prevailing sediment type, *Nephtys* sp., *N. longosetosa* and *S. squamata* were recorded in low abundances (NPWS, 2013).

The conservation objectives for the Blackwater Bank SAC are to conserve the community type 'sand with *N. cirrosa* and *B. elegans* community complex' in a natural condition, and to maintain or increase the distribution and extent of the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' (NPWS, 2013b).



sse Renewables

Arklow Bank Wind Park 2

Designated Sites

Legend

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

Notes

GSI, OceanWise, Esri, Garmin, NaturalVue, OceanWise, Esri, GEBCO, Garmin, NaturalVue, 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 7 13 km

0 3 6 nm

Scale	Date	Drawn By	Checked By	Approved By
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Higher Mill Lane
Buckfastleigh
Devon
TQ11 0EN
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Figure Number 9.1.15

Figure Reference: Ark_010_SACFig9.1.15

Figure 9.1.15. Special Areas of Conservation (SAC) designated for benthic features in the vicinity of the Proposed Development.

1.6 Important Ecological Features

For the purposes of the Benthic Subtidal and Intertidal Ecology EIA, and in accordance with best practice guidelines (Chartered Institute of Ecology and Environmental Management (CIEEM), 2019), IEFs are identified and all potential impacts of a development are assessed against the IEFs to determine whether or not they are significant. The IEFs of an area are those that are considered to be important and potentially affected by the Proposed Development. Importance may be assigned due to quality or extent of habitats, habitat or species rarity, or the extent to which they are threatened (CIEEM, 2019). Species and habitats are considered IEFs if they have a specific biodiversity importance recognised through international or national legislation or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), National Biodiversity Plan or the Marine Strategy Framework Directive).

The criteria used to inform the valuation of IEFs is presented in Table 9.1.5 and the IEFs within the Benthic Subtidal and Intertidal Ecology Study Area, their conservation status and valuation is presented in Table 9.1.6. The biotopes present across the Benthic Subtidal and Intertidal Ecology Study Area have been grouped into broad habitat/community types. The identified IEFs will be taken forward for assessment within the Benthic Subtidal and Intertidal Ecology EIAR and used to assess impacts associated with the construction, operation and decommissioning of the Proposed Development.

Table 9.1.5. Criteria used to inform the valuation of the IEFs in the Benthic Subtidal and Intertidal Ecology Study Area.

Value of IEF	Criteria to define value
International	Internationally designated sites. Habitats and species protected under international law (i.e. Annex I habitats within a SAC boundary).
National	Nationally designated sites. Species protected under national law. OSPAR List of Threatened and/or Declining Species and Habitats. Annex I habitats not within a SAC boundary.
Regional	Regionally important habitats/communities within the Benthic Subtidal and Intertidal Ecology Study Area. Habitats or species that provide important prey items for other species of conservation or commercial value.

Value of IEF	Criteria to define value
Local	Habitats and species which are not protected under conservation legislation which form a key component of the benthic ecology within the Benthic Subtidal and Intertidal Ecology Study Area.

Table 9.1.6. IEFs within the Benthic Subtidal and Intertidal Ecology Study Area.

IEF	Description and representative biotopes	Protection status	Conservation interest	Importance within the Benthic Subtidal and Intertidal Ecology Study Area
Annex I Habitat Features of SACs within the Benthic Subtidal and Intertidal Ecology Study Area				
Reefs	Rocky marine habitats or biological concretions that rise from the seabed. Wicklow Reef is an example of a subtidal reef constructed by the honeycomb worm *Sabellaria alveolata*[6]	Annex I Habitats Directive	Qualifying feature of the Wicklow Reef SAC	International – part of European designated site (Wicklow Reef SAC) National – where present but not a designated feature of a site
Sandbanks which are slight adversely	Sandbanks which are slight adversely covered by sea water all the time. Distinct banks of sandy sediments that are permanently covered by shallow sea water, typically at depths of less than 20 m below chart datum. Blackwater Bank	Annex I Habitats Directive	Qualifying feature of the Blackwater Bank SAC	International – part of European designated site (Blackwater Bank SAC)

[6] Representative biotope of LS.LBR.Sab.Salv for the Annex I Reef habitat feature of the nearby Wicklow Reef SACs has been derived from the description of the habitat and species found during surveys of the SACs, as presented in the National Park and Wildlife Service (NPWS) site synopses (NPWS, 2014a).

IEF	Description and representative biotopes	Protection status	Conservation interest	Importance within the Benthic Subtidal and Intertidal Ecology Study Area
covered by sea water all the time	SAC consists of a series of sandbanks running roughly parallel to the coastline[7]			National – where present but not a designated feature of a site
Subtidal Habitats within the Benthic Subtidal and Intertidal Ecology Study Area				
Subtidal Sands Sediment	Infralittoral fine sand (JNCC code: SS.SSa.IFISa; EUNIS code: MB5) Infralittoral mobile clean sand with sparse fauna (JNCC code: SS.SSa.IFiSa.IMoSa; EUNIS code: MB5231) Infralittoral muddy sand (JNCC code: SS.SSa.IMuSa; EUNIS code: MB5)	None	Of local conservation interest	Local

[7] Representative biotope of SS.SSa.IFiSa.IMoSa and SS.SSa.IFiSa.NcirBat for the Annex I sandbank habitat feature of the nearby Blackwater Bank SACs has been derived from the description of the habitat and species found during surveys of the SACs, as presented in the National Park and Wildlife Service (NPWS) site synopses (NPWS, 2014b).

IEF	Description and representative biotopes	Protection status	Conservation interest	Importance within the Benthic Subtidal and Intertidal Ecology Study Area
	Sertularia cupressina and *Hydrallmania falcata* on tide-swept sublittoral sand with cobbles or pebbles (JNCC code: SS.SSa.IFiSa.ScupHyd; EUNIS code: MB5232)[8]			
Subtidal Coarse and Mixed Sediments	Sparse sponges, *Nemertesia* spp. and *Alcyonidium diaphanum* on circalittoral mixed substrata (JNCC code: MCR.SNemAdia; EUNIS code: MC1217) *Moerella* spp. with venerid bivalves in infralittoral gravelly sand (JNCC code: SS.SCS.ICS.MoeVen; EUNIS code: MB3233) *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment (JNCC code: SS.SMx.CMx.FluHyd; EUNIS code: MC4214)	None	Of local conservation interest	Local

[8] The representative biotope '*Sertularia cupressina* and *Hydrallmania falcata* on tide-swept sublittoral sand with cobbles or pebbles' (JNCC code: SS.SSa.IFiSa.ScupHyd; EUNIS code: MB5232) was not recorded within the latest 2021 benthic survey, but has previously been identified during previous surveys.

IEF	Description and representative biotopes	Protection status	Conservation interest	Importance within the Benthic Subtidal and Intertidal Ecology Study Area
Sabellaria on stable sediments	*Sabellaria spinulosa*, didemnids and other small ascidians on tide-swept moderately wave-exposed circalittoral rock (JNCC code: CR.MCR.CSab.Sspi.As; EUNIS code: MC12812) *Sabellaria spinulosa* on stable circalittoral mixed sediment (JNCC code: SS.SBR.PoR.SspiMx; EUNIS code: MC2211)	None (non-reef communities)	Of local conservation interest	Local (non-reef communities)
Moderate Energy Subtidal Rock	Moderate Energy Circalittoral rock (JNCC code: CR.MCR; EUNIS code: MC12) *Flustra foliacea* on slightly scoured silty circalittoral rock (JNCC code: CR.MCR.EcCr.FaAlCr.Flu: EUNIS code: MC12241) Moderate Energy Infralittoral Rock (JNCC code: IR.MIR; ENIS code: MB12)	None	Of local conservation interest	Local
Intertidal Habitats within the Benthic Subtidal and Intertidal Ecology Study Area				
Barren coarse intertidal sediment	Barren littoral shingle (JNCC code: LS.LCS.Sh.BarSh; EUNIS code: MA3211) Barren littoral coarse sand (JNCC code: LS.LSa.MoSa.BarSa; EUNIS code: MA5231)	None	Of local conservation interest	Local

IEF	Description and representative biotopes	Protection status	Conservation interest	Importance within the Benthic Subtidal and Intertidal Ecology Study Area
Moderately exposed intertidal rock.	Barnacles and fucoids on moderately exposed shores (JNCC code: LR.MLR.BF; EUNIS code: MA1245) *Semibalanus balanoides*, *P. vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock (JNCC code: LR.HLR.MusB.Sem.Sem; EUNIS code: MA12231)	None	Of local conservation interest	Local

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