# Geotechnical Investigation, Irish Atlantic Margin

## Environmental Risk Assessment (EIA Screening) Report

**Woodside Energy (Ireland) Pty Ltd**

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Table A below outlines the key expert staff involved in the preparation of this Environmental Risk Assessment (EIA Screening) Report.

Table A Key expert staff (all Xodus Group Limited)

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| Jen Hilton-Miller | Senior Environmental Consultant / Fisheries Specialist | Ten years' experience in marine science and fisheries assessments.<br>MSc Environmental Consultancy<br>BSc (Hons) Zoology |
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# ABBREVIATIONS

| | |
|---|---|
| AA | Appropriate Assessment |
| ALARP | As Low As Reasonably Practicable |
| BSA | Biologically Sensitive Area |
| BWM | Ballast Water Management |
| CITES | Convention on the International Trade in Endangered Species of Flora and Fauna |
| $CO_2$ | Carbon dioxide |
| CO | Carbon monoxide |
| $CH_4$ | Methane |
| CSAC | Candidate Special Area of Conservation |
| DAHG | Department of Arts, Heritage and the Gaeltacht |
| DCCAE | Department of Communications, Climate Action and Environment |
| DCENR | Department of Communications Energy and Natural Resources |
| DP | Dynamic Positioning |
| DTTAS | Department of Transport, Tourism and Sport |
| EAU | Environment Advisory Unit |
| EEZ | European Economic Zone |
| EIA | Environmental Impact Assessment |
| EIS | Environmental Impact Statement |
| EL | Exploration Licence |
| EMODnet | European Marine Observation and Data Networkesms |
| EMP | Environmental Management Plan |
| EPS | European Protected Species |
| ERA | Environmental Risk Assessment |
| ESMS | Environmental and Social Management System |
| EU | European Union |
| EUNIS | European Nature Information System |
| FEAST | Feature Activity Sensitivity Tool |
| FEL | Frontier Exploration Licence |
| FLO | Fishing Liaison Officer |
| FST | Fuinneamh Sceirde Teoranta |
| GBTS | Galway Bay Test Site |
| GHG | Greenhouse gas |
| HPWBM | High performance water-based mud |
| HSE | Health, Safety and Environment |
| HSEQ | Health, Safety, Environment and Quality |
| ICES | International Council for the Exploration of the Seas |
| IMO | International Maritime Organisation |
| INFOMAR | Integrated Mapping for the Sustainable Development of Ireland's Marine Resource |

| | |
|---|---|
| INSS | Irish National Seabed Survey |
| IOSEA | Irish Offshore Strategic Environmental Assessment |
| IPAS | PAD's Integrated Petroleum Affairs System |
| IPCC | Intergovernmental Panel on Climate Change |
| IUCN | International Union for Conservation of Nature |
| kHz | Kilohertz |
| km | Kilometres |
| LO | Licence Option |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MDAC | Methane-derived authigenic carbonate |
| MOPO | Manual of Permitted Operations |
| MSFD | Marine Strategy Framework Directive |
| NAO | North Atlantic Oscillation |
| NMVOC | Non-methane volatile organic compounds |
| $NO_X$ | Oxides of nitrogen |
| NPWS | National Parks and Wildlife Services |
| $N_2O$ | Nitrous oxide |
| OCNS | Offshore Chemical Notification Scheme |
| OSPAR | Convention for the Protection of the Marine Environment of the North-East Atlantic |
| PAD | Petroleum Affairs Division |
| PIP | Petroleum Infrastructure Programme |
| PLONOR | Pose Little or No Risk |
| PPL | Petroleum Prospecting License |
| PTS | Permanent threshold shift |
| SAC | Special Area of Conservation |
| SEA | Strategic Environmental Assessment |
| SEL | Sound exposure level |
| SFPA | Sea Fisheries Protection Authority |
| $SO_X$ | Sulphur oxides |
| SOPEP | Shipping Oil Pollution Emergency Plan |
| SPA | Special Protection Area |
| SPL | Sound Pressure Level |
| TTS | Temporary threshold shift |
| USBL | Ultra-short Baseline System |
| WIID | Wreck Inventory of Ireland Database |
| WMS | Woodside Management System |

# EXECUTIVE SUMMARY

Woodside Energy (Ireland) Pty Ltd (Woodside) plans to conduct a geotechnical investigation ("the Project") involving the collection of core from up to 22 shallow boreholes distributed throughout the Irish Atlantic Margin at water depths ranging from approximately 50 to 2,600 m. It is anticipated that survey operations will start between Q2 and Q3 2020, subject to regulatory approvals and vessel availability. It is possible that the investigation may be undertaken during the same period in 2021. The entire programme will take 40 days including operations, transit between locations and any weather downtime. The purpose of the investigation is to improve overall understanding of the offshore geology west of Ireland. This is a standalone investigation not related to any planned oil and gas exploration activity for Woodside and will generate open-source data available to the public/industry via the PAD.

This combined Environmental Impact Assessment (EIA) Screening Report and Environmental Risk Assessment has been prepared to support an application by Woodside to the Minister under Regulation 3(1) of the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 as amended by the European Union (Environmental Impact Assessment) (Petroleum Exploration) (Amendment) Regulations 2019, and the European Union EIA Directive 2011/92/EU as amended by Directive 2014/52/EU. It is submitted to the Department of Communications, Climate Action and Environment (DCCAE) to provide the Minister of State with the information required to inform the screening determination on whether the geotechnical investigation should be subject to an EIA. The assessment also addresses the Article 12 obligations of the European Community Habitats Directive 92/43/EEC, which are transposed into Irish law in Regulation 29 (1)(e)(i) of the European Communities (Birds and Natural Habitats) Regulations 2011.

This report accompanies an application by Woodside to the Petroleum Affairs Division (PAD) of the DCCAE for approval to conduct a survey as outlined under Part 2 of the Department's Rules and Procedures for Offshore Petroleum Exploration and Appraisal Operations (PAD, 2014).

The report presents the assessment of the potential impacts of the Project on the marine environment, to demonstrate if the Project would be likely to have significant effect on the environment. Although the proposed borehole locations are widely dispersed across the Irish Atlantic margin and encompass a broad range of water depths and environmental conditions which have been fully considered in the assessment, the footprint of each individual borehole is extremely small and the activities short-term. Following an impact identification exercise to identify the possible interactions between the Project activities and the environmental and socioeconomic receptors, the potential impacts of the project were assessed with respect to the physical presence of the survey vessel and coring equipment; underwater noise generation, atmospheric emissions, discharges to sea and the potential for accidental events.

The EIA Screening process undertaken has concluded that there will be no significant effects on the environment from the proposed geotechnical investigation and it is therefore considered that an EIA is not required.

# 1 INTRODUCTION

## 1.1 Overview

Woodside Energy (Ireland) Pty Ltd (Woodside) plans to conduct a geotechnical investigation ('the Project') involving the collection of core from up to 22 shallow boreholes distributed throughout the Irish Atlantic Margin at water depths ranging from approximately 50 to 2,600 m as shown in Figure 1-1.

The cores will be obtained using a geotechnical survey vessel which will visit each individual borehole location in turn. It is anticipated that survey operations will start between June and early August 2020, subject to regulatory approvals and contractor availability. The Project will take up to 40 days including operational time, transit between locations and allowances for weather downtime. Details of the proposed Project are provided in Section 2.

This combined Environmental Impact Assessment (EIA) Screening Report and Environmental Risk Assessment has been prepared to support an application to the Minister under Regulation 3(1) of the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 as amended by the European Union (Environmental Impact Assessment) (Petroleum Exploration) (Amendment) Regulations 2019, and the European Union EIA Directive 2011/92/EU as amended by Directive 2014/52/EU. It is submitted to the Department of Communications, Climate Action and Environment (DCCAE) to provide the Minister of State with the information required to inform the screening determination on whether the Project should be subject to an EIA. The overall purpose of the environmental information provided is to examine the possibility that the Project, either individually or in combination with other plans and projects, may result in significant negative environmental impacts in Irish waters and the continental shelf.

The assessment also addresses the Article 12 obligations of the European Community Habitats Directive 92/43/EEC, which are transposed into Irish law in Regulation 29 (1)(e)(i) of the European Communities (Birds and Natural Habitats) Regulations 2011. Information is submitted to assist the Minister in determining whether the Project, either individually or in combination with other activities, plans or projects, will have an adverse effect on the conservation status of animal species listed in Annex IV(a) to the Habitats Directive in their natural range.

This document accompanies an application by Woodside to the Petroleum Affairs Division (PAD) of the DCCAE for approval to conduct a survey as outlined under Part 2 of the Department's Rules and Procedures for Offshore Petroleum Exploration and Appraisal Operations (PAD, 2014) (herein referred to as the Rules and Procedures Manual).

## 1.2 Background and Purpose of the Project

Woodside proposes to carry out the geotechnical investigation under a Petroleum Prospecting License (PPL). The PPL was granted by the DCCAE under the Petroleum and Other Minerals Development Act 1960, as applied by the Continental Shelf Act 1968.

The purpose of the investigation is to improve overall understanding of the offshore geology west of Ireland. The specific geological objectives are described in Section 2.1. This is a standalone investigation and not related to any planned oil and gas exploration activity. The data obtained will be given to the PAD for public/industry use, i.e., will not be Woodside proprietary data.

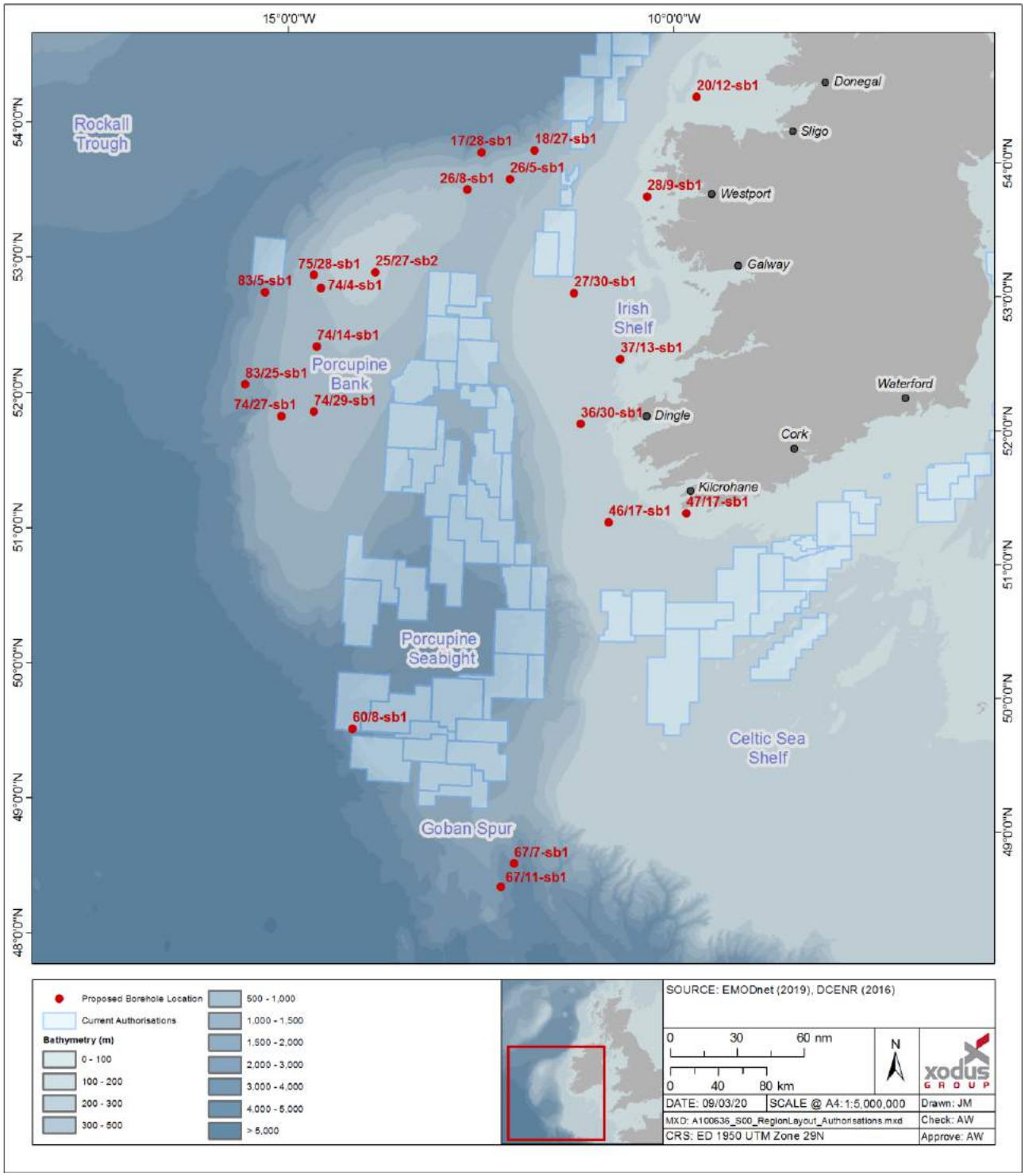


**Figure 1-1: Locations of proposed shallow boreholes**

## 1.3 Legislative Requirements, Guidance and Policies

The DCCAE is responsible for the promotion, regulation and monitoring of the exploration and development of oil and gas in Ireland, both onshore and offshore.

In order to gain approval for the Project, Woodside is required to submit an Application for Approval to the DCCAE as outlined in Section 2.1 of the Rules and Procedures Manual.

In respect of applications made to the Minister for permission to undertake activities under a PPL, the Environment Advisory Unit (EAU) of the DCCAE is responsible for carrying out environmental screening and any environmental assessments determined as being required following screening, in accordance with the requirements set out in the EIA Directive and the Habitats Directive.

On the completion of all environmental assessments by the EAU and after incorporating any suggested conditions which may be recommended by the EAU, the application will then be evaluated by the PAD who will make a recommendation to the Minister regarding whether consent should be given for the activities applied for.

### 1.3.1 Environmental Impact Assessment (EIA) Screening

The EIA Directive (85/337/EEC) was repealed and replaced by Directive 2011/92/EU and amended by Directive 2014/52/EU, which applies to a wide range of public and private projects defined in Annexes I and II. All projects identified in Annex I of the Directive are deemed to have potentially significant impacts on the environment and require mandatory EIA. Projects identified in Annex II require national authorities to decide whether an EIA is required (EIA screening) on the basis of either set criteria / threshold limits or case-by-case examination. The criteria set out in Annex III must be taken into account when a case-by-case evaluation of the need for an EIA is undertaken.

In Ireland, in respect of applications made to the Minister for permission to undertake activities under a PPL, Regulations 3 and 4 of the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 (S.I. 134 of 2013) as amended by the European Union (Environmental Impact Assessment) (Petroleum Exploration) (Amendment) Regulations 2019 (S.I. 124 of 2019) provide for the EIA screening and assessment procedures. Applicable activities include anything referred to in section 9(5) of the Petroleum and Other Minerals Development Act, 1960.

These regulations state that, where the holder of a licence proposes to undertake activities under the licence, the holder shall apply to the Minister for permission to undertake the activities, and that, where such an application is made to the Minister, the EAU shall make a determination as to whether the proposed activities would, or would not, be likely to have significant effects on the environment by virtue, *inter alia*, of their nature, size and location.

Where the EAU makes a determination that the activities would be likely to have significant effects on the environment, it shall require the applicant to submit an environmental impact statement (EIS) in respect of the proposed activities. An EIS presents information in order to assist the Minister in conducting an EIA under the requirements of the EIA Directive.

The Project does not fall under the description of activities included within Annex I or Annex II of the Directive. However, the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013, as amended, allow for the Minister to determine on a case-by-case basis if an EIA is required for any applicable activities carried out under a PPL, as outlined above. Noting that the Project is not a petroleum exploration activity as contemplated by the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013, this combined Environmental Impact Assessment (EIA) Screening Report and Environmental Risk Assessment has been prepared and submitted to satisfy the potential approval requirements under a PPL associated with the Minister exercising such discretion.

Having regard to these requirements, this EIA Screening Report and Environmental Risk Assessment has been prepared to assist the EAU and the Minister in assessing any risk of significant effects associated with the Project. An assessment has been carried out of the potential impacts of the Project on the marine environment and the findings are presented in this report to demonstrate that the subject of the application

would not be likely to have significant effects on the environment by virtue, *inter alia*, of its nature, size and location. The methodology applied in the environmental risk assessment is provided in Section 4 of this report.

The environmental assessment process conducted describes the Project, characterises the baseline environment in and around the Project location and identifies the potential environmental impacts associated with the Project. It goes on to assess the magnitude and significance of the potential impacts and associated effects before detailing any measures that will be used to avoid or reduce the potential impacts. The mitigation measures include embedded design, control and management measures as well as legislative requirements, guidance and good industry practice.

The EIA screening exercise has been conducted with reference to the relevant EU guidance documents, particularly the guidance on screening (European Union, 2017).

### 1.3.2 Appropriate Assessment Screening

The EU Birds Directive 79/409/EEC (updated and consolidated into Directive 2009/147/EC) provides significant protection for Europe's wild birds and identifies those species and subspecies among them which are particularly threatened and in need of special conservation measures. A number of approaches are adopted to provide protection for wild birds, including the designation of Special Protection Areas (SPAs).

The EU Habitats Directive 92/43/EEC aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. The Directive seeks to conserve and protect rare and characteristic habitat types which are important at a European level and listed in Annex I. It also extends protection to a wide range of rare, threatened or endemic species listed in Annex II. The more significant areas within a national territory which host protected habitats or species are designated as Special Areas of Conservation (SACs).

Natura 2000 is a European network of important ecological sites. The network is made up of the above-mentioned SPAs and SACs. Ireland's contribution to Natura 2000 is being created under the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) as amended (S.I. No. 290 of 2013, S.I. No. 499 of 2013 and S.I. No. 355 of 2015). These consolidate the earlier European Communities (Natural Habitats) Regulations 1997 to 2005 and the European Communities (Birds and Natural Habitats) (Control of Recreational Activities) Regulations 2010. All activities that may impact on Natura 2000 sites must be assessed for the potential for significant impacts.

The Birds and Natural Habitats Regulations give effect to the Habitats Directive as a matter of Irish law and require, *inter alia*, that a public authority carry out screening for Appropriate Assessment (AA) of a plan or project for which an application for consent is received. The EAU is responsible for carrying out AA screening assessments (and any required Stage 2 Appropriate Assessment) in accordance with the Regulations, in respect of applications to the Minister for permission to undertake activities under a petroleum prospecting licence.

The regulations require a screening assessment to be completed, to allow the EAU to assess the potential impact of the Project on the designated habitats / species identified. Information required for the EAU to complete the screening assessment has been prepared separately and submitted to the PAD as an AA Screening Report. A summary of the information provided is included in this EIA Screening Report. The AA Screening Report was prepared with reference to relevant guidance including that provided by the Department of Environment, Heritage and Local Government (DEHLG, 2009) and the European Commission (2002; 2018).

In addition, any species listed under Annex IV of the Habitats Directive (termed European Protected Species, EPS) are subject to an assessment of significant impacts under Article 12 of the Directive as described in the following section.

### 1.3.3 Article 12 Assessment

The Birds and Natural Habitats Regulations require an assessment of potential effects from the Project on the conservation status of species protected under Annex IV of the Habitats Directive. The assessment has been completed in line with the Member State obligations set out in Article 12 of the Habitats Directive, which are

transposed into Irish law in Regulation 29 (1)(e)(i) of the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477/2011).

Article 12 of the Habitats Directive requires that Member States take the requisite measures to establish a system of strict protection for Annex IV species, including all cetaceans, in their natural range, prohibiting:

- All forms of deliberate capture of killing of individuals in the wild;
- Deliberate disturbance of these species, particularly during breeding, rearing, hibernation and/or migration;
- Deliberate destruction or taking of eggs from the wild; and
- Deterioration of or destruction of breeding sites or resting places.

### 1.3.4 Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters

Guidance provided by the National Parks and Wildlife Service (NPWS, formerly the Department of Arts, Heritage and the Gaeltacht, 2014) sets out to address several key potential sources of anthropogenic sound that may impact detrimentally upon marine mammals in Irish waters and provides guidance on assessment and mitigation measures.

### 1.3.5 The Irish Offshore Strategic Environmental Assessment 5 (IOSEA5)

The Department of Climate, Energy and Natural Resources (DCENR) (now DCCAE) completed the Irish Offshore Strategic Environmental Assessment 5 (IOSEA5) on 30 October 2015. This SEA was the fifth in a series of regional environmental assessments, required under the EU SEA Directive, to underpin hydrocarbon exploration activities under new and existing offshore authorisations. The geographical range of the IOSEA5 includes Ireland's Designated Continental Shelf out to the 200 nautical mile limit. IOSEA5 (DCENR, 2015) supersedes the previous four regional SEAs conducted.

This EIA Screening Report, the Environmental Risk Assessment and all related Appropriate Assessment reports address the underpinning considerations in the IOSEA5. Specifically, this includes the IOSEA5 Plan for issue of Petroleum Exploration and Production Authorisations in Irish Offshore Waters during the Period 2015 to 2020 and the IOSEA5 Natura Impact Statement.

### 1.3.6 Energy Policy

Following the publication of the *Draft National Energy & Climate Plan* (NECP) 2021-2030 (Government of Ireland, 2018) and the *Climate Action Plan 2019 to Tackle Climate Disruption* (Government of Ireland, 2019), the DCCAE (2019) set out the evolution of policy in the fossil fuel sector through the publication of the *Policy Statement: Petroleum Exploration and Production Activities as part of Ireland's Transition to a Low Carbon Economy*.

In September 2019, following advice from the Climate Change Advisory Council and in line with the Climate Action Plan, the Taoiseach announced that future exploration for oil should end as it is incompatible with a low carbon future, and that the focus should instead be on natural gas as a transition fuel. Following the Taoiseach's announcement, the Government announced in October 2019 that all new licence applications in the currently Open Areas (Celtic Sea and Irish Sea), and any future licensing rounds in the Closed Area (Atlantic Margin), will be for natural gas exploration only and not oil. All applications and authorisations in place before the announcement was made will not be affected by the decision and can continue towards exploration and production for oil and/or gas as per their existing terms (DCCAE, 2019).

The Policy Statement recognises that natural gas must play a core part in Ireland's energy mix over the coming decades in the transition to a zero-carbon future, until renewable energy sources are sufficiently developed to meet Ireland's energy needs. The Policy Statement also recognises that all of Ireland's offshore basins contain both oil and gas. Based on this position, the Government has the following vision for the future of natural gas exploration and production in the Irish offshore (DCCAE, 2019):

1. To develop Ireland's natural gas resources sustainably in order to deliver significant and sustained benefits, including import substitution, fiscal return, national and local economic development and technology learning as a core part of the transition to a low carbon economy.
2. To provide enhanced security of supply for Ireland in the short and medium term while Ireland transitions to more decarbonised sources of energy.
3. To ensure robust regulatory practices in exploration, production and ultimately decommissioning, meeting the highest environmental and safety standards, according to international best practice.
4. To deliver maximum value to the state from exploration activities through managing effective, well monitored work programmes and collecting, maintaining, and providing access to a national database of technical data relating to hydrocarbon exploration.
5. To encourage, enable and guide research initiatives directed at deepening knowledge of Ireland's offshore potential and to collaborate at both national and international level to underpin our understanding of the geology of Ireland's offshore basins.

The proposed geotechnical investigation does not directly support oil or gas exploration or development by Woodside, but is fully in line with the Policy Statement, especially item 5 above.

### 1.3.7 Marine Spatial Planning

In July, 2019, Government approved the General Scheme of the Marine Planning and Development Management Bill, 2019. The Bill seeks to establish in law a new marine planning system, underpinned by a statutory Marine Planning Policy Statement (MPPS) and guided by the National Marine Planning Framework (NMPF). This new marine planning system consists of forward planning, development consent and enforcement. In November 2019, the Government published Ireland's first MPPS alongside the Draft NMPF.

The MPPS (DHPLG, 2019a) describes existing components of Ireland's marine planning system, outlines a vision for the future development of Ireland's marine planning system, and sets out the overarching priorities and principles the Government expects public bodies that engage with the marine planning system to observe.

The NMPF (DHPLG, 2019b) builds on the MPPS by outlining the Government's proposed approach to managing Ireland's marine activities and ensuring sustainable use of marine resources to 2040. This single framework will bring together all marine-based human activities and present its vision, objectives and policies for each activity. It outlines how they will interact with each other in an ocean space that is under increasing spatial demand. Petroleum features as a key sectoral component of this plan, with a number of policies set out that are aimed at supporting exploration and development activities, enhancing security of energy supply and ensuring best practice in regulatory activities.

The finalised NMPF, expected to be adopted in late 2020, will reflect the Government decision regarding the future focus on natural gas only and will be the key decision-making tool for Government departments, State agencies, regulatory authorities and policy makers for decisions on marine activities, meeting the requirements of the EU Marine Spatial Planning Directive (DHPLG, 2019b).

This draft NMPF does not set out spatial designations or marine zonings for specific activities. Arrangements are being made to include provisions in the Marine Planning and Development Management Bill to provide for a future system of designation of Strategic Marine Activity Zones (DHPLG, 2019b).

The proposed geotechnical investigation is a short-term research activity and not affected by the developments in marine spatial planning.

### 1.3.8 Pre-Survey Fisheries Study

The PAD Rules and Procedures Manual requires that applicants produce a Pre-survey Fisheries Assessment as part of the application for approval.

It also recommends that applicants appoint a Fisheries Liaison Officer (FLO), who will be on board the survey vessel for the duration of the survey to facilitate any necessary liaison with fishing vessels and to manage potential operational impacts.

## 1.4 Wider Legislative Framework

### 1.4.1 OSPAR Convention

The OSPAR Convention contains a series of Annexes relevant to the Project, which deal with the following specific areas:

- Annex II: Prevention and elimination of pollution by dumping or incineration;
- Annex III: Prevention and elimination of pollution from offshore sources; and
- Annex IV: Assessment of the quality of the marine environment.

The first Ministerial Meeting of the OSPAR Commission at Sintra, Portugal in 1998 adopted Annex V to the Convention, to extend the cooperation of the Contracting Parties to cover all human activities that might adversely affect the marine environment of the North-East Atlantic.

### 1.4.2 International Convention for the Prevention of Pollution from Ships (MARPOL)

MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. This international treaty was adopted by the International Maritime Organisation (IMO) in 1973, and later updated in 1978 after several severe tanker accidents.

The Convention includes regulations aimed at preventing and minimizing pollution from ships – both accidental pollution and that from routine operations – and currently includes six technical annexes, as follows:

- Annex I - Regulations for the prevention of pollution by oil;
- Annex II - Regulations for the control of pollution by noxious liquid substances in bulk;
- Annex III - Prevention of pollution by harmful substances carried by sea in packaged form;
- Annex IV - Prevention of pollution by sewage from ships;
- Annex V - Prevention of pollution by garbage from ships; and
- Annex VI - Prevention of air pollution from ships.

## 1.5 Structure of the Environmental Risk Assessment (EIA Screening) Report

This report is presented in the following sections:

| | |
|---|---|
| **Section 1** | *Introduction* – provides a background to the project and an overview of applicable legislation and guidance. |
| **Section 2** | *Project Description* – describes the operations associated with the Project. |
| **Section 3** | *Environmental Baseline* – describes the background environmental characteristics and the other socio-economic activities in the area. |
| **Section 4** | *Environmental Risk Assessment Methodology* – describes the methodology used to identify and assess the potential environmental impacts of the Project. |
| **Section 5** | *Assessment of Potential Impacts* – identifies and assesses the potential environmental and social impacts of the project alongside identified management or mitigation measures. This includes sub-sections which cover assessments of the potential cumulative and transboundary environmental and social impacts of the Project. |
| **Section 6** | *Assessment of Annex IV species under Article 12 obligations* – identifies the Annex IV species requiring assessment and assesses the potential for adverse effects on their conservation status. |
| **Section 7** | *Environmental Management* – provides an outline of how Woodside will manage the Project to facilitate protection of the environment and the socio-economic activities. |
| **Section 8** | *Environmental Risk Assessment Conclusions*. |
| **Section 9** | *Environmental Impact Assessment Screening* |
| **Section 10** | *EIA Screening Conclusion* |
| **Section 11** | *Appropriate Assessment (Nature Impact Statement) Screening Conclusions* |
| **Section 12** | *References* |

# 2 PROJECT DESCRIPTION

## 2.1 Purpose and Objectives

The objective of the proposed geotechnical investigation is to collect core from up to 22 shallow boreholes distributed throughout the Irish Atlantic Margin. Once obtained, the cores will be taken ashore for detailed analysis. The purpose is to improve overall understanding of the offshore geology west of Ireland.

The selected borehole targets will address some of the following specific geological objectives:

- Confirm basement age, lithology, composition;
- Identify stratigraphic markers to inform interpretation of basin fill; and
- Identify age and composition of igneous bodies.

As described in Section 1.2, this is a standalone investigation not related to any planned oil and gas exploration activity for Woodside and will generate open-source data available to the public/industry via the PAD.

## 2.2 Project Alternatives

The following options have been considered by Woodside in planning the geotechnical survey:

- Locations of the boreholes;
- Selection of survey contractor (implications for vessel and equipment); and
- Timing of the survey.

Borehole locations are based on existing geophysical information and target rock outcrops identified on geophysical data. The proposed borehole locations were selected based on the highest-ranking locations identified by the Petroleum Infrastructure Programme (PIP) to meet the geological objectives, whilst also taking account of practical considerations such as slope steepness and water depth and avoiding locations within offshore SACs designated for seabed features. The 22 locations shown in Figure 1-1 represent the maximum number; it is possible that some locations will be dropped due to time constraints or technical difficulties.

At the time of this submission, the contract for the geotechnical investigation has not yet been awarded. Therefore, the exact survey vessel and equipment that will be used cannot be defined yet but will be selected based on availability and ability to operate safely and effectively at the required range of water depths. The options for coring shallow boreholes are:

- A geotechnical survey vessel; or
- Seabed coring technology deployed from a vessel of opportunity.

Either vessel type will maintain position over the borehole location using a dynamic positioning (DP) system. No anchors will be used. Both options will be carried forward in the impact assessments and further details are provided in Section 2.4.

The exact start date is subject to regulatory approvals and dependent on the availability of a suitable contractor but is expected to be between June and early August 2020 or similar period in 2021. The entire programme will take a maximum of 40 days including operations, transit between locations and any weather downtime.

## 2.3 Project Overview, Schedule and Size

Details of the 22 selected borehole locations shown in Figure 1-1 are provided in Table 2-1.

**Table 2-1: Details of proposed borehole locations**

| Shallow borehole number | Longitude (ED50) | Latitude (ED50) | Water depth (m) (mean sea level; MSL) | Estimated target depth below seabed (m) |
|---|---|---|---|---|
| 37/13-sb1 | 10°35'36.875"W | 52°33'45.727"N | 101 | 50 |
| 36/30-sb1 | 11°03'17.362"W | 52°04'14.258"N | 139 | 30 |
| 46/17-sb1 | 10°41'15.614"W | 51°20'28.026"N | 158 | 50 |
| 47/17-sb1 | 9°45'45.066"W | 51°25'05.009"N | 50 | 50 |
| 74/29-sb1 | 14°17'59.24"W | 52°03'35.622"N | 302 | 50 |
| 83/25-sb1 | 15°09'17.994"W | 52°13'29.135"N | 1216 | 50 |
| 74/4-sb1 | 14°19'12.3"W | 52°59'05.575"N | 252 | 50 |
| 74/14-sb1 | 14°19'12.675"W | 52°32'50.847"N | 343 | 50 |
| 74/27-sb1 | 14°41'11.242"W | 52°00'33.391"N | 410 | 50 |
| 83/5-sb1 | 15°00'15.621"W | 52°55'26.87"N | 1246 | 50 |
| 75/28-sb1 | 14°25'26.147"W | 53°04'45.188"N | 274 | 50 |
| 25/27-sb2 | 13°39'44.922"W | 53°07'54.219"N | 186 | 50 |
| 18/27-sb1 | 11°44'50.678"W | 54°06'21.759"N | 452 | 50 |
| 26/8-sb1 | 12°34'14.352"W | 53°47'15.959"N | 308 | 50 |
| 17/28-sb1 | 12°24'43.288"W | 54°04'21.517"N | 1040 | 50 |
| 26/5-sb1 | 12°02'11.096"W | 53°52'52.658"N | 349 | 50 |
| 20/12-sb1 | 9°41'11.988"W | 54°32'02.337"N | 91 | 50 |
| 28/9-sb1 | 10°17'48.551"W | 53°47'02.723"N | 57 | 50 |
| 27/30-sb1 | 11°11'03.353"W | 53°02'51.859"N | 127 | 50 |
| 60/8-sb1 | 13°35'22.525"W | 49°42'59.718"N | 2558 | 40 |
| 67/11-sb1 | 11°48'40.03"W | 48°35'12.927"N | 2033 | 50 |
| 67/7-sb1 | 11°40'27.036"W | 48°45'55.192"N | 2334 | 50 |

The survey vessel will visit each individual borehole location in turn. Accurate positioning of the boreholes will be achieved using an ultra-short baseline (USBL) system. These systems include a transceiver which is mounted on the hull of the survey vessel and a transponder or beacon which will be mounted on the seabed frame during deployment. Further details on the specification and use of the USBL system are provided in Section 2.6.

On arrival at the location, an underwater video system (Section 2.7) will be used to check that the proposed location is free of hazards which could affect safe coring operations. The underwater camera will be either mounted on the seabed frame used for the coring and positioned to inspect the seabed prior to landing the frame on the seabed, or a standalone camera which will be lowered to just above the seabed to provide 360-degree observations prior to deploying the seabed frame on the seabed. The camera system itself will have no interaction with the seabed.

Depending on the water depth and the coring rate achievable, the total time at each location including the underwater video check, positioning of the frame, coring the shallow borehole and recovery of all equipment

is expected to be 1.5 to 4 days depending on water depth. The actual number of boreholes achievable within the 40-day programme (from the maximum of 22 proposed) will depend on various factors such as weather conditions, equipment and coring speeds.

The order of the boreholes will be planned to have minimum transit time and distance (resulting in emissions being reduced to as low as reasonably practicable) and to take account of any specific seasonal sensitivities. It is possible that the investigation may be undertaken during the same period in 2021 and this has also been considered in the assessments.

The core samples being recovered will be 61 – 100 mm diameter and the borehole diameter 96 – 219 mm, depending on the system used. Both systems involve the placement of a frame on the seabed as described in Section 2.4, which may penetrate approximately 30 cm into the seabed in very soft sediments. In the case of a geotechnical survey vessel, the seabed footprint will be approximately 5 m x 5 m. In the case of the seabed coring system, there will be three independent footings of 4 m x 1 m each. A temporary 500 m safety zone will be established around the vessel when it is on DP on station. The exclusion zone will cease to be in effect once the vessel leaves the borehole location.

There will be no offshore bunkering; bunkering will take place in port.

## 2.4 Survey Vessel and Equipment

### 2.4.1 Option 1 – Geotechnical Survey Vessel

A DP Class 2 dedicated geotechnical survey vessel with a length of approximately 80 to 110 m may be used. An example of a typical vessel is shown in Figure 2.2. The vessel provides a stable platform for coring operations and is fully equipped with navigational and positioning (USBL) equipment. The borehole coring system may consist of:

- A coring derrick over a moonpool;
- A drill string assembly; and
- A seabed frame to support operational requirements.

Figure 2-1: Example of possible geotechnical survey vessel to be used

### 2.4.2 Option 2 – Seabed coring technology

An alternative to a geotechnical survey vessel is the use of a remotely controlled seabed coring unit. This technology may offer efficiencies by avoiding the time-consuming deployment of a drill string. With the coring unit located on the seabed, seabed coring technology provides a highly stable and controlled platform from which to conduct the borehole coring (Figure 2-2).

The seabed coring system would be deployed from a multi-purpose supply vessel which will be DP Class 2 with a length approximately 80 to 110 m, fully equipped with navigational and positioning (USBL) equipment. An example under consideration by Woodside is shown in Figure 2-3.

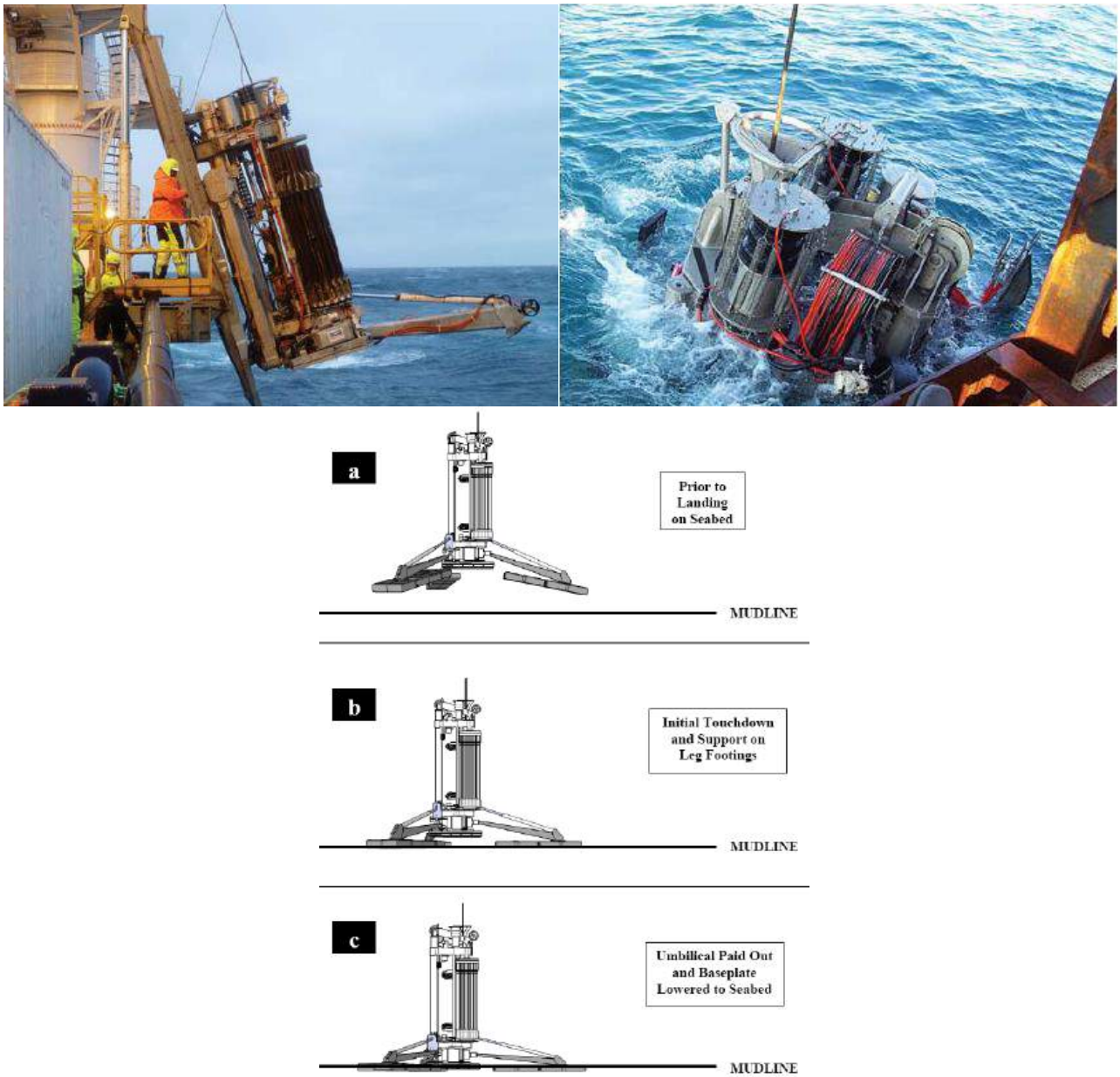


Figure 2-2: Example of seabed coring technology (Benthic, 2016)

Figure 2-3: Multi-purpose supply vessel for suitable for deployment of seabed coring technology

## 2.5 Survey Vessel Specification and Fuel Use

Survey vessel options under consideration are described in Section 2.4. Regardless of whether a geotechnical survey vessel or a seabed coring system carried by a vessel of opportunity is used, the maximum parameters of the vessel will be as shown in Table 2-2.

The selected vessel will be required to pass a Woodside Marine Assurance Inspection Audit (to assess compliance with safety management requirements and marine compliance laws) and will be required to operate in accordance with Woodside's HSE policies.

Routine discharges from marine vessels are typically well-controlled activities that are managed as per the International Maritime Organisation (IMO) standards. Waste generation and disposal from the survey vessel (non-hazardous, hazardous and domestic) will be handled and managed according to relevant legislation and Woodside procedures.

Table 2-2: Geotechnical investigation vessel indicative parameters

| | |
|---|---|
| **Registered tonnage** | 5,400 – 7,000 tonnes |
| **Length overall** | 80 -110 m |
| **Breadth** | 20 – 25 m |
| **Draft (max)** | 6 – 8 m |

Fuel use for these types of activities is typically 12 to15 $m^3$ during operations and 20 to 24 $m^3$ during transit. Estimated fuel use is shown in Table 2-3. The estimated maximum consumption is based on the minimum

time (1.5 days) being spent at each of the borehole locations and the remainder of the maximum duration of the investigation being spent in transit between locations.

Table 2-3: Vessel requirements and estimated fuel consumption

| Activity | Fuel type | Consumption rate (max) $m^3$/day | Estimated duration | Estimated maximum total fuel consumption (tonnes) |
|---|---|---|---|---|
| Transit | Marine diesel | 24 | 7 | 168 |
| Operations | Marine diesel | 15 | 33 | 495 |

## 2.6 USBL Specification and Use

Transponders typically emit pulses of medium frequency sound, generally within the range 20 to 32 Kilohertz (kHz). The source level and an empirical spreading loss equation was applied as obtained from actual field measurements of one of the proposed acoustic positioning systems during geotechnical coring operations as currently proposed for the Project (Warner and McCrodan, 2011) with the results presented in Table 2-4. This is a similar approach as applied in Austin *et al*. (2012). The average source levels (Sound Pressure Level; SPL) for the 1/3-octave bands centred at 20, 25, and 31.5 kHz are 149.9, 173.0, and 151.3 dB re 1 µPa2s at 1 m, respectively.

Table 2-4 Ranges to SPL isopleths for acoustic positioning systems, extracted from Austin *et al* (2012).

| SPL (dB re 1 µPa) | Radius (m) | |
|---|---|---|
| | Sonardyne Ranger, 18 to 36 kHz* | Kongsberg HiPap 500, 33 kHz* |
| 200 | 2 | 5 |
| 190 | 5 | 9 |
| 180 | 8 | 7 |
| 170 | 18 | 30 |
| 160 | 36 | 42 |

* Based on empirical spreading loss estimate measured by Warner and McCrodan (2011).

Transmissions are not continuous but consist of short ‘chirps’ with a duration that ranges from 3 to 40 milliseconds. Transponders will not emit any sound when on standby. For general positioning and when lowering the seabed frame, they will emit one chirp (pulse) every five seconds. When required for precise positioning they will emit one chirp every second. Use of the USBL and beacon is expected to take from a few minutes to 1.5 hours per station depending on the water depth. Once the seabed frame is on the seabed, stationary and a final fix has been recorded, the USBL will be turned off.

## 2.7 Drop Camera Specifications

As discussed in Section 2.3, an underwater camera will be used before borehole coring commences to inspect the seabed. The camera will be a digital drop camera system rated for use in deep water, with real-time video link back to the vessel. This allows for video monitoring and provision of high-resolution photographic images at each of the proposed borehole locations.

## 2.8 Coring Fluids and Discharges

Borehole coring may be conducted with seawater only, with no added chemicals. It is possible that coring fluids may be used when required.

The most likely fluid in this case would be Pure-Bore, an organic, biodegradable, high performance water-based mud (HPWBM). Bentonite will also be carried onboard in case it is needed and this may sometimes be mixed with soda ash. These products are all rated as PLONOR (posing little or no risk to the environment) and contain only OCNS Gold/Silver, E or D rated chemicals.

Only minimal amounts of cuttings will be discharged because 80 - 90% of the core is recovered for analysis. Cuttings are discharged close to the seabed and are estimated to amount to <0.25 $m^3$ per 50 m borehole.

# 3 ENVIRONMENTAL BASELINE

## 3.1 Introduction

As part of the EIA screening process it is important that the main physical, biological and socio-economic sensitivities of the receiving environment are well understood. The footprint of each individual borehole is extremely small (see Section 2.3). However, the proposed borehole locations are widely dispersed across the Atlantic margin to the west of Ireland and encompass a broad range of water depths and environmental conditions. The description is therefore focussed on three smaller study areas adopted for their general similarity in environmental conditions yet covering all the proposed borehole locations as shown in Figure 3-1:

- Porcupine Bank study area;
- Irish Shelf study area; and
- Goban Spur study area.

In addition, the proximity of individual borehole locations to specific features is highlighted where required.

This section draws on a number of information sources including published papers on scientific research in the area and industry-wide information at a strategic or regional level, including but not limited to:

- The Irish Offshore Environmental Assessment (IOSEA) 5 carried out in 2015 covering the whole of Ireland's offshore area (DCENR, 2015);
- Ireland's Marine Atlas: Marine Strategy Framework Directive Predominant Habitat Type (Marine Institute, 2017);
- Reports generated from the ObSERVE programme (Berrow *et al*, 2018; Rogan *et al*, 2018; Jessop *et al,* 2018);
- The Atlas of Cetacean Distribution in North-West European Waters (Reid *et al*, 2003);
- Data on the spawning and nursery grounds of commercially important species (Marine Institute, 2009);
- The Atlas of Commercial Fisheries around Ireland (Marine Institute, 2014);
- Fisheries sensitivity maps in British and Irish waters (Coull *et al.,* 1998) in conjunction with spawning and nursery maps of selected fish species in Irish waters (Ellis *et al*., 2012).

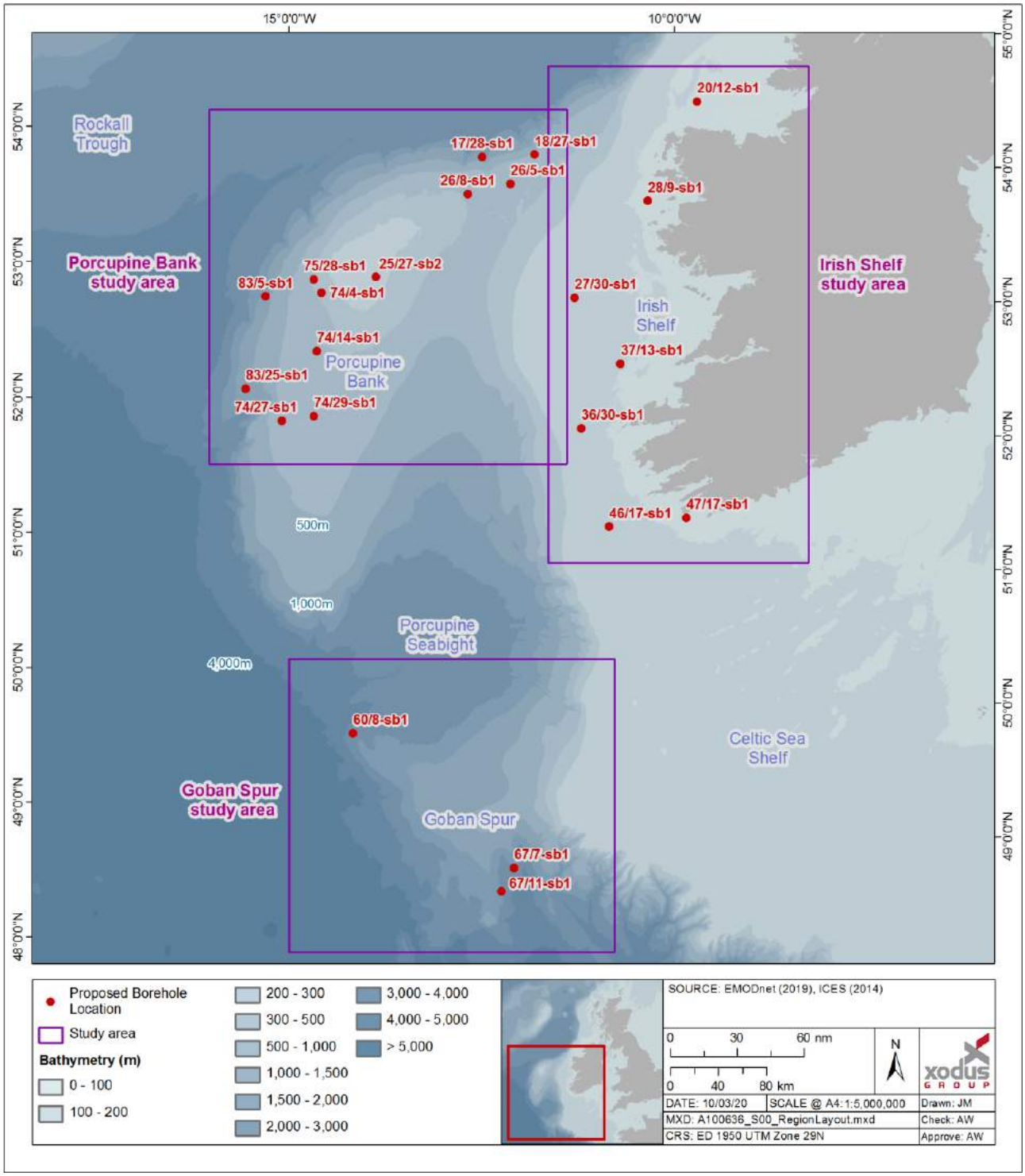


Figure 3-1: Study areas and regional bathymetry

## 3.2 Physical Environment

### 3.2.1 Weather and Sea Conditions

Winds throughout the west coast of Ireland are extremely variable in both direction and speed, owing to the frequent passage of Atlantic depressions into the area from the mid North Atlantic and due to the North Atlantic Oscillation (NAO). Most frequently, winds blow from the west to south-west). However, when a stationary anti-cyclone develops over or west of the British Isles (often during spring and/or autumn), an easterly to north-easterly wind may persist for up to several weeks.

Over the open ocean, winds of greater than 8 m/s (Beaufort Force 5) are experience for 70 to 75% of the winter and 30 to 35% of the summer (DCENR, 2015). The most severe wind conditions are experienced offshore Ireland from October to March, particularly during the winter months of December through February. Severe gales can occur in any month but are most frequent during winter. The most common direction for gales is between south-west and north-west.

The sea states experienced to the west of Ireland are amongst the highest and/or roughest of all the coastal waters of northwest Europe. Wave heights vary seasonally, with the highest, more variable waves (≥ 15 m) occurring during the winter (December to March) and lower, less variable waves (of up to 10 m) occurring during summer (June to September).

The underlying general pattern of oceanic water mass circulation around Ireland's Atlantic margin is indicated in Figure 3-2. A number of large current systems affect the offshore areas, including the Shelf Edge Current and North Atlantic Current, while deep-water currents bring Arctic water southwards beyond the continental slope (DCENR, 2015).

Sea surface temperatures to the west of Ireland show an annual range of between approximately 10-16°C in the south and 10-14°C in the north (MyOcean, 2020). In the spring and summer months, thermal stratification creates a thermocline at approximately 70 to 100 m with water temperature decreasing with depth. On the shelf bottom, temperatures may be as much as 5°C cooler than surface temperatures in summer months. The thermocline begins to break down in the autumn as surface temperatures cool and convection and wind induced mixing take place down to a depth of 500 to 750 m.

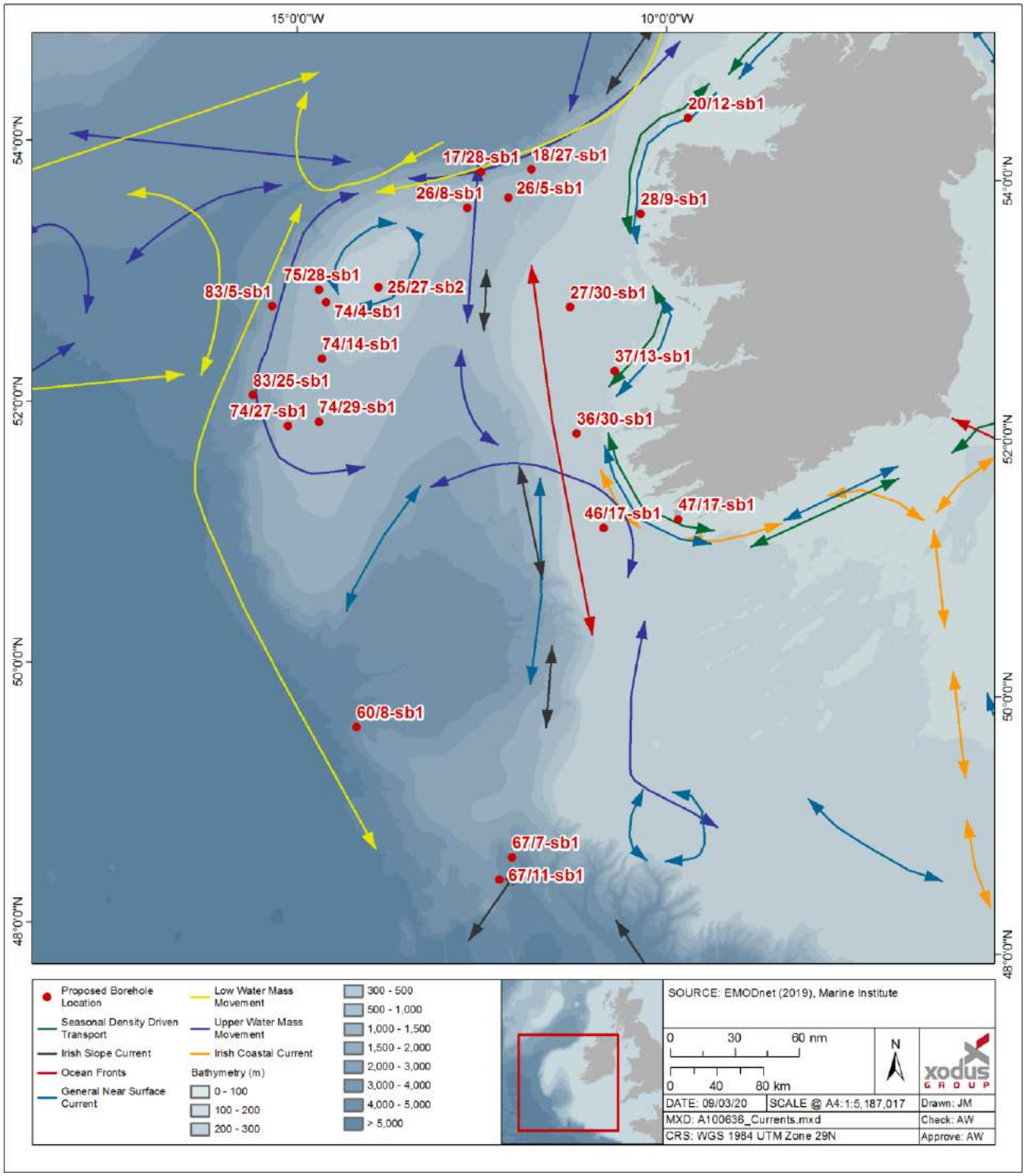


Figure 3-2: Large-scale water mass circulation around Ireland's Atlantic Margin

### 3.2.2 Bathymetry

The present seabed topography of the west of Ireland offshore region is the result of its deep geological structure, later modified as a result of glacial and contemporary processes. Bathymetry, together with the main topographical features of the area, is shown in Figure 3-1.

The continental margin is formed by a westerly extension from the Celtic Sea shelf, that from the shelf edge at about 200 m depth dips gently, via a gradually steepening and smooth upper slope, to a water depth of about 1,400 m (van Weering *et. al*., 1998).

The Irish shelf is confluent with the Celtic Sea shelf and extends from the west coast of Ireland to the shelf edge at 200 m. It is at its narrowest off northwest Ireland and broadest to the southwest of Ireland where the Celtic Sea opens into the Atlantic.

The Porcupine bank is located approximately between 150 and 250 km from the Irish western coastline. It is a south–north orientated plateau forming the northwestern margin of the Porcupine Seabight (Naylor and Shannon, 2009; Naylor *et. al*., 2002). It is linked to the northwestern Irish shelf by the Slyne Ridge with minimum water depths of 250–300 m (Naylor *et al*., 2002) together with a west–east topographic bridge, the 'Porcupine Saddle' characterised by water depths between 300 m and 400 m. To the north and the west, the Porcupine Bank displays a shelf break at a depth of 500 m; the slope is steep and narrow towards the Rockall Trough (Sacchetti *et al.,* 2011). To the south and southeast, the bank opens with a gentle slope to the deep embayment of the Porcupine Seabight. The SW–NE oriented Porcupine Ridge (Naylor *et al*., 2002) is normally taken to be the northern, shallowest section of the Porcupine Bank, where water depths are typically less than 200 m. The shallowest point of the bank is at depth of approximately 145 m and is situated approximately 200 km west of Ireland, however, the majority of the bank is between 200 and 400 m in depth.

The Goban Spur extends as a broad gently sloping platform from the southwest edge of the Celtic Sea shelf to form the southern limit of the Porcupine Seabight.

The borehole locations range in water depth from approximately 50 m to 2,600 m and are distributed over the Irish Shelf, Porcupine Bank and Goban Spur areas (Table 2-1, Figure 3-1).

### 3.2.3 Seabed Conditions

#### *3.2.3.1 Seabed Type*

The seabed environment to the south and west of Ireland has been shaped by glacial periods, when large volumes of material were eroded from the land and shelf and deposited at the shelf edge and over the continental slope. The present-day seabed consists largely of sediments that are the result of reworking and redistribution by near-bottom currents and gravity-driven processes. The seabed habitat types for each of the three study areas are shown in Figure 3-3 - Figure 3-5 (EMODnet, 2019).

The Porcupine Bank study area has broadly been mapped as Atlantic upper bathyal and deep circalittoral sediments (Figure 3-3Figure 3-3). Sediment on the shallower parts of the Porcupine Bank and continental shelf is predominantly smooth and sandy, with varying levels of coarse material (gravel, pebbles, cobbles and isolated boulders). Some areas of harder substrate, such as coarse sediments or rock outcrops, have also been observed in acoustic backscatter data on the shallower parts of the Porcupine Bank (DCENR, 2007). Within the Porcupine Seabight, sediments consist primarily of mud and sandy mud and clayey sands overlying silty clays (DCENR, 2007) and become finer with increasing water depth.

In the Irish shelf study area, sediments are highly varied (Figure 3-4); the principle EUNIS habitats present are Deep circalittoral sand, Deep circalittoral mud and Deep circalittoral coarse sediments, with Deep sea sand or Deep sea muddy sand along the Celtic Sea shelf edge. There are also some hard substrata in areas that experience strong tidal currents.

In the Goban Spur study area, sediments are dominated by fine bathyal and abyssal sediment types (Figure 3-5).

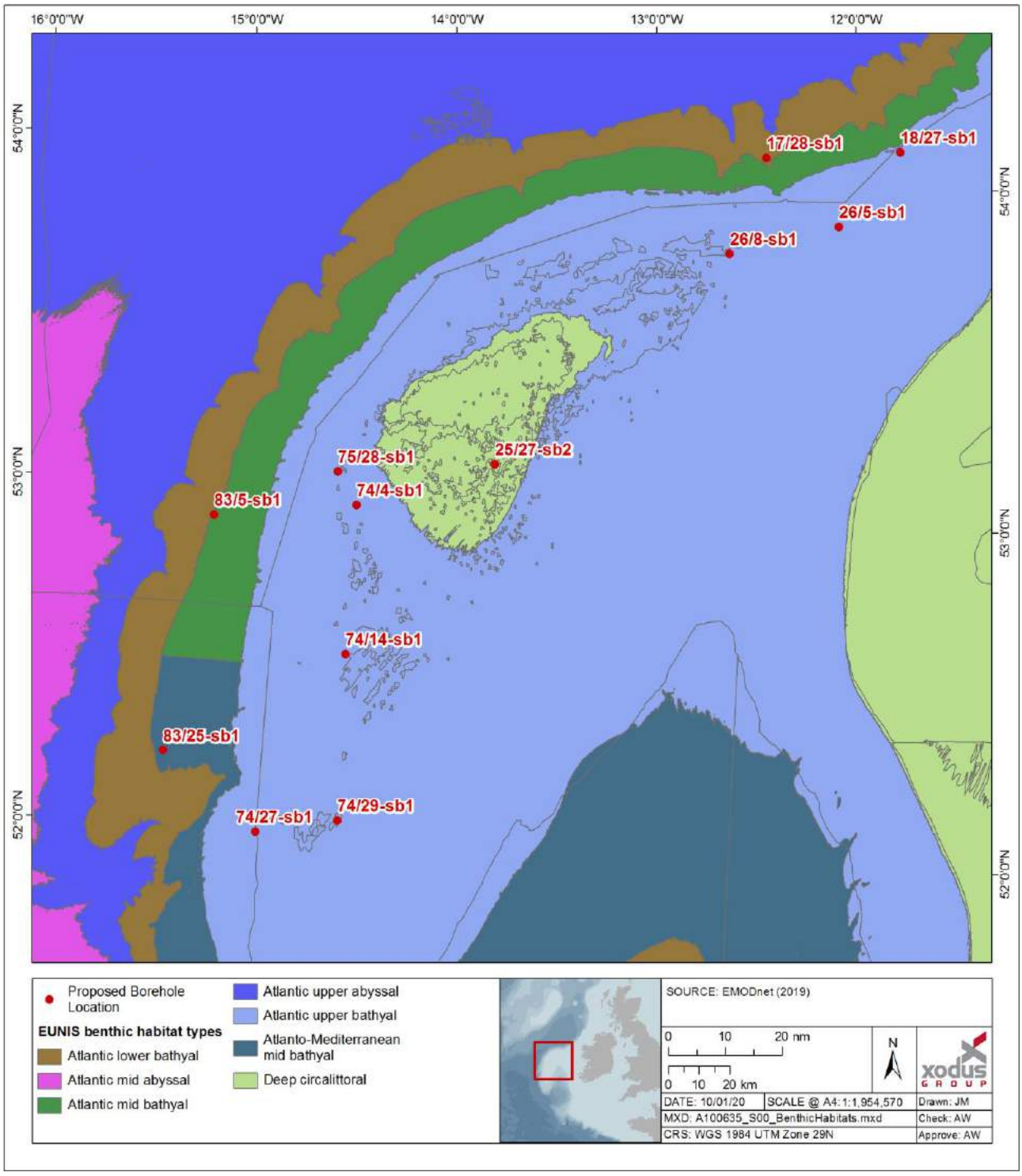


**Figure 3-3: EUNIS Sediment type classification in the Porcupine Bank study area (EMODnet, 2019)**

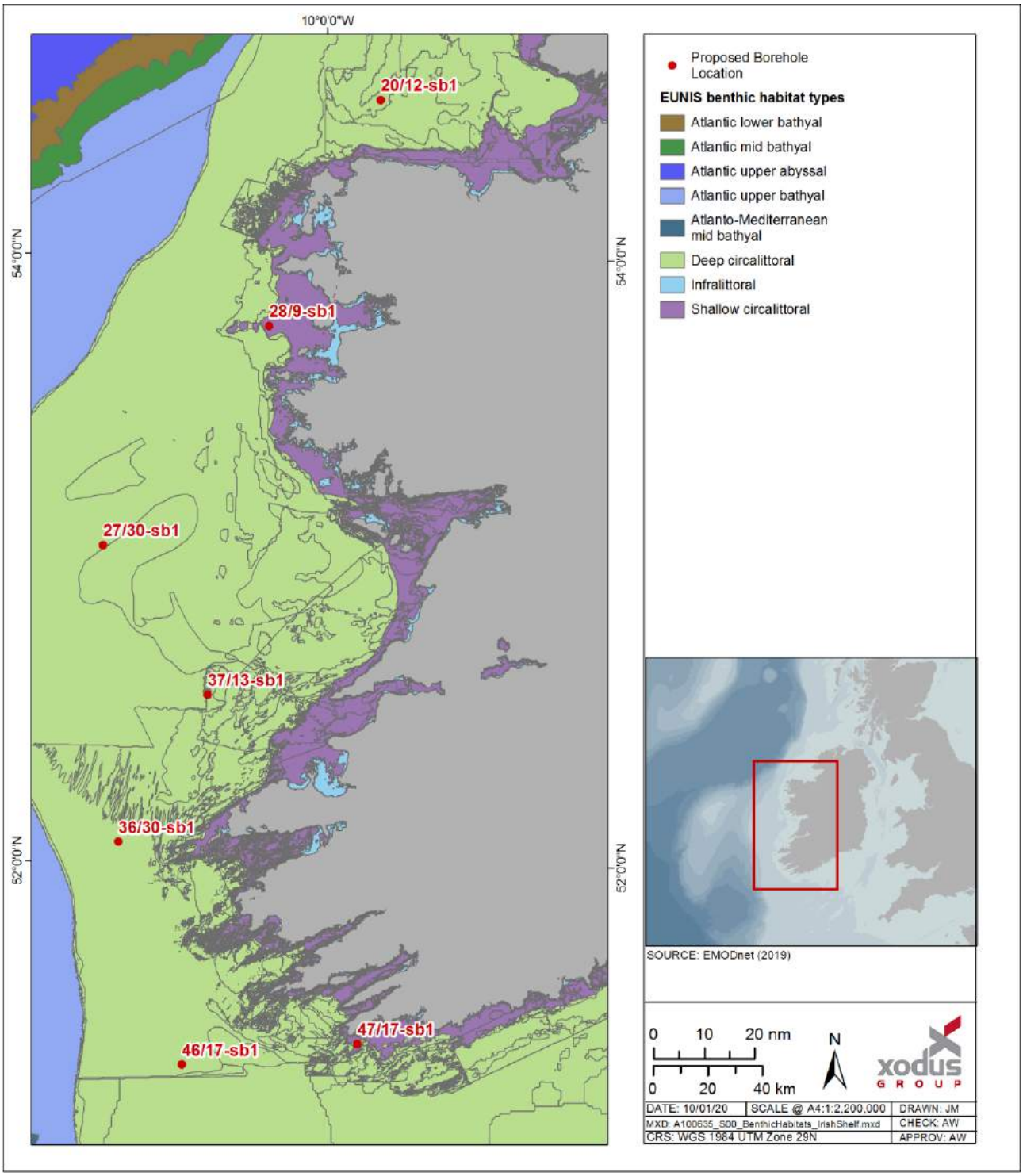


**Figure 3-4:** **EUNIS Sediment type classification in the Irish Shelf study area (EMODnet, 2019)**

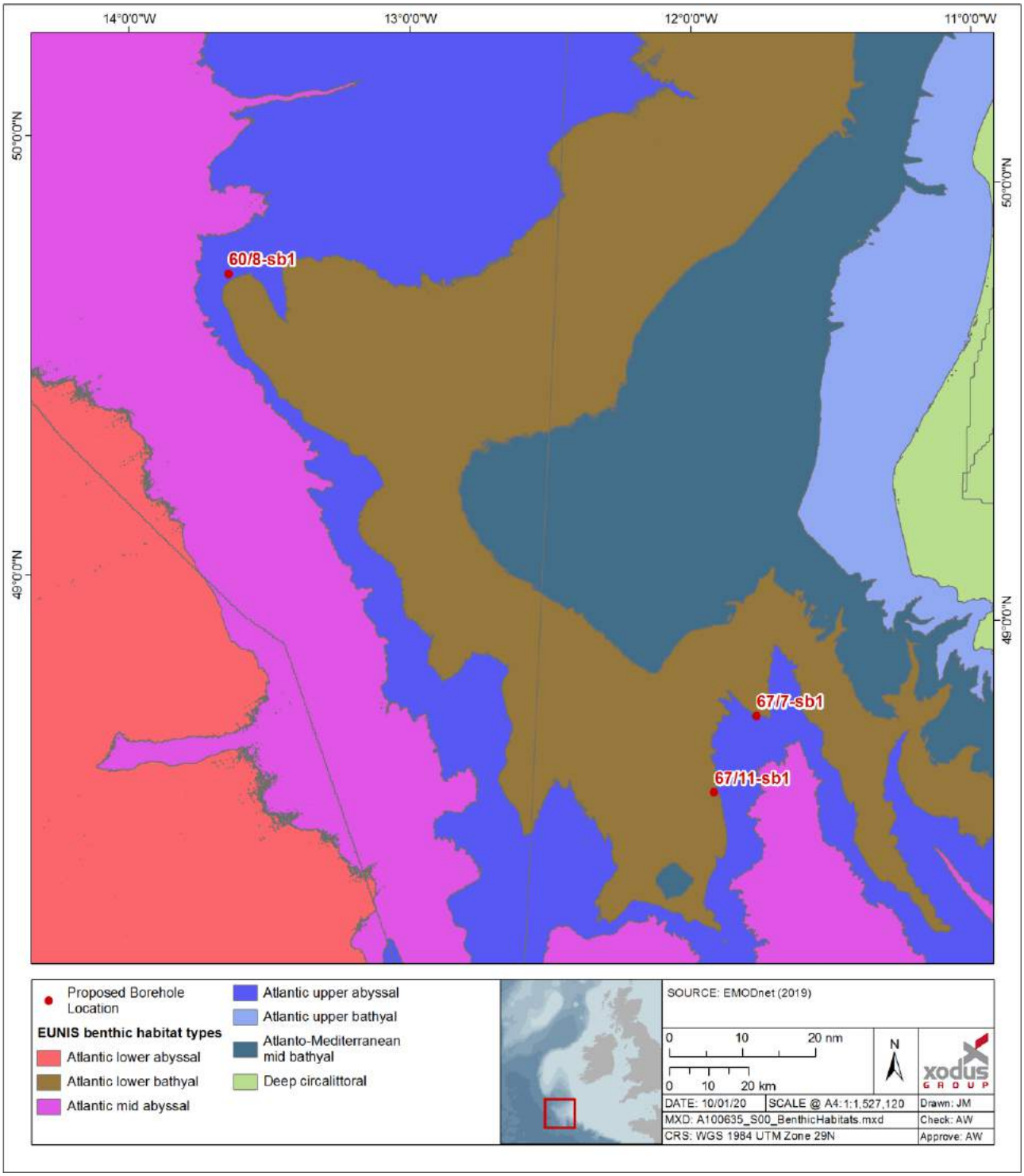


**Figure 3-5:** **EUNIS Sediment type classification in the Goban Spur study area (EMODnet, 2019)**

#### *3.2.3.1 Seabed Features*

##### 3.2.3.1.1 Carbonate mounds

According to OSPAR (2010a), carbonate mounds are "*distinct elevations of the seabed…up to 350 m high and 2 km wide at their base…with a sediment veneer typically composed of carbonate sands, muds and silts…with cold water reef-building corals as characteristic fauna*". There remains speculation as to the origin of carbonate mounds, with possible links to fault-controlled methane seepage from deep hydrocarbon reservoirs, to gas-hydrate dissociation, and to cold-water coral growth. In addition, due to ambiguities in terminology and possible confusion with other types of seabed mound features, OSPAR (2010a) suggested that carbonate mounds should really be termed 'coral carbonate mounds'. OSPAR further defined these as features which have formed by successive periods of coral reef development, sedimentation and erosion.

All known coral carbonate mounds are more than 10,000 years old and may or may not support contemporary cold-water coral reefs. In the OSPAR sea region, they are known to occur in deep water (500 to 1,500 m) along the Atlantic Margin west of Ireland and the UK, generally on banks or towards the upper part of the shelf-slope break such as along the margins of the Porcupine Seabight and Rockall Trough (DCENR, 2007; OSPAR, 2010a). They may be partially or entirely buried through sedimentation and the review by OSPAR (2010a) only considers coral carbonate mounds standing more than 50 m above the surrounding seabed. They tend to be clustered in areas commonly referred to as 'mound provinces'.

OSPAR (2008) has listed several seabed species/habitats (or features), including carbonate mounds, as under threat and/or in decline. Carbonate mounds are widely distributed on the eastern margin of the North Atlantic from the Iberian Peninsula to offshore Norway in water depths of 50 m to perhaps 2,000 m, (Masson *et al*., 1998). They generally occur in small, localised clusters. The findings of deep-sea surveys suggest that the European slopes of the Rockall and Porcupine Basins may be the most prolific areas for the formation of carbonate mounds in the world (Anon, 1999). Discoveries include a giant cluster of reefs including hundreds of buried mounds off south-west Ireland (Kenyon *et al*., 1998) and a field of seafloor mounds in 1,000 m of water in the northern Rockall Trough (Masson *et al*., 1998). The full extent of these features in the OSPAR Maritime Area is unknown. Figure 3-6Figure 3-6, Figure 3-7and Figure 3-8 show the modelled and known distribution of carbonate mounds. Carbonate mounds are amongst the seabed habitat features highlighted as threatened and/or declining within the North-east Atlantic Region; the main threats to carbonate mound features are from habitat loss from physical degradation/alteration of the seabed caused by, for example, demersal fisheries or offshore infrastructure development (OSPAR, 2014).

None of the proposed borehole locations are on or near carbonate mounds. The closest borehole location to a carbonate mound is 75/28-sb1, which is 10 km away from one of the carbonate mounds in the Pelagica mounds province (Figure 3-7). The proposed borehole locations have been selected to avoid sensitive seabed features such as carbonate mounds.

##### 3.2.3.1.2 Other seabed features

Pockmarks are small depressions associated with areas of soft mud, which are thought to have formed at times of fluid/gas escape at the seabed. When associated with modern fluid/gas escape, they may contain hard carbonate material formed from the biogenic oxidation of methane (DCENR, 2007). Pockmarks linked to the presence of hard carbonate material (methane-derived authigenic carbonate or MDAC) may qualify for protection as an EC Habitats Directive Annex I habitat, Submarine structures made by leaking gases. Data on the presence and distribution of pockmarks to the west of Ireland region is limited, but they have been found close to the northerly limits of the Irish continental shelf (DCENR, 2015) more than 130 km to the north of borehole location 20/12-sb1 (Figure 3-7). Potential areas of pockmarks have been observed in the northern and eastern Porcupine Seabight in the vicinity of Hovland and Belgica mound provinces (Games, 2001; Hartley Anderson, 2005; Huvenne et al 2003). Twenty-three pockmarks (262–720 m diameter and 2–6 m depth) were identified on the multibeam bathymetric data, in water depths of 196–285 m in the Slyne Basin (Roy *et al*., 2016; Figure 3.9). These closest of any of these potential areas of known pockmarks to proposed borehole locations is approximately 20 km (see Figure 3.8).

'Sandbanks which are slightly covered by sea water all the time' (herein referred to as sandbanks), depending on their characteristics, depth range and bio-assemblage may also qualify for protection as an EC Habitats Directive Annex I habitat. Sandbanks in Irish waters comprise distinct banks (i.e. elongated, rounded or irregular 'mound' shapes) that may arise from horizontal or sloping plains of sediment that range from gravel to fine sand. They are primarily composed of sandy sediments permanently covered by water, with tops in depths of less than 20 m below chart datum (though the banks may extend to water depths greater than 20 m). The diversity and types of community associated with this habitat are determined particularly by sediment type together with a variety of other physical, chemical and hydrographical factors. These include geographical location, the relative exposure of the coast, topographical structure of the habitat, and differences in the depth, turbidity and salinity of the surrounding water.

Most sandbanks in Irish waters are found in the Irish Sea. To date only two sandbanks, the Ballybunion and Turbot/Kilstiffin Banks, have been identified along the western seaboard at the mouth of the Lower River Shannon cSAC between Counties Kerry and Clare (over 20 km from borehole 28/9-sb1). A small bank also occurs on the north coast of Donegal called Hempton's Turbot Bank (NPWS, 2019) some 20 km from borehole 20/12-sb1 (see Figure 3-7). Note that two isolated deep-water sandbanks may occur offshore in the northern Porcupine area (Figure 3.8); however, with a water depth over their tops of well over 20 m, these would not qualify as "submerged sand banks" as defined by the EU Habitats Directive. Due to the offshore nature of the borehole locations it is unlikely that the study areas will interact with any sandbank features (Figure 3-6 and Figure 3-7).

## 3.3 Biological Environment

### 3.3.1 Plankton

Plankton is comprised of small plants (phytoplankton) and animals (zooplankton). The zooplankton includes holoplanktonic species (permanent members of the plankton) and meroplankton (larval stages of marine invertebrates and fish). Plankton has a limited ability to move and as a result its distribution and abundance is strongly influenced by hydrographic factors such as depth, tidal mixing, temperature stratification and advection. The phytoplankton to the west of Ireland is primarily comprised of diatoms and dinoflagellates with some ciliates present. Turbulence from the Irish shelf front introduces nutrients from deeper waters which causes phytoplankton growth (blooms) along a band of nutrient-rich, cool water along the shelf edge.

In the waters west of Ireland the phytoplankton community is dominated by dinoflagellates including *Ceratium fusus* and *Ceratium furca*. The majority of the remaining phytoplankton are diatoms including *Thalassionema nitzchioides* and other *Thalassiosira* spp., with *Chaetoceros* spp. occurring frequently. Higher abundances of diatoms *Thalassiothrix longissimi* and *T. nitzchioides* are associated with offshore rather than shelf waters (DCENR, 2015).

Copepods dominate the zooplankton community to the west of Ireland in terms of biomass and abundance, particularly large copepod species *Calanus helgolandicus* and *C. finmarchicus*. *Calanus finmarchicus* previously dominated the waters of northwest Europe, whilst *C. helgolandicus* was more abundant in warmer southerly waters. In the waters to the west of Ireland, and indeed throughout the northwest Atlantic, there has been a northward movement of temperate species in recent decades with *C. finmarchicus* being replaced by *C. helgolandicus*, *Pseudocalanus elongates*, *Evadne* spp. and *Podon* spp. together with an overall decline in zooplankton biomass. Copepods are an important trophic link between phytoplankton and fish larvae and these changes may have knock on effects on commercially important fish species such as cod (DCENR, 2015). In addition to these warm water species, euphausiids (krill) comprise an important part of the zooplankton community.

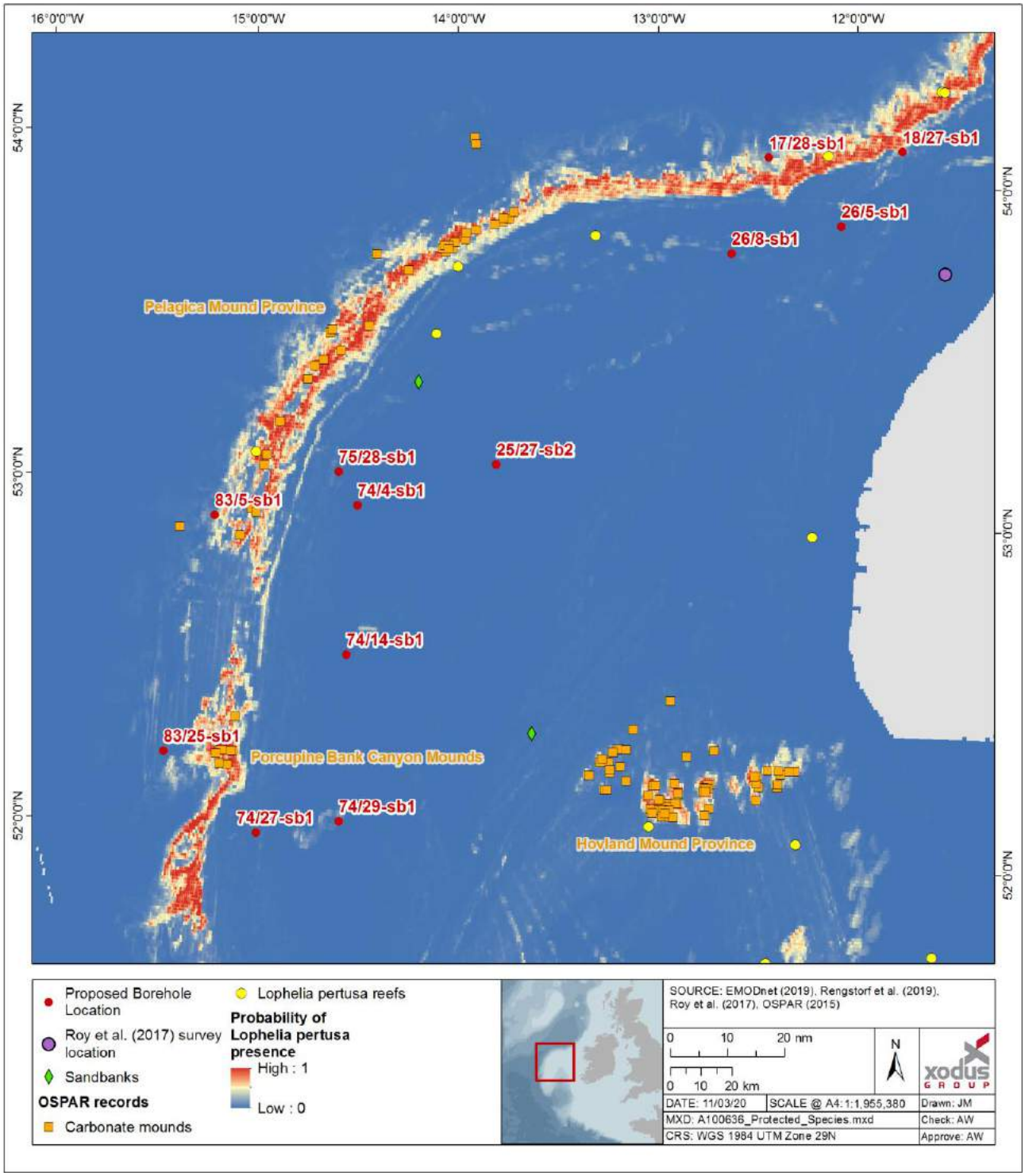


**Figure 3-6:** Sensitive habitats and coral habitat suitability modelling output in the Porcupine Bank study area (EMODnet 2019 and Rangstorf *et al.*, 2013)

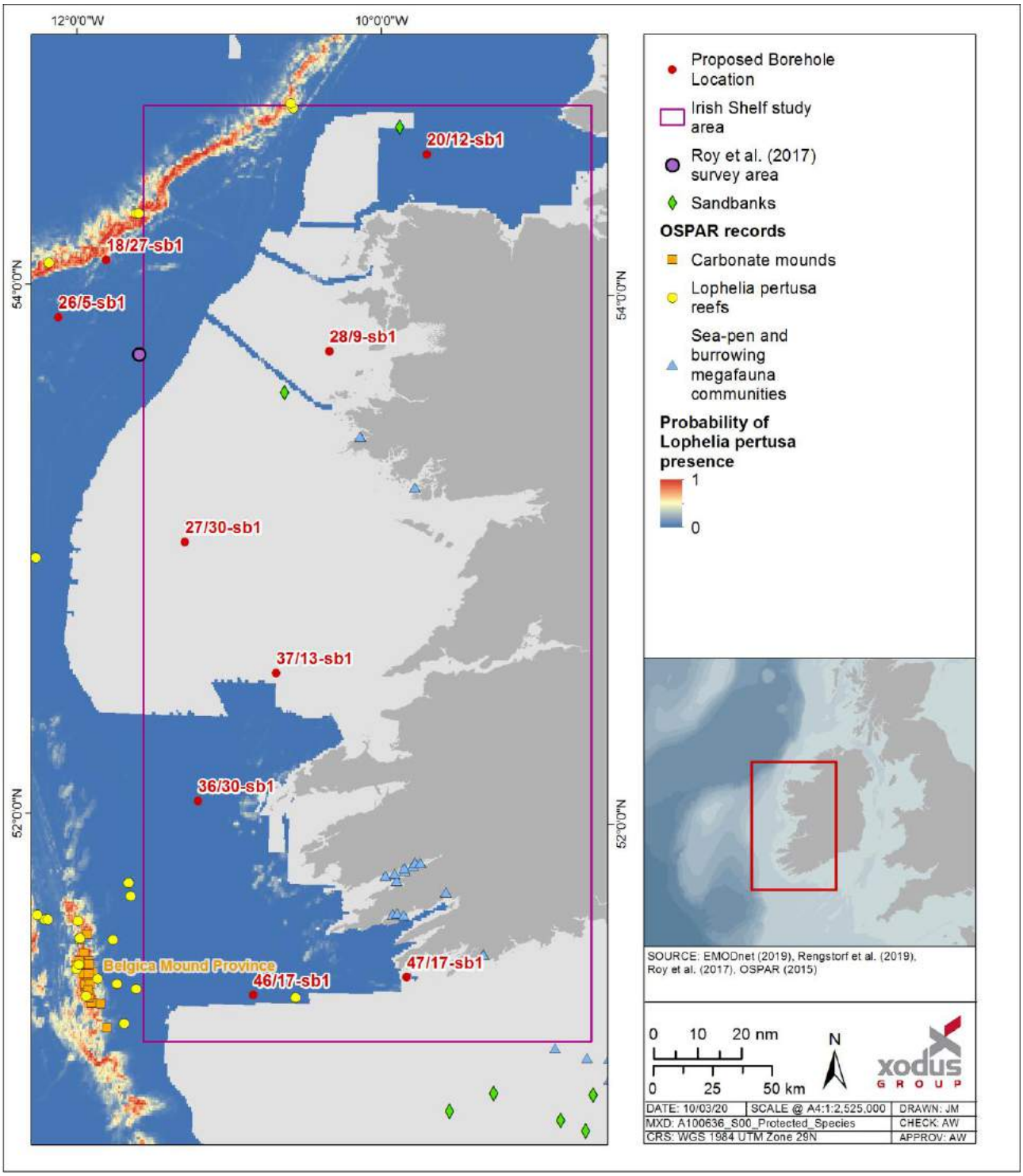


**Figure 3-7:** **Sensitive habitats and coral habitat suitability modelling output in and around the Irish Shelf study area (EMODnet 2019 and Rangstorf *et al.,* 2013)**

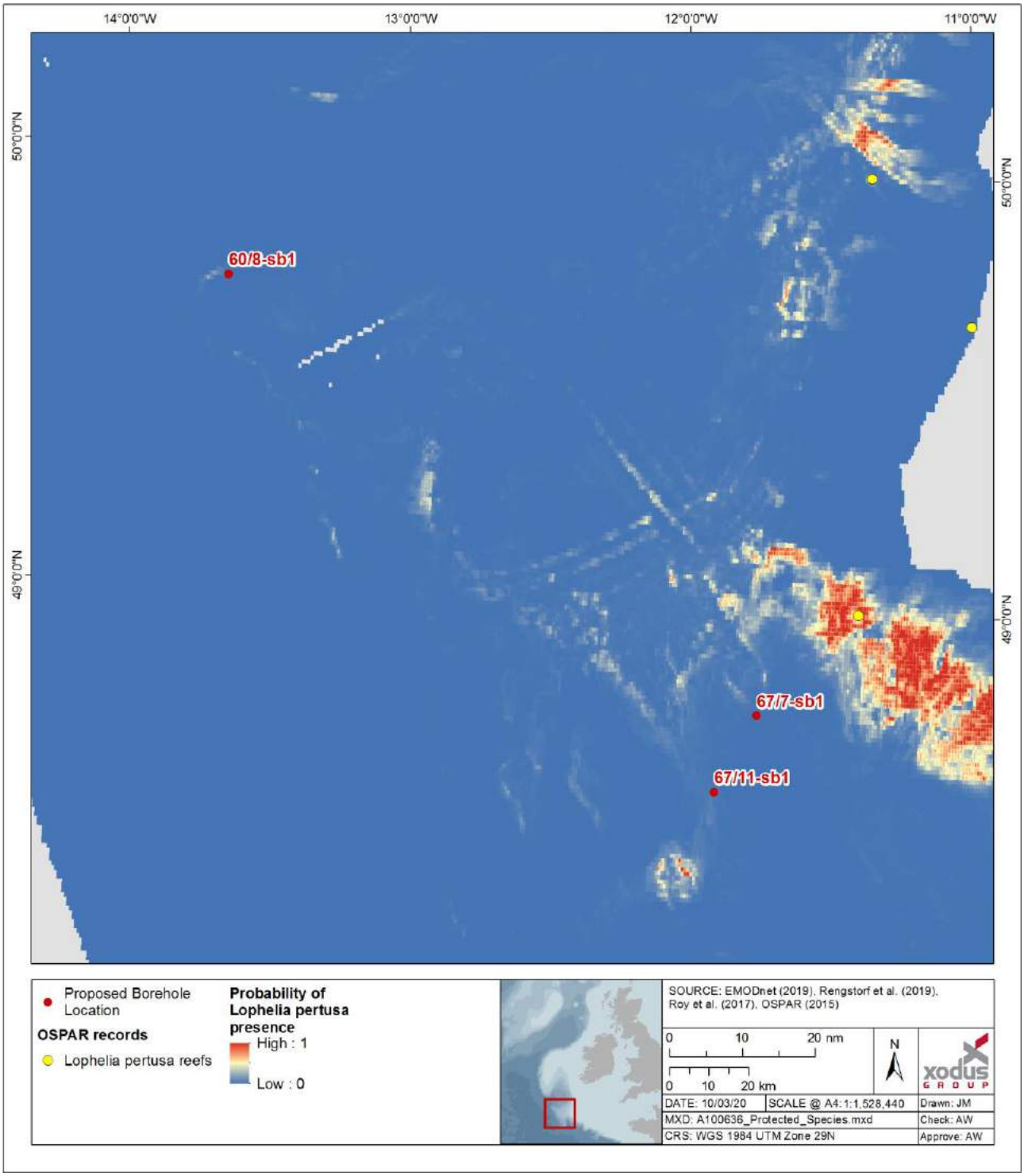


**Figure 3-8:** Sensitive habitats and coral habitat suitability modelling output in the Goban Spur study area (EMODnet 2019 and Rangstorf *et al.* 2013)

### 3.3.2 Benthos

The term benthos describes the organisms that live within and on the seabed. Those benthic species that live on the surface of the seabed are termed epifauna, and those that live within the seabed sediments are referred to as infauna. Factors which affect benthic faunal communities include sediment type, water depth, water temperature, and water currents.

Two community types have been broadly identified over the coastal and continental shelf seabed (50-200 m water depth) west of Ireland in sands and muddy sands: an *Amphiura* community and a *Chamelea gallina* community. The *Amphiura* community includes the brittlestars *Amphiura filiformis* and/or *Amphiura chiajei* while the *Chamelea gallina* community may be characterised by the bivalve mollusc *Chamelea gallina*, together with other bivalves such as *Fabulina* spp., *Mactra* spp., various polychaetes and the brittle star *Amphiura brachiata*. However, this benthic assemblage is typically associated with coastal sands.

Data on the benthic communities of the deeper waters off the west of Ireland (1,500+ m) are limited. The limited surveys conducted have reported Sipuncula (also known as “peanut worms”) and Echinoidea (sea urchins) as abundant taxa at depths of 900 m (DCENR, 2007), whilst deep sea sponge aggregations have been reported at water depths of 1,000-1,500 m (DCENR, 2015).

The benthic megafauna are those species over 1 cm in size that inhabit the sediment-water interface. In the Porcupine Seabight, megafaunal biomass is two to five times greater than in the Bay of Biscay, with records of the holothurian (sea cucumber) *Benthogone rosea* at densities of 0.098 to 0.114 individuals/$m^2$ at 1,400 m water depth, 50 individuals of the holothurian *Kolga hyaline* per $m^2$ at 3,700 m water depth and 34 individuals/$m^2$ at 4,000 m water depth (DCENR, 2007). Megafauna has previously been divided into three groups: crustaceans, echinoderms, and ‘other phyla’ dominated by suspension feeders (DCENR, 2007). These groups were affected by increasing depth, but crustacean biomass and abundance declined quicker than for echinoderms, with the degree of decline for ‘other phyla’ falling between these extremes. Decline of megafaunal biomass with increasing depth is generally due to a decline of food availability (DCENR, 2007).

#### *3.3.2.1 Sea-pens and Burrowing Megafauna*

The OSPAR threatened and/or declining species and habitat ‘Sea-pens and burrowing megafauna’ is found on plains of fine mud, at water depths ranging from 15–200 m or more, which are heavily bioturbated by burrowing megafauna; burrows and mounds may form a prominent feature of the sediment surface with conspicuous populations of sea-pens, typically *Virgularia mirabilis* and *Pennatula phosphorea* (OSPAR, 2010). The burrowing crustaceans present may include *Nephrops norvegicus*, *Calocaris macandreae* or *Callianassa subterranea*. In the deeper fjordic lochs which are protected by an entrance sill, the tall sea-pen *Funiculina quadrangularis* may also be present. The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration. This habitat occurs extensively in sheltered basins of fjords, sea lochs, voes and in deeper offshore waters such as the North Sea and Irish Sea basins and the Bay of Biscay.

Although elements of the OSPAR threatened and/or declining habitat ‘Sea pen and burrowing benthic megafauna communities’ may occur in the study areas it is unclear, through lack of survey data, if those elements would occur at the increased densities required to fulfil the overall criteria under OSPAR guidelines for this threatened and/or declining habitat. According to DCENR (2015) areas of this community occurs in parts of the Celtic sea and inshore bays along the west coast of Ireland. The nearest recorded occurrence of this OSPAR threatened and/or declining habitat is located in Kenmare Bay, 26 km to the north of borehole 47/17-sb1 (Figure 3-7Figure 3-7).

#### *3.3.2.2 Biogenic Reefs (Cold-Water Coral Reefs)*

Certain benthic organisms are particularly important in providing suitable substrate for other animals, thereby greatly enhancing local diversity, and also constitute a physically distinguishable seabed feature. One example is the lattice-work structure of cold-water corals *Lophelia pertusa* and *Madrepora oculata*, which have the potential to modify the seafloor by constructing impressive reef frameworks similar to their tropical counterparts. They tend to flourish on the upper continental slope where steady currents provide suitable feeding conditions for the sessile, passive filter feeding corals, and the most extensive reefs are often associated with elevated coral carbonate mounds (described in Section 3.2.3.1.1). Cold-water coral reefs qualify as ‘reef’ habitat under Annex I of the EU Habitats Directive and *L. pertusa* reefs are also classified as

OSPAR threatened/declining features or species (OSPAR, 2008); hence such habitats are a conservation priority.

Cold-water corals are most commonly associated with carbonate mounds. However, corals can and do grow on glacial dropstones or any other hard substratum given the correct environmental conditions, which include water of an appropriate temperature (4°C - 12°C) and sufficient current to provide an adequate food supply and prevent smothering by sedimentary material.

A regional coral habitat suitability modelling study (Rengstorf *et al*., 2013) used multibeam bathymetry data from the Irish National Seabed Survey (INSS) and a wide range of environmental data to produce a regional high-resolution habitat suitability map of the presence of the cold-water coral *L. pertusa* reefs in the Irish continental margin (Figure 3-8). The outputs of the model indicate a low probability of *L. pertusa* reef presence in the vicinity of any of the proposed borehole locations, with the closest confirmed location of *L. pertusa* being 17 km from borehole 46/17-sb1 (Figure 3-6, Figure 3-7and Figure 3-8).

#### *3.3.2.3 Deep Sea Sponge Aggregations*

Carbonate mounds without coral reefs may be dominated by accumulating sediments and typically have low abundances of filter feeding benthos, but this is not always the case; some support more species than surrounding seabed areas by offering distinct coral rubble and hardground habitats that, in some cases, is even more biodiverse than live coral habitats. Sponges, in particular, may be very abundant on mounds with low coral abundance. Hence, the absence of live coral reefs does not necessarily make coral carbonate mounds less significant in terms of conservation priorities (OSPAR, 2010a). Deep sea sponge aggregations are defined as principally being composed of sponges from two classes: Hexactinellida and Demospongia (OSPAR, 2010b). They are known to occur between water depths of 250-1,300 m (Bett and Rice, 1992), where the water temperature ranges from 4-10°C and there is moderate current velocity (0.5 knots). These sponge aggregations are listed on the OSPAR list of threatened/declining features or species (OSPAR, 2008) with the only mapped records of this feature being located around the north, east and western limits of the Porcupine Seabight. No sponge aggregations are located in close proximity (<40 km) to any of the proposed borehole locations.

### 3.3.3 Fish and Shellfish

Waters to the west of Ireland support a variety of fish and shellfish species. In order to characterise the different species, the following groups and categories have been used:

- Shelf-water species – adult fish typically found in the vicinity of the continental shelves at depths of up to around 250 m;
- Deep-water species - typically found at depths of over 200 m;
- Spawning and nursery grounds – habitat which is used by spawning or juvenile fish.

The three study areas are located in the ICES Celtic Sea Ecoregion, specifically sub-divisions VIa, VIIb, VIIc2, VIIk2 and VIIj2 (see Section 3.3.3.3 below), which are used in reference to stock assessments and management regulations implemented by the EU Commission. These ICES subdivisions are therefore used as the spatial reference for fish and shellfish species in sections 3.3.3.1 and 3.3.3.2 which describe the shelf-water and deep-water fish species of relevance.

#### *3.3.3.1 Shelf-Water Species*

Fish species distribution in shelf and coastal waters is generally determined by sediment type water temperature and water depth.

The sea areas in which the Project is located falls into the ICES Celtic Sea Ecoregion, which is used in reference to stock assessments and management regulations implemented by the EU Commission. The Celtic Sea ecoregion is therefore used as the spatial reference for fish and shellfish species in this section. Many shelf-water fish species which have conservation or commercial importance are present in the ICES Celtic Sea Ecoregion and therefore could occur in the three study areas. Shelf-water species are typically defined as being at depths of less than 200 m with some species being found over the shelf edge at approximately 250 m.

Many of the fish shelf-water species which are of commercial importance are pelagic (found in the water column).

Across the Irish continental shelf and slope, sediment type varies from sand with varying levels of coarse material to mud and sandy mud, becoming finer with depth (Section 3.2.3.1). The seabed of the Irish continental shelf supports several species of fish and shellfish, confirmation of which has been obtained from the ICES Celtic Seas Ecoregion report (ICES, 2018) as summarised below.

Soft sediments host *Nephrops* (the Norway lobster *Nephrops norvegicus)* which create and reside in burrows, emerging only to feed. In addition, scallop (Pectinidae sp.) are known to inhabit this region. The most abundant demersal shelf-water fish species in the ICES Celtic Sea ecoregion are haddock *Melanogramus aeglefinus*, whiting *Merlangius merlangus*, and pout *Trisopterus* spp. Also commonly found are dab *Limanda limanda*, plaice *Pleuronectes platessa*, monkfish (also called anglerfish *Lophius piscatorius*), European hake *Merluccius merluccius*, and several species of sole and megrim. Pelagic fish species which are recorded in the ICES Celtic Sea Ecoregion include herring *Clupea harengus*, boarfish *Capros aper*, blue whiting *Micromesistius poutassou*, mackerel *Scomber scombrus*, and horse mackerel *Trachurus trachurus*. Other species of note which are recorded in the shelf areas include species of elasmobranchs, cod *Gadus morhua*, and gurnard *Triglidae* sp. Cod, haddock and whiting are of conservation concern (ICES, 2018).

#### *3.3.3.2 Deep-Water Species*

In the meso-pelagic zone, between 200 m and 1,000 m water depth, the dominant deep-water fish species in the ICES Celtic Sea Ecoregion are Mueller's pearlside *Maurolicus muelleri*, glacial lantern fish *Benthosema glaciale*, and lancet fish (*Alepisauridae*) (ICES, 2018).

Priede *et al*. (2010) analysed the results of extensive sampling of demersal fish communities within the Porcupine Seabight area from otter trawls taken between 1977 and 2002 in order to investigate the demersal fish species richness within the region at different depths; this research is of relevance to the Porcupine Bank study area. Priede *et al.* (2010) reported over 70 species within the 500 - 1,500 m depth range and found that demersal species richness was highest between 800 m and 2,500 m water depth with a significant peak around 1,500 m depth.

Several species of deep-water sharks are present in the study areas and include the Portuguese dogfish *Centroscymnus coelolepis*, leafscale gulper shark *Centrophorus squamosus* and members of the spiny dogfish (Squalidae) family. Lesser known species may also be present including longnose velvet dogfish *Centroscymnus crepidater*, birdbeak dogfish *Deania calcea*, kitefin shark *Dalatias licha* and knifetooth dogfish *Scymnodon ringens* as well as other lanternshark and catshark species. Although observed in Irish waters, no basking sharks have been sighted within the study areas although tracked basking sharks have been recorded to both the north and south of the Goban Spur (DCENR, 2015).

Ocean sunfish *Mola mola* have been recorded over the Goban Spur in winter and summer. However, this species is not restricted to deep water and has also been recorded over the continental shelf closer to Ireland (Rogan *et al*., 2018). Likewise, blue sharks have been recorded in the summer months over the Goban Spur, however, their distribution appeared to favour areas to the North and East of Irish offshore waters. (Rogan *et al*., 2018).

Ten cephalopod species occur in the seas to the west of Ireland, the most abundant of which is the veined squid *Loligo forbesi* followed by the lesser flying squid *Todaropsis eblanae* and the broadtail shortfin squid *Illex coindetii*. The European common squid *Alloteuthis subulata* is also present. The veined squid primarily occur in inshore regions whilst the broadtail shortfin squid is more widespread in deeper waters and is more likely to occur in the deeper areas such as the Goban Spur (DCENR, 2015).

Several migratory species may be present in the Irish offshore waters. The diadromous Atlantic salmon *Salmo salar,* listed in the Annex II of the EU's Habitats Directive, migrate through Irish waters and travels northwards along the west coast of Ireland to reach Greenland and the Norwegian Sea. The trout *Salmo trutta* also goes to sea to feed but is primarily found in coastal waters. The European eel *Anguilla Anguilla* is present in the ICES Celtic Sea Ecoregion and is of conservation concern. The European eel spends the early stages of its life in estuaries, with most adults migrating across the Atlantic to the Sargasso Sea to mate and die. The species twaite shad *Alosa fallax*, the allis shad *Alosa alosa* and sea lamprey *Petromyzon marinus* are also

Annex II species under the Habitats Directive, but the shad migratory path and lamprey spawning activity is limited to coastal areas or specific times (lamprey typically spawn in June and July).

#### *3.3.3.3 Spawning and Nursery Grounds*

Spawning aggregation behaviour is a key factor which dictates the degree to which a species is dependent on a specific area and period of time for spawning, with inter- and intra-species spatial and temporal variation exhibited in spawning behaviour. The spawning and nursery periods for each species which may use the study areas for spawning or nursery habitat is shown in Table 3-1. The extent of spawning grounds and nursery grounds of fish and shellfish species which potentially use the habitats in the vicinity of the three study areas are shown in Figure 3-9 and Figure 3-10, respectively, according to Coull *et al* 1998 and Ellis *et al* 2012, which corresponds to the information provided by the Marine Institute (2009).

The spawning grounds for horse mackerel, mackerel, blue whiting and hake, which are all pelagic spawners (i.e. do not use the seabed) overlap to some degree with all three study areas. The spawning and nursery grounds of lemon sole does not overlap with any proposed borehole location, Cod, which is of conservation concern, spawns outside of the three study areas. Haddock, which is also of conservation concern, is shown to have a small spawning area within the Irish Bank study area, overlapping with one of the proposed borehole locations (Figure 3-9). Of the species reported to use the three study areas as spawning habitat, *Nephrops* and herring are dependent on the seabed and as such are understood to be more vulnerable to disturbance than pelagic spawning species. Potential *Nephrops* spawning and nursery grounds are primarily recorded to be within the Irish bank and the eastern part of the Porcupine bank study areas, overlapping directly with the proposed boreholes in the Irish Bank study area only. Herring shows no overlap of spawning grounds with the proposed borehole locations and low intensity nursery habitat use within the northern part of the Irish Shelf study area, overlapping with one of the proposed boreholes (Figure 3-9Figure 3-9, Figure 3-10).

The study areas are also used as nursery grounds by anglerfish, blue whiting, whiting, common skate *Dipturus sp.*, hake, ling, mackerel, mackerel, saithe and whiting, primarily within the Irish Shelf study area, the eastern edge of the Porcupine shelf study area and the north eastern corner of the Goban Spur study area (Figure 3-10). The proposed borehole locations within the Goban Spur study area overlap directly with no confirmed nursery habitats, and the proposed borehole locations within the Porcupine Bank study area overlap in a small number of locations with nursery habitat for anglerfish, common skate, hake and ling. (Ellis *et al,* 2012; Coull *et al*, 1998; Figure 3-10).

For mackerel, horse mackerel, hake, and blue whiting the potential spawning grounds which overlap with the proposed borehole locations are a small proportion of the overall spawning grounds recorded for these species. Furthermore, these species spawn by releasing eggs into the water column as mentioned above, and as such are thought to be less vulnerable to disturbance than species which are dependent on the seabed for spawning. In addition, the spawning seasons for blue whiting and hake finishes each year prior to August, and so the proposed Project timeline will not overlap spawning activity for those species. The spawning period of *Nephrops* co-occurs with the proposed Project timelines. Spawning for *Nephrops* is highly dependent on sediment type, with a preference for sediments composed of fine cohesive mud, which forms a low proportion of the sediment types in the three study areas. Furthermore, the spawning areas which have been mapped by Coull et al (1998) and Ellis *et al* (2012) represent the widest known distribution of spawning and nursery grounds based on current knowledge and survey data and should not be taken as rigid unchanging descriptions of presence or absence (Coull *et al*., 1998). In consideration of nursery habitat, the localised areas of proposed boreholes occupy a small proportion of the available nursery habitat for all species concerned.

Table 3-1: Spawning and nursery periods of fish and shellfish species which potentially use any of the three study areas (Coull et al, 1998; Ellis et al, 2020)

| Species | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anglerfish | N | N | N | S*N | S*N | S*N | N | N | N | N | N | N |
| Blue whiting | N | N | N | N | S*N | S*N | SN | N | N | N | N | N |
| Cod | N | N | N | N | N | N | N | N | N | N | N | N |
| Common skate | SN | S*N | S*N | SN | SN | SN | N | N | N | N | N | N |
| Hake | SN | S*N | S*N | SN | SN | SN | N | N | N | N | N | N |
| Herring | SN | SN | SN | N | N | N | N | N | N | N | N | N |
| Horse mackerel | N | N | SN | SN | S*N | S*N | SN | SN | N | N | N | N |
| Ling | N | N | N | N | N | N | N | N | N | N | N | N |
| Mackerel | N | N | SN | SN | S*N | S*N | SN | N | N | N | N | N |
| *Nephrops* | SN | SN | SN | S*N | S*N | S*N | SN | SN | SN | SN | SN | SN |
| Sprat | | | | | S* | S* | S | S | | | | |
| Spurdog | N | N | N | N | N | N | N | N | N | N | N | N |
| Whiting | N | N | N | N | N | N | N | N | N | N | N | N |
| S = Spawning, N = Nursery, SN = Spawning and Nursery; * = peak spawning | | | | | | | | | | | | |

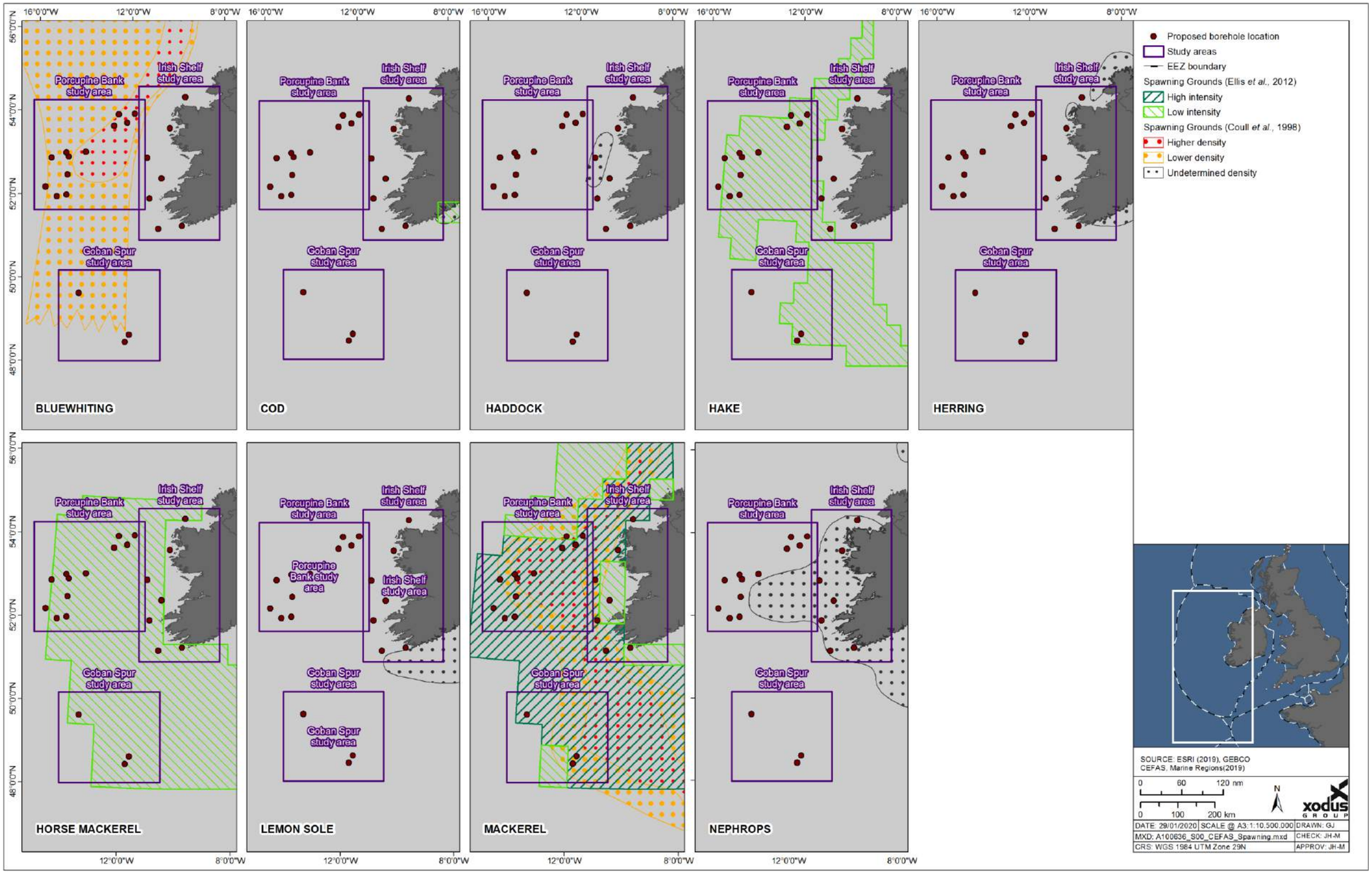


Figure 3-9: Potential spawning grounds of relevant fish and shellfish species according to Coull et al (1998) and Ellis et al (2012)

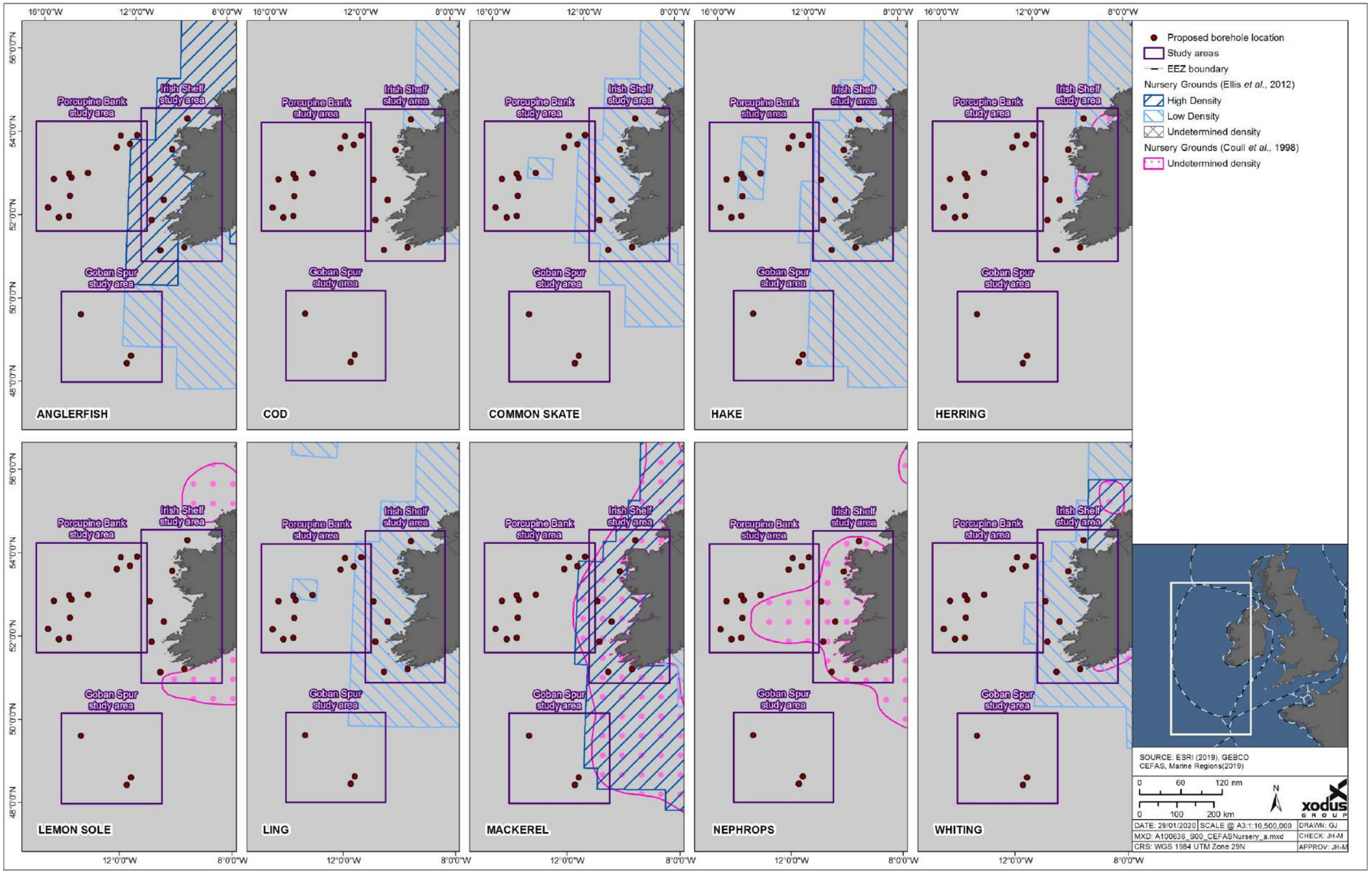


Figure 3-10: Potential nursery grounds of relevant fish and shellfish species according to Coull et al (1998) and Ellis et al (2012)

#### 3.3.3.4 Biologically Sensitive Area

The Marine Institute, working closely with DCENR and Industry, compiled information on the distribution and abundance of eggs and larvae, juvenile and adult fish in the waters around Ireland and presented these data to the EU Commission, showing the biological importance of waters around the south and western coasts of Ireland. In 2003 the EU Commission established a "Biologically Sensitive Area (BSA)" off the south west of Ireland in respect of the known nursery and spawning grounds of fish and shellfish species, establishing specific fishing effort regime inside the BSA and outside the BSA for demersal fishing vessels as well as scallop and crab fisheries.

### 3.3.4 Seabirds

The west coast of Ireland comprises a length of exposed and inaccessible cliffs which provide ideal breeding habitat for many seabird species which feed in the offshore waters to the west of Ireland. Petrels, shearwaters, skuas, gannets, gulls and auks predominate in the offshore waters west of Ireland. The seasonal distribution of seabirds is shown in Figure 3-12.

Petrels and shearwater species are the most pelagic seabird species and spend weeks to months at sea covering vast distances. In the Porcupine Seabight area the dominant species are the northern fulmar *Fulmarus glacialis*, European storm petrel *Hydrobates pelagicus*, Leech's storm petrel *Oceanodroma leucorhoa*, great shearwater *Ardenna gravis*, Manx shearwater *Puffinus puffinus* and sooty shearwater *Puffinus griseus*. Rarer species include Wilson's storm petrel *Oceanites oceanicus* and Cory's shearwater *Calonectris diomedea*. Northern fulmars are present in Ireland all year round whilst the others are seasonal visitors as shown in Table 3-2. Wilson's storm petrels are likely to be observed along the shelf break between May and September (Table 3-2). Great shearwaters are likely to be sighted offshore in summer. Manx shearwater and sooty shearwater *Puffinus griseus* do occur in offshore waters, particularly around the Rockall Trough and Porcupine Bank areas (DCENR, 2015).

The great skua *Catharacta skua* is the most widely distributed skua species off the coast of Ireland, particularly on the continental shelf. It is most abundant in spring and summer in the Porcupine Bank area. The pomarine skua *Stercorarius pomarinus* has a migratory route along the west coast of Ireland, where it seems to loosely follow the shelf break (DCENR, 2015). The rarer long-tailed skua *S. longicaudus,* another migrant species, is the most pelagic of the skua species and rarely approaches coastal areas during migration. It is the least numerous of the seabird species in the region but is likely to be present sporadically in any of the three study areas.

Northern gannets *Morus bassanus* use the shelf edge and continental shelf off the west coast of Ireland to forage.

Gulls are typically coastal species but some travel further offshore in association with fishing vessels. They are unlikely to be observed in the study area in high numbers. The herring gull *L. argentatus* is sporadically observed in offshore waters. The black legged-kittiwake *Rissa tridactyla* is likely to be the most abundant of all the gulls in the study areas (DCENR, 2015).

Terns are summer visitors to Ireland where they breed. Arctic tern *Sterna paradisaea* is the most pelagic of the tern species recorded around Ireland, but those observed so far offshore are likely to be non-breeders. Four auk species occur in Irish waters; common guillemot *Uria aalge*, razorbill *Alca torda* Atlantic puffin *Fratercula arctica* and black guillemot *Cepphus grille*. The Atlantic puffin is the most oceanic of the auks and occurs in the Porcupine Seabight and in the Porcupine Bank north of the Goban Spur (DCENR, 2015).

The ObSERVE programme, developed and funded by the Irish Government, included a large-scale aerial observation survey for seabirds and cetaceans conducted in the summers of 2015 and 2016 and the winters of 2015-2016 and 2016-2017. The survey effort was split into eight areas or "strata" (Figure 3-11 and Figure 3-12; see Section 3.3.5.1 for clearer map of the strata); the three study areas are located in Strata 1, 2, 3, 4, 6, 7 and 8. The survey effort and results are reported in Rogan *et al*. (2018). Analysis of the seabird survey data produced density and abundance estimates for several seabird species and species groups (where identification to species level was not possible).

Total recorded seabird density (including combined-year data from all species recorded) in Strata 1, 2, 3, 4, 6, 7 and 8 during summer was highest in waters close to the coast and also on the Porcupine Bank (Figure 3-11). During winter the area nearest the coast was less important, with abundance remaining high on the Porcupine Bank (Figure 3-12).

The combined-year density and abundance estimates for summer and winter in Strata 1, 2, 3, 4, 6, 7 and 8 produced using the design-based method (which generally gave slightly higher results and can therefore be considered worst-case) are presented in Table 3-3 and Table 3-4.

The most abundant species recorded in Strata 1, 2, 3, 4, 6, 7 and 8 were northern fulmar, followed by manx shearwater, black legged kittiwake and northern gannet. Gannets and manx shearwaters were present in noticeably higher numbers during summer, whilst northern fulmar and black-legged kittiwakes were most abundant during winter.

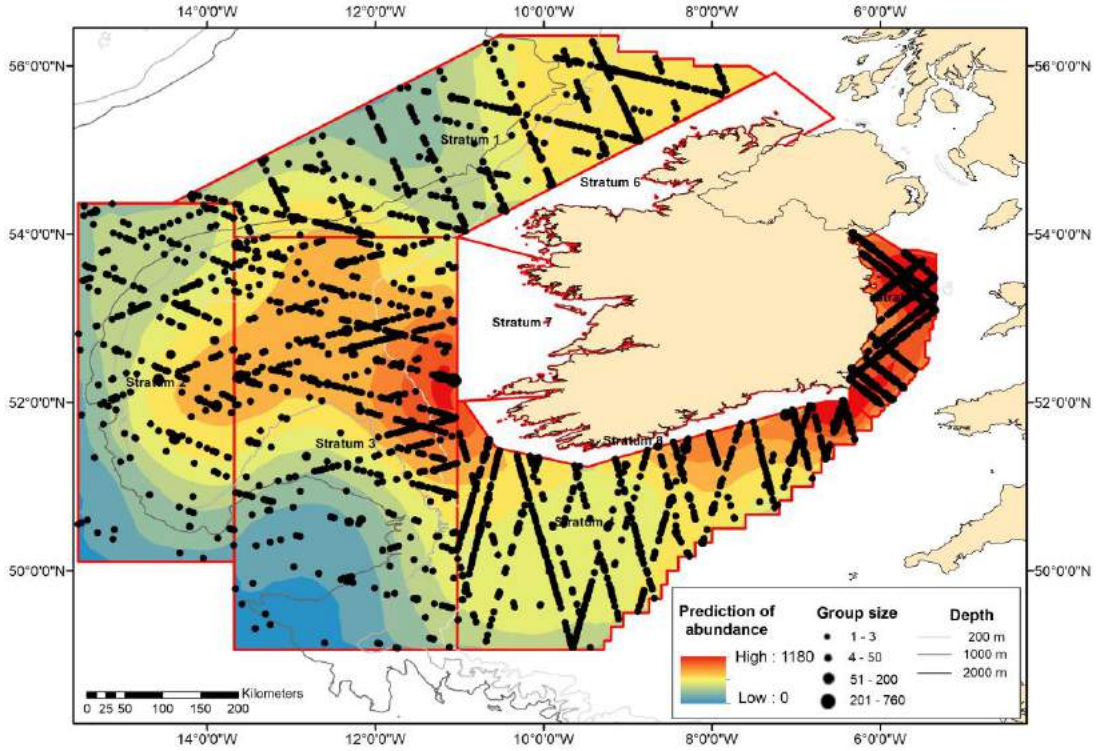


Figure 3-11 Total summer seabird density (Rogan *et al.*, 2018)

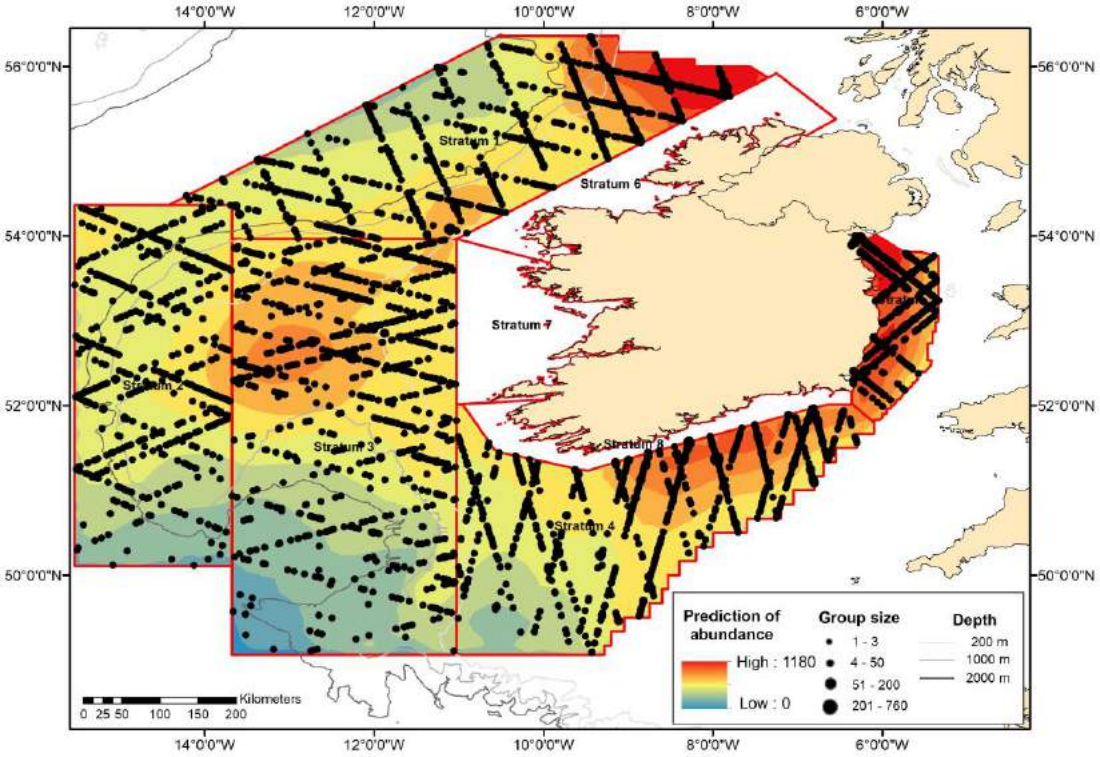


Figure 3-12 Total winter seabird density (Rogan *et al.*, 2018)

Table 3-2 Seasonal presence of seabirds in the vicinity of the study areas (DCENR, 2015)

| Species | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northern fulmar | | | | | | | | | | | | |
| Wilson's storm petrel | | | | | | | | | | | | |
| European storm petrel | | | | | | | | | | | | |
| Great shearwater | | | | | | | | | | | | |
| Manx shearwater | | | | | | | | | | | | |
| Sooty shearwater | | | | | | | | | | | | |
| Cory's shearwater | | | | | | | | | | | | |
| Northern gannet | | | | | | | | | | | | |
| Great cormorant | | | | | | | | | | | | |
| European shag | | | | | | | | | | | | |
| Great skua | | | | | | | | | | | | |
| Pomarine skua | | | | | | | | | | | | |
| Arctic skua | | | | | | | | | | | | |
| Long tailed skua | | | | | | | | | | | | |
| Herring gull | | | | | | | | | | | | |
| Lesser black-backed gull | | | | | | | | | | | | |
| Greater black-backed gull | | | | | | | | | | | | |
| Black-legged kittiwake | | | | | | | | | | | | |
| Sabine's gull | | | | | | | | | | | | |
| Black-headed gull | | | | | | | | | | | | |
| Mew gull | | | | | | | | | | | | |
| Common tern | | | | | | | | | | | | |
| Arctic tern | | | | | | | | | | | | |
| Roseate tern | | | | | | | | | | | | |
| Sandwich tern | Summer visitor to Ireland. Breeds in coastal and inland locations. Most birds arrive in May and concentrations are recorded close to their breeding areas, especially in the Irish Sea. | | | | | | | | | | | |
| Littler tern | Low abundance in Ireland. Highest concentrations in the IOSEA 5 area are in Wexford and Wicklow, but with breeding colonies on the western coast of Ireland at Tralee Bay and Inishkea. | | | | | | | | | | | |
| Common guillemot | | | | | | | | | | | | |
| Razorbill | | | | | | | | | | | | |
| Atlantic puffin | | | | | | | | | | | | |
| Black guillemot | | | | | | | | | | | | |

Blue shading = presence; grey shading = absence

Table 3-3 Estimated seabird density in the relative study areas (Rogan *et al.*, 2018)

| Species* | Density Stratum 1 | | Density Stratum 2 | | Density Stratum 3 | | Density Stratum 4 | | Density Stratum 6 | | Density Stratum 7 | | Density Stratum 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | W | S | W | S | W | S | W | S | W | S | W | S | W |
| Northern gannet | 0.3386 | 0.0380 | 0.0570 | 0.0030 | 0.2121 | 0.0801 | 0.3067 | 0.1659 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Great cormorants & European shags | There were insufficient sightings to generate reliable densities or abundance estimates for this species. | | | | | | | | | | | | | |
| Northern fulmar | 0.1763 | 1.0739 | 0.1733 | 0.5568 | 0.4412 | 0.7314 | 0.1152 | 0.4462 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Great skua | There were insufficient sightings to generate reliable densities or abundance estimates for this species. | | | | | | | | | | | | | |
| Herring & common gull | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0076 | 0.0000 | 0.0158 | 0.0023 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Greater & lesser black backed gulls | 0.0017 | 0.0040 | 0.0008 | 0.0000 | 0.0225 | 0.0030 | 0.0067 | 0.0277 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Black-legged kittiwake | 0.0297 | 0.9751 | 0.0198 | 0.0873 | 0.0175 | 0.1523 | 0.0297 | 0.3437 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Unidentified small gull species | 0.009 | 0.0016 | 0.008 | 0.000 | 0.0013 | 0.0009 | 0.0012 | 0.0028 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Unidentified large gull species | 0.000 | 0.0032 | 0.0008 | 0.000 | 0.0004 | 0.0013 | 0.0055 | 0.1274 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| All gull species (functional group analysis) | 0.0323 | 0.9838 | 0.0220 | 0.0873 | 0.0422 | 0.1575 | 0.0467 | 0.5040 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |

| Species* | Density Stratum 1 | | Density Stratum 2 | | Density Stratum 3 | | Density Stratum 4 | | Density Stratum 6 | | Density Stratum 7 | | Density Stratum 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | W | S | W | S | W | S | W | S | W | S | W | S | W |
| Manx shearwater | 0.0667 | 0.000 | 0.0652 | 0.0006 | 0.7180 | 0.0025 | 0.6056 | 0.0018 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Cory's shearwater | There were insufficient sightings to generate reliable densities or abundance estimates for this species. | | | | | | | | | | | | | |
| Great shearwater | There were insufficient sightings to generate reliable densities or abundance estimates for this species. | | | | | | | | | | | | | |
| Sooty shearwater | There were insufficient sightings to generate reliable densities or abundance estimates for this species. | | | | | | | | | | | | | |
| Petrel species (likely Leach's and European Storm petrel) | 0.1501 | 0.0047 | 0.0289 | 0.0030 | 0.0773 | 0.0108 | 0.2528 | 0.0034 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Auk species (razorbills, guillemots & Atlantic puffins) | 0.0062 | 0.2916 | 0.000 | 0.0104 | 0.0011 | 0.0298 | 0.1308 | 0.4713 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Tern species (Arctic, common, roseate, sandwich, & little tern) | 0.0157 | 0.000 | 0.0046 | 0.0008 | 0.0022 | 0.000 | 0.0048 | 0.000 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| **Total seabird density** | **0.8071** | **2.3922** | **0.4683** | **0.651** | **1.673** | **1.0123** | **1.6088** | **1.4922** | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |

*Note: Total density of animals (animals/km$^2$). Key: S = Summer and W = Winter

Table 3-4: Estimated seabird abundance in the relative study areas (Rogan et al., 2018)

| Species* | Abundance (Stratum 1) | | Abundance (Stratum 2) | | Abundance (Stratum 3) | | Abundance (Stratum 4) | | Abundance (Stratum 6) | | Abundance (Stratum 7) | | Abundance (Stratum 8) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | W | S | W | S | W | S | W | S | W | S | W | S | W |
| Northern gannet | 20,686 | 2,319 | 3,406 | 180 | 21,822 | 8,238 | 19,205 | 10,390 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Great cormorants & European shags | There were 14 observations of a total of 36 individuals. All sightings were coastal and occurred in the Irish Sea, the only stratum that had transects adjoining the coast. There were comparatively more sightings in winter than summer There were insufficient sightings to generate any abundance estimates for the study areas. | | | | | | | | | | | | | |
| Northern fulmar | 10,770 | 65,617 | 10,354 | 33,263 | 45,400 | 75,256 | 7,212 | 27,942 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Great skua | There were 30 sightings of 31 individuals. Sightings were evenly distributed across both summer and winter surveys in both replicate years, and all occurred over continental shelf waters. There were insufficient sightings to generate any abundance estimates for the study areas. | | | | | | | | | | | | | |
| Herring & common gull | 0 | 0 | 0 | 0 | 786 | 0 | 987 | 142 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Greater & lesser black backed gulls | 107 | 242 | 45 | 0 | 2,312 | 312 | 418 | 1,737 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Black-legged kittiwake | 1,813 | 59,577 | 1,181 | 5,214 | 1,803 | 15,675 | 8,149 | 21,524 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Unidentified small gull species | 53 | 97 | 45 | 0 | 139 | 89 | 76 | 177 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |

| Species* | Abundance (Stratum 1) | | Abundance (Stratum 2) | | Abundance (Stratum 3) | | Abundance (Stratum 4) | | Abundance (Stratum 6) | | Abundance (Stratum 7) | | Abundance (Stratum 8) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | W | S | W | S | W | S | W | S | W | S | W | S | W |
| Unidentified large gull species | 0 | 193 | 45 | 0 | 46 | 134 | 342 | 7,978 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| All gull species (functional group analysis) | 1,973 | 60,109 | 1,317 | 5,214 | 4,346 | 16,209 | 2,923 | 31,559 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Manx shearwater | 4,077 | 0 | 3,894 | 37 | 73,880 | 259 | 37,920 | 112 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Cory's shearwater | There were five sightings comprising a total of six individual Cory's shearwaters, all occurring in the first summer survey. Three sightings were in the coastal waters of the Irish Sea, while two sightings were in the deeper offshore waters of the Porcupine basin. There were insufficient sightings to generate any abundance estimates for the study areas. | | | | | | | | | | | | | |
| Great shearwater | There was a single sighting of a Great shearwater occurring in summer 2016 and over the deep waters of the Porcupine Basin. There were insufficient sightings to generate any abundance estimates for the study areas. | | | | | | | | | | | | | |
| Sooty shearwater | There were six sightings that comprised a total of seven Sooty shearwaters. All sightings occurred in the second year of surveys, with five sightings in summer and one sighting in winter. There were insufficient sightings to generate any abundance estimates for the study areas. | | | | | | | | | | | | | |
| Petrel species (likely Leach's & European Storm petrel) | 9,170 | 290 | 1,726 | 180 | 7,952 | 1,113 | 15,827 | 213 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |

| Species* | Abundance (Stratum 1) | | Abundance (Stratum 2) | | Abundance (Stratum 3) | | Abundance (Stratum 4) | | Abundance (Stratum 6) | | Abundance (Stratum 7) | | Abundance (Stratum 8) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | W | S | W | S | W | S | W | S | W | S | W | S | W |
| Auk species (razorbills, guillemots & Atlantic puffins) | 381 | 17,816 | 0 | 622 | 117 | 3,070 | 8,188 | 29,510 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| Tern species (Arctic, common, roseate, sandwich & little tern) | 960 | 0 | 272 | 45 | 231 | 0 | 304 | 0 | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |
| **Total seabird abundance** | **49,317** | **146,165** | **22,974** | **39,736** | **168,471** | **104,157** | **100,734** | **93,435** | Insufficient Sightings | | Insufficient Sightings | | Insufficient Sightings | |

*Note: Total abundance of animals. Key: S = Summer and W = Winter

## 3.3.5 Marine Mammals

### *3.3.5.1 Cetaceans*

This section includes data drawn from the ObSERVE programme aerial survey report (Rogan *et al*., 2018), as well as older sources (DECNR, 2007; DECNR, 2015; Hammond *et al*., 2004; Reid *et al*., 2003; Wall *et al*., 2013; Berrow *et al*., 2010 and O'Cadhla *et al*., 2004), and a desktop review (ERM and CMRC, 2014) and field study using passive acoustic autonomous recorders (McCauley, 2015) both commissioned by Woodside.

Twenty-four species of cetaceans have been recorded in Irish waters, covering shallow coastal waters to deeper open ocean, nineteen of which have been sighted in the three study areas (Table 3-5). The continental shelf is generally more productive due to the nutrient upwelling that provides food for plankton and where higher densities of fish are found.

A number of species breed in Irish waters, including harbour porpoise *Phocoena phocoena*, common dolphin *Delphinus delphis*, bottlenose dolphin *Tursiops truncatus*, Risso's dolphin *Grampus griseus*, white-sided dolphin *Lagenorhynchus acutus*, white-beaked dolphin *Lagenorhynchus albirostris*, pilot whale *Globicephala melas,* and possibly northern bottlenose dolphin and minke whale (Reid *et al*., 2003). However, the location and extent of breeding grounds is unknown. There have been sporadic sightings of Cuvier's beaked whale *Ziphius cavirostris,* humpback whale *Megaptera novaeangliae* and northern right whale *Eubalaena glacialis* in the region (DCENR, 2017*).*

There are also records of deep-diving species such as beaked-whales in areas of complex bathymetry such as the canyon systems fringing the Porcupine basin and Goban Spur (Wall *et al*., 2013, Rogan *et al*., 2018).

The findings of various studies relative to the three study areas are summarised in Table 3-5. Table 3-5 also shows the densities in each study area, where data are available, using Rogan *et al* (2018). Densities are for the summer months for the most relevant strata used by Rogan et al (2018); see Figure 3.13:

- Porcupine Bank study area: Strata 1, 2 and 3;
- Irish Shelf study area: Strata 4, 6, 7 and 8;
- Goban Spur study area: Strata 3.

**Table 3-5 Description of occurrence of cetaceans in the vicinity of the study areas (DECNR, 2007; DECNR, 2015; Hammond *et al*., 2004; Reid *et al*., 2003; Wall *et al*., 2013; Berrow *et al*., 2010; O'Cadhla *et al*., 2004; Rogan, *et al*., 2018)**

| Species | Distribution | Seasonality |
|---|---|---|
| **Atlantic white-sided dolphin** ***Lagenorhyncus acutus*** | Mostly confined to the North Atlantic but have been observed in the North Sea in a number of surveys, particularly in the western part of the North Sea. Their presence is seasonal and peaks between May and September. They are usually observed in groups of tens to hundreds, sometimes up to 1,000 offshore, forming subgroups of 2-15 individuals. DCENR (2007) report that Atlantic white-sided dolphin occur along the edges of the continental shelf at depths of 100-500 m, and generally does not occur in coastal waters. O'Cadhla *et al*. (2004) have records of sightings during summer months all along the Irish Atlantic margin with one sighting in the Porcupine region. Densities at the project study areas are:<br>• Porcupine Bank study area - 0.001 to 0.025 individuals/km$^2$<br>• Irish Shelf study area – 0 individuals/km$^2$<br>• Goban Spur study area - 0.039 individuals/km$^2$ | Present all year, with peaks of sightings in summer and autumn around the south-west coast of Ireland |

| Species | Distribution | Seasonality |
|---|---|---|
| | (Rogan *et al*., 2018). | |
| **Blue whale** ***Balaenoptera musculus*** | Blue whales occur in deep water, between 100 and 1,000 m water depth, although in some regions they have been recorded in shallower waters of less than 200 m. O'Cadhla *et al*. (2004) have recorded a single individual sighting in the north of the Porcupine Basin in May. They also report previous acoustic records using military sonar systems, and previous sparse sightings in the Irish Atlantic Margin. | Recent acoustic surveys have shown that deep-water individuals may occur between October and January, while previous sighting records suggest that they occur between July and September. |
| **Bottlenose dolphin** ***Tursiops truncatus*** | Bottlenose dolphins are the third most frequently recorded species in Irish waters (Berrow *et al.,* 2010). There is increasing evidence to suggest that an offshore ecotype of bottlenose dolphin exists in Irish waters (Wall *et al*., 2013), and during spring/summer months (April-August), and again in high numbers in November by O'Cadhla *et al*. (2004). This species has been recorded in the wider region all year round predominantly in the shelf break, and waters to the south and south-west of Ireland and further offshore in deep North Atlantic waters. Off the west coast of Ireland, the Shannon Estuary is also home to at least one resident bottlenose dolphin population year-round (DCENR, 2007). Densities at the project study areas are:<br>• Porcupine Bank study area - 0.153 to 0.295 individuals/km$^2$<br>• Irish Shelf study area - 0.157 to 1.161 individuals/km$^2$<br>• Goban Spur study area - 0.295 individuals/km$^2$<br>(Rogan *et al*., 2018). | Present all year, with peaks of sightings in May. |
| **Common dolphin** ***Delphinus delphinus*** | Common dolphin, also known as the short beaked common dolphin, are the second most frequently recorded cetaceans in Irish waters (Reid *et al*., 2003). They have been observed over deeper waters across the continental shelf but rarely in water depths exceeding 200 m (Reid *et al.,* 2003). Although the biggest concentrations in Ireland are over the continental shelf and in deeper waters, individuals are frequently observed in shallow inshore waters off the south and south-west coasts and around the Aran Islands (IWDG, 2017). There is evidence of a strong inshore winter peak in numbers along the south coast, possibly associated with movements of sprat (IWDG, 2015). They have been reported in high abundances around the edges of the Porcupine Basin and in the wider region year-round, with sightings being made in coastal waters, along the continental slope, as well as over deeper areas (DCENR, 2007). Densities at the project study areas are:<br>• Porcupine Bank study area - 0.048 to 0.417 individuals/km$^2$<br>• Irish Shelf study area- 0 to 0.257 individuals/km$^2$<br>• Goban Spur study area - 0.257 individuals/km$^2$ | Present all year, with peaks of sightings in summer around the south-west coast of Ireland. |

| Species | Distribution | Seasonality |
|---|---|---|
| | (Rogan *et al*., 2018) | |
| **Cuvier's beaked whale** ***Ziphius cavirostris*** | While the edge of the entire continental shelf is considered important, an area of high importance on the northern edge of the Porcupine Bank and into the Rockall Trough, and the Porcupine Seabight are predicted to have the highest densities of beaked whales. Densities in the study areas are:<br>• Porcupine Bank study area - 0.0005 to 0.0039 individuals/km$^2$<br>• Irish Shelf study area - 0 individuals/km$^2$<br>• Goban Spur study area - 0.0005 individuals/km$^2$<br>(Rogan *et al*., 2018) | The majority of sightings reported in Rogan *et al*. (2018) occurred during winter months. |
| **False killer whale** ***Pseudorca crassidens*** | O'Cadhla *et al*. (2004) reported false killer whale sightings in the southern region of the Porcupine Basin and Goban Spur between June and November. A single sighting of this species was made in the northern limits of the Rockhall trough in the winter of 2016 (Rogan *et al*. 2018) | Most sightings recorded by O'Cadhla *et al*. (2004) were between July and September. |
| **Fin whale** ***Balaenoptera physalus*** | Fin whales are seasonally abundant in shelf edge waters off the coast of Ireland however, the species tend to prefer the deep waters beyond the edge of the continental shelf (Reid *et al*., 2003). The annual movements of fin whale remain largely unknown, although sightings have been made throughout the Irish Atlantic Margin. Wall *et al*. (2013) shows that fin whales appeared to be largely absent from Irish shelf waters during the winter and early spring, though a few animals remained foraging in inshore waters off the south-east coast during the early winter. Fin whale abundance and distribution increased in the waters of the Irish shelf slopes in late summer and autumn (Wall *et al*., 2013). Densities in the study areas are:<br>• Porcupine Bank study area - 0.001 individuals/km$^2$<br>• Irish Shelf study area - 0 individuals/km$^2$<br>• Goban Spur study area - 0 individuals/km$^2$<br>(Rogan *et al*., 2018) | The majority of sightings recorded by Rogan *et al*. (2018) occurred in winter however, occasional sightings were made over the Porcupine Bank and Goban spur during the summer months. |
| **Harbour porpoise** ***Phocoena phocoena*** | The harbour porpoise is a predominantly coastal species. They typically occur in the European continental shelf in waters up to 200 km from the coast (DCENR, 2007). Although these are the smallest cetaceans in Irish waters, they are abundant and widespread. The majority of sightings in the area occur over the continental shelf. Densities in the study areas are:<br>• Porcupine Bank study area - 0.009 to 0.053 individuals/km$^2$<br>• Irish Shelf study area - 0.009 to 0.208 individuals/km$^2$<br>• Goban Spur study area – 0.009 to 0.049 individuals/km$^2$<br>(Rogan *et al*., 2018) | Most sightings occur in summer (Rogan *et al*. (2018). |

| Species | Distribution | Seasonality |
|---|---|---|
| **Humpback whale** ***Megaptera novaeangliae*** | Humpback whale sightings are relatively uncommon in the waters off the west coast of Ireland, and most of them have been observed during summer months. However, they appear to use the offshore waters of the British Isles as a migration corridor between November and March, including the Atlantic margin region of Ireland. Two sighting were recorded over the shelf margin by Rogan *et al*. (2018) during the winter 2015-2016 survey. | Most older records occurred in summer months; the two Rogan *et al*. (2018) sighting occurred in winter. |
| **Killer whale** ***Orcinus orca*** | Killer whales have been reported to be present in the region year-round, predominantly to the west and south of Ireland, as well as in the Irish Atlantic Margin between spring and autumn (DCENR, 2007), however Rogan *et al*. (2018) recorded only three sightings of this species, two in winter and one in summer, over the two years of aerial survey effort and were located on the continental shelf east of the Rockall Trough. | Not expected to occur regularly in any season. |
| **Minke whale** ***Balaenoptera acutorostrata*** | Minke whales are the smallest and most frequently sighted and stranded baleen whale in Irish waters (Berrow *et al*., 2010). Rogan *et al*. (2018) reports that minke whales' favour the coastal waters off the southwest of Ireland during summer. They appear to move away from the coast during winter and increase their use of the continental shelf and shelf edge to the east of the proposed well location. Densities in the study areas are:<br>• Porcupine Bank study area - 0.009 to 0.032 individuals/km$^2$<br>• Irish Shelf study area- 0 to 0.236 individuals/km$^2$<br>• Goban Spur study area – 0.009 individuals/km$^2$<br>(Rogan *et al*., 2018) | Favour southwestern Irish coastal waters during summer, dispersing offshore during winter (Rogan *et al*., 2018). |
| **Northern bottlenose whale** ***Hyperoodon ampullatus*** | Northern bottlenose whales are a deep-diving species typically found offshore in waters deeper than 1,000 m. It is believed that this species migrates north in spring and south in autumn (DCENR, 2007). Berrow *et al*. (2010) reported sightings within the Porcupine seabight, and Rogan *et al*. (2018) recorded one sighting at the southern margin of the Porcupine seabight. A further two sightings were made by Rogan *et al*. (2018) in the Rockall Basin. Densities in the study areas are:<br>• Porcupine Bank study area - 0.009 to 0.025 individuals/km$^2$<br>• Irish Shelf study area- 0 individuals/km$^2$<br>• Goban Spur study area – 0.009 individuals/km$^2$<br>(Rogan *et al*., 2018) | All three records in Rogan *et al*. (2018) were from winter surveys. |
| **Pilot whale** ***Globicephala melas*** | Pilot whales, also known as long-finned pilot whales, are predominantly found over the continental shelf and in coastal areas. It is thought that this species is present year-round in the wider Porcupine Basin (DCENR, 2007). Wall *et al*. (2013) noted that high relative abundances of pilot whales are recorded in the vicinity of deep-water | There was no apparent change in seasonal distribution recorded in Rogan *et al*. (2018). |

| Species | Distribution | Seasonality |
|---|---|---|
| | bathymetric features such as sea mounts. The highest concentrations in the area are found over the Rockall Trough and Goban Spur (Rogan *et al*., 2018). Densities in the study areas are:<br>• Porcupine Bank study area - 0.015 to 0.027 individuals/km$^2$<br>• Irish Shelf study area - 0 individuals/km$^2$<br>• Goban Spur study area – 0.015 individuals/km$^2$<br>(Rogan *et al*., 2018) | |
| **Risso's dolphin** ***Grampus griseus*** | Records from Rogan *et al*. (2018) indicate this species is more common away from the coast but over the continental shelf rather than in very deep water. Some reports indicate this species is present year-round in the wider Porcupine Basin (DCENR, 2007), however Rogan *et al*., (2018) only recorded sightings within the Porcupine seabight during the winter 2015-2016 survey. No sightings were made over the Goban Spur. Densities in the study areas are:<br>• Porcupine Bank study area - 0 to 0.012 individuals/km$^2$<br>• Irish Shelf study area - 0 to 0.057 individuals/km$^2$<br>• Goban Spur study area - 0 individuals/km$^2$<br>(Rogan *et al*., 2018) | Although no sightings were made over the Goban Spur all sightings recorded in the vicinity of the proposed well by Rogan *et al*. (2018) were during the winter months. |
| **Sei whale** ***Balaenoptera borealis*** | It is thought that sei whale *Balaenoptera borealis* migrate through Irish waters in spring, before returning southward in autumn and winter. Subsequently, sei whale sightings have been made in offshore west of Ireland throughout the year (DCENR, 2007). Over the Goban Spur Rogan *et al*. (2018) recorded two potential sei whales' sightings during the summer 2015 survey and one sighting during the winter 2016. Rogan *et al*. (2018) recorded a further Sei whale sighting on the northern limits of the Porcupine bank during the winter 2016 survey. | DCENR (2007) indicates presence offshore in the west of Ireland throughout the year. |
| **Sowerby's beaked whale** ***Mesoplodon bidens*** | Although there are very few confirmed sightings of live Sowerby's beaked whale, strandings have occurred along the west coast of Ireland. It is thought that this species may occur year-round in the Irish Atlantic Margin (DCENR, 2007). Rogan *et al*. (2018) recorded three sightings, of which two were over or on the Rockall Trough shelf edge, and one was over the northern shelf edge of the Porcupine seabight. | Rogan *et al*. (2018) recorded sightings in winter and summer, although total sightings were very low. |
| **Sperm whale** ***Physeter macrocephalus*** | Sperm whales are common in deep-waters offshore Ireland (DCENR, 2007; 2015). While sightings and landings records show them to be most abundant during summer and autumn, stranding records suggest males may be present all year round (DCENR, 2007). Rogan *et al*. (2018) recorded sightings in the vicinity of the Goban Spur during the summer months, Rockall Trough during both summer and winter months, and the western limit of the Porcupine Bank during the winter months. | Sightings occur in all seasons, but more commonly in summer (Rogan *et al*., 2018). |

| Species | Distribution | Seasonality |
|---|---|---|
| **Striped dolphin** ***Stenella coeruleoalba*** | Striped dolphin tend to reside beyond the continental shelf in depths of greater than 1,000 m. However, specimens occasionally occur over the shelf into waters with depths of less than 60 m. O'Cadhla *et al*. (2004) recorded sightings of this species along the Irish Atlantic Margin in summer and early autumn. Rogan *et al*. (2018) only recorded two confirmed sightings of striped dolphin, both of which were off the continental shelf to the west of the Porcupine Bank. Rogan *et al*. (2018) acknowledged difficulties in differentiating striped and common dolphins. Densities in the study areas are:<br>• Porcupine Bank study area - 0.048 to 0.417 individuals/km$^2$<br>• Irish Shelf study area - 0 to 0.257 individuals/km$^2$<br>• Goban Spur study area – 0.257 individuals/km$^2$<br>(Rogan *et al*., 2018) | Both records in Rogan *et al*. (2018) were from the winter 2015-2016 survey. |
| **White-beaked dolphin** ***Lagenorhynchus albirostris*** | White-beaked dolphins occur widely over the northern European continental shelf with more frequent records in the western sector of the northern and central North Sea across to western Scotland and south to western Ireland. Although it has been recorded in the UK continental shelf all year-round, there are higher numbers of records between June and October (Reid *et al*., 2003). There are records of white-beaked dolphins between June and November in the IOSEA2 area (Wall *et al*., 2013). Rogan *et al*. (2018) recorded most sightings over the Porcupine Bank and the shelf edge to the west. A number of sightings occurred in the southeast corner of the Porcupine Seabight, others occurred over the shelf closer to the west Irish coast and one sighting occurred over the Goban Spur. Densities in the study areas are:<br>• Porcupine Bank study area - 0.016 to 0.039 individuals/km$^2$<br>• Irish Shelf study area – 0 individuals/km$^2$<br>• Goban Spur study area – 0.039 individuals/km$^2$<br>(Rogan *et al*., 2018) | Sightings occur in all seasons, but more commonly in summer (Rogan *et al*., 2018). |

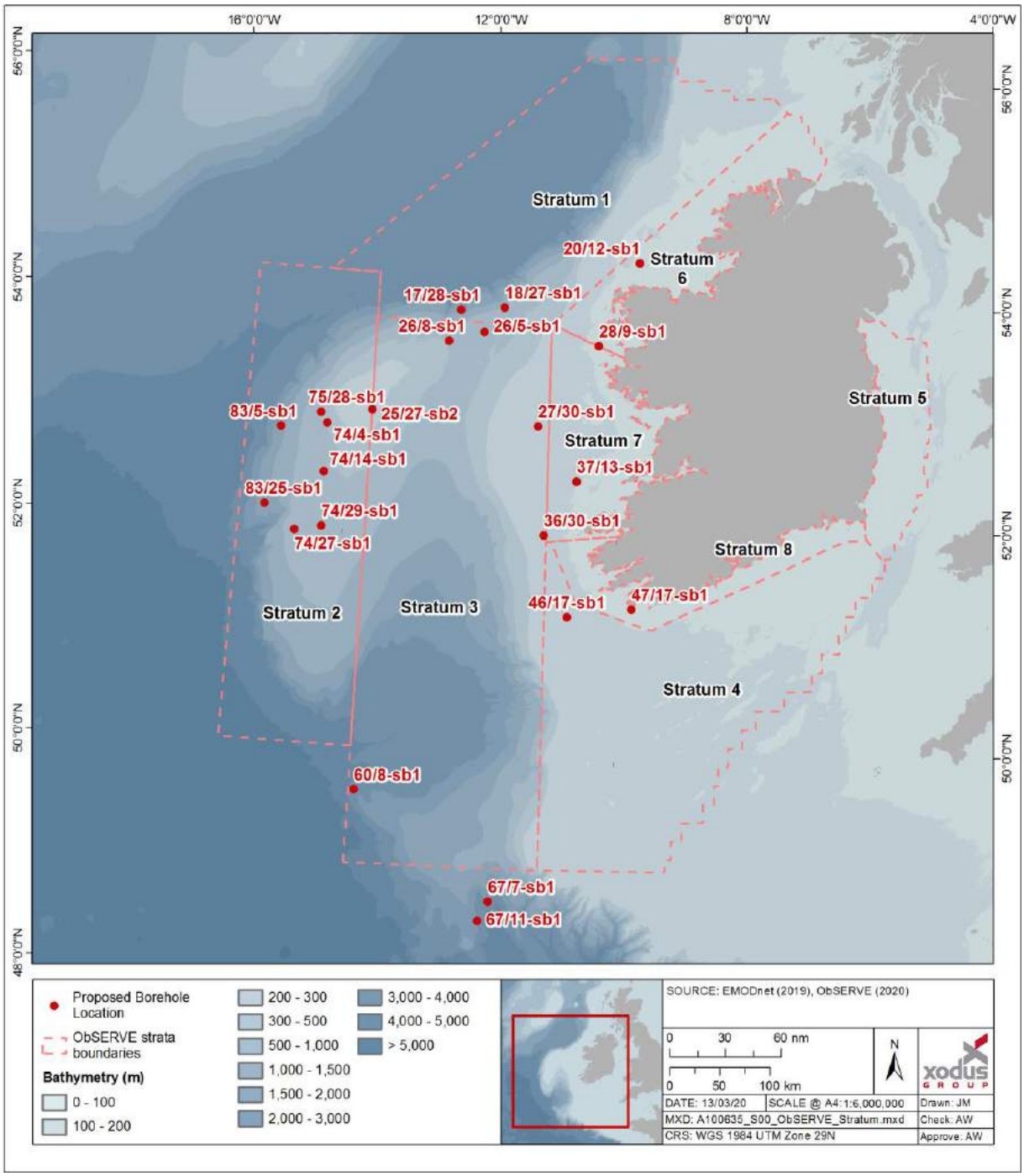


Figure 3-13 Strata used by the ObSERVE programme

### *3.3.5.2 Pinnipeds*

Harbour seals *Phoca vitulina* and grey seals *Halichoerus grypus* are common in Irish waters, although they tend to be concentrated in coastal and nearshore waters. Both species have established terrestrial haul-out sites along all coastlines of Ireland, which they leave when foraging and to which they return to rest during the moulting and breeding season. Outwith the breeding and moulting periods, studies in the UK have shown that both harbour and grey seals will travel significant distances from their colonies. For harbour seals some have

been known to make foraging trips of more than 200 km from their colonies (Sharples *et al*., 2012) and grey seals several hundreds of kilometres from one haul-out site to another. Sightings of pinnipeds reported in Rogan *et al*. (2018) are mostly either coastal or over the continental shelf within 100 km from the coast; however, one individual was recorded over the Porcupine bank, approximately 200 km from shore. Although data gaps exist with regards to seal behaviour offshore (DCENR, 2007), given the distances which they are known to travel, harbour and grey seals may occur at some of the borehole locations, especially those in the Irish Shelf study area and those in the northeastern part of the Porcupine Bank study area, both travelling through and foraging.

#### *3.3.5.3 European Otter*

The European otter *Lutra lutra* is listed in Habitats Directive Annexes II (requiring designation of SACs) and IV (species requiring strict protection). Ireland has long been considered to hold one of the most important remaining populations of European otter in Western Europe and surveys carried out in the early 1980s and again in the early 1990s confirmed the species to be widespread throughout the country. Populations in coastal areas utilise shallow, inshore marine areas for feeding but also require fresh water for bathing and terrestrial areas for resting and breeding holts.

During 2010 and 2011 a national survey of otter populations was undertaken by National Parks and Wildlife Service (NPWS) and reported by Reid *et al.* (2013). The outcomes of this national survey indicate that otters occur throughout Ireland, including west and south coasts. The assessment of the diets of coastal otters in Ireland indicate that those individuals which inhabit the coastal marine waters of Ireland feed predominantly on marine species such as rocklings (Gadidae), wrasse (Labridae), Crustacea, Mollusca, Atlantic eel, goby (Gobiidae), sea scorpions (Cottidae) and blennies, but they also travel inland to estuaries to feed on brackish or freshwater food resources (Reid *et al*., 2013).

### 3.3.6 Marine Reptiles

Five species of marine turtle have been recorded in UK and Irish waters. Studies do not provide much indication on their distribution patterns in Irish and UK waters. Most information was obtained from strandings data, and satellite telemetry studies brought limited information. Turtles are protected under Annex IV of the EU Habitat Directive.

The leatherback turtle *Dermochelys coriacea* is the only species reported annually and considered as a regular user of Irish waters. Sightings suggest that they move into Irish waters from the south and west before migrating north, around the west coast of Ireland or through the Irish Sea (Pierpoint, 2000). It is likely that they follow swarms of jellyfish, their main prey species, into Irish waters (Reeds, 2004). Rogan *et al*. (2018) recorded three leatherback turtles over a two-year period, all in the summer and all over the continental shelf.

Loggerhead turtles *Caretta caretta* and Kemp's Ridley turtles occur less frequently, typically thought to be carried north by adverse weather conditions. Most records of this species are from strandings data. The hawksbill turtle *Eretmochelys imbricata* and the green turtle *Chelonia mydas* have been sighted rarely or found stranded in Ireland. Rogan *et al*. (2018) recorded two sightings of unidentified turtles, one on the shelf edge to the Rockall Trough, and another over the shelf at the south-eastern edge of the Porcupine Seabight.

## 3.4 Conservation

### 3.4.1 Coastal protected sites

An extensive network of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) is located along the western coast of Ireland. SACs are designated for the presence of habitats and species of significant ecological importance listed under Annexes I and II respectively of the Habitats Directive. Irish coastal SACs protect a variety of coastal and marine Annex I habitats and Annex II species and include reefs, caves, cliffs, offshore islands, sand dunes, salt marshes, intertidal bays, beaches and rivers. SPAs are designated for the protection of rare and vulnerable birds listed under the Annex I of the Birds Directive.

None of the proposed borehole locations are situated within a SAC or SPA. The locations of coastal SACs and SPAs in the Irish Shelf study area (the only study area which includes a coastline) are shown in Figure 3-14. The five closest coastal SACs and the five closest SPAs to any borehole location are shown in Table 3-6. A

full list of all SACs located in the vicinity of the three study areas can be found in Appendix A. Note that the Appropriate Assessment Screening Report (Woodside, 2020) also considers those European sites that fall outside of this area but which may have connectivity with the Project.

Table 3-6 Closest coastal SACs and SPAs to the proposed borehole locations

| Site name [Site code] | Qualifying features | Distance to nearest borehole location |
|---|---|---|
| **SACs** | | |
| **Barley Cove to Ballyrisode Point SAC [001040]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Perennial vegetation of stony banks<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• European dry heaths<br>• Petalwort (*Petalophyllum ralfsii*) | 3 km (Borehole 47/17-sb1) |
| **Three Castle Head to Mizen Head SAC [000109]** | • Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• European dry heaths | 4 km (Borehole 47/17-sb1 |
| **Roaringwater Bay and Islands SAC [000101]** | • Large shallow inlets and bays<br>• Reefs<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• European dry heaths<br>• Submerged or partially submerged sea caves<br>• Harbour Porpoise (*Phocoena phocoena*)<br>• Otter (*Lutra lutra*)<br>• Grey Seal (*Halichoerus grypus*) | 11 km (Borehole 47/17-sb1) |
| **Sheep's Head SAC [000102]** | • Northern Atlantic wet heaths with Erica tetralix<br>• European dry heaths<br>• Kerry Slug (*Geomalacus maculosus*) | 14 km (Borehole 47/17-sb1) |
| **Clare Island Cliffs SAC [002243]** | • Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Calcareous rocky slopes with chasmophytic vegetation<br>• Siliceous rocky slopes with chasmophytic vegetation | 15 km (Borehole 47/17-sb1) |
| **SPAs** | | |

| Site name [Site code] | Qualifying features | Distance to nearest borehole location |
|---|---|---|
| **Sheep's Head to Toe Head SPA [004156]** | • Peregrine (*Falco peregrinus*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | 3 km (Borehole 47/17-sb1) |
| **Bills Rocks SPA [004177]** | • Storm Petrel (*Hydrobates pelagicus*)<br>• Puffin (*Fratercula arctica*) | 10 km (Borehole 28/9-sb1) |
| **Clare Island SPA [004136]** | • Fulmar (*Fulmarus glacialis*)<br>• Shag (*Phalacrocorax aristotelis*)<br>• Common Gull (*Larus canus*)<br>• Kittiwake (*Rissa tridactyla*)<br>• Guillemot (*Uria aalge*)<br>• Razorbill (*Alca torda*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | 15 km (Borehole 28/9-sb1) |
| **Inishbofin, Omey Island and Turbot Island SPA [004231]** | • Corncrake (*Crex crex*) | 19 km (Borehole 28/9-sb1) |
| **Stags of Broad Haven SPA [004072]** | • Storm Petrel (*Hydrobates pelagicus*)<br>• Leach's Storm-petrel (*Oceanodroma leucorhoa*) | 19 km (Borehole 20/12-sb1) |

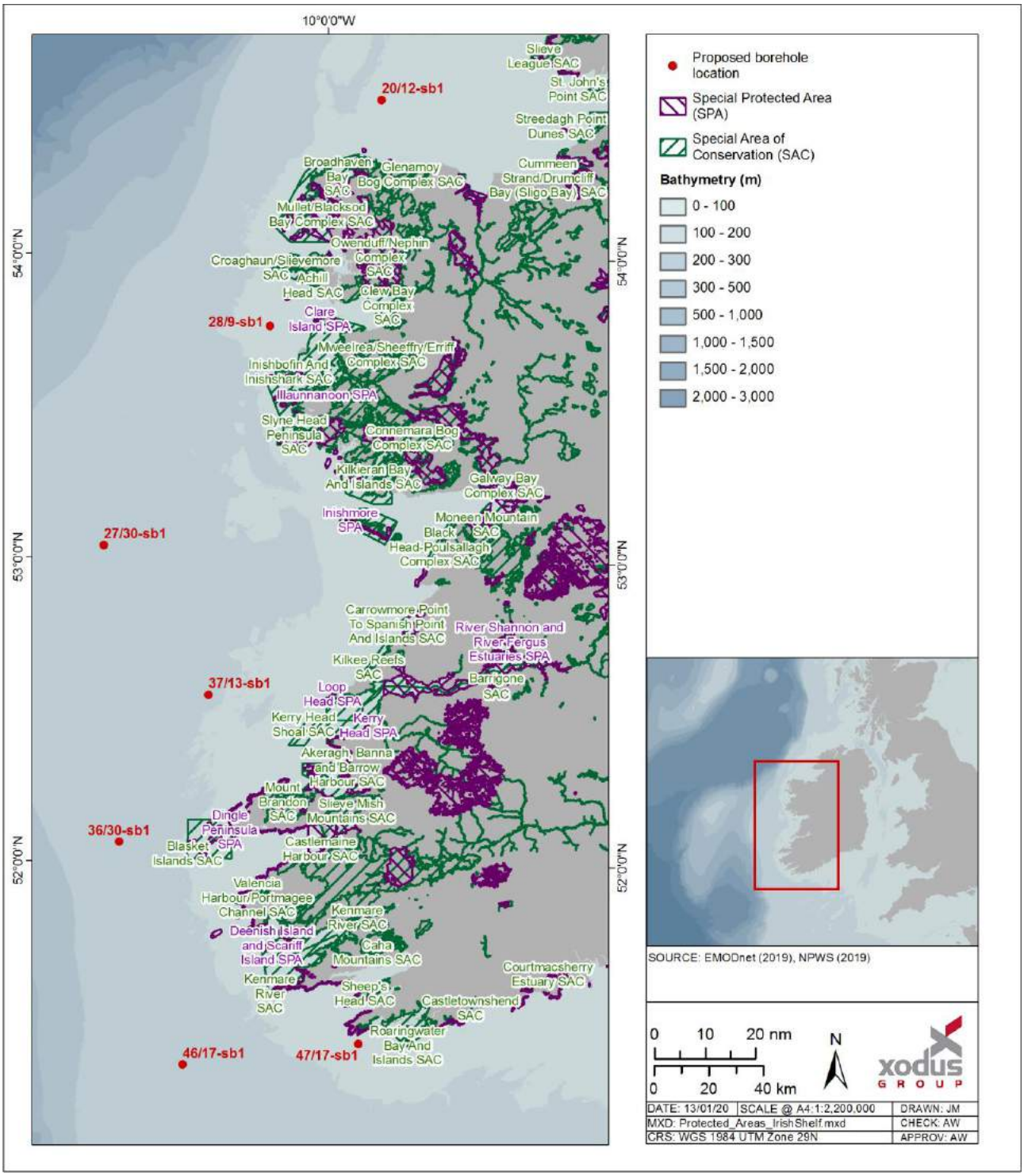


**Figure 3-14** Location of coastal SACs and SPAs in relation to the borehole locations in the Irish Shelf study area

### 3.4.2 Ramsar Sites

The Ramsar Convention, the Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 147 Contracting Parties to the Convention globally, with 1,524 wetland sites, totalling 129.2 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance (NPWS, 2019).

Ireland currently has 45 sites designated as Ramsar Sites, with a surface area of 66,994 hectares (Ramsar 2019), of which six Ramsar sites are located along the western coast of Ireland and designated for marine elements; these include Killala Bay/Moy Estuary [ID 843], Blacksod Bay and Broadhaven [ID 844], Inner, Galway Bay [ID 838], Tralee Bay [ID 440], Castlemaine Harbour [ID 470] and Cork Harbour [ID 837]. None of the borehole locations are within a Ramsar site; the closest is borehole 20/12-sb1, located 27 km from Blacksod Bay and Broadhaven Ramsar site.

### 3.4.3 Offshore Protected Sites

The Irish offshore SACs are designated for the protection of reef habitats listed on the Annex I of the EU Habitats Directive, which include biogenic and geogenic reefs. Biogenic reefs are typically formed by the accumulation of dead and living hard bodied animals such as cold-water coral species which accumulate over millions of years to form carbonate mound structures. These structures can reach up to 350 m height above the seafloor and up to 5 km wide. Patches of reef with coral commonly occur on the steep flanks of the mounds, the most common reef species being *Lophelia pertusa* and *Madrepora oculata*. Other corals including *Desmophyllum cristagalli*, *Flabellum macandrewi* and *Stenocyathus vermiformis* are also present in these SACs. Geogenic reefs are exposed rocky substrate with boulder and cobble fields that provide substrate for colonisation by fauna such as cold-water corals. These coral reefs support a highly biodiverse ecosystem, including communities of anemones, sponges, crustaceans and fish (DAHG, 2014a; 2014b, 2014c).

None of the proposed borehole locations are situated within a SAC. The locations of SACs in the Porcupine Bank study area in relation to the borehole locations are shown in Table 3-7 and Figure 3-15. No protected sites are located within the Goban Spur study area. Note that the Appropriate Assessment Screening Report (Woodside, 2020) also considers those offshore SACs that fall outside of this area. The distribution of carbonate mound structures is presented in Figure 3-6 and discussed in Section 3.2.3.1.1.

Table 3-7 Offshore SACs

| SAC site name [Site code] | Qualifying features | Distance to nearest borehole location |
|---|---|---|
| **Porcupine Bank Canyon SAC [003001]** | Reefs | 12 km (Borehole 74/27-sb1)<br>13 km (Borehole 83/25-sb1)<br>32 km (Borehole 74/29-sb1) |
| **South-West Porcupine Bank SAC [002329]** | Reefs | 19 km (Borehole 74/27-sb1)<br>35 km (Borehole 83/25-sb1) |
| **North-West Porcupine Bank SAC [002330]** | Reefs | 35 km (Borehole 75/28-sb1) |

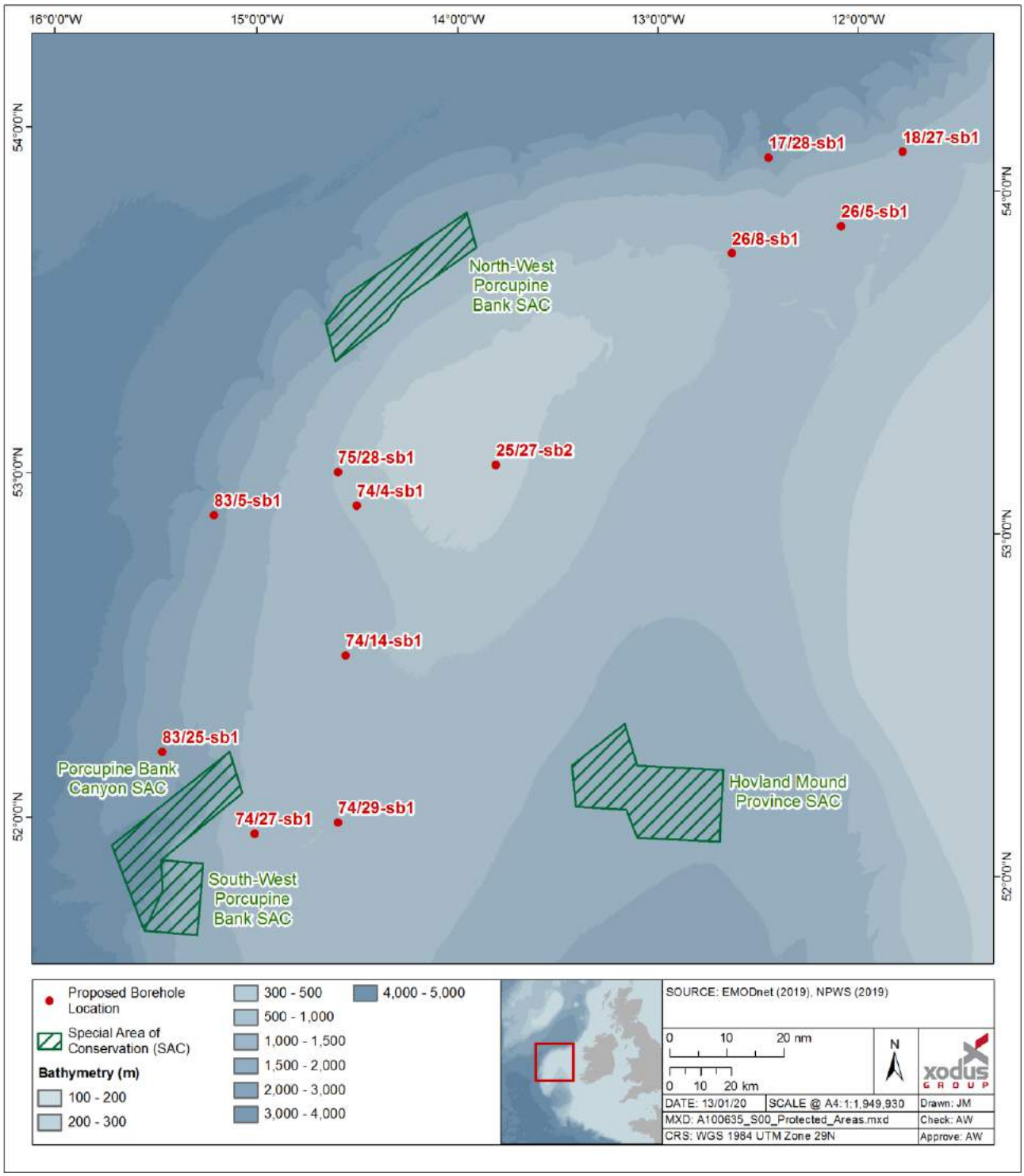


Figure 3-15 Location of Offshore SACs in relation to the borehole locations in the Porcupine Bank study area.

### 3.4.4 Protected Species

The Porcupine Bank, Irish Shelf and Goban Spur study areas are home to many species that are protected or noted as being of conservation concern at national, European or international level. Species of notable conservation concern relevant to the study areas are highlighted throughout Section 3.3; however, for ease of review, key conservation designations for protected species are listed in Table 3-8.

Table 3-8 Designations of protected species in the study areas

| Species | Key applicable designations |
|---|---|
| **Benthos** | |
| *Lophelia pertusa* | The species is not protected, but if it forms a reef structure of sufficient size and quality, the reef may be designated under Annex I of the Habitats Directive.<br>*Lophelia pertusa* reefs also feature on the OSPAR List of Threatened and/or Declining Species or Habitats. |
| *Madrepora oculata* | The species is not protected, but if it forms a reef structure of sufficient size and quality, the reef may be designated under Annex I of the Habitats Directive. |
| Basking shark *Cetorhinus maximus* | Listed as vulnerable on International Union for Conservation of Nature (IUCN) Red List.<br>Features on the OSPAR List of Threatened and/or Declining Species and Habitats. Prohibited species under the Common Fisheries Policy.<br>Listed in Annex I of the United Nations Convention on the Law of the Seas.<br>Listed in Appendices I and II of the Bonn Convention on Migratory Species.<br>Listed in Appendix II (species in which trade must be controlled) of the Convention on International Trade in Endangered Species. |
| Portuguese dogfish *Centroscymnus coelolepis* | Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| Leafscale gulper shark *Centrophorus squamosus* | Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| Orange roughy *Hoplostethus atlanticus* | Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| Spurdog *Squalus acanthias* | Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| **Seabirds** | |
| All seabird species | The Birds Directive makes provision for the maintenance of the populations of all wild bird species across their natural range. Those species that are considered to be rare or vulnerable are listed in Annex I of the Directive and member states are required to designate SPAs to enhance their survival. These species, as well as those recognised under other applicable conservation regimes, are listed below. |
| Lesser black-backed gull *Larus fuscus fuscus* | Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| Black-legged kittiwake *Rissa tridactyla* | Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| European storm petrel *Hydrobates pelagicus* | Listed in Annex I of the Birds Directive. |
| Common Tern *Sterna hirundo* | Listed in Annex I of the Birds Directive. |
| Arctic Tern *Sterna paradisaea* | Listed in Annex I of the Birds Directive. |
| Razorbill *Alca torda* | Annex III of the Bern Convention<br>Annex II of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds. |
| Herring gull *Larus argentatus* | Listed in Annex II of the Birds Directive. |

| Species | Key applicable designations |
|---|---|
| Chough *Pyrrhocorax pyrrhocorax* | Listed in Annex I of the Birds Directive. |
| Puffin *Fratercula arctica* | Listed as migratory species in the EC Birds Directive. |
| Guillemot *Uria aalge* | Listed in Annex I of the Birds Directive.<br>Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| Gannet *Morus bassanus* | Annex III of the Bern Convention<br>Annex II of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds. |
| Manx Shearwater *Puffinus puffinus* | Annex II of the Bern Convention |
| **Marine mammals** | |
| All cetacean species | All cetaceans mentioned in Section 3.3.5 are listed as Annex IV species under the Habitats Directive. Individual species that are additionally recognised under other applicable conservation regimes are listed below. All Irish waters are considered a whale and dolphin sanctuary, although no specific legislation is in place to support this designation. The National Parks and Wildlife Service (NPWS) has a conservation plan in place to protect cetaceans in Irish waters. |
| Harbour porpoise *Phocoena phocoena* | Listed in Annex II of the Habitats Directive.<br>Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| Bottlenose dolphin *Tursiops truncatus* | Listed in Annex II of the Habitats Directive. |
| Blue whale *Balaenoptera musculus* | Features on the OSPAR List of Threatened and/or Declining Species and Habitats. |
| Harbour seal *Phoca vitulina* | Listed in Annex II of the Habitats Directive.<br>Protected in Ireland under the Wildlife Act 1976 (As Amended). |
| Grey seal *Halichoerus grypus* | Listed in Annex II of the Habitats Directive.<br>Protected in Ireland under the Wildlife Act 1976 (As Amended). |
| **Marine Reptiles** | |
| Leatherback turtle *Dermochelys coriacea* | Features on the OSPAR List of Threatened and/or Declining Species and Habitats.<br>Protected in Ireland under the Wildlife Act 1976 (As Amended).<br>Listed in Appendix I of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES) 1975, Appendix II of the Bern Convention 1979, Appendices I and II of the Bonn Convention 1979, and Annex IV of the Habitats Directive. |
| Loggerhead turtle *Caretta caretta* | Listed as vulnerable on the IUCN Red List.<br>Features on the OSPAR List of Threatened and/or Declining Species and Habitats. Protected in Ireland under the Wildlife Act 1976 (As Amended).<br>Listed as Annex IV species under the Habitats Directive. |

## 3.5 Socio-Economic Environment

### 3.5.1 Commercial Fisheries

The waters around Ireland support a range of national and international commercial fishing fleets. A variety of vessels operating demersal and pelagic trawls are active in waters of up to 500 m in depth. In waters of over 500 m depth, the level of fishing activity is lower and is limited to those with specialist deep-water fishing equipment.

The Bord Iascaigh Mhara (BIM) implements a number of restrictions in the waters of relevance to the proposed Project. This includes a seasonal closure of the Porcupine prawn grounds in May each year (Figure 3-16) and effort limits on all vessels operating demersal trawls, scallop dredges and crab pots in the ICES Celtic Sea Ecoregion and in particular within the BSA as mentioned in Section 3.5.1. The BSA overlaps with five out of the seven proposed borehole locations in the Irish Shelf study area. Therefore, due to the restrictions on fishing within the BSA, commercial fishing activity in the vicinity of those locations is likely to be low (Figure 3-16).

#### 3.5.1.1 Fisheries statistics

Fisheries statistics are collected based on ICES statistical rectangles which comprise the smallest standardised statistical unit for recording fishing activity. As shown in Figure 3-16 - Figure 3-19, the three study areas are located within ICES rectangles 38E0, 36D9, 35D8, 34D9, 33D8, 31E0, 31D9 (Irish Shelf study area), 26D8, 28D6 (Goban Spur), 33D4, 33D5, 34D5, 34D4, 35D5, 35D6, 36D7, 36D8, 37D7, 37D8 (Porcupine Bank). The landings weights for 2016 are provided in Table 3-9 and Table 3-10, obtained from the Scientific, Technical and Economic Committee for Fisheries (STECF, 2016).

Of the three study areas, the Porcupine Bank has the highest recorded landings weights largely attributable to high landings weights of Blue Whiting compared to other species. Blue Whiting landings were highest in the study areas from ICES rectangles 33D4 and 34D4, which comprise a relatively low proportion of the landings values distribution for this species from northeast Scotland to the western ICES Celtic Sea Ecoregion (Marine Institute, 2014). In Porcupine Bank, the pelagic species hake and horse mackerel were also landed at higher weights than other species in the study area. Fishing activity targeting hake, mackerel and horse mackerel are recorded at high levels from the northeast of Scotland down to the southwest area of the ICES Celtic Sea Ecoregion and to waters on the west side of the Channel. Demersal fish species monkfish, hake, ling, megrim, skates & rays and witch are recorded at relatively low weights from the Porcupine Bank. In addition, landings weights of *Nephrops* by demersal trawling are reported at relatively low levels in relevant ICES rectangles within the Porcupine Bank study area compared with landings from waters offshore of the eastern coast of Ireland and the Porcupine Prawn Grounds (southeast of the Porcupine Bank proposed borehole locations, Figure 3-17), the Irish Sea and western coast of Scotland with the grounds in the study area comprising a low proportion of the overall grounds which are available (Marine Institute, 2014). The distribution of demersal trawling activity along with other fishing methods is shown in Figure 3-17, Figure 3-18 and Figure 3-19.

In the Irish Shelf study area, horse mackerel and mackerel comprised the highest landings weights, again attributed to the pelagic trawl fleet with some vessels operating seine nets. In addition, demersal species such as hake, haddock, megrim, monk (anglerfish), ray and skates were recorded to have been landed in 2016. Demersal trawling along with long-lines, trammel and gill nets are used to target hake, monk and megrim in the Irish shelf region. *Nephrops* landings are recorded in the Irish Shelf study area from ICES rectangles 31E0 and 34D9 at moderate levels. Landings weights show that crab were landed from the Irish Shelf study area in the nearshore ICES rectangles 36D9, 38E0, and 31D9 by potting vessels. Potting activity is recorded to occur throughout the inshore coastline of Ireland (Marine Institute, 2014). The majority of potting vessels are under 10m or between 10 and 15m in length. The landings data from the STECF does not include data from vessels of under 15m in length, and so may not be representative of the activity for this fleet. However, it is unlikely that high levels of potting activity occurs offshore of the Irish Shelf study area due to weather constraints for vessels of this size.

The Goban Spur study area supports very little fishing activity, with low weights of hake, monk, ling and megrim being recorded in landings records from 2016 (STECF, 2016).

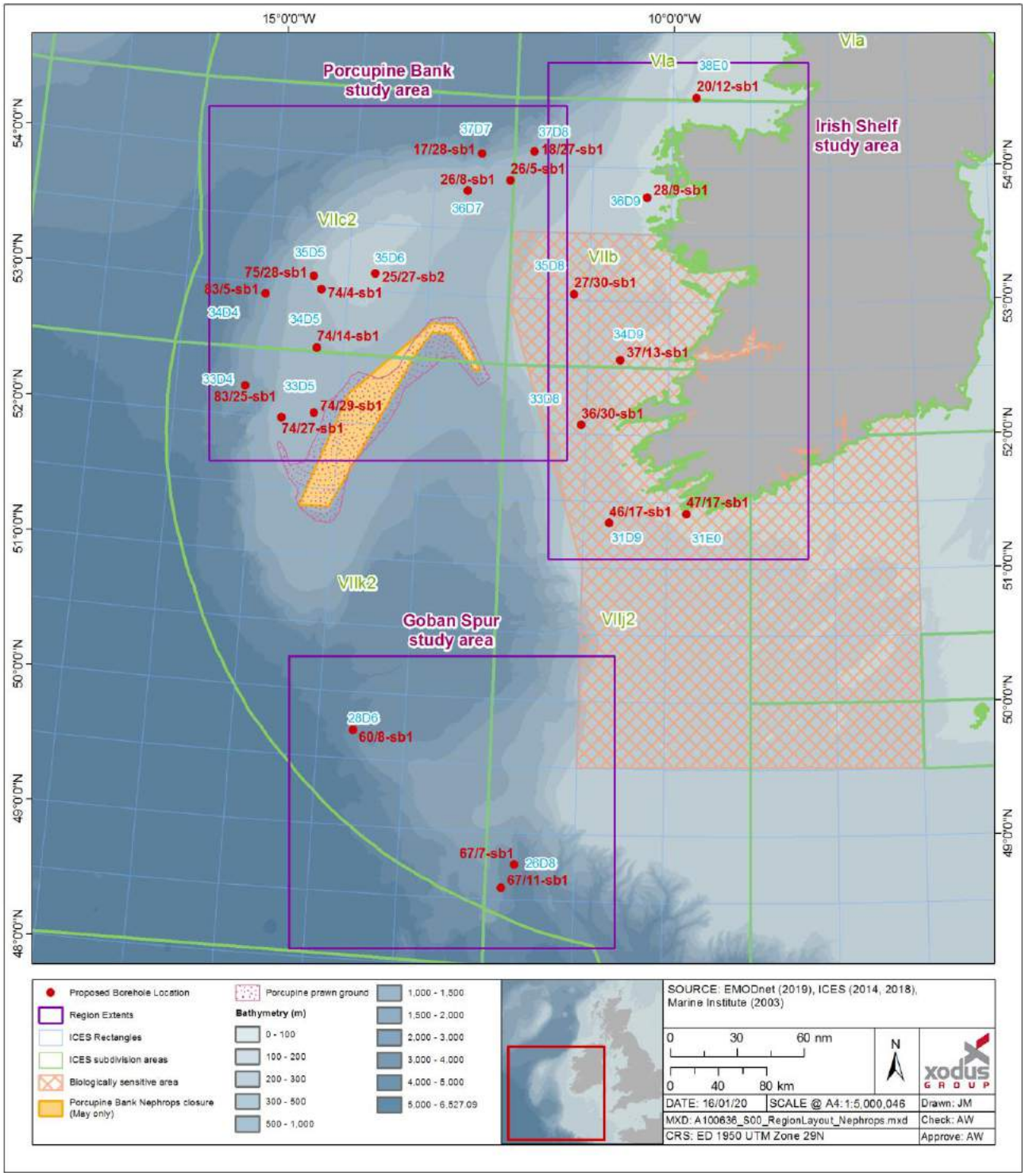


Figure 3-16 Regional fisheries management designations and ICES spatial references

Table 3-9 Landings weights (tonnes) of commercial fisheries species from the Porcupine Bank and Goban Spur study areas (STECF, 2016)

| Study Area | Porcupine Bank | | | | | | | | | Goban Spur |
|---|---|---|---|---|---|---|---|---|---|---|
| ICES Rectangle | 33D4 | 33D5 | 34D4 | 34D5 | 35D5 | 35D6 | 36D7 | 37D7 | 37D8 | 26D8 |
| Albacore Tuna | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| Boarfish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue Whiting | 12400 | 23 | 13790 | 876 | 163 | 0 | 2692 | 5446 | 1974 | 0 |
| Crab | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Haddock | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hake | 0 | 1297 | 15 | 856 | 46 | 102 | 351 | 22 | 1153 | 34 |
| Herring | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Horse Mackerel | 0 | 0 | 0 | 0 | 75 | 0 | 0 | 0 | 2188 | 0 |
| Lemon Sole | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ling | 0 | 30 | 0 | 25 | 15 | 0 | 128 | 0 | 130 | 1 |
| Mackerel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58 | 0 |
| Megrim | 0 | 0 | 0 | 81 | 112 | 46 | 66 | 0 | 213 | 1 |
| Monk | 0 | 171 | 2 | 339 | 296 | 44 | 218 | 0 | 321 | 67 |
| Nephrops | 86 | 49 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| Pollack | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rays & Skates | 0 | 0 | 0 | 10 | 23 | 0 | 0 | 0 | 0 | 0 |
| Squids | 0 | 0 | 0 | 0 | 31 | 0 | 0 | 0 | 0 | 0 |
| Whiting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 0 |
| Witch | 0 | 0 | 0 | 21 | 42 | 14 | 20 | 0 | 0 | 0 |

Table 3-10 Landings weights (tonnes) of commercial fisheries species from the Irish Shelf study area (STECF, 2016)

| Study Area | Irish Shelf | | | | | | |
|---|---|---|---|---|---|---|---|
| ICES Rectangle | 33D8 | 36D9 | 38E0 | 31D9 | 31E0 | 34D9 | 35D8 |
| Albacore Tuna | 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| Boarfish | 711 | 81 | 0 | 0 | 0 | 0 | 442 |
| Blue Whiting | 16 | 0 | 0 | 19 | 0 | 0 | 0 |
| Crab | 0 | 165 | 370 | 120 | 10 | 0 | 0 |
| Haddock | 40 | 0 | 275 | 74 | 130 | 129 | 79 |
| Hake | 737 | 4 | 0 | 1135 | 211 | 21 | 399 |
| Herring | 0 | 0 | 0 | 0 | 174 | 0 | 63 |
| Horse mackerel | 592 | 4360 | 502 | 681 | 103 | 0 | 4836 |
| Lemon sole | 0 | 0 | 0 | 32 | 43 | 10 | 8 |
| Ling | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mackerel | 704 | 1420 | 115 | 136 | 11 | 0 | 2454 |
| Megrim | 259 | 0 | 0 | 226 | 198 | 78 | 123 |
| Monk | 1085 | 10 | 5 | 321 | 274 | 91 | 577 |
| Nephrops | 6 | 1 | 0 | 10 | 534 | 231 | 2 |
| Pollack | 6 | 0 | 0 | 111 | 56 | 0 | 14 |
| Rays & Skates | 18 | 32 | 0 | 0 | 44 | 23 | 36 |
| Squids | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Whiting | 16 | 0 | 16 | 90 | 221 | 120 | 11 |
| Witch | 16 | 0 | 0 | 12 | 42 | 12 | 9 |

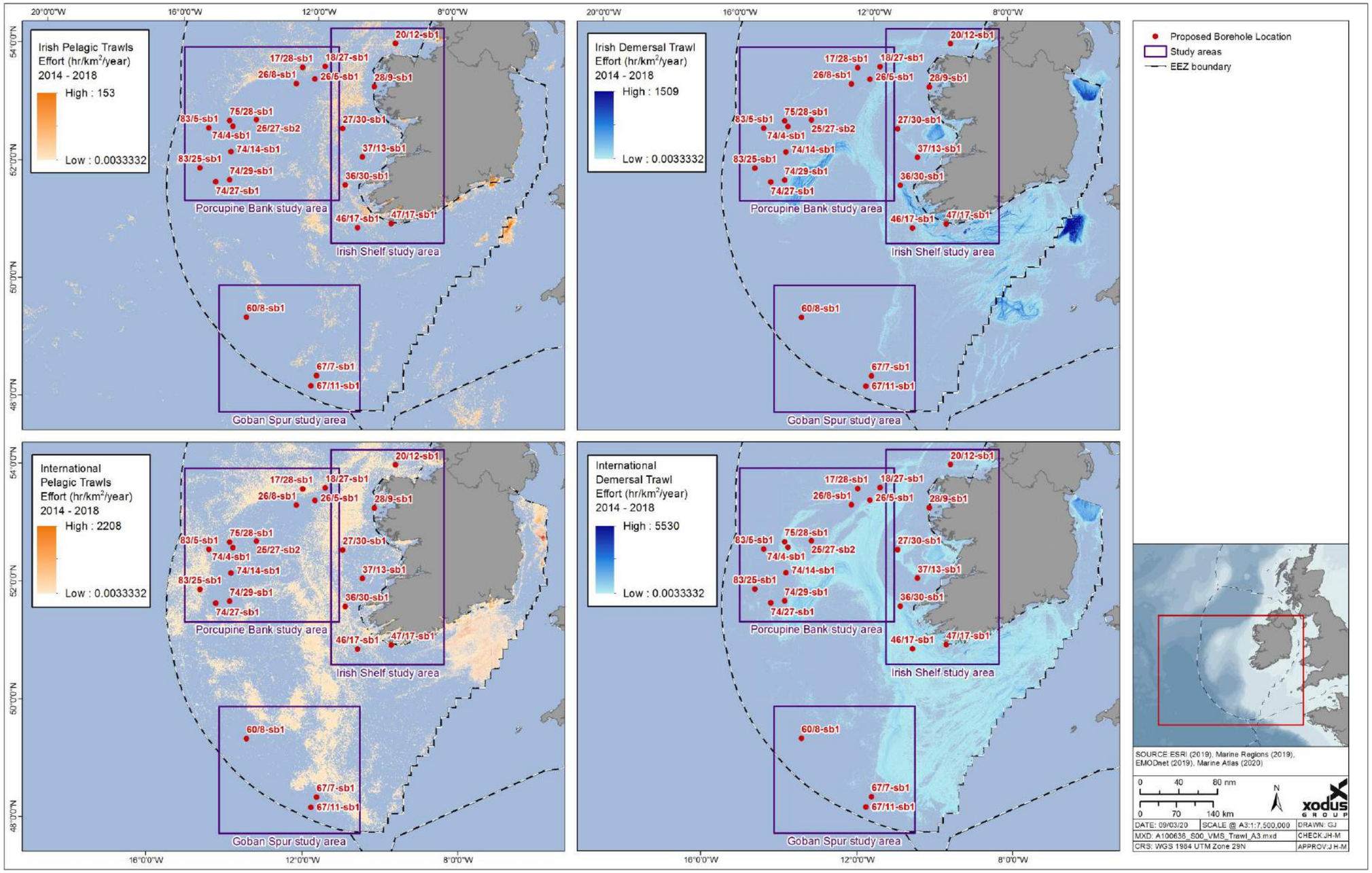


Figure 3-17 Fishing effort (hr/km$^2$/year) by Irish and non Irish (international) vessels operating pelagic and demersal trawls (2014-2018; Marine Institute, 2020)

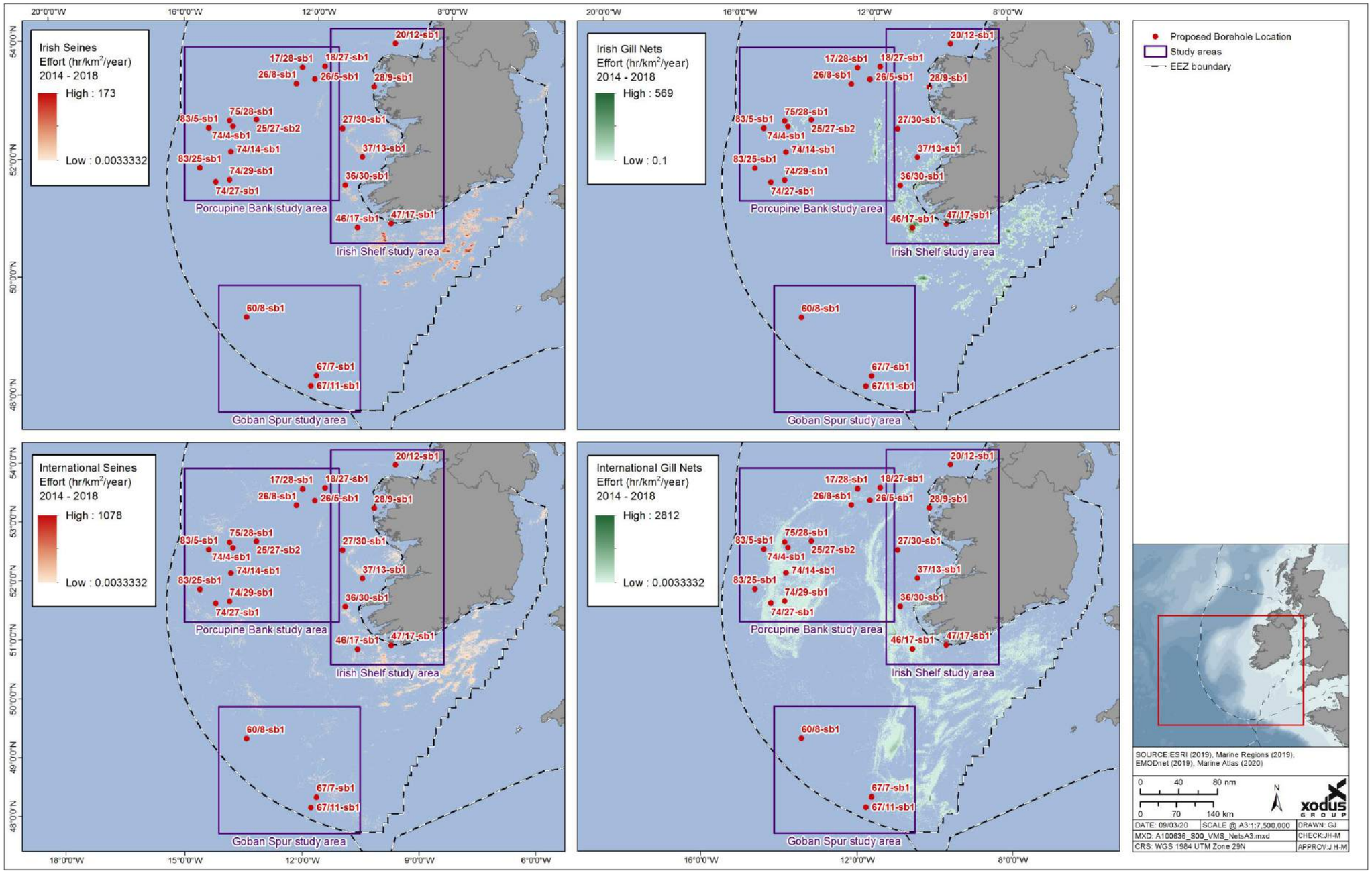


Figure 3-18 Fishing effort (hr/km²/year)by Irish and non Irish (international) vessels operating seine and gill nets (2014-2018; Marine Institute, 2020)

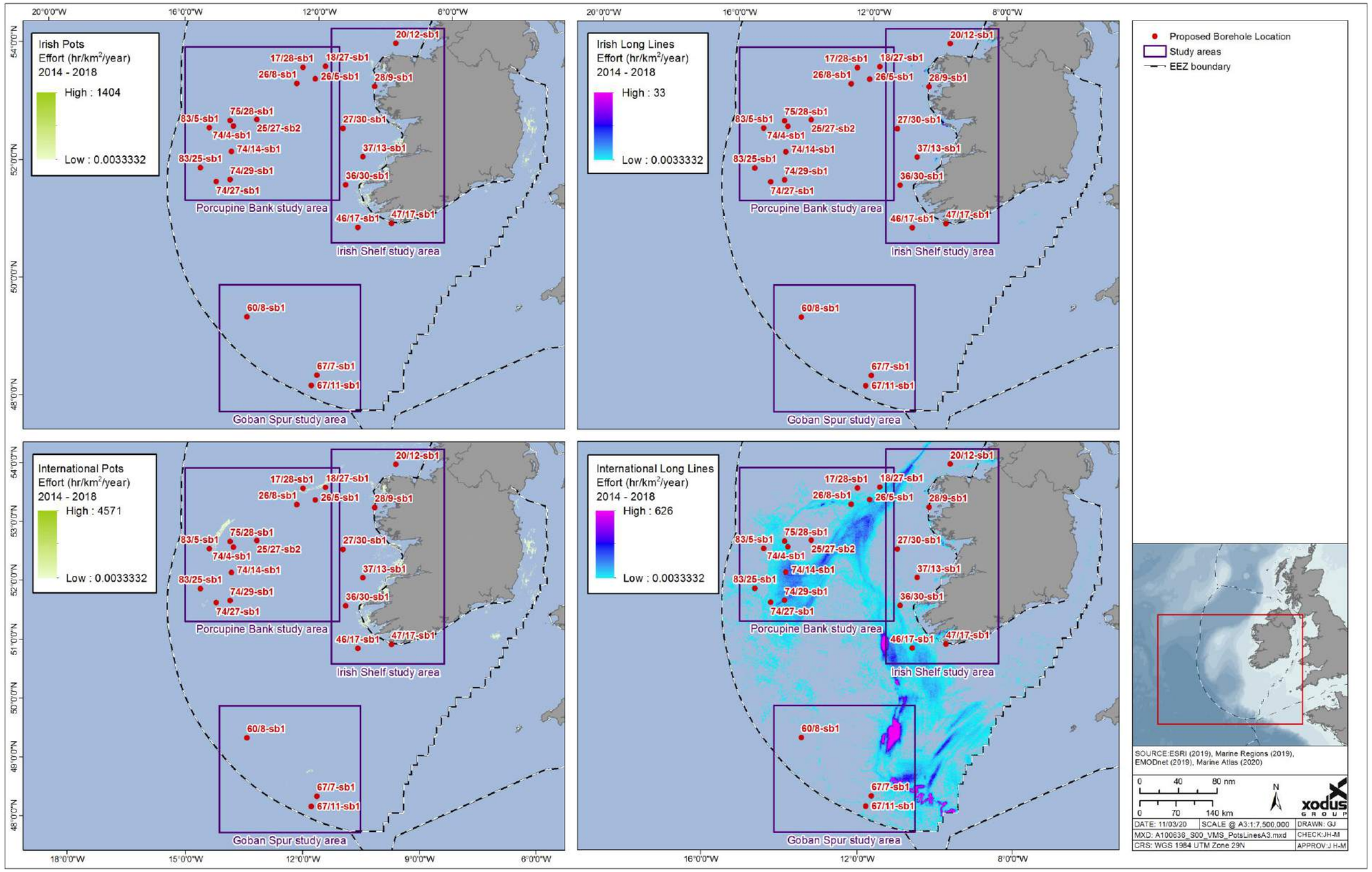


Figure 3-19 Fishing effort (hr/km$^2$/year) by Irish and non Irish (international) vessels operating pots and long lines (2014-2018; Marine Institute, 2020)

### 3.5.2 Aquaculture

Ireland's aquaculture sector is expanding. In 2017 there were 47,147 tonnes of product harvested, with a value of €208.4 million. Production increased by 7% in tonnage and 24% in value between 2016 and 2017, continuing an overall 5-year trend of expansion. The aquaculture industry employs approximately 1,900 people under various conditions equating to approximately 1,000 full times roles. Salmon contributes approximately 40% of the total tonnage and 67% of the value of the industry, although the oyster sector provides the majority of employment, approximately 1,300 jobs. Donegal, Cork, Galway, Mayo and Kerry host the majority of production and employment (BIM, 2018).

All of the licensed aquaculture sites (finfish, shellfish and seaweed) are in coastal locations and situated over 20 km from any of the proposed borehole locations (DAFM, 2020).

### 3.5.3 Oil and Gas Activity

A total of 207 wells have been drilled in Irish waters according to data from the PAD Integrated Petroleum Affairs System (IPAS, 2019). The majority of wells within Irish waters are restricted to the North Celtic Sea, Fastnet, northern Porcupine and Slyne offshore areas (Figure 3-20, Figure 3-21 and Figure 3-22). The most recent exploration well to be drilled is the Iolar well (52/4-1, EL3/18), located in the Porcupine Basin, which was drilled in 2019. This well was plugged and abandoned. There are no drilling plans currently authorised for 2020.

The closest oil and gas field development to the study areas is the Corrib Gas Project located 30 km from borehole 20/12-sb1. The Corrib field consists of a subsea development with five production wells connected via flexible flowlines to a production manifold where the gas is comingled and fed into the main pipeline to the Bellanboy Bridge terminal in County Mayo. The only other development is the Kinsale field, another gas development, which is located in the Celtic Sea and is currently undergoing decommissioning which is due to commence in 2020/2021 after field production ceases.

The nearest well to the study areas is 30 km southeast of borehole 18/27-sb1 (Figure 3-20), whilst the nearest pipeline to the study areas is the Corrib pipeline which is located 30 km southwest of borehole 20/12-sb1 (Figure 3-21). A number of licenses have been issued within the study areas; these are summarised in Table 3-11 and shown in Figure 3-20, Figure 3-21 and Figure 3-22.

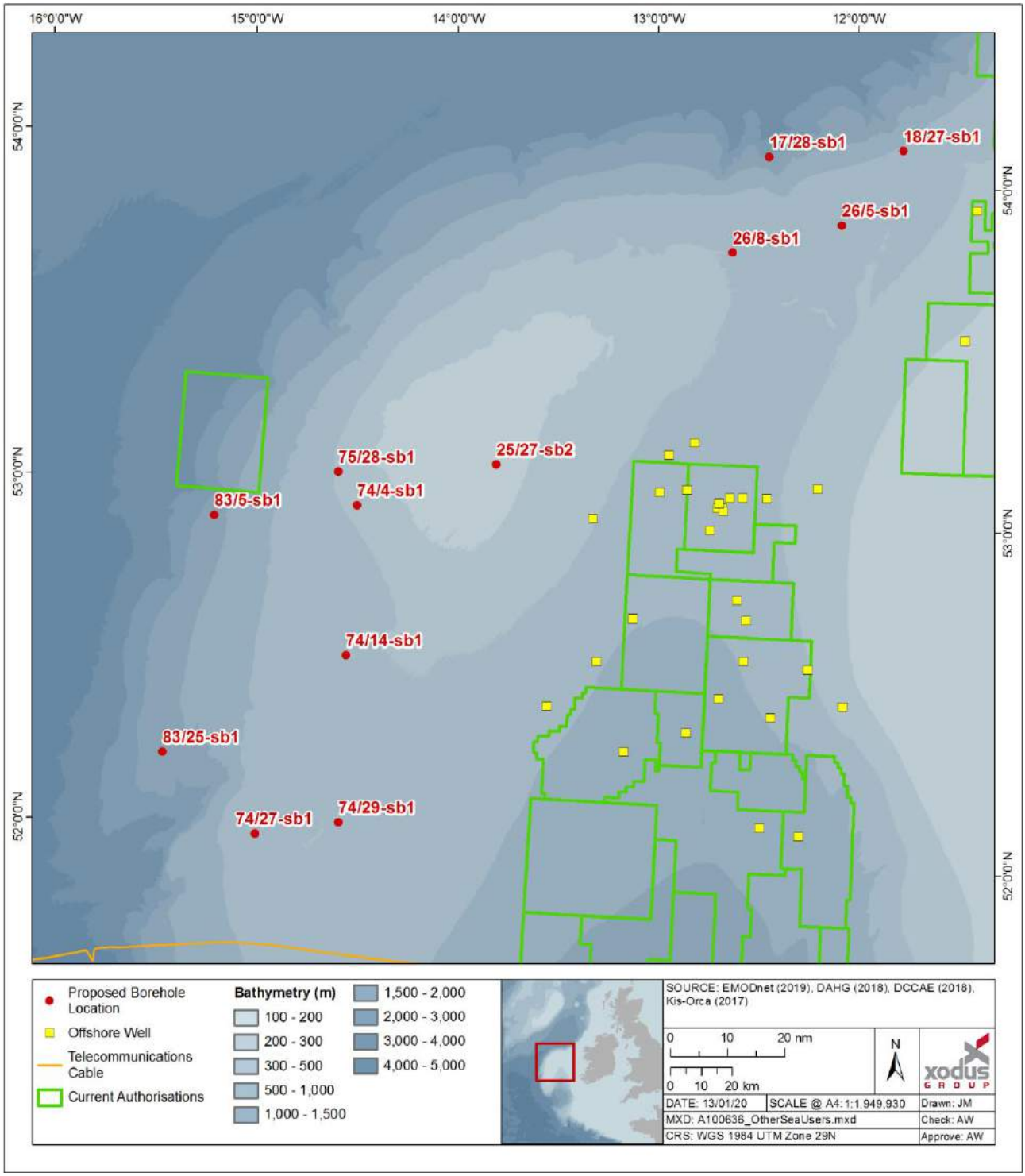


Figure 3-20 Location of oil and gas licences and offshore infrastructure in the Porcupine Bank study area

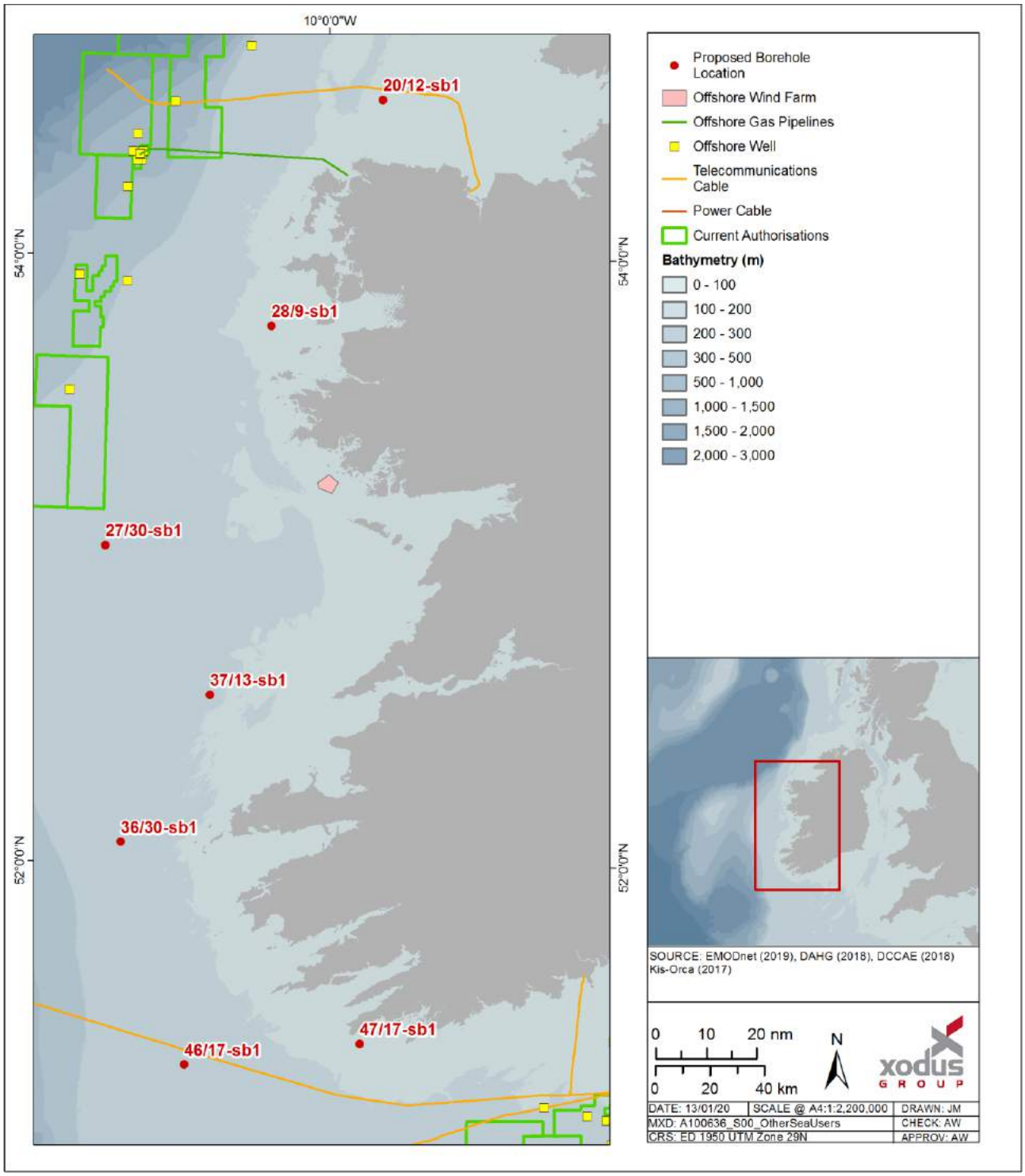


Figure 3-21 Location of Oil and Gas licences and offshore infrastructure the Irish Shelf area

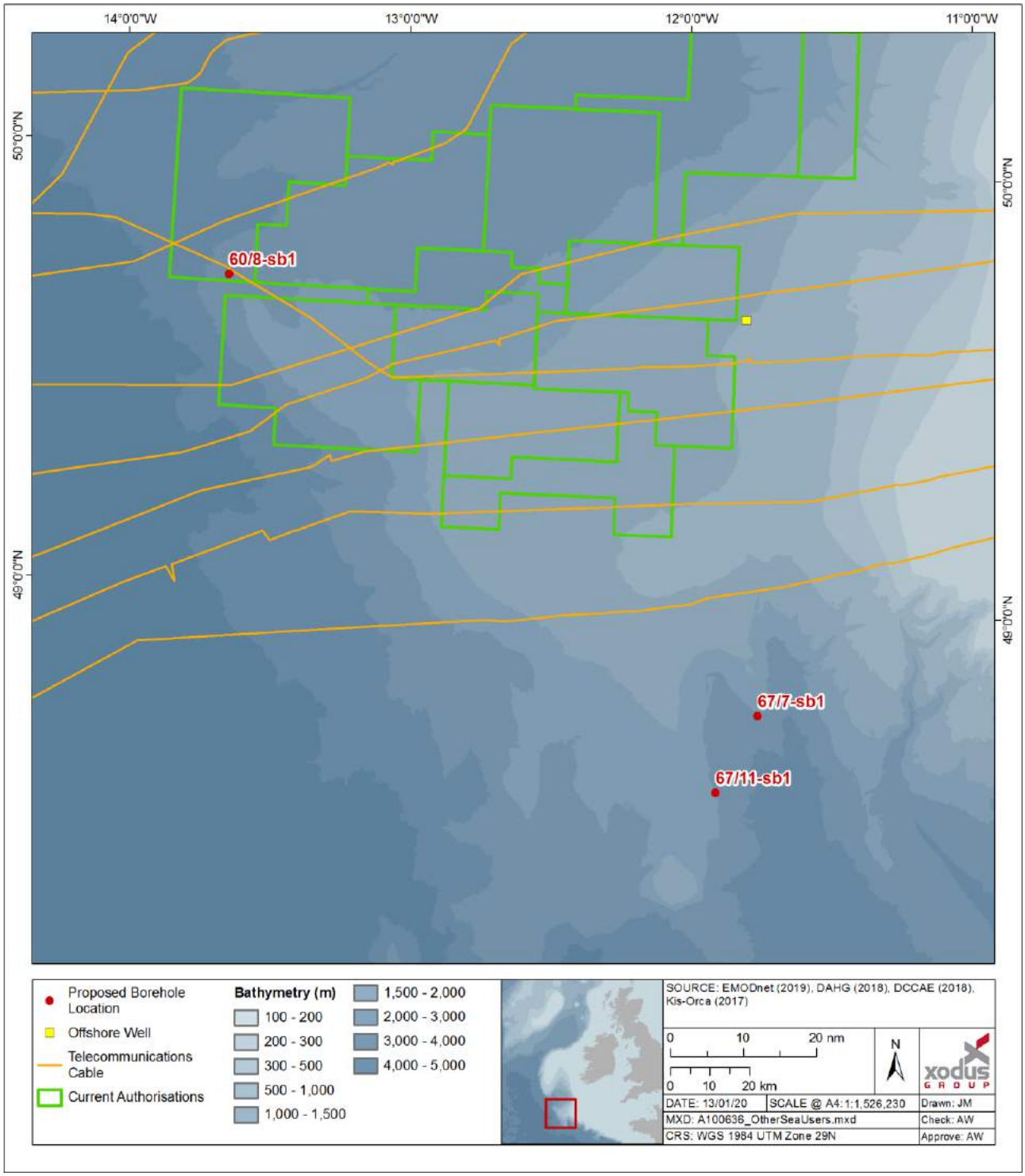


Figure 3-22 Location of Oil and Gas licences and offshore infrastructure in the Goban Spur study area

Table 3-11 Active Oil and Gas Licencing Options (LO), Exploration Licences (EL), Frontier Exploration Licence Frontier (FEL) in the study areas

| Operator | Block |
|---|---|
| **Porcupine Bank** | |
| Europa Oil and Gas | LO16/22 |
| Petrel Resources | LO16/24 |
| Capricorn Ireland | LO16/18 |
| Europa Oil and Gas | EL2/13 |
| Europa Oil and Gas | LO16/20 |
| Predator Oil and Gas | LO16/26 |
| Serica Energy Slyne | EL1/06 |
| **Irish Shelf** | |
| Nexen Petroleum | LO16/23 |
| Shell E&P Ireland | Corrib Lease |
| Island Oil and Gas | EL4/06 |
| Island Assets | EL1/04 |
| Capricorn Ireland | EL2/04 |
| Woodside Energy (Ireland) | EL5/13 |
| Antrim Exploration (Ireland) | EL1/13 |
| AzEire | EL1/19 |
| Europa Oil and Gas | EL3/13 |
| Europa Oil and Gas | FEL1/17 |
| AzEire | LO16/32 |
| Island Expro | EL5/05 |
| EXOLA | EL1/11 |
| **Goban Spur** | |
| Statoil Exploration (Ireland) | EL10/18 |
| Statoil Exploration (Ireland) | EL8/18 |
| Statoil Exploration (Ireland) | EL9/18 |
| CNOOC Petroleum | EL1/18 |
| CNOOC Petroleum | EL4/18 |
| Providence Resources | EL6/14 |
| Nexen Petroleum | EL2/18 |
| ExxonMobil E&P Ireland | EL6/18 |
| AzEire | LO16/31 |

### 3.5.4 Renewables - Wind

There are no wind farms within the vicinity of the proposed boreholes. The closest leased site is Fuinneamh Sceirde Teoranta (FST) which is located 8 km from the coast of Carna in County Galway and is the only proposed renewable energy development on the west coast of Ireland (FST, 2016) (Figure 3-21).

### 3.5.5 Renewables – Wave

There are no wave projects within the vicinity of the proposed borehole locations. The closest renewables sites are the Atlantic Marine Energy Test Site (AMETS), located <10 km from Annagh Head in County May, and the Galway Bay Test Site (GBTS), located <1 km from the coast of Spiddal in County Galway (SEAI, 2019).

### 3.5.6 Telecommunications Cables

The locations of subsea cables in the study areas is shown in Figure 3-20, Figure 3-21 and Figure 3-22. The closest subsea cables (<5 km) to any borehole locations are listed in Table 3-12.

Table 3-12 Closest subsea cables (Kis-orca, 2020)

| Operator | Cable | Status | Nearest Borehole Location | Distance and Direction |
|---|---|---|---|---|
| Aquacomms | AE Connect | Active | 20/12-sb1 | 4 km N |
| Hibernia Express | Hibernia Express | Active | 46/17-sb1 | 5 km N |
| Reliance Globalcom | FLAG Atlantic North | Active | 60/8-sb1 | 1 km N |

The closest subsea cable to any borehole location is the FLAG Atlantic North cable 1 km north of borehole 60/8-sb1. It is not known whether this cable is surface laid or trenched and buried; however, due to the depth of water in which the cable is laid and the distance from shore, it is assumed that this section of cable is surface laid at this location. Woodside will obtain specific, prior written consent from DCCAE due the location of boreholes 60/8-sb1 and 20/12-sb1 within 4 km of active cables.

### 3.5.7 Military Activity

There are no military disposal sites or practice or training grounds in the study areas (DCENR, 2007).

### 3.5.8 Shipping Activity

The majority of shipping activity in waters to the west of Ireland is transatlantic sailing between the Americas and ports in Ireland, the UK and mainland Europe (DCENR, 2007). Offshore, in the Porcupine Bank and Goban Spur study areas the majority of the shipping traffic consists of transatlantic cargo shipping routes running east-west and relatively light traffic levels. However, over the Irish Shelf the majority of the shipping routes consist of both cargo and tanker routes running north-south in direction across the whole study area and experiences high traffic levels in comparison (Figure 3-23, Figure 3-24 and Figure 3-25).

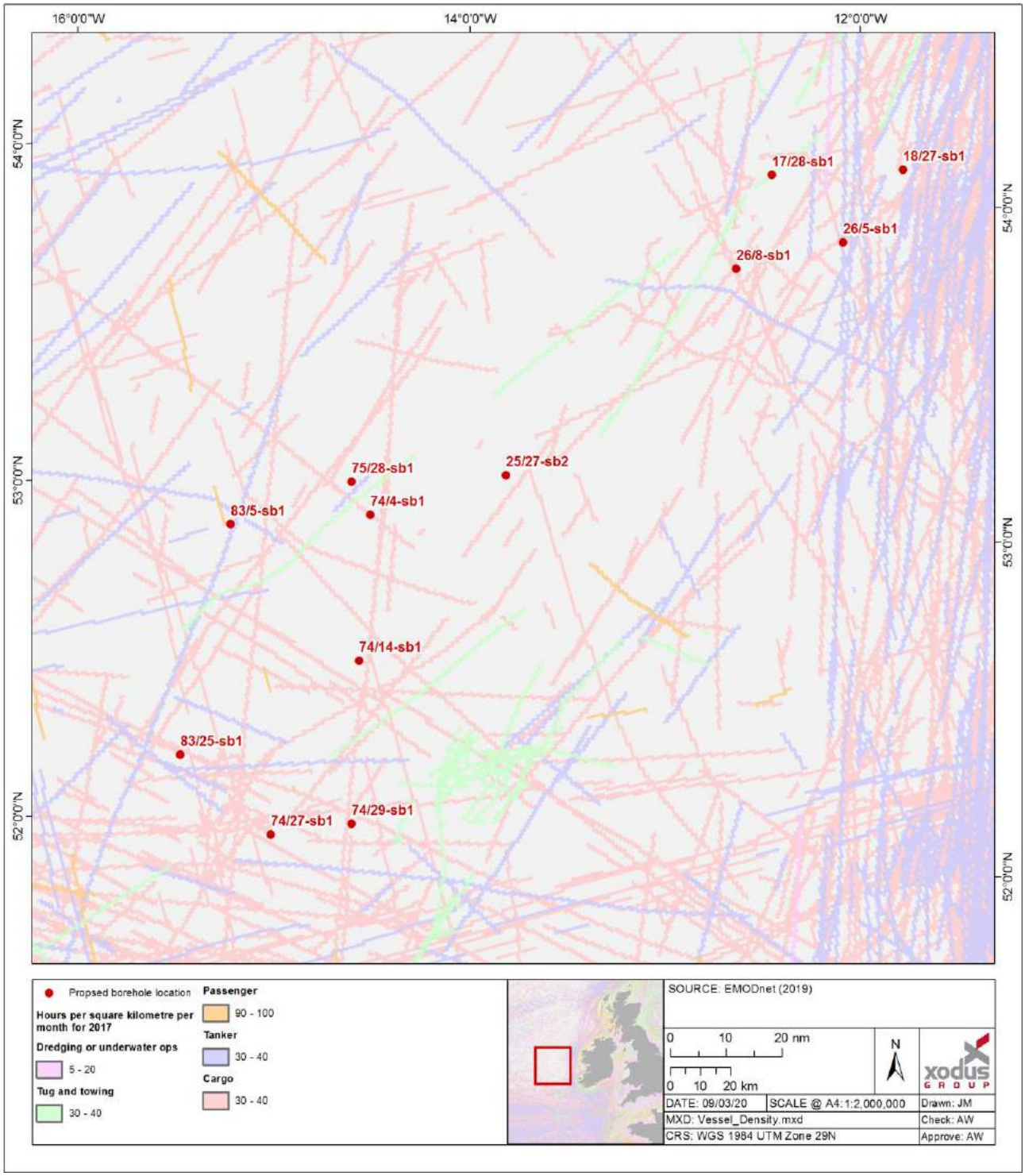


Figure 3-23 Vessel traffic across the Porcupine Bank (Emodnet, 2017)

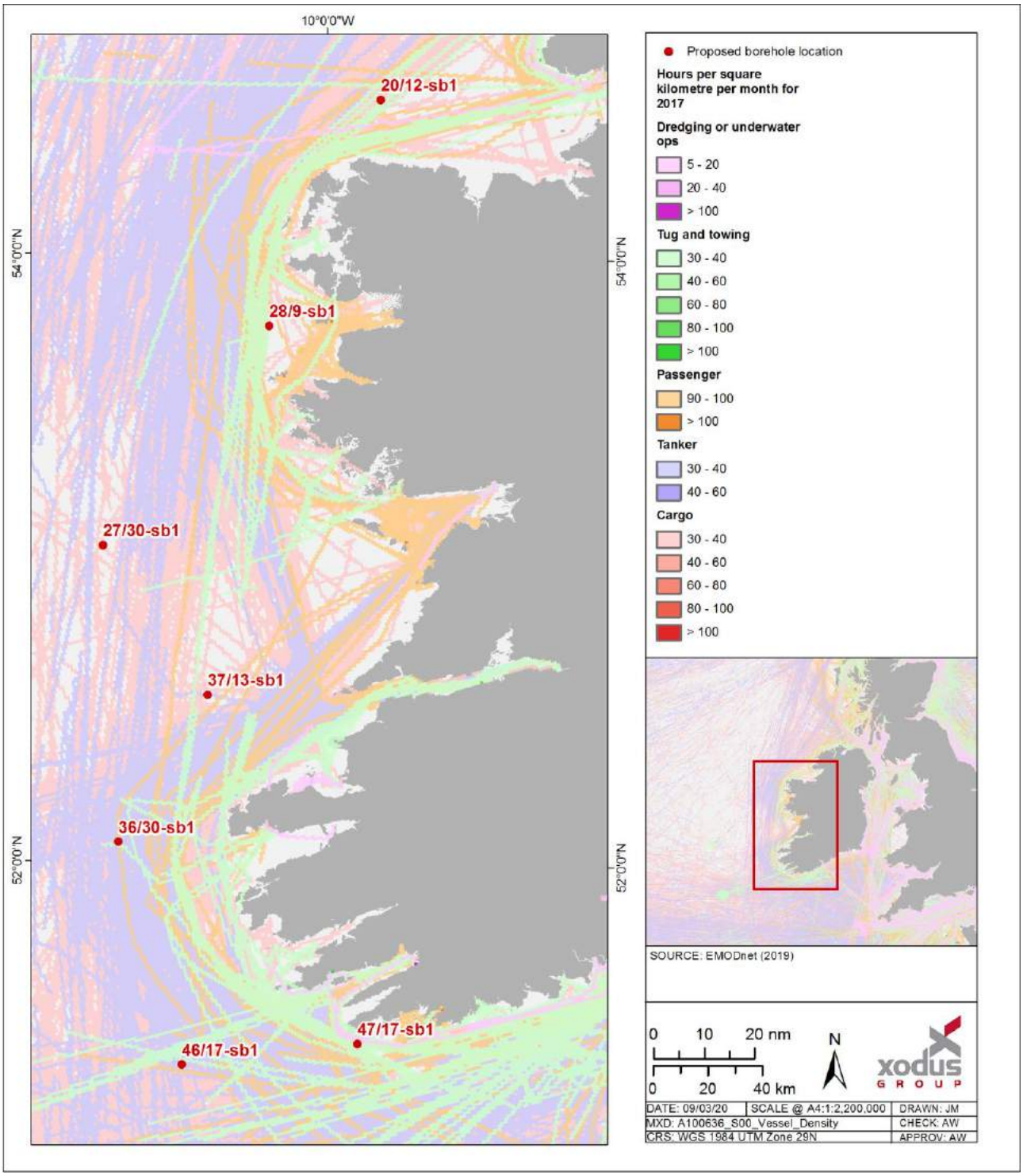


Figure 3-24 Vessel traffic across the Irish Shelf study area (Emodnet, 2017)

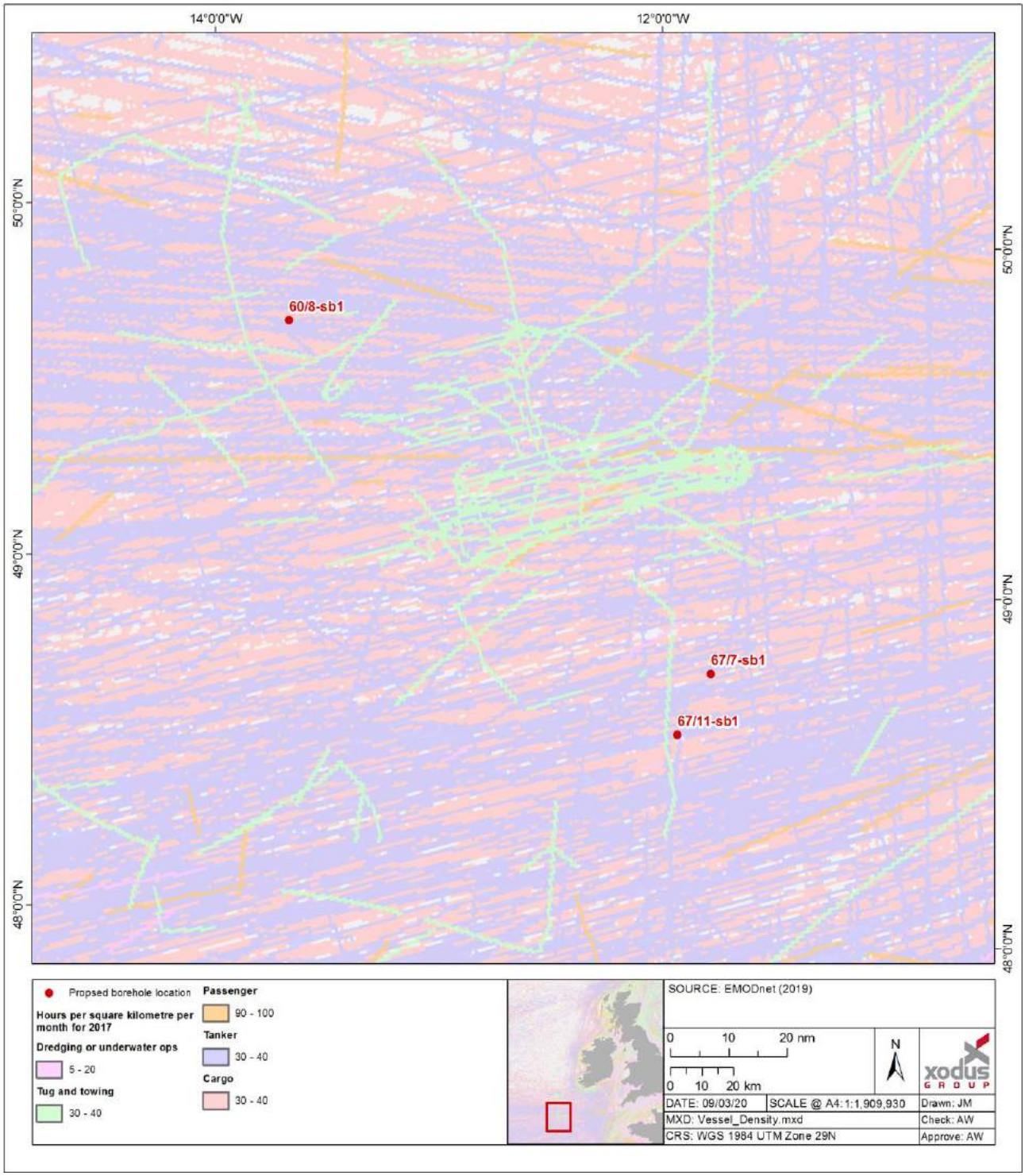


Figure 3-25 Vessel traffic across the Goban spur study area (Emodnet, 2017)

### 3.5.9 Archaeology and Other Infrastructure

The western Irish waters have potential for surviving prehistoric archaeological features and deposits associated with periods of low sea level (DCENR, 2015), with the sheltered areas close to the coast having the highest potential for surviving archaeological features. The greatest proportion of wrecks around the Irish coast lie in inshore areas in depths of less than 50 m due to the greater number of navigational hazards and risks to ships near the coast.

Losses associated with trade routes, the western approaches, fishing and wartime activity have also occurred in the deeper waters to the south and west of Ireland and as such remains may also be anticipated here. The survival of the physical remains of shipwrecks and crashed aircraft on the seabed correlates strongly with sedimentary burial within finer grained sediments. Due to the water depths, wave climate and limited human use of Irish offshore waters, the submerged prehistoric archaeology and palaeolandscape potential of these deep-water areas is likely to be low. However, shipwrecks are likely to represent the chief archaeological resource in the area.

The National Monuments Service Wreck Inventory of Ireland Database (WIID) provides the locations of wrecks within waters to the west of Ireland (National Monuments Service, 2018). Of these, the nearest wrecks (<10 km) to the proposed borehole locations are detailed in Table 3-13 and Figure 3-26 to Figure 3-28 illustrate the locations of wrecks in the three study areas.

Table 3-13 Known wrecks within 10 km of any proposed borehole location (National Monuments Service, 2018)

| Wreck | Nearest Borehole Location | Distance and Direction |
|---|---|---|
| Unknown | 47/17-sb1 | 4 km N |
| La Impatiente | 47/17-sb1 | 5 km NW |
| Taurima | 47/17-sb1 | 5.3 km NW |
| Manacles | 47/17-sb1 | 5.3 km NW |
| Taurima II | 47/17-sb1 | 5.4 km NW |
| Ribble | 47/17-sb1 | 5.4 km NW |
| Bohemian (SS) | 47/17-sb1 | 5.5 km NW |
| Welbury (SS) | 46/17-sb1 | 5.5 km N |
| St. Gervaise | 47/17-sb1 | 5.6 km NW |
| Oswestry (SS) | 47/17-sb1 | 5.9 km NW |
| Warley Pickering (SS) | 46/17-sb1 | 6.1 km SW |
| Memphis (SS) | 47/17-sb1 | 6.3 km NW |
| Adalands (SS) | 46/17-sb1 | 6.9 km SW |
| Manchestor Inventor | 46/17-sb1 | 7.1 km W |
| Unknown | 47/17-sb1 | 7.3 km SW |
| Unknown | 47/17-sb1 | 7.4 km N |
| Queensmore (SS) | 47/17-sb1 | 7.8 km NW |
| Baron Sempill (SS) | 00GS-1 | 7.9 km NW |
| U-49 | PVR B | 8.6 km SE |
| Alyssum (HMS) | 47/17-sb11 | 9.5 km N |
| Seang Choon (SS) | 47/17-sb1 | 3.9 km S |

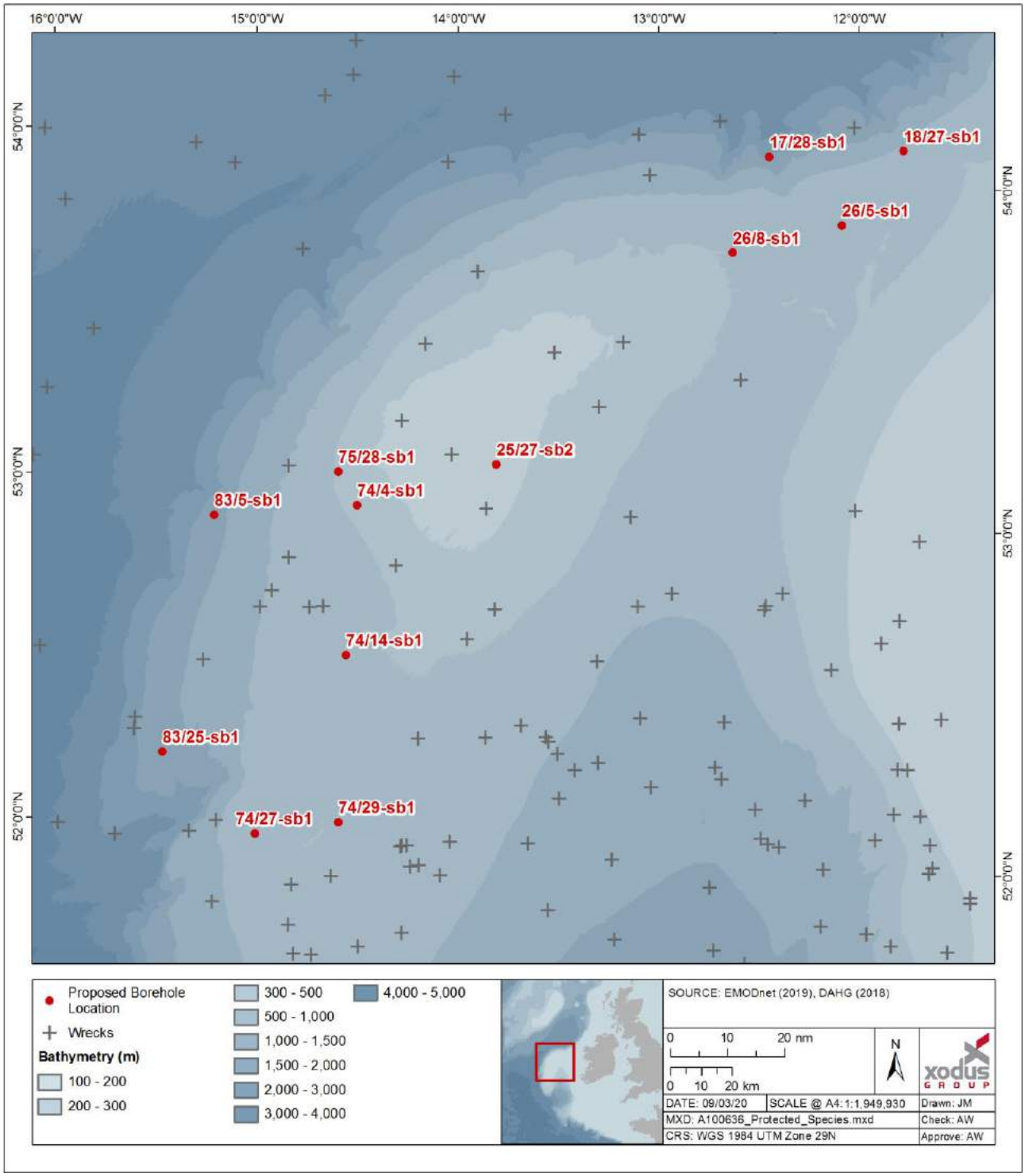


Figure 3-26 Location of wrecks in the Porcupine Bank study area (National Monuments Service, 2018)

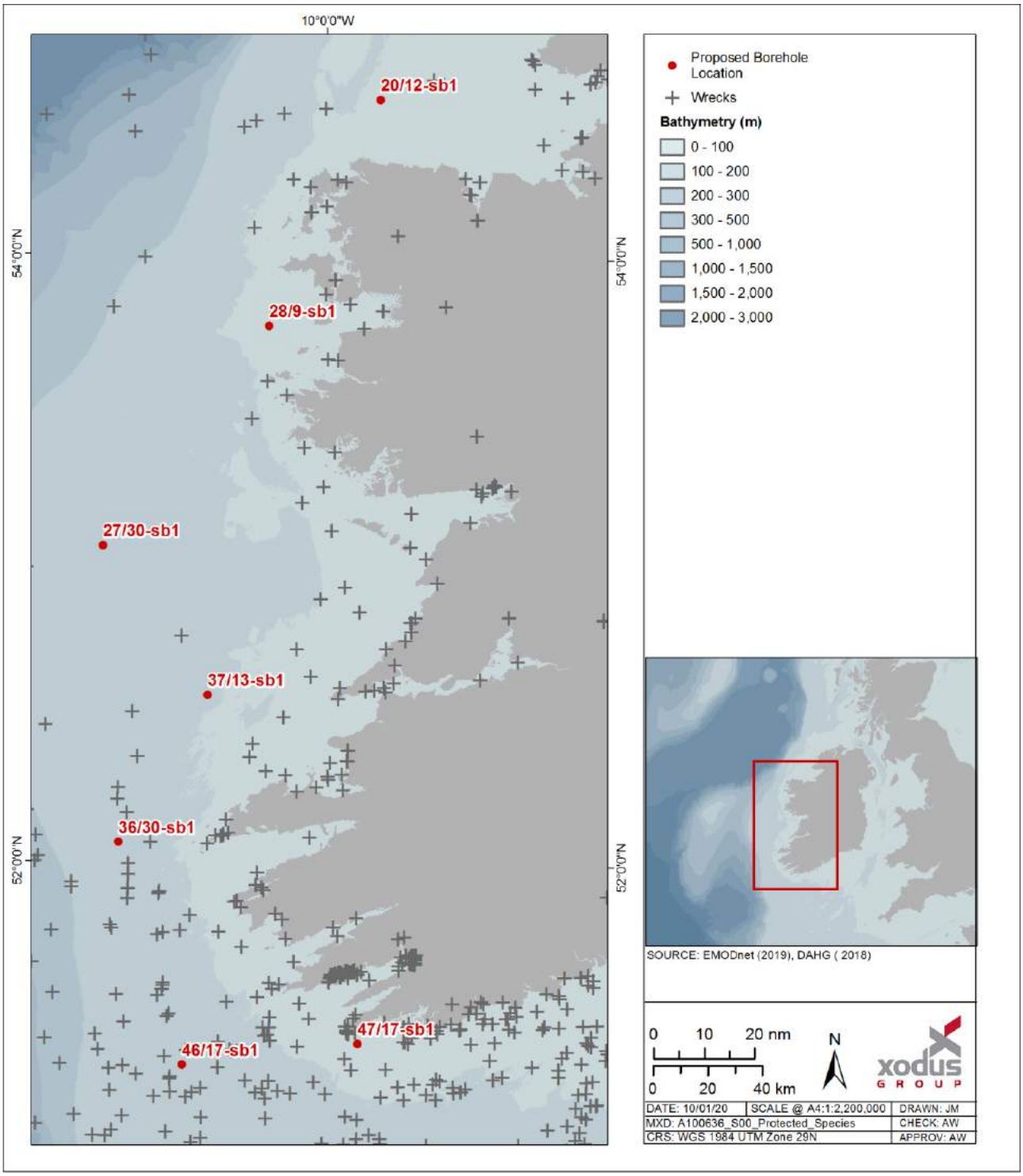


Figure 3-27 Location of wrecks in the Irish Shelf study area (National Monuments Service, 2018)

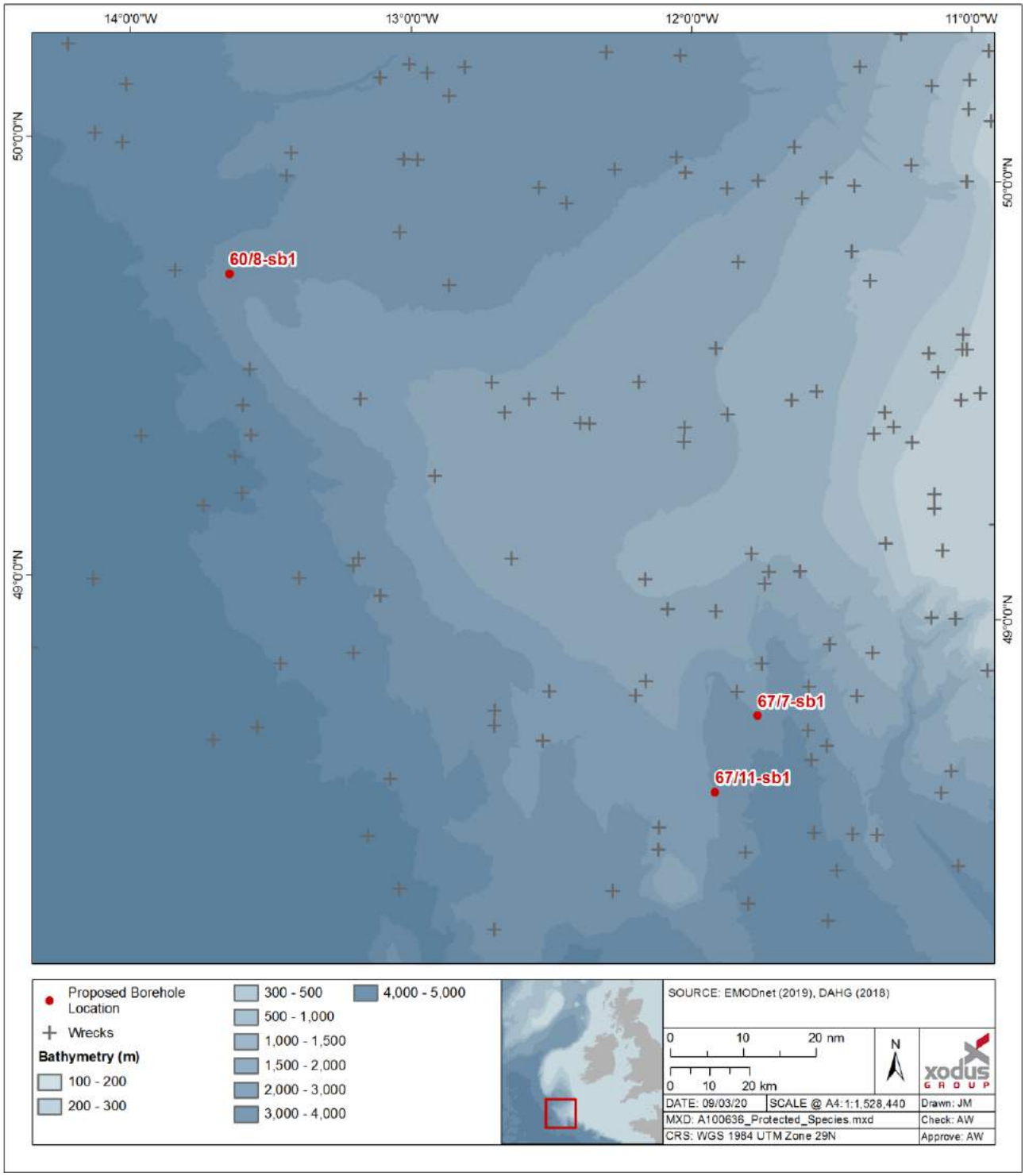


Figure 3-28 Location of wrecks in the Goban spur study area (National Monuments Service, 2018)

### 3.5.10 Recreation

There is unlikely to be any recreational activity close to the proposed borehole locations in the three study areas located in offshore waters (Porcupine bank, Irish Shelf and Goban spur) due to the distance from the coast. Angling is typically limited to depths of 100 m (DCENR, 2007), much shallower than the majority of the proposed borehole locations. The only exceptions to this are 47/17-sb1, 20/12-sb1 and 28/9-sb1, which are located in water of 50-100 m depth.

Tourism in Ireland generated approximately €8.4 billion in 2017 and supported approximately 260,000 jobs (DTTAS, 2018). In 2016, the estimated revenue from overseas visitors was €4.6 billion, of which €1.9 billion was spent in the west coast counties of Donegal, Sligo, Mayo, Galway, Clare, Limerick, Kerry, Cork (Fáilte Ireland, 2018).

# 4 ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY

## 4.1 Introduction

This section describes how the potential environmental impacts associated with the Project have been identified, how Woodside has sought and taken account of the opinions of stakeholders and how these issues have been addressed. Woodside considers environmental risk assessment (ERA) an essential step in good environmental management practice and consequently it is a fundamental part of Woodside's Management System.

Central to a proactive ERA is the requirement to identify potential impacts on the environment or other users of that environment, and to consider potential cumulative and transboundary impacts. Once identified, these must be assessed to define the level of potential risk they present to the environment so that, where necessary, such risks can be removed or reduced through design or the adoption of operational measures (mitigation).

## 4.2 Identification of Environmental Issues

An impact identification exercise was undertaken to identify the possible interactions between the Project activities and the environmental and socioeconomic receptors, the impact mechanisms and the potential impacts or risks requiring further assessment as part of the EIA screening process. The decision as to which issues required further assessment was based on the specific proposed activities, the environmental and socioeconomic sensitivities and consideration of wider stakeholder interests. The findings of the exercise are presented in Section 5.1.

For those potential impacts and risks identified for further assessment, the following methodology was used to determine the potential or otherwise of likely significant effects. The process followed the Woodside Environmental Impact Assessment Guidelines and Woodside's established operational risk management guidelines. As the ERA did not identify a credible scenario for an accidental or unplanned event that would result in a likely significant effect, the methodology described below is that used for planned events only.

## 4.3 Assessment of Significance

The use of a defined methodology framework, as outlined below, makes the assessment of environmental significance as objective and transparent as possible.

Impact assessment encompasses both planned and unplanned events and should therefore account for the full range of both routine impacts and credible risk scenarios associated with an activity. The identification and assessment of risks from unplanned events is managed according to the Woodside Risk Management Procedure and the assessment methods to be used for impacts resulting from planned events is outlined in Woodside's Environmental Assessment Guidelines. The impact and risk significance rankings and methodologies outlined below are based on these Woodside documents. The approach described below has been applied as relevant to the EIA Screening Report.

### 4.3.1 Impact Assessment Considerations

The first stage is to categorise the interaction as either an impact or a risk event based on whether it is likely to result from a planned or routine event, or an unplanned / emergency situation.

### 4.3.2 Planned Events

For each identified impact resulting from a planned/routine event/footprint, the assessment of significance follows a six-stage process (Figure 4-1), which is further described in the sections below.

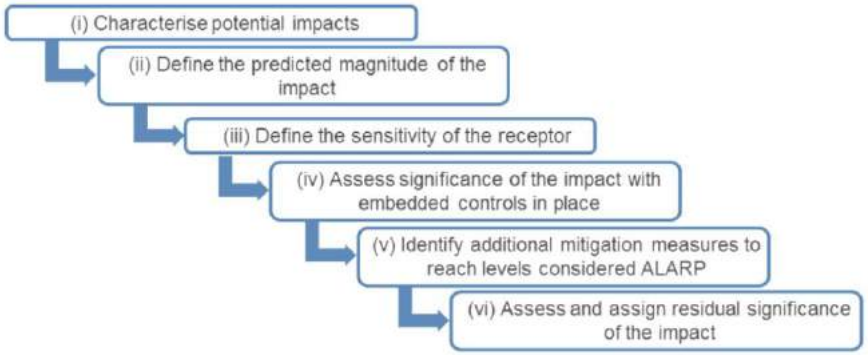


Figure 4-1 Process overview for assessing impacts

#### 4.3.2.1 Characterising Impacts

In order to establish the context for an impact (i.e. the interaction of a planned activity with a receptor, as opposed to the risk from an unplanned event), it is necessary to understand the impact characteristics. Impacts may result from several different processes, all of which need to be considered in the assessment process:

- **Direct** – impacts result from a direct interaction between the activity and the receptor;
- **Indirect** – impacts result from subsequent interactions as a result of a direct interaction e.g. impacts to seagrass or mangrove habitat affecting the viability of species reliant on these habitats;
- **Induced** – impacts result from activities that are a direct consequence of the activity being assessed but not considered part of the activity e.g. impacts due to the influx of people looking to benefit from the establishment of a construction camp;
- **Cumulative** – result from the interaction of impacts from the activity with the impacts from other activities, producing additional (cumulative) impacts e.g. underwater noise from coring interacting with underwater noise from approved seismic surveys in the same area, potentially expanding the likely area of avoidance across key areas or pathways.

Identified impacts are documented in an Environment Impact and Risk Register and the characteristics of the impact recorded, along with the aspect of the activity responsible for the impact and the subsequent definition of impact magnitude and receptor sensitivity.

#### 4.3.2.2 Defining Magnitude

Magnitude is essentially a measure of the predicted change likely to occur as a result of the impact, rated as being negligible, slight, minor, moderate, major or catastrophic. The key drivers for defining the magnitude of an impact are the expected duration and scale of the predicted change. Where relevant, the magnitude of an impact can also take into account the frequency or repetitiveness of the change and whether it has a local, regional or international 'extent'.

Magnitude is defined through a qualitative process based on a consistent set of parameters and is therefore determined based on expert judgement guided by common criteria. The determination of scale and duration should be based on the type of impact being assessed.

As the scale and duration of the predicted change increase, the magnitude of the impact increases. If the change occurs frequently or extends over a regional or international extent, this should also be considered in defining the predicted magnitude of the impact, in order to arrive at a credible assessment of whether the predicted magnitude of the specific impact is judged to be negligible, slight, minor, moderate, major or catastrophic (Table 4-1).

#### 4.3.2.3 Defining Sensitivity of the Receptor

The assessment of impact significance also takes into account the sensitivity of the receiving environment (receptor sensitivity). Sensitivity is again determined on a qualitative basis using expert judgement and is determined to be **low, medium** or **high**. Key considerations in determining the sensitivity of the receptor are:

- **Quality** – is the receptor considered to be relatively high quality, or is it damaged/degraded e.g. the difference between healthy coral reef and bleached or physically damaged reef which is less able to support associated species;
- **Sensitivity to change** – is the receptor highly sensitive to environmental change and less likely to be able to adapt?
- **Importance** – is the receptor considered to be of local, regional or international importance (refer to relevant literature such as the IUCN Red List of Threatened Species)?

The definition of sensitivity should also take into account any relevant legal protection, government policy, stakeholder views or ecosystem services value.

Definitions and guidance for determining receptor sensitivity are given in Table 4-2.

Table 4-1 Environment impact consequence/magnitude guidance table (planned events)

| Magnitude | Marine sediment | Water quality | Air quality | Ecosystems / habitats | Species |
|---|---|---|---|---|---|
| **Catastrophic** | **Permanent** contamination (levels significantly above than relevant standards &/or background) on a **regional** scale that requires >50 years for recovery. | **Permanent** contamination (levels significantly above relevant standards) on a **regional** scale that requires >50 years for recovery. | Air quality significantly above relevant standards causing **permanent** impact to local ecosystem function or human health on a **regional** scale. | **Permanent** impact to ecosystem/habitat service on a **regional** scale that requires >50 years for recovery/ remediation. | **Permanent** impact or eradication of population on a **regional** scale that requires >50 years for recovery |
| **Major** | **Long-term** contamination (levels significantly above than relevant standards &/or background) on a **regional** scale that requires 10-50 years for recovery. | **Long-term** contamination (levels significantly above relevant standards) on a **regional** scale that requires 10-50 years for recovery. | Air quality significantly above relevant standards causing **long-term** impact to local ecosystem function or human health on a **regional** scale. | **Long-term** impacts to Ecosystem/habitat service on a **regional** scale that requires 10-50 years for recovery/ remediation. | **Long-term** impact of population on a **regional** scale that requires 10-50 years for recovery. |
| **Moderate** | **Medium-term** contamination (levels significantly above than relevant standards &/or background) on a **far-field** scale that requires 2-10 years for recovery. | **Medium-term** contamination (levels significantly above relevant standards) on a **far-field** scale that requires 2-10 years for recovery. | Air quality significantly above relevant standards causing **medium-term** impact to local ecosystem function or human health on a **far-field** scale. | **Medium-term** impacts to ecosystem/habitat service on a **far-field** scale that requires 2-10 years for recovery/ remediation. | **Medium-term** impact to population on a **far-field** scale that requires 2-10 years for recovery. |
| **Minor** | **Short-term** contamination (levels above relevant standards &/ or background) on a **near-fiel**d scale that requires 1-2 years for recovery. | **Short-term** Contamination (levels above relevant standards &/or background) on a **near-fiel**d scale that requires 1-2 years for recovery. | Air quality significantly above relevant standards causing **short-term** impact to local ecosystem function or human health on a **near-fiel**d scale that requires 1-2 years for recovery. | **Short-term** impact to ecosystem/ habitat service on a **near-fiel**d scale that requires 1-2 years to recover. | **Short-term** impact to population on a **near-fiel**d scale requiring 1-2 years to recover. |
| **Slight** | **Short-term** contamination (levels above relevant standards &/ or background) on a **near-field** scale that requires <1 year for recovery. | **Short-term** contamination (levels above relevant standards &/or background) on a **near-field** scale that requires <1 year for recovery. | Slight, **short-term** impact to the environment on a **near-fiel**d scale requiring <1 year for recovery. | Slight, **short-term** localised effect on ecosystem/ habitat service on a **near-field** scale with full recovery expected <1 year. | Slight, **short-term** localised impact on species on a **near-field** scale with full recovery expected <1 year. |
| **Negligible** | **Temporary** contamination that is **localised** and requires <1 month for recovery. | **Temporary** contamination that is **localised** and requires <1 month for recovery. | **Temporary** impact to environment that is **localised** requiring <1 month for recovery | **Temporary** impact (hours to 1 month) to ecosystem or habitat that is **localised**. | **Temporary** impact (<1 month) to species that is **localised**. |

Table 4-2 Receptor sensitivity guidance (planned events)

| Sensitivity | Low | Medium | High |
|---|---|---|---|
| | *Highly degraded, low biodiversity value ecosystems or those with a high recovery capacity.* | *Natural ecosystem, species, habitat including ecosystems with slight disturbance/ degradation or those with a moderate recovery capacity.* | *Highly valued ecosystems, species, habitats or physical or biological attributes or those with a low recovery capacity.* |
| **Marine Sediment** | - Port<br>- Contaminated sediment | - Natural state | - Supports area/species of ecological importance (infauna, seagrass) |
| **Water quality** | - Port<br>- Polluted watercourse | - Natural state<br>- Industrial water source (power station) | - Drinking water/domestic water<br>- Supports area/species of ecological importance<br>- Supports unique industry (fishery, aquaculture) |
| **Air quality (incl. odour)** | - Existing pollution (industrial air shed)<br>- Areas where people might be expected to pass through, but exposure for any extended period is unlikely | - Flora/Fauna of moderate susceptibility/ moderate tolerance of air emissions (crops)<br>- Areas or buildings where occasional longer periods of exposure may occur | - Ecological sites (rock art) designated at national/international level<br>- Flora/Fauna of very high susceptibility/ very low tolerance of air emissions (mangroves)<br>- Residential buildings where near-constant presence of people is possible and long-term exposure is likely |
| **Ecosystems/ habitats** | - Commonly occurring habitats (abyssal plain), not subject to significant decline<br>- Pre-disturbed/degraded habitats (existing infrastructure/development) | - Sites of local biodiversity value but not intact, fragile or unique (open water, nearshore) | - Habitats recognised as intact or unique (wetlands) or areas recognised as having high environmental value (Coral reef, mangroves)<br>- Protected area designation, significant part of lifecycle, critical species |
| **Species** | - Widespread common species (Plankton, seagulls) | - Regionally important population of a species, either because of population size or distributional context (pelagic/ demersal fish, reptiles) | - Species listed at a national/international level (Blue whale, migratory birds) |
| **Ecosystem services** | - No third party use | - Other users (shared, routine use, tourism) | -Multiple dependent/subsistence supply, high cultural value |

#### *4.3.2.4 Assessing Impact Significance (Planned Events)*

The significance of an impact is a product of the predicted magnitude of the change and the sensitivity of the affected receptor.

The assessment of significance is undertaken based on embedded (or inherent) controls being in place. These are the controls being implemented as part of the activity in order to meet normal industry standards, health and safety or legislative requirements (e.g. the double-hull on a vessel, segregated drainage, or the factory-fitted sound enclosure around an item of machinery). Embedded controls form part of the activity description and differ from mitigation measures which are subsequently incorporated to address a specific impact (e.g.

restrictions on fuel bunkering in low-light, water spraying to suppress dust during construction or avoiding vessels taking up port facilities during busy periods).

Impact significance is rated from A (the most significant impact) through to F (least significant impact) based on the combination of impact magnitude and receptor sensitivity using the matrix shown in Table 4-3 below. The six levels of impact significance resulting from the assessment process allow comparison between the Environmental Risk Consequence and Environmental Impact Significance in order to deliver consistency between the assessment of Risks and Impacts associated with a specific activity.

Table 4-3 Matrix for assessing impact significance based on magnitude and sensitivity (planned events)

| | **Receptor Sensitivity** | | |
|---|---|---|---|
| **Consequence / Magnitude** | Low | Medium | High |
| Catastrophic | B | A | A |
| Major | C | B | A |
| Moderate | D | C | B |
| Minor | E | D | C |
| Slight | F | E | D |
| Negligible/No lasting effect | F | F | E |

The aim of Impact Assessment is to inform the appropriate management of impacts (e.g. prevent, control, mitigate and/or manage impacts to a level determined to be As Low As Reasonably Practicable (ALARP)), resulting in a Woodside-managed activity, development or production asset which is ultimately deemed to be acceptable and meets the relevant requirements for approval. The significance of an impact provides an indication as to whether further mitigation measures should be considered and also acts as a threshold for internal approvals.

Definitions for each of the potential significance ratings (A to F) are provided in Table 4-4.

Table 4-4 Definition of significance ratings (planned events)

| **Significance** | **Definition** | **Potential impact significance** |
|---|---|---|
| A | Applicable limits or standards are substantially exceeded and/or catastrophic or major magnitude impacts are expected to receptors of medium/high or high sensitivity respectively. For impacts assessed as being of **Significance Level A**, further mitigation is required to reduce the potential magnitude of the impact in order for the activity to proceed. | Considered significant |
| B | Applicable limits or standards are exceeded and/or moderate, major or catastrophic magnitude impacts are expected to occur to receptors of high, medium or low sensitivity respectively. Impacts assessed as **Significance Level B** should be avoided as far as practicable and further control/mitigation measures considered. | Considered significant |
| C | Impacts are close to applicable limits or standards, or within standards but with potential for occasional exceedance. Minor, moderate or major magnitude impacts are predicted to occur to receptors of high, medium or low sensitivity respectively. Further control/mitigation measures should be considered. | Considered significant |

| Significance | Definition | Potential impact significance |
|---|---|---|
| D | Impact magnitude is within applicable standards but is considered to have significance. Slight, minor or moderate impacts are predicted to occur to receptors of high, medium or low sensitivity respectively. It should be shown that an impact of **Significance Level D** has been reduced to ALARP levels and is being managed and monitored effectively. | Further assessment required to determine significance |
| E | The receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and well within applicable standards, and/or the receptor is of low value. An activity can proceed with impacts deemed to be of **Significance Level E**, although impacts should still be managed and monitored. | Not significant |
| F | For an impact of **Significance Level F,** the receptor will essentially not be affected by a particular activity, or the predicted effect is deemed to be indistinguishable from natural background variations. | Not significant |

## 4.4 Stakeholder Consultation

The Woodside engagement process is designed to encourage open and transparent communication and feedback between the company and stakeholders.

The approach to stakeholder engagement for the geotechnical investigation incorporates the requirements of the Rules and Procedures Manual, including pre-submission consultation, fisheries consultation, notifications to fishers via IOOA procedures, statutory consultation during the application for approval, and post-approval consultation. Engagements to date have been completed in line with the above requirements and no material issues have been raised.

A particular focus has been on pre-submission consultations with Irish and international fisheries representatives as part of the Pre-survey Fisheries Assessment (see Section 5.2.2). Pre-submission engagement commenced in early February 2020 with a summary of feedback themes and Woodside's response below (Table 4-5).

Table 4-5 Stakeholder consultation summary <HOLD – Table is not essential and may not be needed>

| Feedback theme | Woodside response |
|---|---|
| Relevant consents and approvals | Woodside communicated that the activity is proposed to be conducted under licence from the DCCAE in accordance with relevant national and European regulations. |
| Presence of a Fishing Liaison Officer (FLO) and Marine Mammal Observer (MMO) onboard the vessel | Woodside communicated that the activity will have a FLO onboard the survey vessel to liaise with fishers during the activity. As there are no geophysical components to this activity, Woodside is not planning to have an MMO onboard the survey vessel. |
| Compensation frameworks and considerations | Woodside communicated that each borehole should take no longer than four days to complete so we do not anticipate there being any impact to fishing ground access or viability. Woodside is therefore not proposing any form of disturbance compensation. |
| Consultation process | Woodside is conducting pre-activity engagement commensurate with the proposed scope. The purpose of pre-activity consultation is to understand if there are any potential impacts from the proposed activity and if so, to use that information to inform our decision making and planning. |

# 5 ASSESSMENT OF POTENTIAL IMPACTS

## 5.1 Interactions Identified for Assessment

Table 5-1 shows the matrix of potential interactions between the Project activities and the environmental and social receptors, developed during the impact identification exercise described in Section 4.2. Table 5-2 considers the impact mechanisms and identifies the potential impacts requiring further assessment as part of the EIA screening process.

Table 5-1 Matrix from issues identification

| Activity/ Hazards | Physical environment | | | Biological environment | | | | | | | | Socio-economic environment | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Seabed Sediments | Air Quality / GHG Emissions | Marine Water Quality | Fish | Marine Mammals | Marine Reptiles | Planktonic Communities | Benthic Habitats and Communities | Protected sites - offshore | Protected sites - coastal | Birds | Fisheries | Navigation and shipping | Underwater archaeology | Other industries |
| Atmospheric emissions – routine vessel air emissions | | | | | | | | | | | | | | | |
| Discharges (aqueous) to sea – routine vessel discharges | | | | | | | | | | | | | | | |
| Discharges (particulate) to sea – cuttings and coring fluids | | | | | | | | | | | | | | | |
| Physical presence of survey vessel (in transit and on location) | | | | | | | | | | | | | | | |
| Physical presence and seabed disturbance – equipment deployed on the seabed, coring operations | | | | | | | | | | | | | | | |
| Underwater noise – DP, coring, USBL | | | | | | | | | | | | | | | |
| Waste generation and disposal – hazardous, non-hazardous, domestic | | | | | | | | | | | | | | | |
| **Accidental events** | | | | | | | | | | | | | | | |
| Release (spillage) or hydrocarbons or chemicals to sea | | | | | | | | | | | | | | | |

| Key | | |
|---|---|---|
| | | An interaction is not reasonably expected. |
| | | An interaction is reasonably possible. |

Table 5-2 Sources of Potential Environmental Impact

| Sources of Impact | Possible Receptor Interactions | Interactions with no potentially significant impacts and not considered further | Potential impacts assessed further |
|---|---|---|---|
| Atmospheric emissions:<br>• Emissions to air from fuel use on the survey vessel | • Air quality<br>• Contribution to greenhouse gases | **Air quality:**<br>Given the low levels of emissions, the short duration of the Project and the offshore location, there will be **no likely significant effects on local or regional air quality**, and this is not assessed further. | **Contribution to greenhouse gas emissions:**<br>Greenhouse gas emissions are, by their nature, cumulative. Although the emissions from the survey vessel are not significant in this context, given the importance of the issue and stakeholder concern, they have been quantified, and mitigation measures identified.<br>➢ **Section 5.5: Atmospheric emissions** |
| Discharges to sea:<br>• Routine discharge of ballast water, blackwater, grey water and food waste from the survey vessel | • Marine water quality<br>• Planktonic communities<br>• Fish | **Marine water quality; planktonic communities; fish:**<br>Routine discharges from marine vessels are typically well-controlled activities that are managed as per the International Maritime Organisation standards.<br>A single survey vessel will be operating for up to 40 days at various open-water offshore locations west of Ireland and represents a negligible increase to shipping activity in the area.<br>Considering the above, there will be **no likely significant effects on marine water quality or biological receptors from routine vessel discharges** are this is not assessed further.<br>The relevant control measures are identified in Section 5.5. | Not applicable |
| Discharges to sea: | • Seabed sediments<br>• Marine water quality | **Marine water quality; planktonic communities; fish:**<br>Given the small size of the boreholes, the very low toxicity of the fluids and the very small | **Seabed sediments; benthic habitats and communities:**<br>Potential impacts from the settlement of cuttings on seabed sediments, benthic habitats |

| Sources of Impact | Possible Receptor Interactions | Interactions with no potentially significant impacts and not considered further | Potential impacts assessed further |
|---|---|---|---|
| • Discharges of cuttings and coring fluids at the seabed | • Planktonic communities<br>• Fish<br>• Benthic habitats and communities | quantities of cuttings generated, there will be **no likely significant effects on marine water quality or biota from cuttings or coring fluid discharges and this is not assessed further**, although the relevant control measures are identified in Section 5.5. | and communities are assessed, together with the mitigation measures.<br>➢ **Section 5.2.2: Seabed impacts – benthic habitats and communities** |
| Physical presence:<br>• Survey vessel (in transit and on location) | • Marine mammals<br>• Marine reptiles<br>• Fisheries<br>• Navigation and shipping | **Marine mammals; marine reptiles:**<br>Project activities will not take place within any areas protected for marine fauna.<br>A single survey vessel will be operating for up to 40 days at various open-water offshore locations west of Ireland and represents a negligible increase to shipping activity in the area.<br>Considering the above, there will be **no likely significant effects on marine fauna from the physical presence of the vessel** and this is not assessed further.<br>The potential for underwater noise impacts is discussed separately below. | **Fisheries; navigation and shipping:**<br>Woodside has consulted with fishery representatives and the potential impacts on fisheries are addressed in Section 5.2.4. Interactions with shipping generally are also considered in this section.<br>➢ **Section 5.2.4 Interactions with other sea users** |
| Physical presence and seabed disturbance:<br>• Equipment deployed on the seabed<br>• Coring operations | • Seabed sediments<br>• Fish<br>• Benthic communities and habitats<br>• Underwater archaeology<br>• Fisheries | **Fish:**<br>The placement of a seabed frame on the seabed, as well as the coring activities themselves, has the potential for very localised direct impacts on the seabed and associated communities. In addition, any sediment plumes raised during activities may lead to temporary increases in suspended particles in the water column close to the seabed. The survey vessel will not use anchors. | **Seabed sediments; benthic communities and habitats:**<br>Potential impacts on benthic habitats and communities from the temporary deployment of equipment on the seabed are addressed, together with the mitigation measures.<br>➢ **Section 5.2.2: Seabed impacts – benthic habitats and communities**<br>**Underwater archaeology:** |

| Sources of Impact | Possible Receptor Interactions | Interactions with no potentially significant impacts and not considered further | Potential impacts assessed further |
|---|---|---|---|
| | • Telecommunication cables | The equipment will be in place for 1.5 to 4 days at each location, after which recovery from any disturbance is expected to be rapid. There will be **no likely significant effects on fish from seabed disturbance** and this is not assessed further. | Although none of the boreholes are located near any known wrecks, the mitigation in place to avoid interaction with any chance finds is presented.<br>➢ **Section 5.2.3: Seabed impacts – underwater archaeology**<br><br>**Fisheries; telecommunication cables:**<br>The seabed equipment is expected to be within the temporary 500 m safety zone around the vessel and therefore there are unlikely to be any issues with snagging of fishing gear. Woodside has consulted with fishery representatives and the potential impacts on fisheries are addressed. Potential interactions with telecommunication cables and mitigation measures are also addressed.<br>➢ **Section 5.2.4: Interactions with other sea users** |
| Underwater noise:<br>• Continuous noise sources (vessel use of DP)<br>• Impulsive noise sources (USBL) | • Fish<br>• Marine mammals<br>• Marine reptiles<br>• Coastal protected sites | **Fish; marine reptiles:**<br>Project activities will not take place within any areas protected for marine fauna. There are limited underwater noise issues with the Project as no acoustic survey equipment will be deployed. Underwater noise generation is limited to vessel and coring noise and use of USBL positioning equipment.<br>A single survey vessel operating for approximately 40 days at various open-water offshore locations west of Ireland represents a negligible increase to shipping activity in the area. | **Marine mammals; coastal protected sites:**<br>An assessment of potential impacts on marine mammals from the limited underwater noise associated with the Project is presented in Sections 5.3 and 6.<br>The focus is on species listed in Annex IV of the Habitats Directive and species associated with coastal SACs that could occur in the vicinity of the coring activities.<br>➢ **Section 5.3 Underwater noise** |

| Sources of Impact | Possible Receptor Interactions | Interactions with no potentially significant impacts and not considered further | Potential impacts assessed further |
|---|---|---|---|
| | | There will be **no likely significant effects on fish or marine turtles from underwater noise** and this is not assessed further. | |
| Waste generation and disposal from the survey vessel (non-hazardous, hazardous, domestic). | None identified additional to those for discharges to sea | Disposal of applicable waste to sea from the survey vessel is discussed above under routine discharges to sea. All other waste such as hazardous and non-hazardous solid waste will not be disposed to sea and will be managed according to relevant legislation.<br>Information is provided in Section 2.5 of the project description, Section 5.5 and Section 6 Environmental management, but **there will be no likely significant effects from waste generation,** and this is not assessed further in Section 5. | Not applicable |

In addition to the planned activities considered in Table 5-2, consideration was also given to the risk of an accidental release of fuel or coring fluids to sea. The risk from releases of fuel during bunkering is removed as there will be no offshore bunkering (Section 2.3). A hydrocarbon spill due to loss of fuel inventory following a vessel collision would require the following sequence of events:

- A cause of vessel interaction must result in a collision;
- The collision must have enough force to penetrate the vessel hull;
- The collision must be in the exact location of the fuel tank; and
- The fuel tank must be full, or at least of volume whereby the fuel level is higher than the point of penetration.

The probability of this chain of events aligning to result in a breach of fuel tanks resulting in a spill that could potentially affect the marine environment is considered remote and therefore such a release is not considered a credible scenario.

The only credible type of accidental release from the Project is the spillage of hydrocarbons (diesel fuel, hydraulic oil and lubricants) or chemicals (coring fluids) from vessel decks during storage or handling. Only relatively small amounts of fuel or chemicals could be released in this way, and measures will be in place to prevent or respond to any such releases. Given the short duration of the Project and the low risks to the environment from accidental releases, it is concluded that **significant environmental effects associated with hydrocarbon or chemical spills can be discounted** and are not considered further in this assessment. However, the relevant control measures are documented in Section 5.6.

## 5.2 Physical Presence

### 5.2.1 Introduction

The physical presence of the survey vessel, the seabed frame and the boreholes themselves have the potential to result in:

- Impacts to the seabed namely benthic habitats and species and underwater archaeology; and
- Interference with other shipping, navigation and fishing activities that may occur in the area.

Assessments of the potential impacts to these receptors are presented in Section 5.2.2.1 below.

### 5.2.2 Seabed Impacts - benthic habitats and communities

#### *5.2.2.1 Potential Impacts*

The proposed activities (as detailed in Section 2) have the potential to disturb the seabed. The key activities that may interact with the seabed area are:

1. Deployment and positioning of the seabed frame or PROD unit onto the seabed at each borehole location; and
2. The deposition and settlement of cuttings onto the seabed at each borehole location.

The above activities have the potential to lead to changes in the seabed habitat, which could have positive or negative impacts on the biota within the physical footprint of such activities, including:

- Direct loss of benthic species and seabed habitat; and
- Wider indirect disturbance to the benthic environment through the suspension and re-settlement of sediments.

The coring of the boreholes will be conducted using either a geotechnical survey vessel or a seabed coring system deployed from a multi-purpose supply vessel which will maintain position using a DP system. As the

survey vessel will not use anchors to maintain position, disturbance to the seabed from the use of equipment will be limited to the temporary placement of the seabed frame at each borehole location.

Note that the potential impact of the deposition of cuttings and coring fluids onto the seabed is discussed in Section 5.5. This section is therefore only concerned with the physical impacts to the seabed associated with the use of the coring equipment as noted in item 1 above.

As discussed in Sections 3.2.3, the seabed in the study areas consists predominantly of soft sediments ranging from sands to muds, generally becoming finer with increasing water depth, and with varying levels of coarse material (gravel, pebbled, cobbles and isolated boulders). None of the borehole locations are situated within or adjacent to protected areas designated for seabed habitats. No records of sea-pens and burrowing megafauna habitat, biogenic reefs or deep-sea sponge aggregations have been recorded within 15 km of the proposed borehole locations.

Predictive habitat mapping indicates that the borehole locations have a low probability of encountering cold water corals. Of the Annex I habitats occurring in the Irish Atlantic margin which could potentially be encountered during the geotechnical investigation, cold water coral reefs are the most vulnerable to physical damage as they are slow growing.

The closest known pockmarks to any proposed borehole location is at a distance of approximately 20 km (Section 3.2.3.1.2). Pockmarks are considered geohazards and therefore the borehole locations will avoid such features, with confirmation made by drop-down camera as noted in Section 5.2.2.2.

The area directly affected will be highly localised within the footprint of the seabed frame at up to 22 borehole locations. Any sessile epifauna on which the frame is placed may be damaged or lost. In very soft sediments, as may be encountered at the deepest borehole locations, the frame may penetrate a few centimetres into the sediment which may cause displacement or loss of individual infauna (animals that burrow into the sediment or form tubes within it) such as polychaete worms The frame will remain in position for up to four days, after which it will be recovered, and nothing will be left on the seabed. In very soft sediments, small depressions may be left in the seabed. Recovery from the minor disturbance is expected to begin immediately due to natural processes.

The seabed disturbance described may also result in sediment suspension and re-settlement beyond the direct footprint of the coring equipment but, given the scale and duration of seabed disturbance during the above activities, will be extremely limited in extent. The re-settlement of sediments may result in the smothering of epifaunal species (see Gubbay, 2003 for a review) with the degree of impact related to their ability to clear particles from their feeding and respiratory surfaces (e.g. Rogers, 1990). However, Defra (2010) states that impacts arising from sediment re-suspension are short-term (generally over a period of a few days to a few weeks). In addition, infaunal communities, which are dominant in soft sediments, are naturally habituated to sediment transport processes and are therefore less susceptible to the impacts of temporarily increased sedimentation rates.

#### *5.2.2.2 Mitigation Measures*

Woodside will take measures to avoid or reduce any potential impacts of the Project on the seabed:

- No anchors will be deployed;
- A drop down underwater video of each borehole location will be undertaken prior to deployment of the frame on the seabed, to check the proposed location is free of hazards and that there are no cold water coral reefs present; should these features be present, the frame will not be lowered onto the seabed and coring activity will not take place at that location;
- The seabed frame will be accurately positioned on the seabed at each pre-determined borehole location where safe and practicable to do so, reducing any seabed impacts where possible. All deployment and recovery activities will be undertaken as per pre-determined procedures and Vessels Manual of Permitted Operations (MOPO).

#### *5.2.2.3 Residual Impacts*

The area of seabed potentially affected by the use of coring equipment is assessed as being limited to approximately 12-25 $m^2$ at each borehole location which totals to approximately 264-550 $m^2$. Borehole coring

activities may also result in sediment re-suspension and re-settlement around the edges of the direct footprint of the coring equipment. To estimate the area likely to be influenced by potential sediment suspension and re-settlement around activities causing seabed disturbance, it has been assumed that this is likely to occur within a radius of 10 m of the edge of the borehole. On this basis, the area where an indirect residual impact may occur as result of sediment disturbance is estimated to amount to less than 500 $m^2$. The suspension and re-settlement of sediment plumes and resultant smothering of sediments and fauna will be localised and only temporary in nature, limited to a few days at most at each borehole location.

Considering the small scale and temporary nature of the seabed impact, the mitigation to avoid sensitive habitats and the potential for rapid recovery once each borehole is completed, the consequence of the impact is considered to be '**slight**' and the receptor sensitivity ranked as **'low'**. It is therefore considered that the residual significance level of impacts to seabed habitats and species is ranked as **'negligible/no lasting effect'** and considered to be '**not significant**'.

### 5.2.3 Seabed Impacts - underwater archaeology

#### *5.2.3.1 Potential Impacts*

Project activities have the potential to damage any features of archaeological interest that may be present within the immediate footprint of the seabed frame that will be placed on the seabed temporarily at each borehole location. The potential for impact to features of archaeological interest from deposition of cuttings is not considered to be of significance since the deposition of cuttings in itself is unlikely to damage any archaeological features.

As outlined in Section 3.5.9, shipwrecks are likely to represent the chief archaeological resources in the offshore areas west of Ireland. The greatest density of wrecks is in the southern part of the Irish Shelf study area. The two nearest recorded wrecks are located approximately 4 km from borehole 47/17-sb1 (Table 3-13).

#### *5.2.3.2 Mitigation Measures*

Woodside has identified the following measures to mitigate the possibility of any damage or disturbance to features of archaeological significance:

- No anchors will be deployed;
- A drop down underwater video of each borehole location will be undertaken prior to placement of the frame on the seabed, to check the proposed location is free of hazards and that there are no features of archaeological interest; if any potential marine artefacts are observed, the frame will not be lowered onto the seabed and coring activity will not take place at that location;
- The seabed frame will be accurately positioned on the seabed at each pre-determined borehole location where safe and practicable to do so, reducing any impacts at the seabed where possible. All deployment and recovery activities will be undertaken as per pre-determined procedures and Vessels Manual of Permitted Operations (MOPO).
- If a discovery of a shipwreck or object of historical interest is made during the above process, Woodside will immediately report the discovery and its location to the relevant Government Departments and Agencies identified by PAD (2014) in the Rules and Procedures Manual.

#### *5.2.3.3 Residual impacts*

Considering the very small area of potential seabed impact from the coring activities and the absence of known wrecks at the borehole locations, is it extremely unlikely that any features of archaeological importance will be present at the proposed locations. Given the measures to be implemented, the risk to features of archaeological importance is negligible.

## 5.2.4 Interactions with Other Sea Users

### *5.2.4.1 Potential Impacts*

During the Project, the presence of the survey vessel has the potential to interfere with other shipping, navigation and fishing activities that may occur in the area. The survey vessel will not have any towed equipment or conduct activities along survey lines. The 22 borehole locations are distributed throughout the Irish Atlantic Margin and the vessel is expected to visit each one for 1.5 to 4 days.

In addition, two of the proposed boreholes lie 4 km or less from a telecommunications cable on the seabed and the risk of damage to the cables needs to be considered.

#### 5.2.4.1.1 Increased vessel traffic and collision risk

The temporary physical presence of the survey vessel has the potential to interfere with other sea users that may be present in the area, including increasing the risk of vessel collisions.

The Project is expected to start between June and early August 2020 and will take up to 40 days including operational time, transit between locations and allowances for weather downtime.

#### 5.2.4.1.2 Temporary exclusion

Whilst the survey vessel is on location, a temporary 500 m radius safety zone will be maintained around it at each borehole location. The purpose of the safety zone is to ensure the safety of all personnel involved in the Project and to minimise the risk of collisions between the survey vessel and other vessels in the area. As such, the 500 m safety zone (with an area of approximately 0.8 $km^2$ around each borehole location) will exclude other sea users, including fisheries, for a period of 1.5 to 4 days at each borehole location. The longer duration applies to those boreholes in deep water. The safety zone will not be maintained once each borehole is complete.

All seabed equipment is expected to be within the 500 m safety zone around the survey vessel when it is on location, and therefore there are unlikely be any issues with snagging of fishing gear.

#### 5.2.4.1.3 Telecommunication cables

As detailed in Section 3.5.6, one of the boreholes (60/8-sb1) is located approximately 1 km north of the FLAG Atlantic North cable. A further borehole (20/12-sb1) lies 4 km from an AE Connect cable. Placement of the seabed frame and subsequent coring activities have the potential to damage such cables.

Given the very small footprint of the coring activities, it is extremely unlikely that there would be any interaction with telecommunications cables at these distances.

### *5.2.4.2 Mitigation Measures*

#### 5.2.4.2.1 Increased vessel traffic and collision risk; temporary exclusion

A number of mitigation measures will be employed to minimise the impact of increased vessel traffic and collision risk resulting from the Project:

- Dissemination of information to fishery stakeholders to commence as early as possible by way of providing a stakeholder consultation information sheet to the relevant fishers in Ireland. In the case of other EU nationalities, the information sheet (available in French and Spanish) will be distributed to fishing organisations in countries identified in the landings data in sufficient time outlining details of the planned operations.
- A Marine Notice will be published by the Department of Transport, Tourism and Sport (DTTAS) before the Project commences.
- Daily Radio Navigation Warnings will be broadcast during survey operations.
- Notification of the geotechnical investigation will be given in detail in a Notice to Fishermen which will be published in the relevant fishing journals and online portals (e.g. The Marine Times, The Irish Skipper,

Kingfisher Fortnightly Bulletin). These publications have a wide UK, Scottish and Irish fishing industry audience and readership.

- A safety zone will be maintained around the survey vessel whilst on location, when it is restricted in its ability to manoeuvre.
- A dedicated Fisheries Liaison Officer (FLO) will be on board the survey vessel for the duration of the investigation with onshore support available, including the ability to liaise with foreign vessel owners if required.
- The survey vessel will issue Sécurité messages over VHF radio as required.
- The survey vessel contractor will ensure that the survey vessel will follow the rules set out in IMO Convention on the International Regulations for Preventing Collisions at Sea, 1973 (COLREGs).
- Where possible, and in order to avoid potential confusion, coordinates which are shared with the fishing industry will be provided in WGS84 Latitude - Longitude format.
- The survey vessel will display SOLAS compliant lights and shapes and noise signals to alert other seafarers in the area.

5.2.4.2.2 Telecommunication Cables

- No anchors will be deployed.
- Woodside will obtain specific, prior written consent from DCCAE to conduct activities within 4 km of the active cables.
- A drop-down underwater video of each borehole location will be undertaken prior to placement of the frame on the seabed, to check the proposed location is free of hazards including any cables; should any cables be present, the frame will not be lowered onto the seabed and the coring activity will not take place at that location.
- The seabed frame will be accurately positioned on the seabed at each pre-determined borehole location where safe and practicable to do so. All deployment and recovery activities will be undertaken as per pre-determined procedures and Vessels Manual of Permitted Operations (MOPO).

#### *5.2.4.3 Residual Impacts*

5.2.4.3.1 Increased vessel traffic and collision risk

Although there will be an increase in the number of vessels in the area during the Project, these activities will only be of a relatively limited duration. As noted in the mitigation measures above, standard communication and notification procedures will be in place to ensure that all vessels operating in the area are aware of the activities, including the presence of the survey vessel.

Offshore, in the Porcupine Bank and Goban Spur study areas the majority of the shipping traffic consists of transatlantic cargo shipping routes running east-west and relatively light traffic levels. However, over the Irish Shelf the majority of the shipping routes consist of both cargo and tanker routes running north-south in direction across the whole study area and experiences high traffic levels in comparison (Figure 3-23, Figure 3-24 and Figure 3-25).

With the limited vessel requirements and the mitigation measures to be employed, there is little increase in the risk of vessel collision as a consequence of increased vessel activities from the Project. In addition, the Project is small and temporary, and there is ample sea room around the Project location for route adjustments through the Project duration. Through the implementation of the proposed mitigation the overall consequence of a physical presence impacts resulting from increased vessel traffic and collision risk as a result of the Project is '**Low**. It is therefore considered that the residual significance level of impacts resulting from increased vessel traffic and collision risk is ranked as **'negligible/no last effect'** and considered to be '**not significant**'.

5.2.4.3.2 Temporary exclusion

As outlined in Section 5.2.4.2 vessels will be temporarily excluded from an area of approximately 0.8 km$^2$ (around each borehole location) around the survey vessel as a result of the Project. Taking into account the localised and temporary nature of the access restrictions for a period of up to a maximum of 40 days posed by the Project and the low level of vessel traffic, the overall consequence of interference with fishing and shipping activity is considered to be is '**low**. It is therefore considered that the residual significance level of impacts resulting temporary exclusion is ranked as **'negligible'** and considered to be '**not significant**'.

#### 5.2.4.3.3 Telecommunication cables

The mitigation measures described in Section 5.2.4.2 will reduce the likelihood of any interactions during borehole 60/8-sb1 and 20/12-sb1 coring activities with the FLAG Atlantic North cable or AE Connect cable respectively. Taking into account the highly localised nature of activities planned at these borehole location, and that these cables are at least 1 km away from the borehole activities, the overall consequence of interference with the FLAG cable is considered to be is '**low**. It is therefore considered that the residual significance level is ranked as **'negligible'** and considered to be '**not significant**'.

## 5.3 Underwater Noise

### 5.3.1 Introduction

Sound in the marine environment is generated by natural sources such as rain, breaking waves and marine life, including whales, dolphins and fish; this is known as ambient noise and it varies within the marine soundscape. Human use of the marine environment adds additional sound from numerous sources including shipping, oil and gas exploration and production, aircraft and military activity, installation of marine structures, recreational watercraft and many others. Anthropogenic sounds that exceed ambient noise levels have the potential to impact marine species by disrupting normal biological, physiological or behavioural activities.

Many species found in the marine environment use sound to understand their surroundings, track prey and communicate, and this is most pronounced in the marine mammal taxa. Toothed whales, dolphins and porpoises are able use sound to build up an image of their environment and to detect prey and predators through echolocation.

Exposure to natural sounds in the marine environment may elicit responses in marine species; for example, harbour seals have been shown to respond to the calls of killer whales with anti-predator behaviour (Deecke *et al.,* 2002). In addition to responding to natural sounds, marine species may also respond to man-made noise. For example, bottlenose dolphins have been shown to modify their acoustic activity in areas of heavy marine traffic by reducing their call rate during the passage of operating vessels (Luís *et al*., 2014). Whilst there is a lack of species-specific information on behavioural response collected under controlled or well-documented conditions, enough evidence exists to suggest that sound may elicit potentially biologically-important impacts to marine mammals and that noise from man-made sources may affect animals to varying degrees depending on the sound source, its characteristics and the susceptibility of the species present (e.g., Nowacek *et al*., 2007).

In addition to potential behavioural impacts of noise, marine mammals exposed to an adequately high sound source may experience a temporary shift in hearing ability (termed a temporary threshold shift; TTS) (e.g., Finneran *et al.,* 2005). In some cases, the source level may be sufficiently high such that the animal exposed to the sound level might experience physical damage to their hearing apparatus and the shift in hearing ability may become irreversible (termed a permanent threshold shift; PTS) (Southall *et al.,* 2007; Southall *et al.,* 2019).

Underwater noise sources associated with the Project which have the potential to illicit marine mammal response include:

1. Survey vessel (utilising DP and borehole coring equipment); and
2. USBL.

This section assesses the potential impacts from the proposed activities above on marine mammals, including cetaceans and pinnipeds (seals).

Borehole coring operations and vessel activities are characterised as continuous noise sources, whereas USBL noise is impulsive (i.e. a series of discrete pulsed sounds). Source sound levels are normally described in decibel (dB) re 1 µPa at 1 m (as if measured at 1 m from the source). In practice, it is not usually possible to measure at 1 m from an active noise source that is physically distributed over an area of several square metres. However, this method allows different source levels to be compared and reported on a standardised scale. The noise source data used in the noise assessment for USBL are summarised below.

### 5.3.2 Potential Impacts

#### *5.3.2.1 Criteria for onset of TTS and PTS*

Sound propagation calculations (as described in Section 5.3.2.2) allow the received noise level from the source to be determined at different distances. To determine the potential consequence of these received levels on any marine mammal exposed to introduced sound(s) it is necessary to relate the levels to known or estimated potential impact thresholds. A number of thresholds or methods for determining thresholds exist (e.g. the $dB_{ht}$ method described by Nedwell *et al*., 2007, Southall *et al.,* 2007 and Finneran, 2016) and each has advantages and disadvantages.

The DAHG guidance (NPWS, 2014), alongside other guidance such as that from Marine Scotland (2014), recommends using the hearing criteria proposed by Southall *et al*. (2007) to define PTS and TTS in marine mammals. However, it is important to note that, whilst UK and US regulators interpret the PTS values to be indicative of potential injury impacts from underwater sound (Marine Scotland, 2014; NOAA, 2018), the DAHG guidance interprets TTS criteria as having the potential for both injury and disturbance (NPWS, 2014).

The recommended criteria from Southall *et al.* (2007) are based on a combination of linear (i.e. un-weighted) peak pressure levels and mammal hearing-weighted (M-weighted) sound exposure levels (SEL). The M-weighting function is designed to represent the bandwidth within which the species represented by a particular hearing group are most sensitive to acoustic exposures, thus having the greatest potential to have auditory impacts.

Based on current knowledge of functional hearing in marine mammals, Southall *et al*. (2007) defined five distinct, functional hearing groups. The hearing groups relevant to the Project include low-, mid- and high-frequency cetaceans (including whales, dolphins and porpoises) and pinnipeds in water (including seals, walruses and similar animals). Species known to be found within the region of the Project (see Section 3.3.5) have been classed into the hearing groups as follows[1]:

- **Low-frequency cetaceans**: Sei whale, blue whale, minke whale and fin whale; with an estimated hearing range of 7 hertz to 22 kilohertz;
- **Mid-frequency cetaceans**: Risso's dolphin, short-beaked common dolphin, white-beaked dolphin, striped dolphin, bottlenose whale, beaked whales, Atlantic white-sided dolphin, bottlenose dolphin, false killer whale, killer whale, long finned pilot whale and the sperm whale with an estimated hearing range of 150 hertz to 160 kilohertz;
- **High frequency cetaceans**: harbour porpoise; with an estimated hearing range of 200 hertz to 180 kilohertz; and
- **Pinnipeds in water**: harbour seal and grey seal; with an estimated hearing range of 75 hertz to 75 kilohertz.

The hearing threshold criteria (i.e. PTS and TTS) defined for each hearing group proposed in Southall *et al*. (2007) have been characterised for three different types of sound. These sound types include:

- **Multiple pulsed sound** (i.e. sound comprising two or more discrete acoustic events per 24 hour period, such as impact piling or USBL positioning beacons);

[1] These hearing group names have been modified by Southall *et al* (2019) to better align with acoustic terminology and representative hearing data. 'Mid-frequency cetaceans' are referred to as 'high-frequency cetaceans', 'high-frequency cetaceans' are now 'very-high frequency cetaceans', and 'pinnipeds in water' have become 'phocid carnivores in water' therein. For the purposes of following the DAHG guidance, the Southall *et al.* (2007) paper's suggested nomenclature has been followed (NPWS, 2014).

- **Single pulsed sound** (i.e. a single acoustic event in any 24-hour period, such as an underwater explosion); and
- **Continuous sound** (i.e. non-pulsed sound such as continuous running machinery, vessels or drilling).

In relation to the potential noise sources from the Project, USBL is considered to be a multiple-pulsed source type and vessel and coring operations are non-pulsed (i.e. continuous) source type.

The relevant criteria proposed by Southall *et al.* (2007) for assessing the potential for PTS due to multiple and single pulsed sounds are considered to be an un-weighted peak pressure level of 230 dB re 1 µPa and an M-weighted cumulative SEL of 198 dB re 1 $\mu Pa^2s$ for all cetaceans. The criteria for pinnipeds are an un-weighted peak pressure level of 218 dB re 1 µPa and an M-weighted cumulative SEL of 186 dB re 1 $\mu Pa^2s$. These criteria values are derived from values for onset of TTS with an additional allowance of +6 dB for peak sound and +15 dB for SEL to estimate the potential onset of PTS. Southall *et al.* (2007) states that these thresholds represent suitable levels for a precautionary approach to risk from human-induced hearing impacts to marine mammals. However, the paper also cautions that there is not sufficient data to identify a clear relationship between auditory sensitivity and hearing damage (Southall *et al.*, 2007; Southall *et al.*, 2019).

For continuous sound, the relevant criteria proposed by Southall *et al*. (2007) for the onset of PTS are an un-weighted peak pressure level of 230 dB re 1 µPa and an M-weighted SEL of 215 dB re 1 µPa2s for all cetaceans. The criteria for pinnipeds are an un-weighted peak pressure level of 218 dB re 1 µPa and an M-weighted SEL of 203 dB re 1 µPa2s.

It is important to note that the above criteria were developed using a precautionary approach, meaning that:

- The criteria do not take into account the potential for recovery in hearing between subsequent pulses or days of exposure, and are therefore likely to overestimate hearing damage caused by time varying exposure;
- The M-weighting curves are heavily generalised, in that they emphasise the frequency range at which each hearing classification is deemed to be most sensitive. In reality, the hearing threshold audiograms for individual mammal species will not adhere to this shape, but will instead comprise a much narrower “trough” shape, showing peak sensitivity somewhere in the range identified by the hearing group classification and decreasing sensitivity with increasing and decreasing frequency about this “trough”. Recent work by Southall *et al.* (2019) have modified the M-weighting functions using novel hearing data to better define the sensitivities inherent to the various hearing groups; and
- The peak pressure difference between TTS and PTS was arbitrarily taken to be 6 dB for pulsed sound based on TTS/dB noise relationships from a study of a very different mammal species, chinchillas (Henderson and Hamernik, 1986), compared to the arbitrarily defined 15 dB for continuous sound, meaning that the pulsed sound criteria are potentially very precautionary and introduce some level of uncertainty.

The criteria which have been employed to assess impacts to marine mammals as a result of the Project, as described in NPWS (2014), are summarised in Table 5-3. In line with the DAHG guidance, noise impacts to marine mammals, including the potential for injury and disturbance, have been assessed against the TTS onset thresholds from Southall *et al.* (2007). However, these have been supplemented with the PTS onset thresholds and contemporary threshold criteria from Southall *et al*. (2019) to give a fuller understanding of the likelihood of impacts to marine mammals resulting from Project-related activities which is substantiated by the most current data.

Table 5-3 NOAA (2018), Southall et al (2019) and Southall et al (2007) criteria for onset of TTS and PTS (per 24 hour period) to marina mammals from impulsive sound.

| Hearing Group | TTS onset thresholds (received level) | | | | PTS onset thresholds (received level) | | | |
|---|---|---|---|---|---|---|---|---|
| | *Peak pressure, dB re 1 µPa* | | Weighted $SEL_{24h}$, *dB re 1 µPa²s* ($L_{E,HW,24hr}$) | | *Peak pressure, dB re 1 µPa* | | Weighted $SEL_{24h}$, *dB re 1 µPa²s* ($L_{E,HW,24hr}$) | |
| | NOAA (2018) / Southall *et al* (2019) | Southall *et al*. (2007) | NOAA (2018) / Southall *et al* (2019) | Southall *et al*. (2007) | NOAA (2018) / Southall *et al* (2019) | Southall *et al*. (2007) | NOAA (2018) / Southall *et al* (2019) | Southall *et al*. (2007) |
| **Low-frequency cetaceans** | 213 | 224 | 168 | 183 | 219 | 230 | 183 | 198 |
| **Medium-frequency cetaceans** | 224 | 224 | 170 | 183 | 230 | 230 | 185 | 198 |
| **High-frequency cetaceans** | 196 | 224 | 140 | 183 | 202 | 230 | 155 | 198 |
| **Pinnipeds in water** | 212 | 212 | 170 | 171 | 218 | 218 | 185 | 186 |

The following sections aim to characterise the noise emissions from Project-specific sources and address the likelihood and significance of potential impacts to marine mammals occurring near the borehole locations which may be exposed to these sounds.

#### *5.3.2.2 Noise sources and sound propagation calculations*

Increasing the distance from the noise source usually results in the level of noise reducing, due primarily to the spreading of the sound energy with distance, analogous to the way in which the ripples in a pond spread after a stone has been thrown in. The way that the noise spreads (geometrical divergence) will depend upon several factors such as water column depth, pressure, temperature gradients, and salinity, as well as surface and bottom conditions. Thus, even for a given locality, there are seasonal variations to the way that sound will propagate. However, in simple terms, the sound energy may spread out in a spherical pattern (close to the source) or a cylindrical pattern (much further from the source) or somewhere in between, depending on several factors.

The specifications for the USBL positioning system to be used are provided in Section 2.6. The source level and an empirical spreading loss equation was applied as obtained from actual field measurements of one of the proposed acoustic positioning systems during geotechnical coring operations as currently proposed for the Project (Warner and McCrodan, 2011) with the results presented in Table 5-4. This is a similar approach as applied in Austin *et al*. (2012).

Table 5-4 Ranges to SPL isopleths for acoustic positioning systems, extracted from Austin et al (2012).

| SPL (dB re 1 µPa) | Radius (m) | |
|---|---|---|
| | Sonardyne Ranger, 18 to 36 kHz* | Kongsberg HiPap 500, 33 kHz* |
| 200 | 2 | 5 |
| 190 | 5 | 9 |
| 180 | 8 | 7 |
| 170 | 18 | 30 |
| 160 | 36 | 42 |

* Based on empirical spreading loss estimate measured by Warner and McCrodan (2011).

Noise propagation calculations were undertaken to support the assessment of impacts from impulsive noise (USBL). The outputs from these calculations, when compared with published threshold criteria for onset of effects, provide insights into the ranges (zones of influence) within which potential TTS or PTS impacts to marine mammals may occur.

These ranges are determined by:

- The sound pressure levels (SPLs) received from impulsive sounds which might induce physiological or behavioural effects;
- Potential physiological impacts from a single exposure to impulsive noise (peak pressure) and the cumulative sound exposure levels (SEL) animals are subjected to over time (calculated using the relevant marine mammal hearing-weightings (M-weightings) and taking into account the amount of sound energy to which receptors are exposed over the course of 24 h).

It is important to bear in mind that the outputs from the calculations are not absolute (i.e. impacts only occur within the output distance ranges) and a variety of physiological and environmental factors can influence the actual noise levels received by an animal and their behavioural response to those noises, thereby influencing the significance of the impact. However, the calculations and the impact thresholds are based on the best available scientific evidence in which potential impacts can be assessed. The distance ranges provided by the noise propagation calculations offer a way in which the potential spatial extent of the impact can be understood and in which the impact assessment presented can define the magnitude of the potential impact.

#### *5.3.2.3 Sound propagation calculation results*

The results of the sound propagation calculations are described as radii in which TTS and PTS onset are likely to occur. These potential impact zones, as calculated for USBL activities, are summarised in

Table 5-5.

Table 5-5 Sound propagation calculation results: potential TTS and PTS onset zones for 200 USBL pulses for low frequency (LF), medium frequency (MF) and high frequency (HF) cetaceans and phocids in water (PCW)

| | | TTS Onset | | PTS Onset | |
|---|---|---|---|---|---|
| **Hearing group** | **Threshold Sources** | **SELcum (dB re: 1 µPa/s @ 1 m)** | **Peak Pressure (dB re: 1 µPa @ 1 m)** | **SELcum (dB re: 1 µPa/s @ 1 m)** | **Peak Pressure (dB re: 1 µPa @ 1 m)** |
| LF | Southall *et al.* (2007) | 4 m | Does Not Exceed | Does not exceed | Does Not Exceed |
| | Southall *et al.* (2019); NMFS (2018) | 20 m | | 4 m | |
| MF | Southall *et al.* (2007) | 4 m | Does Not Exceed | Does not exceed | Does Not Exceed |
| | Southall *et al.* (2019); NMFS (2018) | 20 m | | 4 m | |
| HF | Southall *et al.* (2007) | 4 m | Does Not Exceed | Does not exceed | Does Not Exceed |
| | Southall *et al.* (2019); NMFS (2018) | 170 m | | 70 m | |
| PCW | Southall *et al.* (2007) | 15 m | Does Not Exceed | 3 m | Does Not Exceed |
| | Southall *et al.* (2019); NMFS (2018) | 20 m | | 4 m | |

### 5.3.3 Mitigation Measures

No requirement for specific mitigation measures has been identified with respect to underwater noise from the planned activities.

However, as described in Section 2.6, the use of the USBL will be limited to that required to ensure accurate positioning of the frame on the seabed.

### 5.3.4 Residual Impacts

Using the most recently published (and most conservative) thresholds,

Table 5-5 shows that the zone of potential TTS from USBL use for high frequency cetacean species is 170 m, while that for mid-frequency cetaceans, low-frequency cetaceans and pinnipeds is 20 m.

These zones are calculated on the assumption that the mammal would stay stationary during a period of USBL activity, which is considered to be unrealistic. A more realistic assumption is that, upon hearing the onset of the activity, the mammal would move away from the sound source, hence the first pulse would provide the highest 'dose' of sound, with each subsequent pulse contributing less to their exposure as they move away from the source.

#### *5.3.4.1 Seals*

The results in

Table 5-5 demonstrate the extremely low likelihood that any seal will be exposed to noise levels sufficient to result in TTS or PTS. To be at risk of experiencing TTS, and animal would have to be extremely close (<20 m) to the USBL positioning equipment during the short period of USBL use at each borehole (few minutes to 1.5 hours depending on water depth), and to remain directly within the beam for the duration. TTS effects are unlikely due to the low source level, beam directivity and high level of absorption associated with the frequency range of the source (18-36 kHz).

To determine the likelihood of impact in terms of actual number of animals, it is possible to calculate the number of animals likely to experience TTS using local density and population estimates. Using density estimates for each borehole location derived from data provided by Russell *et al.* (2017), NPWS (2010, 2011) and Cronin *et al*. (2003), the maximum number of grey seal or harbour seal likely to be within the zone where TTS could occur at any one time is considerably less than one, representing a negligible percentage of the seal populations in Ireland, based on available estimates of population sizes for Ireland as a whole of 5,509 for grey seal (O'Cadhla *et al*., 2005) and 2,905 for harbour seal (NPWS, 2011). Based on this information, there is no credible risk to seals of TTS from use of the USBL, or of PTS, given that the radius of effect is limited to within 4 m as shown in Table 5-5.

The number of seals expected to be encountered in the Goban Spur area and the western part of the Porcupine Bank study area is likely to be very low, and few, if any animals, would be expected to be found in the vicinity of the boreholes in these areas as they are so far from the coast (over 200 km). Seals may be encountered in the vicinity of the boreholes in the Irish Shelf study area and the eastern part of the Porcupine Bank study area. Considering the very small zone of potential TTS to seals (20 m from source) and the short duration of the USBL use (up to one hour), receptor sensitivity is ranked as High and the consequence of the potential impact from USBL use is **'negligible/no last effect'.** The resulting significance is ranked as **'E'** and '**not significant'**.

#### *5.3.4.2 Cetaceans*

5.3.4.2.1 Harbour porpoise (high-frequency cetacean)

As shown in

Table 5-5, recoverable injury to hearing apparatus (TTS) could potentially occur to any individual harbour porpoise that happen to be present within a worst-case zone of influence extending to approximately 170 m from the USBL equipment during the short period of USBL use at each borehole (few minutes to 1.5 hours depending on water depth). Rogan *et al.* (2018) provide density estimates from the ObSERVE Programme for 'strata' (defined sea areas around Ireland). The proposed borehole locations fall within all but one of these strata as shown in Table 5-6.

Table 5-6 Presence of borehole locations within the strata defined by Rogan et al. (2018)

| Stratum | Proposed Borehole |
|---|---|
| 1 | 17/28-sb1<br>18/27-sb1 |
| 2 | 25/27-sb2<br>74/4-sb1<br>74/14-sb1<br>74/27-sb1<br>74/29-sb1<br>75/27-sb1<br>83/5-sb1<br>83/25-sb1 |
| 3 | 26/5-sb1<br>26/8-sb1<br>27/30-sb1<br>36/30-sb1<br>60/8-sb1*<br>67/7-sb1*<br>67/11-sb1* |
| 4 | 46/17-sb1 |
| 5 | No proposed boreholes are located within this area |
| 6 | 20/12-sb1 |
| 7 | 28/9-sb1<br>37/13-sb1 |
| 8 | 47/17-sb1 |
| * These borehole locations lie outside of any strata but have been included within Stratum 3 as it is the closest | |

Using the density estimates for each stratum, the maximum number of harbour porpoise likely to be within the zone where TTS or PTS could occur at any one time is less than one (maximum of 0.02; Table 5-7). Based on the most recent harbour porpoise population estimate for Ireland as a whole of 39,118 individuals (Rogan *et al.*, 2018), the percentage of the population that could potentially be affected by USBL use at each borehole is estimated to be <0.00005% (Table 5-7).

Considering the very small zone of potential TTS to harbour porpoise (170 m from source) and the short duration of the USBL use (few minutes to 1.5 hours depending on water depth), receptor sensitivity is ranked as High and the consequence of the potential impact from USBL use is **'negligible/no last effect'.** The resulting significance is ranked as **'E'** and '**not significant'**.

Table 5-7 Harbour porpoise density and likelihood of being affected by PTS or TTS, as part of the Irish population

| Stratum | Density (individual per km$^2$) | Maximum number of animals predicted to be in the TTS impact zone at any one time | Maximum number of animals predicted to be in the PTS impact zone at any one time | % of reference population potentially affected by TTS for each borehole | % of reference population potentially affected by PTS for each borehole |
|---|---|---|---|---|---|
| 1 | 0.053 | 0.0048 | 0.0008 | 0.000012 | 0.000002 |

| | | | | | |
|---|---|---|---|---|---|
| 2 | 0.049 | 0.0044 | 0.0008 | 0.000011 | 0.000002 |
| 3 | 0.049 | 0.0044 | 0.0008 | 0.000011 | 0.000002 |
| 4 | 0.032 | 0.0029 | 0.0005 | 0.000007 | 0.000001 |
| 6 | 0.212 | 0.0192 | 0.0033 | 0.000049 | 0.000008 |
| 7 | 0.037 | 0.0034 | 0.0006 | 0.000009 | 0.000001 |
| 8 | 0.208 | 0.0189 | 0.0032 | 0.000048 | 0.000008 |

#### 5.3.4.2.2 Other cetaceans

As shown in

Table 5-5, recoverable injury to hearing apparatus (TTS) could potentially occur to any individual mid- and low-frequency cetaceans that happen to be present within a worst-case zone of influence extending to approximately 20 m from the USBL equipment during the short period of USBL use at each borehole (few minutes to 1.5 hours depending on water depth). Using the highest density estimates for each species and study area as shown in Table 3-5, the number of animals potentially affected at each borehole location is considerably less than one (highest number is 0.001 individuals for bottlenose dolphin in the Irish Sea study area), representing negligible percentages of the cetacean populations in Irish waters, based on available estimates of population sizes for Irish waters (Hammond *et al,* 2009; Hammond *et al*, 2017; JNCC, 2015).

Based on this information, there is no credible risk to mid- and low-frequency cetaceans of TTS from use of the USBL equipment, or of PTS, given that the radius of effect is limited to within 4 m as shown in Table 5-5. Whilst the presence of these species in the zone of potential impact during the short period of USBL use (few minutes to 1.5 hours at each borehole) cannot be ruled out, the number of individual animals that could potentially experience TTS is so small that it would be largely undetectable against natural variation and would have no effect at the population level.

Considering the very small zone of potential TTS to mid- and low-frequency cetaceans (20 m from source) and the short duration of the USBL use, receptor sensitivity is ranked as High and the consequence of the potential impact from USBL use is **'negligible/no last effect'.** The resulting significance is ranked as **'E'** and '**not significant'**.

## 5.4 Atmospheric emissions

### 5.4.1 Introduction

The only atmospheric emissions associated with the project are related to fuel consumption by the survey vessel, which will result in the emission of various combustion gases including:

- Carbon dioxide;
- Methane;
- Nitrous oxide;
- Sulphur oxides;
- Nitrogen oxides;
- Carbon monoxide; and
- Non-methane volatile organic compound(s).

Atmospheric emissions, with potential impacts on natural ecosystems and human well-being, may potentially result in impacts at a local, regional, transboundary and global scale.

On a global scale, concern with regard to atmospheric emissions is now increasingly focused on global warming and climate change. The Intergovernmental Panel on Climate Change (IPCC) in its fourth assessment report states that *'Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations (GHG).'* Climate change projections included in the IPCC report for Europe and Africa forecast a temperature increase of between 2.3°C and 5.3°C in the period from 2080 to 2099. GHG includes water vapour, $CO_2$, $CH_4$, $N_2O$, ozone and chlorofluorocarbons. The most abundant GHG is water vapour followed by $CO_2$. IPCC (2007) reports a 35% increase in $CO_2$ concentrations compared to pre-industrial concentrations and states that the combustion of fossil fuels is the primary contributor.

The IPCC and the US Climate Change Program have researched the environmental impacts of climate change and indicated that impacts may include:

- Increased frequencies of heat waves, droughts and fires;
- Coastal flooding as a result of rising sea levels caused by melting of ice caps, glaciers and polar ice sheets;
- Severe hurricane activity and increased frequency of severe precipitation;
- Infectious disease migration into new regions;
- Loss of wildlife habitats; and
- Increased levels of ground level ozone causing heart and respiratory illnesses (IPCC, 2007).

As discussed in Section 5.1, there are no likely significant effects on local or regional air quality, and this is not assessed further.

### 5.4.2 Quantification of emissions

In order to calculate the worst-case emissions from the Project, it has been assumed that:

- The survey vessel will be used for the maximum duration of 40 days, and
- Operations associated with borehole coring will take 33 days in total and the survey vessel will be in transit between the borehole locations for 7 days.

In order to calculate atmospheric emissions, the vessel estimated activity quantities have been used in conjunction with Institute of Petroleum Guidelines (IP, 2000) and EEMS emission factors (EEMS, 2008).

A summary of predicted fuel use and the subsequent atmospheric emissions for the Project is provided in Table 5-8.

### 5.4.3 Mitigation Measures

A number of mitigation measures will be employed to minimise the impact of atmospheric emissions resulting from the Project:

- Practical steps to limit atmospheric emissions during the Project will include advanced survey planning and engine maintenance to allow for efficient operations and fuel utilisation.
- The survey contractor will comply with the MARPOL Convention 73/78 Appendix VI on atmospheric emissions: no emissions of ozone depleting substances, content of sulphur in fuel oil not exceeding 0.5% m/m, and no incineration of garbage containing more than traces of heavy metals.
- The survey vessel will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2014.
- Woodside will verify that the survey vessel contractor procedures align with the relevant Woodside marine requirements.

### 5.4.4 Residual impacts

The Project will generate approximately 1,812 tonnes of $CO_2$ equivalent. Whilst there may be locally elevated concentrations of the gases detailed in Table 5-8, the dispersive nature of the exposed offshore environment means that these will be short-lived. Emissions of $CO_2$ will contribute to global warming and ocean acidification, whilst emissions of $SO_2$ and NOx can result in acidifying effects and the formation of ground-level ozone. However, there is unlikely to be a direct, demonstrable effect of the emissions arising from the Project since they will be negligible in a national or global context.

Through practical steps to limit the release of atmospheric emissions, Woodside will minimise the environmental risks associated with atmospheric emissions from the Project. Therefore, given the dispersive nature of the exposed offshore environment and the distance of the majority of the borehole locations (except stations 47/17-sb1 and 28/9-sb1 as illustrated in Figure 1-1) to shore, the overall consequence of adverse environmental impact through atmospheric emissions associated with the Project is '**negligible**' with receptor sensitivity as **'Low'**. It is therefore considered that the residual significance level as result of atmospheric emissions is ranked as **'F'** and '**not significant.**

Table 5-8 Atmospheric emissions from the Project

| Activity | Source | Details | | | Atmospheric emissions (tonnes) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vessel | Duration | Fuel use (tonnes/ day) | Total fuel use (tonnes) | $CO_2$ | $CH_4$ | $N_2O$ | $SO_x$ | NOx | CO | NMVOC | $CO_{2\text{-}e}$[2] |
| **Survey vessel in transit** | TBC | 7 days | 20.232 | 141.62 | 448.95 | 0.03 | 0.03 | 1.70 | 8.36 | 2.22 | 0.34 | 459.14 |
| **Survey vessel during operations** | TBC | 33 days | 12.645 | 417.29 | 1322.79 | 0.08 | 0.09 | 5.01 | 24.62 | 6.55 | 1.00 | 1352.83 |
| | | | | **Total** | 1771.74 | 0.10 | 0.12 | 6.71 | 32.98 | 8.77 | 1.34 | 1811.97 |

[2] "Carbon dioxide equivalent ($CO_{2\text{-}e}$) is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, $CO_{2\text{-}e}$ signifies the amount of $CO_2$ which would have the equivalent global warming impact.

## 5.5 Discharges to Sea

### 5.5.1 Introduction

During the Project activities, there will be minimal discharges associated with borehole coring. The discharges may include:

- Coring fluids; and
- Associated borehole cuttings.

Coring fluids will only be used if necessary, and only minimal amounts of cuttings will be discharged, as discussed in Section 2.8. Due to the small volume of OCNS Gold/Silver, E or D rated or PLONOR coring fluids/chemicals and cuttings discharged at the seabed (<0.25 $m^3$ per 50 m borehole), no significant impacts on water quality or associated biota are expected from those discharges and are therefore not further assessed. Relevant inbuilt mitigation measures are provided in Section 5.5.2.

The proposed discharges could affect the water column and associated benthic flora and fauna and seabed habitats through physical impacts (direct displacement of seabed, increased turbidity affecting feeding and respiration) and chemical impacts (toxicity).

Increased suspended solids may also result in direct irritation to certain types of marine benthic organisms, abrading protective mucous coatings and increasing their susceptibility to parasites and infections, as well as affecting growth, reproduction and feeding. The coring fluids (detailed in Section 2.8), contain OCNS rated chemicals and are non-toxic. As such, there is no expected potential for bioaccumulation of toxins through the food chain.

Discharges associated with vessel operations (waste water (sewage and grey water), food waste, oily bilge water, drainage, ballast waters) are considered to have a minor environmental impact and are therefore not considered further in this section.

### 5.5.2 Mitigation Measures

Woodside procedures for chemical management, as well as specific regulatory controls, will be in place to prevent or reduce the potential environmental impacts. A number of mitigation measures will be applied to the Project to limit, where practicable, the potential environmental impacts from the coring fluid discharges

- If required, chemicals and coring fluids will be selected in line with Woodside's chemical selection policy. As detailed in Section 2.8, Woodside has selected products that contain only PLONOR and OCNS rated gold, silver, E or D chemicals.
- The survey vessel will have a Vessel Waste Management Plan (for managing solid and hazardous waste) which requires dedicated waste segregation bins, records of all waste to be disposed (treated or recycled) and waste streams to be handled and managed according to their hazard and recyclability class.
- Vessel discharges (sewage, drainage, food waste and bilge water) will be controlled in line with MARPOL 73/78 requirements and no discharges will be made within 12 nm of the coastline.
- The survey vessel will have an IMO Approved oil in water separator (oil in water < 15 ppm);
- The contracted vessel will adhere to the Ballast Water Management (BWM) Convention requirements and to the Woodside International Invasive Marine Species Guidelines.

### 5.5.3 Residual impacts

Potential seabed impacts from the coring of each borehole are likely to be minor and localised. It is expected that any chemicals from coring fluid and suspended particles will be quickly dispersed in the water column to negligible concentrations.

Considering the transient nature of water column impact, and the open water unpolluted offshore environment, receptor sensitivity is ranked as Medium and the consequence of the potential impacts from borehole cuttings discharges to the water column is considered to be **'negligible/no last effect'**. The resulting significance is ranked as **'F'** and '**not significant'**.

## 5.6 Accidental Releases

### 5.6.1 Introduction

All marine activities, including borehole coring, carry with them some risk of accidents, which may occur due to procedural weaknesses, human error, equipment failure or extreme natural conditions. As discussed in Section 5.1, the only credible accidental release scenario is the loss of relatively small quantities of hydrocarbons or chemicals from vessel desks and therefore significant environmental effects associated with hydrocarbon or chemical spills from the Project can be discounted. The relevant control measures are documented below.

### 5.6.2 Risk Reduction

Woodside and the survey contractor will take measures prevent accidental releases and to reduce the impacts of any releases that may occur:

- The crew of the survey vessel will undergo environmental awareness and safety inductions. Incident response training will form part of the induction for any crew joining the survey vessel. The survey vessel will be class certified by a recognised certifying authority.
- No offshore bunkering operations will take place during operations.
- A safety zone will be maintained around the survey vessel whist on location, when it is restricted in its ability to manoeuvre.
- Woodside will ensure relevant stakeholders are consulted and notified prior to and during survey operations as detailed above under Section 5.2.4.2.
- Vessel Shipping Oil Pollution Emergency Plan (SOPEP) will be in place as per vessel class requirements.
- Liquid chemical and fuel storage areas are bunded or secondarily contained where practicable, when they are not being handled/moved temporarily.
- Spill kits will be maintained and located in close proximity to hydrocarbon (marine diesel) storage and deck areas for use to contain and recover deck spills.
- Equipment located on deck utilising hydrocarbons (e.g. cranes, winches or other hydraulic equipment) will be maintained to reduce risk of loss of hydrocarbon containment to the marine environment.
- If chemicals and coring fluids are required, they will be selected in line with Woodside's chemical selection policy. As detailed in Section 2.8, Woodside has selected products that contain only PLONOR and OCNS rated gold, silver, E or D chemicals.
- All chemicals will be managed in line with Woodside engineering and operating standards and procedures.

## 5.7 In-Combination Impacts

In accordance with the EIA Directive (2011/92/EU) as amended by Directive (2014/52/EU) and Habitats Directive (92/43/EEC), companies must consider the impact that proposed plans and projects could have on the receiving environment in combination with other plans and projects in the area.

As all the potential impacts identified and assessed in Sections 5.1 to 5.6 above are localised, temporary and not significant, there is no potential for significant effects from the Project in combination with other plans and projects in terms of seabed impacts or discharges to sea. Consideration is given below to the potential for mobile species with sensitivity to underwater noise, and for fishing and shipping activities, to be affected by the Project in-combination with other activities.

In-combination effects with other offshore projects are anticipated to comprise mostly oil and gas activities in the surrounding area, principally geophysical surveys. Information obtained from current applications is listed in Table 5-9. The closest operating field to the Project is the Corrib Gas Field, located approximately 30 km from borehole 20/12-sb1. No wind or wave renewable projects are located near the borehole locations. There is an absence of military activity and recreational activities in the vicinity of the Project. Additionally, the IOSEA 5 did not identify any cumulative impacts with fisheries and shipping as a concern (DCENR, 2015).

Given that the closest of these application to the Project is located approximately 30 km away and that the proposed activities for the Project are limited in extent, of very short duration and are not situated in any sensitive locations, there will be no significant in-combination effects on marine mammals through underwater noise.

Similarly, given the short duration and small scale of the safety zones around each borehole (radius of 500 m for 1.5 to 4 days), there will be no significant in-combination effects on other sea users from the presence of the survey vessel. Woodside will implement mitigation measures as described in Section 5.2.4.2 to ensure that other sea users including fishers are notified in advance and kept informed of the location of the survey vessel for the duration of the geotechnical investigation (up to 40 days).

Table 5-9 Current oil and gas exploration and production applications to the DCCAE

| Location | Operator | Activity | Shared pathway of effect | Distance from Project |
|---|---|---|---|---|
| Barryroe licence area, North Celtic Sea, Standard Exploration Licence (SEL) 1/11) | Exola DAC | Geophysical, environmental baseline and habitat assessment site survey.<br>Operations are planned to take place between April 2020 and late November 2020. | Underwater noise from acoustic survey equipment (side scan sonar, single-beam echosounder, multi-beam echosounder, pinger sub-bottom profiler, USBL, magnetometer) | Approximately 118 km (Borehole 47/17-sb1) |
| Kinsale Head Gas Field, Celtic Sea, 40-70 km off the County Cork coast | PSE Kinsale Energy | Decommissioning of Kinsale Head gas fields facilities (removal of Kinsale Alpha and Kinsale Bravo platform jackets).<br>The fields are expected to become uneconomic around 2020/2021, whereupon the wells will be plugged and the associated facilities decommissioned. | Underwater noise from decommissioning (e.g. mechanical cutting, rock placement, vessel noise, post decommissioning survey) | Approximately 112 km from well 48/20-A1 (Borehole 47/17-sb1) |
| Kinsale Head, Ballycotton and Seven Head sgas fields, Celtic Sea, 40-70 km off the County Cork coast. | PSE Kinsale Energy<br>PSE Seven Heads Limited | Decommissioning of certain facilities of the Kinsale Head, Ballycotton and Seven Heads gas fields including:<br>• Plugging and abandoning of development wells;<br>• Removal of two platform topsides structures;<br>• Removal of a number of subsea facilities. | Underwater noise from decommissioning (e.g. mechanical cutting, rock placement, vessel noise, post decommissioning survey) | Approximately 103 km from end of Seven Heads pipeline<br>(Borehole 47/17-sb1). |

| Location | Operator | Activity | Shared pathway of effect | Distance from Project |
|---|---|---|---|---|
| | | The fields are expected to become uneconomic around 2020/2021, whereupon the wells will be plugged and the associated facilities decommissioned. | | |
| Kiely East Prospect, northwest Porcupine Basin | Europa Oil & Gas Ltd | Geophysical and environmental site survey<br>Survey operations due to take place between February 2020 and late November 2020 | Underwater noise from acoustic survey equipment (side scan sonar, single-beam echosounder, multi-beam echosounder, sub-bottom profiler, magnetometer) | Approximately 90 km (Borehole 74/29-sb1) |
| Edgeworth Prospect, eastern flank of Porcupine Basin, Blocks 54/7 and 54/8. | Europa Oil & Gas Ltd | Geophysical and environmental site survey<br>Survey operations due to take place between February 2020 and late November 2020 | Underwater noise from acoustic survey equipment (side scan sonar, single-beam echosounder, multi-beam echosounder, sub-bottom profiler, magnetometer). | Approximately 82 km (Borehole 46/17-sb1) |
| Continental shelf and eastern flank of Rockall Trough, Blocks 19/11, 19/12, 18/20, 19/16, 19/17, 19/18, 18/25 and 19/21 | CNOOC Petroleum Europe Limited | Seismic, geophysical and environmental site survey<br>May take place June to November 2020 | Underwater noise from acoustic survey equipment (2D HR seismic, side scan sonar, single-beam echosounder, multi-beam echosounder, sub-bottom profiler, magnetometer). | Approximately 44 km (Borehole 18/27-sb1). |
| Dunquin South formation in the southern Porcupine Basin, Block 44/29, | ENI Ireland BV | Debris clearance, geophysical, environmental baseline and habitat assessment site survey | Underwater noise from acoustic survey equipment (side scan sonar, multi-beam | Approximately 108 km (Borehole 46/17-sb1) |

| Location | Operator | Activity | Shared pathway of effect | Distance from Project |
|---|---|---|---|---|
| Frontier Exploration Licence (FEL) 3/04; 150 km off the south west coast of Ireland. | | May take place June to September 2020 | echosounder, sub-bottom profiler, USBL) | |
| Selected sections of the entire Corrib Offshore Pipeline and umbilical system from the landfall at Glengad, (Broadhaven Bay), north west County Mayo, to the Corrib field. | Vermillion E&P Ireland Limited | Offshore pipeline survey and inspection/maintenance of the offshore facilities in the Corrib field and remedial work on the P3 well.<br>Survey planned to take place between July and October 2020. | Underwater noise from acoustic survey equipment (side scan sonar, multi-beam echosounder, sub-bottom profiler) | 31 km from closest point on Corrib pipeline (Borehole 20/12-sb1).<br>Approximately 36 km from Corrib field (Block 18/25) (Borehole 26/5-sb1). |
| Inishkea prospect, Blocks 18/19 and 18/20.<br>The Greater Working Area is approximately 4 km north west of the Corrib gas pipeline and 63 km from landfall at Inishkea South Island. | Europa Oil and Gas (Inishkea) Ltd | Geophysical and environmental baseline site survey<br>Survey operations planned to take place between February and late November 2020 | Underwater noise from acoustic survey equipment (side scan sonar, single-beam echosounder, multi-beam echosounder, sub-bottom profiler, USBL, magnetometer) | Approximately 44 km from closest point of the survey area (Greater Working Area)<br>(Borehole 26/5-sb1). |

In addition to the oil and gas activities listed in Table 5-9 that could possibly overlap with the current Project in terms of timing, two further projects need to be considered as detailed below.

### 5.7.1 Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) Survey Programme

INFOMAR is planning to conduct survey activities offshore in the Celtic Sea and inshore along the Atlantic coast of Cork and Kerry between April and October 2020. Current information suggests that Geological Survey Ireland will operate four survey vessels in inshore and offshore waters throughout the survey period, while the Marine Institute will conduct four separate offshore cruises ranging from 17 to 37 days during the survey period (INFOMAR, 2020). Borehole locations 46/17-sb1 and 47/17-sb1 lie close to or within the proposed INFOMAR inshore and offshore survey areas respectively and therefore there is a possibility of overlap of activities.

Data acquisition methods will include hydrographic and geophysical survey activities and seabed grab sampling and there are therefore shared pathways of effect for underwater noise and seabed disturbance, in addition to interference with other sea users, particularly static-gear fisheries. As discussed above, potential impacts from Woodside's borehole coring activities are very localised and the activities at boreholes 46/17-sb1 and 47/17-sb1 are expected to take only 1.5 days each so there will be no significant in-combination impacts. In addition to the mitigation measures described in Section 5.2.4.2, Woodside will maintain contact with Geological Survey Ireland to reduce any in-combination impacts.

### 5.7.1 Havfrue Cable System Installation

America-Europe Connect 2 Ltds is constructing a trans-Atlantic subsea fibre optic cable extending from the US to Denmark. A spur from the main cable in the Rockall Trough will connect it to Ireland with landfall at Old Head, Co. Mayo. This project was planned for 2019 but may overlap with Woodside's proposed geotechnical investigation. The boreholes are not situated on the spur route; it lies closest to the more northerly borehole locations, especially 18/27-sb1 and 28/9-sb1.

In areas of soft sediment, the cable will trenched and buried using a plough towed by an installation vessel and therefore has a common pathway of impact in terms of seabed disturbance. As discussed above, the extremely small seabed footprint of each of the boreholes means there is no likelihood of significant in-combination impacts on the seabed with the proposed geotechnical investigation.

Coring activities are very localised and the activities at boreholes 18/27-sb1 and 28/9-sb1 are expected to take only 1.5 days each. The mitigation measures described in Section 5.2.4.2 will minimise any in-combination disturbance to other sea users, including fishers.

## 5.8 Transboundary Impacts

Of the potential environmental impacts identified and assessed in Sections 5.1 to 5.6 above, none have the potential to result in transboundary impacts.

# 6 ASSESSMENT OF ANNEX IV SPECIES UNDER ARTICLE 12 OBLIGATIONS

## 6.1 Relevant Protected Species and Sources of Potential Impact

As required by Article 12 of the Habitats Directive, the potential impact on the favourable conservation status of species listed on Annex IV of the Habitats Directive must be assessed prior to a project receiving consent. The first step in this is to consider the Annex IV species that could be present in Irish offshore and coastal waters (within the area potentially affected by the Project); this list is presented below and draws on the environmental baseline presented in Section 3:

- Marine reptiles
  - Marine turtles are the only reptiles which occur in Irish waters, where five species have been recorded. All five species of marine turtles are listed as Annex IV species but the leatherback turtle *Dermochelys coriacea* is the only species observed with enough regularity to be considered native to Irish waters (DCENR, 2015). Data from tagged turtles suggest that leatherback turtles move into Irish waters from the south and west before moving northward around the west coast of Ireland or through the Irish Sea (Pierpoint, 2000) following swarms of jellyfish (their main prey species) into Irish waters (Reeds, 2004). As described in Section 5.1, although there is a possibility of interaction between the Project and marine reptiles through the physical presence of the survey vessel, underwater noise and accidental releases of hydrocarbons or chemicals, there are no likely significant effects on marine reptiles from any of these potential impact mechanisms. As such, there will be no adverse impact upon the population status of any turtle species and no further assessment is required.
- Fish
  - The European sea sturgeon *Acipenser sturio* is listed on Annex IV of the Habitats Directive and is found in some offshore waters. However, OSPAR (2009) report the offshore area west of Ireland to be outwith the range of this species. As a result, there will therefore be no adverse impact upon the population status of this species and no further assessment is required.
- Marine mammals
  - All cetacean species are listed on Annex IV of the Habitats Directive. Of these, 24 species of cetacean have been recorded in Irish waters. Reviewing the baseline data presented in Section 3.3.5.1, nineteen species may occur in the study areas for the project and are thus considered in this assessment. As described in Section 5.1, although there is a possibility of interaction between the Project and marine mammals through the physical presence of the survey vessel, underwater noise and accidental releases of hydrocarbons or chemicals, the only impact mechanism with a potentially significant effect is underwater noise.
- Mammals
  - The majority of other mammal species (in addition to the marine mammals mentioned above) listed on Annex IV of the Habitats Directive are terrestrial and therefore there will be no adverse impact upon the population status of these species as a result of the Project and no further assessment is required. However, the European otter *Lutra lutra* (although listed as a terrestrial mammal on Annex IV of the Habitats Directive) has marine habits and uses the nearshore coastal waters in some parts of Ireland as described in Section 3.3.5.3. As presented in Section 3.4.1, there are several SACs along the west Ireland coast designated for the European otter. Otter populations in coastal areas utilise shallow, inshore marine areas for feeding. Therefore, the zone of influence for otters around the coastal European sites is expected to be the same as the site boundaries themselves. The closest approach of the Project to the coast and to a coastal SAC designated for otters is 11 km (borehole 47/17-sb1, and the Roaringwater Bay and Islands SAC) which means that there is unlikely to be any

interaction between the Project and otters. There will therefore be no adverse impact upon the population status of otters and no further assessment is required.

Considering the proposed Project activities (Section 2) and the baseline condition of the receptors of interest (Sections 3.3. and 3.4) the only potentially significant impact mechanism identified on Annex IV species is that of underwater noise on cetaceans, which is assessed below.

## 6.2 Assessment of Potential Impacts and In-Combination Impacts

Noise sources from the Project area limited to impulsive noise from use of the USBL system and continuous noise from the vessel and coring activities. The potential impacts of underwater noise from the Project on cetaceans are assessed in detail in Section 5.3 above and the findings are summarised below. The DAHG guidance (NPWS, 2014) interprets TTS criteria as having the potential for both injury and disturbance and this criterion has formed the main basis of the assessment. In addition, the assessment focussed on the noise from the USBL system which was identified to have the greatest potential for impact based on SEL thresholds for low-, mid- and high-frequency cetaceans.

Harbour porpoise, the only high-frequency cetacean occurring in the study areas, could potentially experience recoverable injury to hearing apparatus (TTS) if any individuals are present within a worst-case zone of influence extending to approximately 170 m from the USBL equipment during the short period of USBL use at each borehole (few minutes to 1.5 hours depending on water depth). Using applicable density estimates for the various borehole locations, the maximum number of harbour porpoise likely to be within the zone where TTS could occur at any one time is less than one (maximum of 0.02). Based on the most recent harbour porpoise population estimate for Ireland as a whole of 39,118 individuals (Rogan *et al*., 2018), the percentage of the population that could potentially be affected by USBL use at each borehole is estimated to be <0.00005% (see Table 5-7).

TTS also could potentially occur to any individual mid- and low-frequency cetaceans that happen to be present within a worst-case zone of influence extending to approximately 20 m from the USBL equipment during the short periods of USBL use. Using applicable density estimates, the number of animals potentially affected at each borehole location is considerably less than one (highest number is 0.001 individuals for bottlenose dolphin in the Irish Sea study area) and represents negligible percentages of the different cetacean populations in Irish waters.

To understand the residual impact on animals that may be experiencing some disruption to normal behaviour, it is important to consider a number of factors including the size and location of the potential disturbance zone (larger areas mean a greater potential to interact with a greater number of animals) and length of time for which the sound source will be present (the longer the period the greater potential to have significant effects). Behavioural changes such as moving away from an area for short periods of time, reduced surfacing time, masking of communication signals or echolocation clicks, vocalisation changes and separation of mothers from offspring for short periods, do not necessarily imply that detrimental effects will result for the animals involved (JNCC, 2010). Temporarily affecting a small proportion of a population would be unlikely to result in population level effects and would not be considered as non-trivial disturbance (i.e. would not be significant disturbance).

Whilst the presence of cetacean species in the zone of potential impact during the short period of USBL use cannot be ruled out, the number of individual animals that could potentially experience TTS or are likely to exhibit some form of change in behaviour for the period in which they encounter the noise is so small that it would be largely undetectable against natural variation and would have no effect at the population level.

Given the above, mortality or significant disturbance of the Annex IV cetacean species that may be present in the area (including during breeding and migration) or deterioration or destruction of breeding sites or resting places is not likely. Thus, the Project is unlikely to adversely affect the favourable conservation status of any of the Annex IV species that may be present.

Section 5.7 above presents information on other plans and projects that may take place in the vicinity of the Project and considers the potential for cetaceans to be affected by the Project in-combination with other activities that will generate underwater noise.

Given that the proposed activities for the Project are limited in extent, of very short duration and are not situated in any sensitive locations, there is not expected to be an overlap in zones of impact and there will be no significant in-combination effects on marine mammals through underwater noise.

In conclusion, based on the details of current applications for other projects inshore and offshore the coast of Ireland, their distance from the Project, the limited spatial extent and duration and location of proposed activities, there will be no in-combination effects on relevant Annex IV animal groups and their conservation status will not be adversely affected.

# 7 ENVIRONMENTAL MANAGEMENT

## 7.1 Introduction

This section outlines the environmental management philosophy and procedures that will be in place to ensure that the mitigation and management measures described in this document will be implemented effectively.

Woodside is committed to protecting the environment and consequently manages environmental matters as a critical business activity. Woodside has a corporate combined Health, Safety, Environment and Quality (HSEQ) Policy (2019).

Woodside employs a structured approach to the management of environment impacts and risks via formal and documented Environmental Management Plans (EMPs). The EMPs ensure that impacts and risks from Woodside's operations are of an acceptable level or reduced to 'as low as reasonably practicable', and also drive continuous improvement in Woodside's environmental performance. The development of EMPs assist in providing confidence to regulators, stakeholders and the community at large that Woodside is undertaking activities in an environmentally responsible manner. In addition, Woodside has several social impact management policies. These include Human Rights policy and Sustainable Communities policy

## 7.2 Environmental Management and Commitments

Consistent with international best practice, Woodside's approach involves the implementation and maintenance of a dynamic, documented Environmental and Social Management System (ESMS) as part of the overall integrated Woodside Management System (WMS).

Woodside is committed to protecting the environment and consequently manages environmental matters as a critical business activity. The Project described in this submission will be carried out in accordance with this WMS and with Woodside policy and procedures.

ERA for the Project, including consultation with stakeholders, is an ongoing process which will continue through all stages of operations.

The mitigation and management measures identified during the ERA process will be incorporated into a commitments register. These commitments will be incorporated into the Environmental Management Plan (EMP) for the Project.

## 7.3 Contractor HSE Management

### 7.3.1 Training and competency

#### *7.3.1.1 Overview*

Woodside as part of its contracting process undertakes assessments of a proposed Contractor's environmental management system. This assessment is undertaken for the survey as part of the pre-mobilisation process. The assessment determines whether there is a clearly defined organisational structure that clearly defines the roles and responsibilities for key positions. The assessment also assesses whether there is an up-to-date training matrix that defines any corporate and site/activity-specific environmental training and competency requirements.

As a minimum, environmental awareness training is required for all personnel, detailing awareness and compliance with the Contractor's environmental policy and environmental management system.

#### *7.3.1.2 Inductions*

Inductions are provided to all personnel (Contractor, company representatives, survey vessel crew) before the mobilisation of vessels or on arrival on a vessel. The induction covers the HSE requirements and environmental information specific to the activity location.

## 7.3.2 Monitoring, inspections, management of non-conformance and review

### *7.3.2.1 Monitoring*

Woodside and its Contractors will undertake a programme of periodic monitoring during the survey – starting at mobilisation and continuing through the duration of the survey. This information will be collected using the tools and systems outlined below, developed based on the commitments within environmental approval documentation. The collection of this data will form part of the permanent record of compliance maintained by Woodside and will form the basis for demonstrating that the environmental commitments are met.

### *7.3.2.2 Inspections*

Environmental performance inspections will be undertaken to:

- Identify potential new, or changes to existing, environmental impacts and risk and methods for reducing those to ALARP;
- Confirm that mitigation measures detailed are effectively reducing environmental impacts and risk, that mitigation measures proposed are practicable and provide appropriate information to verify compliance; and
- Confirm compliance with the commitments detailed within the EMP.

The following internal /inspections will be undertaken to review the environmental performance of the survey:

- Pre-mobilisation inspection report (prior to the completion of the survey mobilisation);
- Periodic inspection report (during activity); and
- Operational compliance inspections relevant to environmental risk of activities e.g. compliance with training commitments and satisfactory close out of items from previous inspections.

The internal inspections and reviews, combined with the ongoing monitoring, and collection of evidence for commitments are used to assess environmental performance.

Woodside may also periodically select activities for which to undertake an environmental audit as per Woodside's internal auditing as part of Woodside's EMS and/or assurances processes.

Non-conformances identified will be reported and/or tracked. Audit/inspection findings relevant to continuous improvement of environmental performance are tracked through the survey vessel compliance action register.

### *7.3.2.3 Management of non-conformance*

Woodside employees and Contractors are required to report all environmental incidents and non-conformance with environmental commitments.

Incidents will be reported using an Incident and Hazard Report Form, which includes details of the event, immediate action taken to control the situation, and corrective actions to prevent reoccurrence. An internal computerised database is used for the recording and reporting of these incidents. Incident corrective actions are monitored and closed out in a timely manner.

### *7.3.2.4 Management of change*

Management of changes to the scope of the activity will require a risk assessment to be conducted in accordance with the environmental risk management methodology (Section 4) to determine the significance of any potential new environmental impacts or risks not provided for in this document. Minor changes where a review of the activity and the environmental risks and impacts of the activity does not change will be considered a 'minor revision'. Minor administrative changes, where an assessment of the environmental risks and impacts is not required (e.g. document references, contact details, etc.), will also be considered a 'minor revision'.

Minor revisions as defined above will be made internally using Woodside's document control process. If the change to risk is determined to be significant a revision of the documents will be conducted and submitted to PAD.

#### 7.3.2.5 Survey-specific environmental awareness

Before the survey commencement, a Woodside representative will undertake an induction workshop with all relevant personnel. The induction workshop provides an opportunity to reiterate specific environmental sensitivities or commitments associated with the activity. Attendance lists are recorded and retained.

During operations, regular HSE meetings will be held on the survey vessel which cover all crew. During these meetings, environmental incidents are reviewed and awareness material presented on a regular basis. Attendance records are retained on the survey vessel.

Additional materials are to be provided to project personnel as required to facilitate/support compliance and collection.

# 8 ENVIRONMENTAL RISK ASSESSMENT CONCLUSIONS

The combined environmental risk assessment and EIA screening has been prepared and submitted to PAD to support an application for approval under Regulation 3(1) of the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 and the European Union EIA Directive 2011/92/EU, as amended by Directive 2014/52/EU. The application is for obtaining core at up to 22 boreholes offshore west of Ireland. The report presents the assessment of the potential impacts of the Project on the marine environment, to demonstrate if the Project would be likely to have significant effect on the environment by virtue, *inter alia*, of its nature, size and location.

Through description of the Project and the baseline environment, potential interactions between aspects of the Project and receptors (or factors) have been identified. For each interaction; this has been assessed and significance of the interaction given. Where required, mitigation measures have been proposed to reduce the potential impact on the marine environment.

The Project has been assessed in combination with other projects and plans in the region, to identify any potential for cumulative impacts. Although there is expected be some temporary minor environmental impact during the Project, through the implementation of industry best practise, legal requirements and guidance, and Woodside project-specific commitments, residual impacts of the Project have been assessed as not significant.

# 9 ENVIRONMENTAL IMPACT ASSESSMENT SCREENING

The requirement for EIA is based upon the overall significance of all resulting impacts from the project considered together. The EC Guidance on EIA Screening (2017) (Directive 2011/92/EU as amended by 2014/52/EU) provides a checklist consisting of 27 questions relating to the potential impacts of a project and the significance of such impacts. The checklist forms the basis for overall communication of significance evaluation for this EIA screening report and provides an overview of the anticipated impacts of the project upon the human and natural environment. The checklist has been used as an aid, alongside the full assessment provided in the above document, to screen the Project to determine if there are likely to be significant impacts and if an EIA is required (Table 9-1).

Table 9-1 EIA Screening Checklist Questions

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| 1. Will construction, operation, decommissioning or demolition works of the Project involve actions that will cause physical changes in the locality (topography, land use, changes in waterbodies, etc.)? | **Yes**<br><br>The geotechnical investigation may lead to the discharge of cuttings and coring fluids onto the seabed of each borehole location. | **No**<br><br>The discharge of cuttings and coring fluids will be very small and occur at the vicinity of each borehole location with recovery expected in a short timescale.<br><br>**Section 5.4** |
| 2. Will construction or the operation of the Project use natural resources such as land, water, materials or energy, especially any resources which are non-renewable or are in short supply? | **Yes**<br><br>The use of natural resources will predominantly entail use of fossil fuels. No other natural resources are expected to be used. | **No**<br><br>The usage of the natural resources required (fossil fuels and other products/materials required to operate the survey vessel) will be comparable to other shipping operations. The quantification of the fossil fuels that will be required are presented in **Section 2.5**, Table 2.2, alongside **Section 5.3**, Table 5.9.<br><br>. |
| 3. Will the Project involve the use, storage, transport, handling or production of substances or materials which could be harmful to human health, to the | **Yes**<br><br>The operation of the survey vessel and survey equipment will require the usage of fossil fuels. Coring fluids and | **No**<br><br>If required, only small volumes of PLONOR and OCNS rated gold, silver, D and E coring fluids will be used and discharged at each borehole location. No significant impacts are expected from those discharges. Woodside will have procedures in place for chemical |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| environment or raise concerns about actual or perceived risks to human health? | chemicals will also be carried onboard for contingency. | management and regulatory controls to prevent or reduce the potential environmental impacts. |
| 4. Will the Project produce solid wastes during construction or operation or decommissioning? | **Yes**<br><br>Wastes are generated from the survey vessel as a result of normal operational such as bulk wastes (including domestic refuse, scrap metals and packaging)<br><br>In addition wastes, cuttings, and coring fluids will be generated during the Project which have the potential to impact the seabed fauna and flora and the water column. | **No**<br><br>Wastes generated as a result of the survey operations are not expected to differ from typical routine shipping activities.<br><br>All solid wastes will be managed under a robust vessel Waste Management Plan. This plan will detail the requirements for the segregation and appropriate storage, transfer and transport of wastes (to reduce risk of loss of containment).<br><br>Only small amounts of cuttings generated by borehole coring will be discharged at the seabed. The settlement of cuttings and coring fluids onto the seabed will be localised in the vicinity of each borehole location with recovery expected be quick. Potential water column impacts are also likely to be very short term and localised.<br><br>**Section 5.5** |
| 5. Will the Project release pollutants or any hazardous, toxic or noxious substances to air or lead to exceeding Ambient Air Quality standards in Directives 2008/50/EC and 2004/107/EC)? | **Yes**<br><br>Power generation will be required for the operation of the survey vessel. Thus, emissions to air will occur as a result of the generation of power as a result of fossil fuel consumption for delivery of the activities | **No**<br><br>Practical steps to limit the release of atmospheric emissions during the Project will include advanced planning to enable efficient operations and fuel utilisation and well maintained and operated power generation equipment.<br><br>The contractor will comply with the MARPOL Convention 73/78 Appendix VI on atmospheric emissions: no emissions of ozone depleting substances, content of sulphur in fuel oil not exceeding 0.5% m/m, and no incineration of garbage containing more than traces of heavy metals. The survey vessel will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2014. |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| | | The quantification of the atmospheric emissions that will be generated as a result of the Project are presented in **Section 5.4** in **Table 5.9.** |
| 6. Will the Project cause noise and vibration or the releasing of light, heat energy or electromagnetic radiation? | **Yes**<br><br>Noise will be generated within the marine environment during the Project. Noise would be generated predominantly as a result of DP thrusters on the survey vessel, borehole coring and from the USBL system. | **No**<br><br>The assessment presented in this document concluded that no significant impacts to marine animals is anticipated.<br><br>**Section 5.3** |
| 7. Will the Project lead to risks of contamination of land or water from releases of pollutants onto the ground or into surface waters, groundwater, coastal wasters or the sea? | **Yes**<br><br>The operation of the survey vessel will require the usage of fossil fuels and the use of onboard chemicals at sea.<br><br>There is potential that an accident could occur which could result in a loss of fossil fuels and /or chemicals to the environment which could be harmful to the environment and raise concerns about the actual and perceived risks to human health. | **No**<br><br>The crew of the survey vessel will undergo environmental awareness and safety induction. Incident response training will also form part of the induction for any crew joining the survey vessel.<br><br>The survey vessel will have a SOPEP in place as per vessel class requirements. The SOPEP is designed to assist the decision-making process during a spill, indicate what resources are required to combat the spill (taking into account the explosion risks associated with hydrocarbons), minimise any further discharges, and mitigate its effects.<br><br>There is a very low probability that an accidental event would occur which could result in potential impacts to the environment or human health. The assessment presented in this document concluded that overall the potential significance of an accidental release of fossil fuels or chemicals is considered to be moderate and not significant. |
| 8. Will there be any risk of accidents during construction or operation of the | **Yes**<br><br>The operation of the survey vessel and borehole coring will require the | **No** |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| Project that could affect human health or the environment? | usage of fossil fuels and the possible use of onboard chemicals at sea.<br><br>There is potential that an accident could occur which could result in a loss of fossil fuels and /or chemicals to the environment which could be harmful to the environment and raise concerns about the actual and perceived risks to human health. | The crew of the survey vessel will undergo environmental awareness and safety induction. Incident response training will also form part of the induction for any crew joining the survey vessel.<br><br>The survey vessel will have a SOPEP in place as per vessel class requirements. The SOPEP is designed to assist the decision-making process during a spill, indicate what resources are required to combat the spill (taking into account the explosion risks associated with hydrocarbons), minimise any further discharges, and mitigate its effects.<br><br>There is a very low probability that an accidental event would occur which could result in potential impacts to the environment or human health. The assessment presented in this document concluded that overall the potential significance of an accidental release of fossil fuels or chemicals is considered to be moderate and not significant. |
| 9. Will the Project result in environmentally related social changes, for example, in demography, traditional lifestyles, employment? | **No** | **No** |
| 10. Are there any other factors that should be considered such as consequential development which could lead to environmental impacts or the potential for cumulative impacts with other existing or planned activities in the locality? | **Yes**<br><br>Several other survey activities may take place in waters to the west and south of Ireland during the period of the geotechnical investigation. | **No**<br><br>The very limited impacts from the geotechnical investigation, its short duration and distance from the planned activities means that there are not likely to be any cumulative impacts.<br><br>The geotechnical investigation is a standalone research activity and there are no consequent developments associated with it. |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| 11. Is the project located within or close to any areas which are protected under international, EU, or national or local legislation for their ecological, landscape, cultural or other value, which could be affected by the Project? | **Yes**<br><br>There are four offshore SACs in waters to the west of Ireland (Figure 3.16). However, none of the boreholes are located within any of the offshore SACs. The closet borehole to a protected site (Porcupine Bank Canyon SAC) is borehole 74/27-sb1 located within 12 km.<br><br>There are numerous SACs SPAs and Ramsar sites along the west coast of Ireland (Figure 3.15). The nearest coastal protected site (Barley Cover to Ballyrisode Point) is approximately 3 km from the proposed 47/17-sb1borehole location.<br><br>An Appropriate Assessment Screening Report has been prepared. | **No**<br><br>The only source event identified to have potential pathways with connectivity to the protected sites is underwater noise.<br><br>Harbour porpoise was identified as a relevant feature (receptor) of two SACs (Blasket Islands SAC and Roaring Bay and Islands and SAC) that could potentially be impacted by underwater noise caused by the Project. When assessing the potential impacts from underwater noise, it was determined that likely significant effects on these European sites with regard to injury or behavioural disturbance to harbour porpoise from underwater noise sources can be excluded.<br><br>Grey seal was identified as a relevant feature (receptor) of seven SACs (Blasket Islands; Duvillaun Islands; Hom Head and Rinclevan; Inishbofin and Inishshark; Inishkea Islands; Slieve Tooey/Tormore Island/Loughros Beg Bay; and Slyne Head Island) with pathways for connectivity with regard to underwater noise. Harbour seal was identified as a relevant feature (receptor) of four SACs (Glengariff Harbour and Woodland; Kenmare River; Kilkieran Bay and Islands; and Killala Bay/Moy Estuary) with pathways for connectivity with regard to underwater noise. When assessing the potential impacts from underwater noise, it was determined that likely significant effects on these European sites with regard to injury or behavioural disturbance to grey or harbour seals from underwater noise sources can be excluded.<br><br>**See Woodside (2020)** |
| 12. Are there any other areas on or around the location that are important or sensitive for reasons of their ecology e.g. wetlands, watercourses or other waterbodies, the coastal zone, mountains, forests or woodlands, that could be affected by the Project? | **Yes**<br><br>The offshore areas in which the proposed boreholes are host to an array of marine mammals.<br><br>There is potential that underwater noise generated by the project could disturb marine mammals. | **No**<br><br>An assessment of the potential impacts on marine mammals from underwater noise concluded that there will be no likely significant effects.<br><br>**Section 5.3** |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| 13. Are there any areas on or around the location that are used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, resting, overwintering, migration, which could be affected by the Project? | **Yes**<br><br>There are numerous SACs, SPAs, and Ramsar sites along the south and west coast of Ireland and offshore. The nearest coastal protected site is approximately 3 km from the Project (borehole location 47/17-sb1). A number of these sites are important for breeding, nesting, foraging and overwintering birds<br><br>An Appropriate Assessment Screening Report has been prepared. | **No**<br><br>Under Article 12 of the Habitats Directive, assessment of LSE was conducted on protected species. Marine mammals were deemed to require further assessment as part of the Stage 1 Appropriate Assessment Screening process. However, on assessing the likelihood of impact from underwater noise on the Annex IV species compared to their estimated Irish populations it was determined neither require further assessment as part a Stage 2 Appropriate Assessment.<br><br>**See Woodside (2020)** |
| 14. Are there any inland, coastal, marine or underground waters (or features of the marine environment) on or around the location that could be affected by the Project? | **Yes**<br><br>The Project is located within the marine environment, potential features that could be affected include seabed habitats and species, marine mammals and other marine biota. Potential effects could result from a number of activities associated with the project including:<br>- Interaction with seabed during borehole coring, including deposition and settlement of cuttings;<br>- Underwater noise from survey vessel and USBL; and<br>- Accidental releases.<br><br>The coastline of south and west Ireland contain sensitive habitats | **No**<br><br>The only credible type of accidental release from the Project is the spillage of hydrocarbons (diesel fuel, hydraulic oil and lubricants) or chemicals (coring fluids) from vessel decks during storage or handling. Only relatively small amounts of fuel or chemicals could be released in this way, and measures will be in place to prevent or respond to any such releases.<br><br>The assessment of potential impacts from planned activities with respect to the physical presence of the survey vessel and coring equipment,; underwater noise, atmospheric emissions and discharges to sea demonstrated there will be no significant effects on the marine or coastal environment from the proposed geotechnical investigation.<br><br>**Section 5** |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| | including wetlands, coastal water bodies and estuaries. The operation of the survey vessel will require the usage of fossil fuels and the use of onboard chemicals at sea. There is potential that an accident could occur which could result in a loss of fossil fuels and /or chemicals into the marine environment which could affect these coastal sensitive areas. | |
| 15. Are there any areas or features of high landscape or scenic value on or around the location which could be affected by the Project? | **Yes**<br><br>The coastline of south and west Ireland are in places of high landscape value.<br><br>The operation of the survey vessel and borehole coring will require the usage of fossil fuels and the possible use of onboard chemicals at sea.<br><br>There is potential that an accident could occur which could result in a loss of fossil fuels and /or chemicals into the marine environment which could affect these sensitive areas. | **No**<br><br>The crew of the survey vessel will undergo environmental awareness and safety induction. Incident response training will also form part of the induction for any crew joining the survey vessel.<br><br>The survey vessel will have a SOPEP in place as per vessel class requirements. The SOPEP is designed to assist the decision-making process during a spill, indicate what resources are required to combat the spill (taking into account the explosion risks associated with hydrocarbons), minimise any further discharges, and mitigate its effects.<br><br>There is a very low probability that an accidental event would occur which could result in potential impacts to the environment or human health. The assessment presented in this document concluded that overall the potential significance of an accidental release of fossil fuels or chemicals is considered to be moderate and not significant.<br><br>**Section 5.5** |
| 16. Are there any routes or facilities on or around the location which are used by the public for access to recreation or other facilities, which could be affected by the Project? | **Yes**<br><br>The coastline of south and west Ireland is a valued resource for recreational activities such as surfing, | **No**<br><br>The crew of the survey vessel will undergo environmental awareness and safety induction. Incident response training will also form part of the induction for any crew joining the survey vessel. |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| | angling, bathing, wildlife watching and tourism.<br><br>The operation of the survey vessel and borehole coring will require the usage of fossil fuels and the use of board chemicals at sea.<br><br>There is potential that an accident could occur which could result in a loss of fossil fuels and /or chemicals into the marine environment which could affect these recreational areas. | The survey vessel will have a SOPEP in place as per vessel class requirements. The SOPEP will cover when the survey vessel is sailing in between borehole locations and not while on location. The SOPEP is designed to assist the decision-making process during a spill, indicate what resources are required to combat the spill (taking into account the explosion risks associated with hydrocarbons), minimise any further discharges, and mitigate its effects.<br><br>There is a very low probability that an accidental event would occur which could result in potential impacts to the environment or human health. The assessment presented in this document concluded that overall the potential significance of an accidental release of fossil fuels or chemicals is considered to be moderate and not significant.<br><br>**Section 5.5** |
| 17. Are there any transport routes on or around the location that are susceptible to congestion or which cause environmental problems, which could be affected by the Project? | **Yes**<br><br>Offshore, in the Porcupine Bank and Goban Spur study areas the majority of the shipping traffic consists of transatlantic cargo shipping routes and relatively light traffic levels. However, over the Irish Shelf the majority of the shipping routes consist of both cargo and tanker routes across the whole study area and experiences high traffic levels in comparison. | **No**<br><br>Woodside will implement measures to minimise interference which include consultation and notification with relevant authorities and organisations and maintain a 500 m safety zone around the survey vessel.<br><br>**Section 5.1** |
| 18. Is the Project in a location in which it is likely to be highly visible to many people? | **No**<br><br>The proposed borehole locations are all located offshore at varying distances from the coast. The closest locations to the coast are those within | **No**<br><br>It is considered unlikely that people will be able to see the survey operations from the coast. There is unlikely to be any recreational activity close to the proposed borehole locations due to the distance from the coast. |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| | the Irish Shelf study area which (Figure 3.1). | Woodside will implement measures to minimise interference which include consultation and notification with relevant authorities and organisations and maintain a 500 m safety zone around the survey vessel. |
| 19. Are there any areas or features of historic or cultural importance on or around the location that could be affected by the Project? | **Yes**<br><br>Some of the borehole locations are located within <10 km of areas identified as having features of archaeological significance (Section 3.5.9). Therefore proposed activities have the potential to interact with these features. | **No**<br><br>Considering the very small area of potential seabed impact from the coring activities and the absence of known wrecks at the borehole locations, is it extremely unlikely that any features of archaeological importance will be present at the proposed locations.<br><br>Given that no anchors are to be used, and considering the measures to be implemented including use of a drop-down underwater video to check that no unknown features of archaeological interest are present, the risk to any features of archaeological importance is negligible. |
| 20. Is the Project located in a previously undeveloped area where there will be loss of greenfield land? | **No**<br><br>The site constitutes a undeveloped but licenced marine space. The Project is temporary in nature and does not constitute a development. | **No** |
| 21. Are there existing land uses within or around the location e.g. homes, gardens, other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, mining or quarrying that could be affected by the Project? | **Yes**<br><br>Fishing activity in this offshore area may be somewhat affected by the Project, but the impact will be minor and restricted to the vicinity of the survey which is stationary at each borehole location. | **No**<br><br>Impacts upon fishing activity, shipping, or any other activities at sea within the area, are not expected to be significant and will occur over the temporary duration of the Project.<br><br>Woodside will consult with relevant authorities and organisations. Woodside will also communicate with other sea users through standard communication channels, including A Notice to Mariners which will be developed and disseminated to other marine users through the Marine Safety Directorate and Kingfisher bulletins. Woodside will also consider the requirement for a FLO.<br><br>**Section 5.2** |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| 22. Are there any plans for future land uses within or around the location that could be affected by the Project? | **No** | **No** |
| 23. Are there areas within or around the location which are densely populated or built-up, that could be affected by the Project? | **Yes**<br><br>The majority of the Project is located in offshore waters with 7 borehole locations located in the Irish Shelf area closest to the coastline. Borehole station 47/17-sb1 is located approximately 3 km from the west coast of Ireland.<br><br>The operation of the survey vessel will require the usage of fossil fuels and the use of onboard chemicals at sea.<br><br>There is potential that an accident could occur which could result in a loss of fossil fuels and /or chemicals into the marine environment which could affect rural communities living on the west coast of Ireland. | **No**<br><br>The crew of the survey vessel will undergo environmental awareness and safety induction. Incident response training will also form part of the induction for any crew joining the survey vessel.<br><br>The survey vessel will have a SOPEP in place as per vessel class requirements. The SOPEP is designed to assist the decision-making process during a spill, indicate what resources are required to combat the spill (taking into account the explosion risks associated with hydrocarbons), minimise any further discharges, and mitigate its effects.<br><br>There is a very low probability that an accidental event would occur which could result in potential impacts to the environment or human health. The assessment presented in this document concluded that overall the potential significance of an accidental release of fossil fuels or chemicals is considered to be moderate and not significant.<br><br>**Section 5.5** |
| 24. Are there any areas within or around the location which are occupied by sensitive land uses e.g. hospitals, schools, places of worship, community facilities, that could be affected by the Project? | **No**<br><br>The project is located at least 3 km offshore from the west of Ireland coastline. | **No** |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| 25. Are there any areas within or around the location which contain important, high quality or scarce resources e.g. groundwater, surface waters, forestry, agriculture, fisheries, tourism, minerals, that could be affected by the Project? | **Yes**<br><br>The proposed boreholes are located within areas that contain commercial fishing resources.<br><br>The coastal waters of west Ireland are important for mariculture and tourism.<br><br>The operation of the survey vessel and borehole coring will require the usage of fossil fuels and the possible use of onboard chemicals at sea.<br><br>There is potential that an accident could occur which could result in a loss of fossil fuels and /or chemicals into the marine environment which could affect these areas and resources. | **No**<br><br>The crew of the survey vessel will undergo environmental awareness and safety induction. Incident response training will form part of the induction for any crew joining the survey vessel.<br><br>The survey vessel will have a SOPEP in place as per vessel class requirements. The SOPEP is designed to assist the decision-making process during a spill, indicate what resources are required to combat the spill (taking into account the explosion risks associated with hydrocarbons), minimise any further discharges, and mitigate its effects.<br><br>There is a very low probability that an accidental event would occur which could result in potential impacts to the environment or human health. The assessment presented in this document concluded that overall the potential significance of an accidental release of fossil fuels or chemicals is considered to be moderate and not significant.<br><br>**Section 5.5** |
| 26. Are there any areas within or around the location which are already subject to pollution or environmental damage e.g. where existing legal environmental standards are exceeded, that could be affected by the Project? | **No**<br><br>No readily identifiable areas exist within the proposed borehole locations where environmental standards are exceeded. | **No**<br><br>It is not likely that the project will have any significant impacts upon areas which already suffer from environmental damage. |
| 27. Is the Project location susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. | **Yes**<br><br>The Atlantic waters within which the project is located can be subject to severe winds, fogs, wave heights etc. | **No**<br><br>Such environmental conditions are expected within the Atlantic waters. Woodside intends to undertake the survey activities in the months of the year less prone to extreme |

| Screening checklist question | Yes / No? Briefly describe | Is this likely to result in a significant effect? Yes/No? – Why? |
|---|---|---|
| **Brief Project Description** | To obtain core at up to 22 borehole locations offshore the west of Ireland. | |
| temperature inversions, fogs, severe winds, which could cause the Project to present environmental problems? | | environmental conditions and therefore they are not expected to result in environmental problems for the survey activities. |

# 10 EIA SCREENING CONCLUSIONS

Under the European Union (Environmental Impact Assessment) Regulations implemented into Irish legislation the Project can be screened out for further EIA on the following grounds:

- The Project does not fall under the description of activities included within Annex I or Annex II of the Directive;
- The European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 as amended allow for the Minister to determine on a case-by-case basis whether an EIA is required for any petroleum activities. Therefore, having regard to these requirements, this EIA Screening Report and Environmental Risk Assessment has been prepared to assist the EAU and the Minister in assessing any risk of significant effects associated with the Project. The results of the screening assessment presented in Section 9 of this report conclude that the Project will not cause significant individual environmental impacts; and
- The operation is not likely to have significant impacts upon Natura 2000 sites as determined by the Appropriate Assessment Screening Report (Woodside, 2020).

Using EU screening methodology (EU, 2017), no individual project impacts (as set out within individual questions in the screening checklist in Section 9) have been assessed as significant, and therefore this report screens out the requirement to carry out an EIA under the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 and EU EIA Directive 2014/52/EU.

# 11 HABITATS DIRECTIVE ASSESSMENT SCREENING CONCLUSIONS

The Appropriate Assessment Screening Report has been prepared alongside this EIA Screening Report to fulfil the approval requirements as set out by PAD (Woodside, 2020). The purpose of the Appropriate Assessment Screening Report was to identify whether there was a potential for the Project, either individually or in combination with other plans and projects, to have a likely significant effect on a European Site (SAC or SPA including draft, candidate and proposed sites).

The only source event from the Project that had a potential pathway with connectivity to the protected sites was underwater noise.

Harbour porpoise was identified as a relevant feature (receptor) of two SACs (Blasket Islands SAC and Roaring Bay and Islands and SAC) with pathways for connectivity with regard to underwater noise. Based on the best scientific evidence, including the use of sound propagation calculations, it was concluded that likely significant effects on these European sites with regard to injury to harbour porpoise from continuous noise sources or from the use of USBL can be excluded. In addition, likely significant effects with regard to behavioural disturbance from the continuous noise of the survey vessels or the impulsive noise from the USBL can be excluded.

Grey seal was identified as a relevant feature (receptor) of seven SACs (Blasket Islands; Duvillaun Islands; Hom Head and Rinclevan; Inishbofin and Inishshark; Inishkea Islands; Slieve Tooey/Tormore Island/Loughros Beg Bay; and Slyne Head Island) with pathways for connectivity with regard to underwater noise. Harbour seal was identified as a relevant feature (receptor) of four SACs (Glengariff Harbour and Woodland; Kenmare River; Kilkieran Bay and Islands; and Killala Bay/Moy Estuary) with pathways for connectivity with regard to underwater noise. Based on the best scientific evidence, including the use of sound propagation calculations, it was concluded that likely significant effects on these European sites with regard to injury to grey seal or harbour seal from continuous noise sources or from the use of USBL can be excluded. In addition, likely significant effects with regard to behavioural disturbance from the continuous noise of the survey vessels or the impulsive noise from the USBL can be excluded.

Based on the details of current applications for other Projects inshore and offshore the coast of Ireland, their distance from the Project and the limited extent and duration and location of proposed activities, likely significant effects from the Project on these European sites in-combination with any other activities generating underwater noise can be excluded.

Based on the assessments presented in this document it can be concluded that the Project, either individually or in combination with other plans or projects, in view of best scientific knowledge, will not have an adverse effect on the integrity of any relevant European site and that a Stage 2 Appropriate Assessment is not required.

# 12 REFERENCES


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# APPENDIX A PROTECTED SITES

## Coastal Special Areas of Conservation (SACs)

Table A1 Designated coastal SACs with marine features in the Irish Shelf study area

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| **Killala Bay/Moy Estuary SAC [000458]** | • Estuaries<br>• Mudflats and sandflats not covered by seawater at low tide<br>• Annual vegetation of drift lines<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Humid dune slacks<br>• Narrow-mouthed Whorl Snail (*Vertigo angustior)*<br>• Sea Lamprey (*Petromyzon marinus*)<br>• Harbour Seal (*Phoca vitulina)* | 39 km SE (Borehole 20/12-sb1) |
| **Lackan Saltmarsh and Kilcummin Head SAC [000516]** | • Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes) | 39 km SE (Borehole 20/12-sb1) |
| **Broadhaven Bay SAC [000472]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Large shallow inlets and bays<br>• Reefs<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Submerged or partially submerged sea caves | 21 km S (Borehole 20/12-sb1) |
| **Erris Head SAC [001501]** | • Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Alpine and Boreal heaths | 32 km SW (Borehole 20/12-sb1) |
| **Mullet/Blacksod Bay Complex SAC [000470]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Large shallow inlets and bays<br>• Reefs<br>• Salicornia and other annuals colonising mud and sand<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)<br>• Machairs<br>• Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation | 36 km N (Borehole 28/9-sb1)<br>38 km SW (Borehole 20/12-sb1) |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| | • Alkaline fens<br>• Otter (*Lutra lutra)*<br>• Petalwort (*Petalophyllum ralfsii*) | |
| **Inishkea Islands SAC [000507]** | • Machairs<br>• Grey Seal (*Halichoerus grypus*)<br>• Petalwort (*Petalophyllum ralfsii*) | 34 km N (Borehole 28/9-sb1) |
| **Duvillaun Islands SAC [000495]** | • Grey Seal (*Halichoerus grypus)* | 32 km N (Borehole 28/9-sb1) |
| **Doogort Machair/Lough Doo SAC [001497]** | • Machairs<br>• Petalwort (*Petalophyllum ralfsii*) | 32 km NE (Borehole 28/9-sb1) |
| **Croaghaun/Slievemore SAC [001955]** | • Northern Atlantic wet heaths with Erica tetralix<br>• European dry heaths<br>• Alpine and Boreal heaths<br>• Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*)<br>• Siliceous rocky slopes with chasmophytic vegetation | 20 km N (Borehole 28/9-sb1) |
| **Achill Head SAC [002268]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Large shallow inlets and bays<br>• Reefs | 19 km N (Borehole 28/9-sb1) |
| **Keel Machair/Menaun Cliffs SAC [001513]** | • Perennial vegetation of stony banks<br>• Machairs<br>• Alpine and Boreal heaths<br>• Petalwort (*Petalophyllum ralfsii*) | 21 km NE (Borehole 28/9-sb1) |
| **Bellacragher Saltmarsh SAC [002005]** | • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*) | 37 km NE (Borehole 28/9-sb1) |
| **Clew Bay Complex SAC [001482]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Coastal lagoons<br>• Large shallow inlets and bays<br>• Annual vegetation of drift lines<br>• Perennial vegetation of stony banks<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Machairs<br>• Old sessile oak woods with Ilex and Blechnum in the British Isles<br>• Geyer's Whorl Snail (*Vertigo geyeri*)<br>• Otter (*Lutra lutra*)<br>• Harbour seal (*Phoca vitulina*) | 35 km NE (Borehole 28/9-sb1) |
| **Clare Island Cliffs SAC [002243]** | • Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Calcareous rocky slopes with chasmophytic vegetation<br>• Siliceous rocky slopes with chasmophytic vegetation | 15 km E (Borehole 28/9-sb1) |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| **West Connacht Coast SAC [002998]** | • Common Bottlenose dolphin (*Tursiops truncate*) | 14 km SE (Borehole 28/9-sb1)<br>31 km SW (Borehole 20/12-sb1) |
| **Lough Cahasy, Lough Baun and Roonah Lough SAC [001529]** | • Coastal lagoons<br>• Perennial vegetation of stony banks<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Machairs | 26 km E (Borehole 28/9-sb1) |
| **Rusheenduff Lough SAC [001311]** | • Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*<br>• Slender Naiad (*Najas flexiles*) | 26 km SE (Borehole 28/9-sb1) |
| **Inishbofin and Inishshark SAC [000278]** | • Coastal lagoons<br>• Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)<br>• Northern Atlantic wet heaths with *Erica tetralix*<br>• European dry heaths<br>• Grey seal (*Halichoerus grypus*) | 16 km S (Borehole 28/9-sb1) |
| **Omey Island Machair SAC [001309]** | • Machairs<br>• Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.<br>• Petalwort (*Petalophyllum ralfsii*) | 28 km S (Borehole 28/9-sb1) |
| **Barnahallia Lough SAC [002118]** | • Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*<br>• Slender Naiad (*Najas flexiles*) | 29 km SE (Borehole 28/9-sb1) |
| **Kingstown Bay SAC [002265]** | • Large shallow inlets and bays | 30 km S (Borehole 28/9-sb1) |
| **Slyne Head Peninsula SAC [002074]** | • Coastal lagoons<br>• Large shallow inlets and bays<br>• Reefs<br>• Annual vegetation of drift lines<br>• Perennial vegetation of stony banks<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Machairs<br>• Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)<br>• Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*<br>• Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.<br>• European dry heaths | 35 km S (Borehole 28/9-sb1) |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| | • *Juniperus communis* formations on heaths or calcareous grasslands<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)<br>• Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)<br>• Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)<br>• Alkaline fens<br>• Petalwort (*Petalophyllum ralfsii*)<br>• Slender Naiad (*Najas flexiles*) | |
| **Slyne Head Islands SAC [000328]** | • Reefs<br>• Grey seal (*Halichoerus grypus*) | 37 km S (Borehole 28/9-sb1) |
| **Murvey Machair SAC [002129]** | • Machairs<br>• Petalwort (*Petalophyllum ralfsii*) | >40 km from project |
| **Dog's Bay SAC [001257]** | • Annual vegetation of drift lines<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• European dry heaths | >40 km from project |
| **Cregduff Lough SAC [001251]** | • Transition mires and quaking bogs<br>• Slender Naiad (*Najas flexiles*) | >40 km from project |
| **Rosroe Bog SAC [000324]** | • Blanket bogs (* if active bog)<br>• Depressions on peat substrates of the Rhynchosporion | >40 km from project |
| **Lough Nageeron SAC [002119]** | • Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*<br>• Slender Naiad (*Najas flexiles*) | >40 km from project |
| **Connemara Bog Complex SAC [002034]** | • Coastal lagoons<br>• Reefs<br>• Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)<br>• Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*<br>• Natural dystrophic lakes and ponds<br>• Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation<br>• Northern Atlantic wet heaths with *Erica tetralix*<br>• European dry heaths<br>• Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)<br>• Blanket bogs<br>• Transition mires and quaking bogs<br>• Depressions on peat substrates of the Rhynchosporion<br>• Alkaline fens | 38 km SE (Borehole 28/9-sb1) |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| | • Old sessile oak woods with Ilex and Blechnum in the British Isles<br>• Marsh Fritillary (*Euphydryas aurini*)<br>• Salmon (*Salmo salar*)<br>• Otter (*Lutra lutra*)<br>• Slender Naiad (*Najas flexilis*) | |
| **Kilkieran Bay and Islands SAC [002111]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Coastal lagoons<br>• Large shallow inlets and bays<br>• Reefs<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritime*)<br>• Machairs<br>• Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*<br>• Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)<br>• Otter (*Lutra lutra*)<br>• Harbour seal (*Phoca vitulina*)<br>• Slender Naiad (*Najas flexilis*) | >40 km from project |
| **Galway Bay Complex SAC [000268]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Coastal lagoons<br>• Large shallow inlets and bays<br>• Reefs<br>• Perennial vegetation of stony banks<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Turloughs<br>• *Juniperus communis* formations on heaths or calcareous grasslands<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)<br>• Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*<br>• Alkaline fens<br>• Limestone pavements<br>• Otter (*Lutra lutra*)<br>• Harbour seal (*Phoca vitulina*) | >40 km from project |
| **Black Head-Poulsallagh Complex SAC [000020]** | • Reefs<br>• Perennial vegetation of stony banks<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation<br>• Alpine and Boreal heaths<br>• *Juniperus communis* formations on heaths or calcareous grasslands | >40 km from project |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| | • Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)<br>• Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)<br>• Petrifying springs with tufa formation (Cratoneurion)<br>• Limestone pavements<br>• Submerged or partially submerged sea caves<br>• Petalwort (*Petalophyllum ralfsii*) | |
| **Inisheer Island SAC [001275]** | • Coastal lagoons<br>• Reefs<br>• European dry heaths<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)<br>• Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)<br>• Limestone pavements | >40 km from project |
| **Inishmaan Island SAC [000212]** | • Reefs<br>• Perennial vegetation of stony banks<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Machairs<br>• European dry heaths<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)<br>• Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)<br>• Limestone pavements | >40 km from project |
| **Inishmore Island SAC [000213]** | • Coastal lagoons<br>• Reefs<br>• Perennial vegetation of stony banks<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Dunes with Salix repens ssp. argentea (*Salicion arenariae*)<br>• Humid dune slacks<br>• Machairs<br>• European dry heaths<br>• Alpine and Boreal heaths<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)<br>• Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)<br>• Limestone pavements<br>• Submerged or partially submerged sea caves<br>• Narrow-mouthed Whorl Snail (*Vertigo angustior)* | >40 km from project |
| **Inagh River Estuary SAC [000036]** | • Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*) | >40 km from project |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| | • Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes) | |
| **Carrowmore Point to Spanish Point and Islands SAC [001021]** | • Coastal lagoons<br>• Reefs<br>• Perennial vegetation of stony banks<br>• Petrifying springs with tufa formation (Cratoneurion) | >40 km from project |
| **Carrowmore Dunes SAC [002250]** | • Reefs<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Narrow-mouthed Whorl Snail (*Vertigo angustior)* | >40 km from project |
| **Kilkee Reefs SAC [002264]** | • Large shallow inlets and bays<br>• Reefs<br>• Submerged or partially submerged sea caves | >40 km from project |
| **Lower River Shannon SAC [002165]** | • Sandbanks which are slightly covered by sea water all the time<br>• Estuaries<br>• Mudflats and sandflats not covered by seawater at low tide<br>• Coastal lagoons<br>• Large shallow inlets and bays<br>• Reefs<br>• Perennial vegetation of stony banks<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi)*<br>• Water courses of plain to montane levels with the R*anunculion fluitantis* and *Callitricho-Batrachion* vegetation<br>• Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)<br>• Alluvial forests with Alnus glutinosa and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*)<br>• (Freshwater Pearl Mussel (*Margaritifera margaritifera*)<br>• Sea Lamprey (*Petromyzon marinus*)<br>• Brook Lamprey (*Lampetra planeri*)<br>• River Lamprey (*Lampetra fluviatilis*)<br>• Salmon (*Salmo salar)*<br>• Common Bottlenose dolphin (*Tursiops truncates*)<br>• Otter (*Lutra lutra*) | >40 km from project |
| **Barrigone SAC [000432]** | • *Juniperus communis* formations on heaths or calcareous grasslands<br>• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)<br>• Limestone pavements<br>• Euphydryas aurinia (Marsh Fritillary) | >40 km from project |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| **Kerry Head Shoal SAC [002263]** | • Reefs | 34 km SE (Borehole 37/13-sb1) |
| **Magharee Islands SAC [002261]** | • Reefs | >40 km from project |
| **Akeragh, Banna and Barrow Harbour SAC [000332]** | • Annual vegetation of drift lines<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi)*<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Humid dune slacks<br>• European dry heaths | >40 km from project |
| **Tralee Bay and Magharees Peninsula, West to Cloghane SAC [002070]** | • Estuaries<br>• Mudflats and sandflats not covered by seawater at low tide<br>• Coastal lagoons<br>• Large shallow inlets and bays<br>• Reefs<br>• Annual vegetation of drift lines<br>• Perennial vegetation of stony banks<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Dunes with Salix repens ssp. argentea (*Salicion arenariae*)<br>• Humid dune slacks<br>• Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)<br>• Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)<br>• Otter (*Lutra lutra*)<br>• Petalwort (*Petalophyllum ralfsii*) | >40 km from project |
| **Blasket Islands SAC [002172]** | • Reefs<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• European dry heaths<br>• Submerged or partially submerged sea caves<br>• Harbour Porpoise (*Phocoena phocoena*)<br>• Grey Seal (*Halichoerus grypus*) | 25 km E (Borehole PVR B) |
| **Castlemaine Harbour SAC [000343]** | • Estuaries<br>• Mudflats and sandflats not covered by seawater at low tide<br>• Annual vegetation of drift lines<br>• Perennial vegetation of stony banks | >40 km from project |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| | • Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Dunes with Salix repens ssp. argentea (*Salicion arenariae*)<br>• Humid dune slacks<br>• Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)<br>• Sea Lamprey (*Petromyzon marinus*)<br>• River Lamprey (*Lampetra fluviatilis*)<br>• Salmon (*Salmo salar*)<br>• Otter (*Lutra lutra*)<br>• Petalwort (*Petalophyllum ralfsii*) | |
| **Lough Yganavan and Lough Nambrackdarrig SAC [00370]** | • Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)<br>• Kerry Slug (*Geomalacus maculosus*) | >40 km from project |
| **Valencia Harbour/Portmagee Channel SAC [002262]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Large shallow inlets and bays<br>• Reefs | >40 km from project |
| **Ballinskelligs Bay and Inny Estuary SAC [000335]** | • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Petalwort (*Petalophyllum ralfsii*) | >40 km from project |
| **Drongawn Lough SAC [002187]** | • Coastal lagoons | >40 km from project |
| **Kenmare River SAC [002158]** | • Large shallow inlets and bays<br>• Reefs<br>• Perennial vegetation of stony banks<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• European dry heaths<br>• *Juniperus communis* formations on heaths or calcareous grasslands<br>• Calaminarian grasslands of the *Violetalia calaminariae*<br>• Submerged or partially submerged sea caves<br>• Narrow-mouthed Whorl Snail (*Vertigo angustior*)<br>• Lesser Horseshoe Bat (*Rhinolophus hipposideros*) | 36 km N (Borehole 47/17-sb1) |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| | • Otter (*Lutra lutra*)<br>• Harbour Seal (*Phoca vitulina*) | |
| **Glengarriff Harbour and Woodland SAC [000090]** | • Old sessile oak woods with Ilex and Blechnum in the British Isles<br>• Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)<br>• Kerry Slug (*Geomalacus maculosus*)<br>• Lesser Horseshoe Bat (*Rhinolophus hipposideros*)<br>• Otter (*Lutra lutra*)<br>• Harbour Seal (*Phoca vitulina*) | 36 km N (Borehole 47/17-sb1) |
| **Farranamanagh Lough SAC [002189]** | • Coastal lagoons<br>• Perennial vegetation of stony banks | 18 km N (Borehole 47/17-sb1) |
| **Reen Point Shingle SAC [002281]** | • Perennial vegetation of stony banks | 22 km NE (Borehole 47/17-sb1) |
| **Dunbeacon Shingle SAC [002280]** | • Perennial vegetation of stony banks | 24 km NE (Borehole 47/17-sb1) |
| **Three Castle Head to Mizen Head SAC [000109]** | • Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• European dry heaths | 4 km NW (Borehole 47/17-sb1) |
| **Barley Cove to Ballyrisode Point SAC [001040]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Perennial vegetation of stony banks<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• European dry heaths<br>• Petalwort (*Petalophyllum ralfsii*) | 3 km N (Borehole 47/17-sb1) |
| **Roaringwater Bay and Islands SAC [000101]** | • Large shallow inlets and bays<br>• Reefs<br>• Vegetated sea cliffs of the Atlantic and Baltic coasts<br>• European dry heaths<br>• Submerged or partially submerged sea caves<br>• Harbour Porpoise (*Phocoena phocoena)*<br>• Otter (*Lutra lutra)*<br>• Grey Seal (*Halichoerus grypus*) | 11 km NE (Borehole 47/17-sb1) |
| **Lough Hyne Nature Reserve and Environs SAC [000097]** | • Large shallow inlets and bays<br>• Reefs<br>• Submerged or partially submerged sea caves | 32 km E (Borehole 47/17-sb1) |
| **Kilkeran Lake and Castlefreke Dunes SAC [001061]** | • Coastal lagoons<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes) | >40 km from project |

| SAC site name [Site code] | Qualifying features | Distance and direction from project |
|---|---|---|
| **Clonakilty Bay SAC [000091]** | • Mudflats and sandflats not covered by seawater at low tide<br>• Annual vegetation of drift lines<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes)<br>• Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) | >40 km from project |
| **Courtmacsherry Estuary SAC** | • Estuaries<br>• Mudflats and sandflats not covered by seawater at low tide<br>• Annual vegetation of drift lines<br>• Perennial vegetation of stony banks<br>• Salicornia and other annuals colonising mud and sand<br>• Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)<br>• Mediterranean salt meadows (*Juncetalia maritimi*)<br>• Embryonic shifting dunes<br>• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)<br>• Fixed coastal dunes with herbaceous vegetation (grey dunes) | >40 km from project |

## Offshore Special Areas of Conservation (SACs)

Table A2 Designated Offshore SACs

| SPA site name [Site code] | Qualifying features | Distance and direction from Project |
|---|---|---|
| **South-east Rockall Bank SAC [003002]** | • Reefs | >40 km from project |
| **North-west Porcupine Bank SAC [002330]** | • Reefs | 35 km N (Borehole 75/28-sb1) |
| **Hovland Mound Province SAC [002328]** | • Reefs | >40 km from project |
| **Porcupine Bank Canyon SAC [003001]** | • Reefs | 12 km NW (Borehole 74/27-sb1)<br>13 km SE (Borehole 83/25-sb1)<br>32 km W (Borehole 74/29-sb1) |
| **South-west Porcupine Bank SAC [002329]** | • Reefs | 12 km SW (Borehole 74/27-sb1)<br>35 km S (Borehole 83/25-sb1) |
| **Belgica Mound Province SAC [002327]** | • Reefs | >40 km from project |

## Special Protection Areas (SPAs)

Table A3 Designated coastal SPAs with marine features in the Irish Shelf study area

| SPA site name [Site code] | Qualifying features | Distance and direction from Project |
|---|---|---|
| **Killala Bay/Moy Estuary SPA [004036]** | • Ringed Plover (*Charadrius hiaticula*)<br>• Golden Plover (*Pluvialis apricaria*)<br>• Grey Plover (*Pluvialis squatarola*)<br>• Sanderling (*Calidris alba*)<br>• Dunlin (*Calidris alpina*)<br>• Bar-tailed Godwit (*Limosa lapponica*)<br>• Curlew (*Numenius arquata*)<br>• Redshank (*Tringa totanus*)<br>Wetland and Waterbirds | 39 km SE (Borehole 20/12-sb1) |
| **Illanmaster SPA [004074]** | • Storm Petrel (*Hydrobates pelagicus*) | 22 km S (Borehole 20/12-sb1) |
| **Stags of Broad Haven SPA [004072]** | • Storm Petrel (*Hydrobates pelagicus*)<br>• Leach's Storm-petrel (*Oceanodroma leucorhoa*) | 19 km S (Borehole 20/12-sb1) |
| **Blacksod Bay/Broad Haven SPA [004037]** | • Great Northern Diver (*Gavia immer*)<br>• Light-bellied Brent Goose (*Branta bernicla hrota*)<br>• Common Scoter (*Melanitta nigra*)<br>• Red-breasted Merganser (*Mergus serrator*)<br>• Ringed Plover (*Charadrius hiaticula*)<br>• Sanderling (*Calidris alba*)<br>• Dunlin (*Calidris alpina*)<br>• Bar-tailed Godwit (*Limosa lapponica*)<br>• Curlew (*Numenius arquata*)<br>• Sandwich Tern (*Sterna sandvicensis*)<br>• Dunlin (*Calidris alpina schinzii*)<br>• Wetland and Waterbirds | 36 km NE (Borehole 28/9-sb1)<br>36 km NE (Borehole 20/12-sb1) |
| **Inishglora and Inishkeeragh SPA [004084]** | • Storm Petrel (*Hydrobates pelagicus*)<br>• Cormorant (*Phalacrocorax carbo*)<br>• Shag (*Phalacrocorax aristotelis*)<br>• Barnacle Goose (*Branta leucopsis*)<br>• Lesser Black-backed Gull (*Larus fuscus*)<br>• Herring Gull (*Larus argentatus*)<br>• Arctic Tern (*Sterna paradisaea*) | >40 km from project |
| **Inishkea Islands SPA [004004]** | • Shag (*Phalacrocorax aristotelis*)<br>• Barnacle Goose (*Branta leucopsis*)<br>• Ringed Plover (*Charadrius hiaticula*)<br>• Sanderling (*Calidris alba*)<br>• Purple Sandpiper (*Calidris maritima*)<br>• Turnstone (Arenaria interpres)<br>• Common Gull (*Larus canus*)<br>• Herring Gull (*Larus argentatus*)<br>• Arctic Tern (*Sterna paradisaea*) | 34 km N (Borehole 28/9-sb1) |

| SPA site name [Site code] | Qualifying features | Distance and direction from Project |
|---|---|---|
| | • Little Tern (*Sterna albifrons*)<br>• Dunlin (*Calidris alpina schinzii*) | |
| **Duvillaun Islands SPA [004111]** | • Fulmar (*Fulmarus glacialis*)<br>• Storm Petrel (*Hydrobates pelagicus*)<br>• Barnacle Goose (*Branta leucopsis*) | 32 km N (Borehole 28/9-sb1) |
| **Doogort Machair SPA [004235]** | • Dunlin (*Calidris alpina schinzii*) | 32 km NE (Borehole 28/9-sb1) |
| **Bills Rocks SPA [004177]** | • Storm Petrel (*Hydrobates pelagicus*)<br>• Puffin (*Fratercula arctica*) | 10 km NE (Borehole 28/9-sb1) |
| **Clare Island SPA [004136]** | • Fulmar (*Fulmarus glacialis*)<br>• Shag (*Phalacrocorax aristotelis*)<br>• Common Gull (*Larus canus*)<br>• Kittiwake (*Rissa tridactyla*)<br>• Guillemot (*Uria aalge*)<br>• Razorbill (*Alca torda*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | 15 km E (Borehole 28/9-sb1) |
| **Cross Lough (Killadoon) SPA [004212]** | • Sandwich Tern (*Sterna sandvicensis*) | 26 km E (Borehole 28/9-sb1) |
| **High Island, Inishshark and Davillaun SPA [004144]** | • Fulmar (*Fulmarus glacialis*)<br>• Barnacle Goose (*Branta leucopsis*)<br>• Arctic Tern (*Sterna paradisaea*) | 18 km S (Borehole 28/9-sb1) |
| **Illaunnanoon SPA [004221]** | • Sandwich Tern (*Sterna sandvicensis*) | 32 km SE (Borehole 28/9-sb1) |
| **Cruagh Island SPA [004170]** | • Manx Shearwater (*Puffinus puffinus*)<br>• Barnacle Goose (*Branta leucopsis*) | 28 km S (Borehole 28/9-sb1) |
| **Slyne Head to Ardmore Point Islands SPA [004159]** | • Barnacle Goose (*Branta leucopsis*)<br>• Sandwich Tern (*Sterna sandvicensis*)<br>• Arctic Tern (*Sterna paradisaea*)<br>• Little Tern (*Sterna albifrons*) | 26 km E (Borehole 28/9-sb1) |
| **Connemara Bog Complex SPA [004181]** | • Cormorant (*Phalacrocorax carbo*)<br>• Merlin (*Falco columbarius*)<br>• Golden Plover (*Pluvialis apricaria*)<br>• Common Gull (*Larus canus*) | >40 km from project |
| **Inishmore SPA [004152]** | • Kittiwake (*Rissa tridactyla*)<br>• Arctic Tern (*Sterna paradisaea*)<br>• Little Tern (*Sterna albifrons*)<br>• Guillemot (*Uria aalge*) | >40 km from project |
| **Inner Galway Bay SPA [004031]** | • Great Northern Diver (*Gavia immer*)<br>• Cormorant (*Phalacrocorax carbo*)<br>• Grey Heron (*Ardea cinerea*) | >40 km from project |

| SPA site name [Site code] | Qualifying features | Distance and direction from Project |
|---|---|---|
| | • Light-bellied Brent Goose (*Branta bernicla hrota*)<br>• Wigeon (*Anas penelope*)<br>• Teal (*Anas crecca*)<br>• Shoveler (*Anas clypeata*)<br>• Red-breasted Merganser (*Mergus serrator*)<br>• Ringed Plover (*Charadrius hiaticula*)<br>• Golden Plover (*Pluvialis apricaria*)<br>• Lapwing (*Vanellus vanellus*)<br>• Dunlin (*Calidris alpina*)<br>• Bar-tailed Godwit (*Limosa lapponica*)<br>• Curlew (*Numenius arquata*)<br>• Redshank (*Tringa totanus*)<br>• Turnstone (*Arenaria interpres*)<br>• Black-headed Gull (*Chroicocephalus ridibundus*)<br>• Common Gull (*Larus canus*)<br>• Sandwich Tern (*Sterna sandvicensis*)<br>• Common Tern (*Sterna hirundo*)<br>• Wetland and Waterbirds | |
| **Cliffs of Moher SPA [004005]** | • Fulmar (*Fulmarus glacialis*)<br>• Kittiwake (*Rissa tridactyla*)<br>• Guillemot (*Uria aalge*)<br>• Razorbill (*Alca torda*)<br>• Puffin (*Fratercula arctica*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | >40 km from project |
| **Mid-Clare Coast SPA [004182]** | • Cormorant (*Phalacrocorax carbo*)<br>• Barnacle Goose (*Branta leucopsis*)<br>• Ringed Plover (*Charadrius hiaticula*)<br>• Sanderling (*Calidris alba*)<br>• Purple Sandpiper (*Calidris maritima*)<br>• Dunlin (*Calidris alpina*)<br>• Turnstone (*Arenaria interpres*)<br>• Wetland and Waterbirds | >40 km from project |
| **Illaunonearaun SPA [004114]** | • Barnacle Goose (*Branta leucopsis*) | >40 km from project |
| **Loop Head SPA [004119]** | • Kittiwake (*Rissa tridactyla*)<br>• Guillemot (*Uria aalge*) | >40 km from project |
| **River Shannon and River Fergus Estuaries SPA [004077]** | • Cormorant (*Phalacrocorax carbo*)<br>• Whooper Swan (*Cygnus cygnus*)<br>• Light-bellied Brent Goose (*Branta bernicla hrota*)<br>• Shelduck (*Tadorna tadorna*)<br>• Wigeon (*Anas penelope*)<br>• Teal (*Anas crecca*)<br>• Pintail (*Anas acuta*)<br>• Shoveler (*Anas clypeata*)<br>• Scaup (*Aythya marila*)<br>• Ringed Plover (*Charadrius hiaticula*)<br>• Golden Plover (*Pluvialis apricaria*) | >40 km from project |

| SPA site name [Site code] | Qualifying features | Distance and direction from Project |
|---|---|---|
| | • Grey Plover (*Pluvialis squatarola*)<br>• Lapwing (*Vanellus vanellus*)<br>• Knot (*Calidris canutus*)<br>• Dunlin (*Calidris alpine*)<br>• Black-tailed Godwit (*Limosa limosa*)<br>• Bar-tailed Godwit (*Limosa lapponica*)<br>• Curlew (*Numenius arquata*)<br>• Redshank (*Tringa totanus*)<br>• Greenshank (*Tringa nebularia*)<br>• Black-headed Gull (*Chroicocephalus ridibundus*)<br>• Wetland and Waterbirds | |
| **Kerry Head SPA [004189]** | • Fulmar (*Fulmarus glacialis*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | >40 km from project |
| **Magharee Islands SPA [004125]** | • Storm Petrel (*Hydrobates pelagicus*)<br>• Shag (*Phalacrocorax aristotelis*)<br>• Barnacle Goose (*Branta leucopsis*)<br>• Common Gull (*Larus canus*)<br>• Common Tern (*Sterna hirundo*)<br>• Arctic Tern (*Sterna paradisaea*)<br>• Little Tern (*Sterna albifrons*) | >40 km from project |
| **Tralee Bay Complex SPA [004188]** | • Whooper Swan (*Cygnus cygnus*)<br>• Light-bellied Brent Goose (*Branta bernicla hrota*)<br>• Shelduck (*Tadorna tadorna*)<br>• Wigeon (*Anas penelope*)<br>• Teal (*Anas crecca*)<br>• Mallard (*Anas platyrhynchos*)<br>• Pintail (Anas acuta)<br>• Scaup (*Aythya marila*)<br>• Oystercatcher (*Haematopus ostralegus*)<br>• Ringed Plover (*Charadrius hiaticula*)<br>• Golden Plover (*Pluvialis apricaria*)<br>• Grey Plover (*Pluvialis squatarola*)<br>• Lapwing (*Vanellus vanellus*)<br>• Sanderling (*Calidris alba*)<br>• Dunlin (*Calidris alpina*)<br>• Black-tailed Godwit (*Limosa limosa*)<br>• Bar-tailed Godwit (*Limosa lapponica*)<br>• Curlew (Numenius arquata)<br>• Redshank (*Tringa totanus*)<br>• Turnstone (*Arenaria interpres*)<br>• Black-headed Gull (*Chroicocephalus ridibundus*)<br>• Common Gull (*Larus canus*)<br>• Wetland and Waterbirds | >40 km from project |
| **Dingle Peninsula SPA [004153]** | • Fulmar (*Fulmarus glacialis*)<br>• Peregrine (*Falco peregrinus*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | 39 km SE (Borehole 37/13-sb1) |

| SPA site name [Site code] | Qualifying features | Distance and direction from Project |
|---|---|---|
| | | 39 km E (Borehole 36/30-sb1) |
| **Castlemaine Harbour SPA [004029]** | • Red-throated Diver (*Gavia stellata*)<br>• Cormorant (*Phalacrocorax carbo*)<br>• Light-bellied Brent Goose (*Branta bernicla hrota*)<br>• Wigeon (*Anas penelope*)<br>• Mallard (*Anas platyrhynchos*)<br>• Pintail (*Anas acuta*)<br>• Scaup (*Aythya marila*)<br>• Common Scoter (*Melanitta nigra*)<br>• Oystercatcher (*Haematopus ostralegus*)<br>• Ringed Plover (*Charadrius hiaticula*)<br>• Sanderling (*Calidris alba*)<br>• Bar-tailed Godwit (*Limosa lapponica*)<br>• Redshank (*Tringa totanus*)<br>• Greenshank (*Tringa nebularia*)<br>• Turnstone (*Arenaria interpres*)<br>• Chough (*Pyrrhocorax pyrrhocorax*)<br>• Wetland and Waterbirds | >40 km from project |
| **Iveragh Peninsula SPA [004154]** | • Fulmar (*Fulmarus glacialis*)<br>• Peregrine (*Falco peregrinus*)<br>• Kittiwake (*Rissa tridactyla*)<br>• Guillemot (*Uria aalge*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | >40 km from project |
| **Puffin Island SPA [004003]** | • Fulmar (*Fulmarus glacialis*)<br>• Manx Shearwater (*Puffinus puffinus*)<br>• Storm Petrel (*Hydrobates pelagicus*)<br>• Lesser Black-backed Gull (*Larus fuscus*)<br>• Razorbill (*Alca torda*)<br>• Puffin (*Fratercula arctica*) | >40 km from project |
| **Skelligs SPA [004007]** | • Fulmar (*Fulmarus glacialis*)<br>• Manx Shearwater (*Puffinus puffinus*)<br>• Storm Petrel (*Hydrobates pelagicus*)<br>• Gannet (*Morus bassanus*)<br>• Kittiwake (*Rissa tridactyla*)<br>• Guillemot (*Uria aalge*)<br>• Puffin (*Fratercula arctica*) | >40 km from project |
| **Deenish Island and Scariff Island SPA [004175]** | • Fulmar (*Fulmarus glacialis*)<br>• Manx Shearwater (*Puffinus puffinus*)<br>• Storm Petrel (*Hydrobates pelagicus*)<br>• Lesser Black-backed Gull (*Larus fuscus*)<br>• Arctic Tern (*Sterna paradisaea*) | >40 km from project |
| **The Bull and The Cow Rocks SPA [004066]** | • Storm Petrel (*Hydrobates pelagicus*)<br>• Gannet (*Morus bassanus*)<br>• Puffin (*Fratercula arctica*) | 39 km NW (Borehole 47/17-sb1) |

| SPA site name [Site code] | Qualifying features | Distance and direction from Project |
|---|---|---|
| | | 38 km NE (Borehole 46/17-sb1) |
| **Beara Peninsula SPA [004155]** | • Fulmar (*Fulmarus glacialis*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | 23 km NW (Borehole 47/17-sb1)<br><br>39 km NE (Borehole 46/17-sb1) |
| **Sheep's Head to Toe Head SPA [004156]** | • Peregrine (*Falco peregrinus*)<br>• Chough (*Pyrrhocorax pyrrhocorax*) | 3 km N (Borehole 47/17-sb1) |
| **Clonakilty Bay SPA [004081]** | • Shelduck (*Tadorna tadorna*)<br>• Dunlin (*Calidris alpina*)<br>• Black-tailed Godwit (*Limosa limosa*)<br>• Curlew (*Numenius arquata*)<br>• Wetland and Waterbirds | >40 km from project |
| **Courtmacsherry Bay SPA [004219]** | • Great Northern Diver (*Gavia immer*)<br>• Shelduck (*Tadorna tadorna*)<br>• Wigeon (*Anas penelope*)<br>• Red-breasted Merganser (*Mergus serrator*)<br>• Golden Plover (*Pluvialis apricaria*)<br>• Lapwing (*Vanellus vanellus*)<br>• Dunlin (*Calidris alpina*)<br>• Black-tailed Godwit (*Limosa limosa*)<br>• Bar-tailed Godwit (*Limosa lapponica*)<br>• Curlew (*Numenius arquata*)<br>• Black-headed Gull (*Chroicocephalus ridibundus*)<br>• Common Gull (*Larus canus*)<br>• Wetland and Waterbirds | >40 km from project |
| **Old Head of Kinsale SPA [004021]** | • Kittiwake (*Rissa tridactyla*)<br>• Guillemot (*Uria aalge*) | >40 km from project |
| **Sovereign Islands SPA [004124]** | • Cormorant (*Phalacrocorax carbo*) | >40 km from project |