Iolar Exploration Well - Environmental Risk Assessment (EIA Screening) Report

Document No: **IE-EXP-52/04-IOLAR-HS-00010-RP-01**

Rev: **U2**

Rev	Date	Reason for Revision
U2	04/10/18	Re-issued for use following PAD gate review
U1	31/08/18	Issued for Use

Authorisation Record		Lead Environmental Consultant	Environmental Specialist	Environmental Specialist
		Xodus Signed	Xodus Signed	Xodus Signed
U2	04/10/18	Polly Tarrant	Iain Dixon	Annette Woodham
Rev	Date	Prepared by	Checked by	Approved by

Iolar Exploration Well

Environmental Risk Assessment (EIA Screening) Report

Nexen Petroleum UK Ltd

Assignment Number: A100460-S00
Document Number: A-100460-S00-REPT-002

Xodus Group
Xodus House, 50 Huntly Street
Aberdeen, UK, AB10 1RS

T +44 (0)1224 628300
E info@xodusgroup.com
www.xodusgroup.com

Environmental Risk Assessment (EIA Screening) Report

A100460-S00

Client: Nexen Petroleum UK Ltd
Document Type: Report
Document Number: A-100460-S00-REPT-002

			Polly Tarrant Digitally signed by Polly Tarrant Date: 2018.10.04 10:38:13 +01'00'	Iain Dixon Digitally signed by Iain Dixon Date: 2018.10.04 11:04:15 +01'00'	Annette Woodham Digitally signed by Annette Woodham Date: 2018.10.04 10:42:48 +01'00'	
A02	04/10/2018	Re-issued for use following PAD gate review	PTa	IMTD	AW	
A01	31/08/2018	Issued for Use	PTa	AW	AW	
R01	03/08/2018	Issued for Review	PTa / DR	AW	AW	-
Rev	**Date**	**Description**	**Issued By**	**Checked By**	**Approved By**	**Client Approval**

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

Name	Company	Title	Relevant Qualifications/ Experience
Annette Woodham	Xodus Group Limited	Project Manager / EIA Specialist	IMarEST member Over 25 years' experience as working as a Marine Environmental Consultant. BSc (Hons) Marine Biology
David Renner	Xodus Group Limited	Lead Environmental Consultant	10 years' experience as a Marine Environmental Scientist / Consultant BSc (Hons) Marine Biology
Iain Dixon	Xodus Group Limited	EIA Specialist	IEMA Associate 40 years' working as a marine environmental consultant PhD Benthic Ecology MSc Oceanography BSc (Hons) Biology
Polly Tarrant	Xodus Group Limited	Lead Environmental Consultant	CIEEM 8 years' experience as Marine Environmental Consultant MSc Marine Environmental Protection BSc (Hons) Marine Biology

CONTENTS

ABBREVIATIONS

BOP	Blow out preventer
CEMP	Coordinated Environmental Monitoring Programme
CODA	Cetacean Offshore Distribution and Abundance
CO_2	Carbon dioxide
CO	Carbon monoxide
CPA	Closest Point of Approach
CRU	Commission for the Regulation of Utilities
CH_4	Methane
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
DREAM	Dose-related risk and effect assessment model
DWT	Dry weight tonnes
EEZ	European Economic Zone
EIA	Environmental Impact Assessment
EIFs	Environmental impact factors
EMP	Environmental Management Plan
EMS	Environmental Management System
ERA	Environmental risk assessment
EL	Exploration Licence
EMODnet	European Marine Observation and Data Network
ENVID	Environmental issues identification
EPS	European Protected Species
ERL	Effects Range Low
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
GHG	Greenhouse gas
HSE&SR	Health, Safety Environment and Social Responsibility Policy
HP	High Pressure

HT	High Temperature
ICES	International Council for the Exploration of the Seas
INFOMAR	Integrated Mapping For the Sustainable Development of Ireland's Marine Resource
INSS	Irish National Seabed Survey
IOSEA	Ireland Offshore Strategic Environmental Assessment
IMO	International Maritime Organisation
IPAS	PAD's Integrated Petroleum Affairs System
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
km	Kilometres
LO	Licence Option
LOT	Leak of test
LSE	Likely Significant Effect
MARPOL	International Convention for the Prevention of Pollution from Ships
MEMW	Marine Environmental Modelling Workbench
MDAC	Methane-derived authigenic carbonate
MMO	Marine mammal observer
MMMU	Marine Mammal Management Units
MOW	Mediterranean Outflow Water
MSDS	Material safety data sheet
MSFD	Marine Strategy Framework Directive
NMFS	National Marine Fisheries Service
NMVOC	Non-methane volatile organic compounds
NOEC	No observed effect concentration
NO_X	Oxides of nitrogen
NPWS	National Parks and Wildlife Services
N_2O	Nitrous oxide
OBM	Oil based mud
OSCP	Oil Spill Contingency Plan
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAD	Petroleum Affairs Division
PEC	Predicted environmental concentration
PHB	Poly beta-hydroxybutyrate
PM	Particulate matter
PNEC	Predicted no effect concentration
PTS	Permanent threshold shift

PUDAC	Permit to Use and Discharge Added Chemicals
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SEP	Stakeholder engagement plan
SEL	Sound exposure levels
SNCBs	Statutory Nature Conservation Bodies
SO_X	Sulphur oxides
SPA	Special Protection Area
THC	Total hydrocarbon
TTS	Temporary threshold shift
TVDSS	Total vertical depth subsea
VMS	Vessel Monitoring Systems
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
VSP	Vertical Seismic Profiling
WBM	Water Based Muds

1 INTRODUCTION

1.1 Overview

Nexen Petroleum U.K Ltd (Nexen) plans to drill a single exploration well in the Iolar prospect in Frontier Exploration Licence (FEL) 3/18 in the Porcupine Basin offshore west of Ireland (termed the 'Project'). The expected hydrocarbon type for the exploration well is oil.

The Project lies approximately 232 km west of the Irish mainland in water depths of approximately 2,200 m (Figure 1.1).

The well will be drilled using a floating drill ship suitable for the deep-water west of Ireland with the earliest start date for drilling operations being April 2019. The total duration of the drilling and suspension/abandonment operations (on location) is expected to be 100 to 150 days.

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 (EIA)) (Petroleum Exploration) Regulations 2013 and the European Union EIA Directive 2011/92/EU, as amended by Directive 2014/52/EU.

Therefore, this report has also been prepared to fulfil drilling approval requirements as set out by the Petroleum Affairs Division (PAD), part of the Department of Communications, Climate Action and Environment (DCCAE) formally the Department of Communications Energy and Natural Resources (DCENR), and to consult on the need for an EIA.

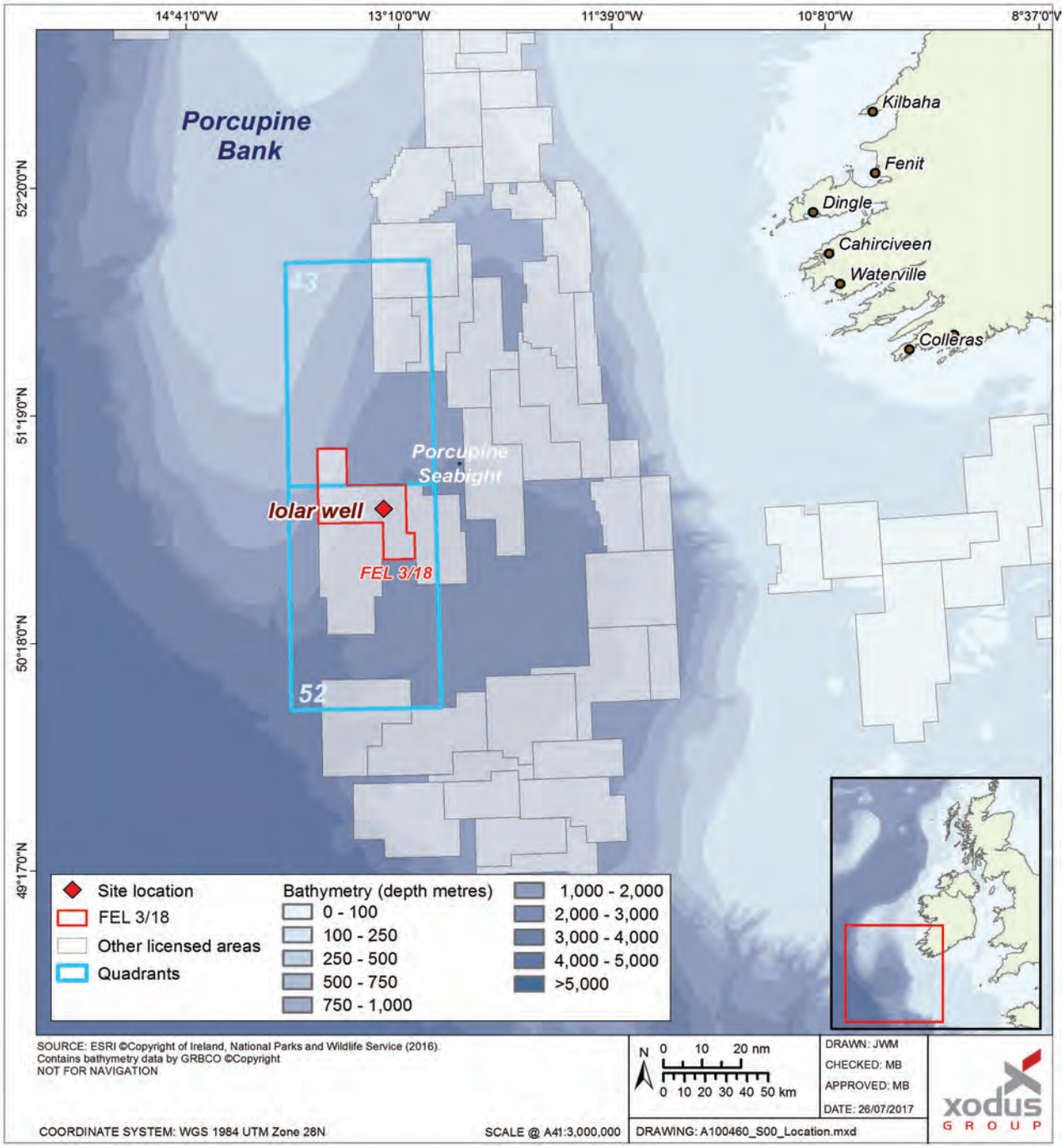
The overall purpose of the environmental information provided is to examine the possibility that the proposed Project, either individually or in combination with other plans and projects, may result in significant negative environmental impacts in Irish waters and the continental shelf.

1.2 Background and Purpose of the Well

Licence Option (LO) 16/7 was acquired by Nexen as part of the 2015 bid round and is now FEL 3/18. The 52/4-A (Iolar) well will be the first drilled by Nexen in Ireland. The Iolar prospect is a large Jurassic structural closure on the western side of the Porcupine Basin adjacent to the Porcupine High.

The purpose of the proposed well is to gather data on the reservoir characteristics, hydrocarbon presence, pressures and temperatures. Once exploration drilling operations are complete, the well will be abandoned, whether or not commercially viable quantities of hydrocarbons are found.

Figure 1.1 Project Location



1.3 The Applicant

Nexen is a well-established upstream oil and gas company with a global portfolio. A key focus of Nexen is exploration and appraisal of interests in the North Sea, offshore West Africa and the north east Atlantic.

Contact details are provided below.

Michelle Ball
EHS Lead, Ireland
Nexen Petroleum UK Ltd.
Discovery House
Prime Four Business Park
Kingswells
Aberdeen
UK
AB15 8PU
T: +44(0) 1224 371767
E: michelle.ball@nexencnoocltd.com

Rory Dunphy
Manager, Regional Office – Ireland
Nexen Petroleum UK Ltd
Parkview House
Block 2C
Beech Hill Business Park
Clonskeagh
Dublin 4
Rep. of Ireland
D04 K5D0T: +353(0) 1 – 669 4801
E: rory.dunphy@nexencnoocltd.com

1.4 Legislative Requirements

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. The Petroleum Affairs Division (PAD), within the DCCAE, is the body whose role is to maximise the benefits to the State from exploration for and production of indigenous oil and gas resources, while ensuring that activities are conducted with due regard to their impact on the environment and other land/sea users.

In order to gain approval for the Project, Nexen is required by the PAD of the DCCAE to submit an Application for Approval to Drill a Well in two stages (as outlined in Section 3.1 of the Rules and Procedures for Offshore Petroleum Exploration and Appraisal Operations (part 3 of PAD, 2014):

> A Generic Well Proposal at least 90 days before commencement of operations; and

> A Final Well Proposal at least 30 days before commencement of operations.

In addition, environmental assessments must be carried out and reported as part of the application, to meet the requirements of the European Union (EU) Environment Impact Assessment (EIA) Directive and the EU Habitats Directive and the relevant implementing regulations in Ireland, namely the EU (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 and the European Communities (Birds and Natural Habitats) Regulations 2011. Further details of the EU directives are provided in Section 1.5.3.

In addition, if a well is to be plugged and abandoned, an Application for Approval to Plug and Abandon shall be submitted to the PAD of DCCAE at least 48 hours before commencement of abandonment operations (as outlined in Section 3.8 of the Rules and Procedures for Offshore Petroleum Exploration and Appraisal Operations (part 3 of PAD, 2014).

Nexen has developed a Permits, Licences, Authorisations, Notifications and Consents (PLANC) register to identify and manage the various legislative submission requirements associated with the Project.

1.4.1 Requirement for environmental assessment

1.4.1.1 Environmental Impact Assessment (EIA)

1.4.1.1.1 Environmental Impact Assessment (EIA) Directive

The EIA Directive (85/337/EEC) was introduced in 1985, and was repealed and replaced by Directive 2011/92/EU and amended by Directive 2014/52/EU, where it applies to a wide range of public and private projects, which are 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 at a national level whether an EIA is required on the basis of set criteria / threshold limits or on the basis of a case by case examination. The criteria by which national authorities are required to take account are laid down in Annex III of the Directive. The information to be presented in an EIA is listed in Annex IV.

1.4.1.1.2 Environmental Risk Assessment (EIA Screening) Report

The obligations of the EIA Directive are implemented in Ireland in relation to oil and gas exploration via the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013. These regulations state that, where the holder of a licence proposes to undertake activities[1] 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, and the Minister considers the activities, the subject of the application would be likely to have significant effects on the environment by virtue, *inter alia*, of their nature, size and location, he or she shall require the applicant to submit an Environmental Impact Statement in respect of the activities the subject of the application.

An Environmental Impact Assessment Report or EIAR (formerly known as an Environmental Impact Statement) presents information in order to assist the Minister in conducting an EIA under the requirements of the EIA Directive. Any project which is listed under Annex I of the Directive must always to be subject to EIA. Any project listed in Annex II must be evaluated on a case by case basis by national authorities to determine whether or not an EIA is required. 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. Exploration drilling is not listed as an Annex I or II activity. However, the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013 allow for the relevant minister to determine on a case-by-case basis if an EIA is required for any petroleum activities, as outlined above.

Having regard to these requirements, this Environmental Risk Assessment (EIA Screening) Report has been prepared to assist the Department 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. The findings of the environmental risk assessment are presented in this Environmental Risk Assessment (EIA Screening) 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 EIA Screening process is summarised in Figure 1.2, and 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 the mitigation that will be used to eliminate/lessen the severity of the potential impacts. The mitigation measures include embedded design, control and management measures as well as legislative requirements, guidance and good industry practice. The Environmental Risk Assessment (EIA Screening) Report also outlines plans and procedures that will be put in place to manage the consequences of potential accidental releases.

[1] 'Activities' includes searching for petroleum (within the meaning of section 8(7) and Section 9(5) of the Petroleum and Other Minerals Development Act 1960) under an exploration licence.

1.4.1.2 Habitats Directive Assessment and European Protected Species (EPS) Assessment Screening

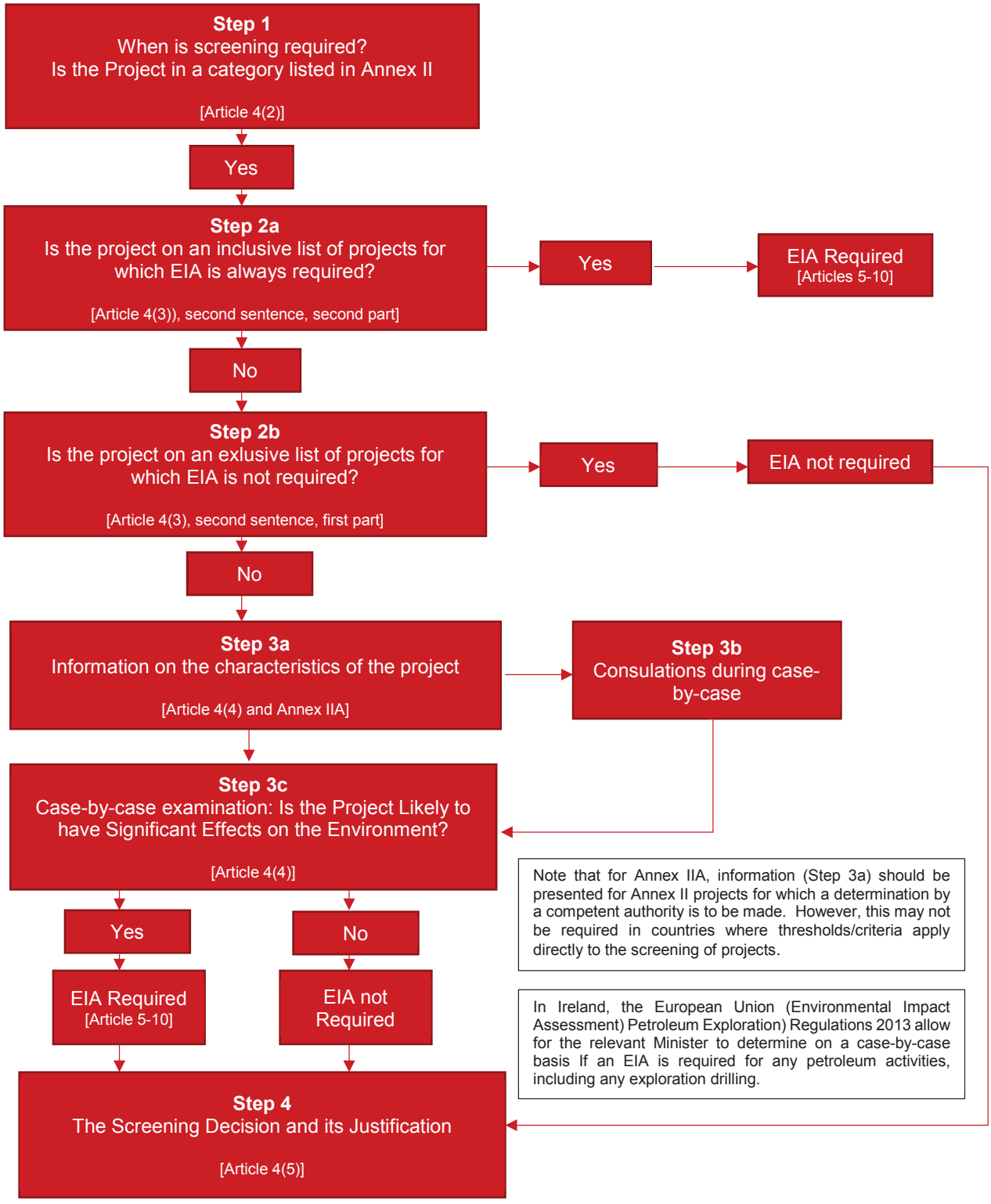
The EU Birds Directive 79/409/EEC (updated and consolidated into Directive 2009/147/EC) provides significant protection for Europe's wild birds and identifies those species and subspecies among them which are particularly threatened and in need of special conservation measures. A number of approaches 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). 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. In addition, any species listed under Annex IV of the Habitats Directive (which includes all cetaceans) are subject to an assessment of significant impacts under Article 12 of the Directive (termed European Protected Species, EPS).

The regulations require a screening assessment to be completed, to allow the Department of Arts, Heritage and the Gaeltacht (DAHG) - National Parks and Wildlife Services (NPWS) to assess the potential impact of the drilling on the designated habitats / species identified. Information required for NPWS to complete the screening assessment must be provided. This has been prepared separately and has been submitted to NPWS via DCCAE (Nexen, 2018), and a summary of the information provided is included in this EIA Screening Report.

Figure 1.2 EIA Screening flow diagram (European Commission, 2017 amended to mention relevant Irish Regulations)



1.4.2 The Irish Offshore Strategic Environmental Assessment 5 (IOSEA5)

The Department of Climate, Energy and Natural Resources (DCENR) (now DCCAE) completed the 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. This range includes all authorisations and activities within the Porcupine Basin. IOSEA5 (DCENR, 2015) supersedes the previous four regional SEAs conducted including that undertaken specifically for the Porcupine Basin, IOSEA2 (DCENR, 2007).

This EIA Screening Report, the Environmental Risk Assessment and all related Appropriate Assessment reports will 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.

1.4.3 Additional approval requirements

Alongside the submission of the Final Well Proposal (as mentioned in Section 1.4), the following should also be prepared and approved and submitted to DCCAE for approval (as outlined in Section 3.1 of the Rules and Procedures for Offshore Petroleum Exploration and Appraisal Operations (part 3 of PAD, 2014):

- Emergency Procedures Manual;
- Oil Spill Contingency Plan (OSCP); and
- Drilling Unit's Operation Manual.

In addition, in Ireland the use and discharge of chemicals are permitted through a Permit to Use and Discharge Added Chemicals (PUDAC), which is required to be submitted 60 days before commencement of operations.

The OSCP will be submitted for approval under the operators' safety case submissions to the Irish Coastguard; however, the updated Rules and Procedures Manual redacting the provisions in Part 3 relating to the OSCP has not been issued.

1.5 Wider Legislative Framework

1.5.1 OSPAR Convention

The OSPAR Convention contains a series of Annexes relevant to exploration drilling, 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.

1.5.2 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.

1.5.3 Industry standards and guidelines

The following standards and guidelines are produced by various bodies operating within the Exploration and Production sector and are available either publicly via their websites, or to members of the relevant association.

1.5.3.1 International Association of Oil & Gas Producers (IOGP)

The IOGP prepared the 'Guidelines for waste management with special focus on areas with limited infrastructure' (Report No. 413, September 2008 (Updated March 2009)). It builds on the previous 'Waste Management Guidelines' from IOGP (Report No. 2.58/196, September 1993). It provides guidance on principles and practices of effective waste management, as well as information on waste streams and technologies typically applicable in exploration and production operations.

1.5.3.2 National Parks and Wildlife Services (NPWS)

NPWS prepared the 'Guidance to Manage the Risk of Marine Mammals from Man-made Sources in Irish Waters' (NPWS, 2014), which sets out to address several key potential sources of anthropogenic sound that may impact detrimentally upon marine mammals in Irish waters. It incorporates the Code of Practice for acoustic surveys and provides guidance and mitigation measures in this respect, which where relevant apply to activities often undertaken during offshore oil and gas exploration.

1.6 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, the company; overview of applicable international conventions and national legislation that regulate exploration drilling offshore Ireland.
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	*Environmental Management* – provides an outline of how Nexen will manage the Project to facilitate protection of the environment and the socio-economic activities.
Section 7	*Environmental Risk Assessment Conclusions*.
Section 8	*Environmental Impact Assessment Screening*
Section 9	*EIA Screening Conclusion*
Section 10	*Appropriate Assessment (Nature Impact Statement) Screening Conclusions*
Section 11	*References*

2 PROJECT DESCRIPTION

This section describes the proposed drilling programme and the alternatives considered for drilling a deep-water, high pressure / high temperature (HP/HT)[Note 1] exploration well in the Iolar prospect.

2.1 Purpose and objectives

The purpose of the proposed well is to gather data on the reservoir characteristics, hydrocarbon presence, pressures and temperatures. This information will be used to help form decisions on any future development at the Iolar prospect. However, once exploration drilling operations are complete, the well will be abandoned, whether or not commercially viable quantities of hydrocarbons are found.

The primary objective of the Project is to verify and evaluate the hydrocarbon potential, fluid properties and reservoir quality in the Middle to Upper Jurassic age fault block, in the Iolar prospect, in FEL 3/18. The two secondary objectives are to verify and evaluate the hydrocarbon potential, fluid properties and reservoir quality in the interpreted J3L Top Oxfordian reservoir and to evaluate the hydrocarbon potential, fluid properties and reservoir potential of the Cretaceous succession in the FEL 3/18 area.

2.2 Project Alternatives

The various options for the Project have been evaluated in terms of technical feasibility, environmental impact, health and safety, reputation and cost. The Environmental Assessment process was initiated early in the planning stage to support the option selection process.

Whilst not drilling the well (the do-nothing option) would avoid any potential for environmental impact, it would prevent Nexen from investigating and confirming hydrocarbon reserves in the licence block and would not facilitate optimum utilisation of potential reserves that might be developed to the benefit of Nexen and the nation.

The following options have been considered by Nexen in planning the exploration well:

- Selection of drilling rig;
- Time of year for drilling;
- Selection of mud system and cuttings disposal;
- Selection of well logging and sampling operations including vertical seismic profiling (VSP); and
- Suspension or abandonment.

The outcomes of the option selection are described below in the rest of Section 2 and form the basis for the assessment in this ERA report.

Note 1
The Energy Institute defines a high pressure / high temperature (HP/HT) wells as:

"High temperature in this context can be defined as when the undisturbed bottom hole temperature at prospective reservoir depth (or total depth) is greater than 300ºF (149ºC). High pressure can be defined as either when the maximum anticipated pore pressure of any porous formation to be drilled through exceeds a hydrostatic gradient of 0.8psi/ft. (representing an Equivalent Mud Weight (EMW) of 1.85SG or 15.4ppg) or, needing deployment of pressure control equipment with a rated working pressure in excess of 10,000psi (690bar, 69MPa). Note that areas of high pressure (abnormal pressure) need not necessarily be accompanied by high temperatures and vice versa."

The Iolar well can be considered a HP/HT well under this definition because the temperature and the surface wellhead pressure is above the designated 300°F and 10,000psi respectively. The Iolar well has a maximum bottom hole static temperature of 323°F and a base case wellhead pressure of 10,300psi; maximum wellhead pressure of +/-12,000psi.

2.3 Project Overview and Schedule

The proposed Iolar 52/04-1 well is located in Irish FEL 3/18, 232.4 km west of the Irish mainland in the Porcupine Basin. Details of the likely well location are provided in Table 2.1.

Table 2.1 Iolar well details

Well name	Surface coordinates (UTM28N ED50)	Water depth (datum Lowest astronomical tide (LAT))[2]
Iolar	50° 53' 31.16"N 13° 21' 24.38"W	2,162 m

For the purposes of this ERA, a spud date of April 2019 has been assumed, since this is the earliest window of opportunity for drilling operations and is likely to be favourable in terms of weather conditions. The total duration of the drilling and suspension/abandonment operations (on location) is expected to be 100 to 150 days. The weather window for the drilling activities is between 1st April and 30th September.

2.3.1 Project size

The overall size of the Project will be limited to the drill ship itself and the 500 m radius safety exclusion zone which will be place around the drill ship whilst on location. This safety exclusion zone will be approximately 0.8 km^2.

2.4 Drill Ship

The drill ship to be used to drill the Iolar exploration well will be the IceMAX. This is a drill ship with proven capability to drill HP/HT wells and to operate in the harsh environment west of Ireland. It will maintain position over the drilling location for the duration of exploration drilling activity using a dynamic positioning (DP) system (Figure 2.1).

Floating drill ships are specially built seagoing vessels that drill in deep waters. Drilling equipment is installed on the deck, with the derrick normally placed in the middle of the ship. The well is drilled through an opening (called a "moon pool") that extends to the water's surface below the derrick.

Computer-controlled thrusters will be operating more or less continuously to keep the drill ship precisely over the drilling location for the 100 to 150 days of operations.

Dynamically positioned drill ships are capable of navigating under their own steam and positioning themselves at the drilling location. In addition to the drill ship, the drilling operations will require other support vessels (for supply of materials and for safety standby duties) and helicopter transfer of personnel to and from the drill ship during the drilling period. Helicopters may be used occasionally to supply the drill ship with equipment required at short notice and will also be used in the event of an emergency situation. Otherwise, all transport of drilling equipment, supplies, water, fuel and food will be undertaken by supply vessels, which will also return waste and surplus equipment to shore. Table 2.2 shows an overview of the estimated fuel consumption of the drill ship and its associated support vessels and aircraft for the duration of the Project.

The drill ship is designed to withstand wind speeds that exceed the 100-year return extreme and highest significant wave heights up to the 100-year return. The design criteria for the drill ship were based around the metocean criteria in Fugro (2017a); these criteria cover data from 1997 to 2015 and therefore include any changes in metocean conditions due to climate change up to this date.

[2] LAT = Mean sea level (MSL) -1.9 m.

Figure 2.1 IceMAX floating drill ship to be used for the Project

Table 2.2 Vessel requirements and estimated fuel consumption

Activity	Vessel	Fuel type	Consumption rate	Duration	Total fuel consumption (tonnes)
DP drill ship on location	IceMAX	Diesel	50 tonnes/day	150 days	7,500
Support shipping	Standby vessel	Diesel	1.7 tonnes/day	150 days	225
Support shipping	Supply vessels (x3)	Diesel	10 tonnes/day	150 days per vessel	4,500
Transport personnel and freight (5 x 1 hour 15-minute return flights from Kerry per week)	S92 Helicopter	Jet fuel	0.78 tonnes/per one-way trip	22 days	34.5

2.5 Well Engineering

The drilling activity proposed is a single deviated well. Should the well be deemed a success, there is potential to drill a short side track for coring purposes. The Iolar well will be to a total depth of either 6,310 m total vertical depth subsea (TVDSS) in the success case and 5,923 m in the dry hole case. Figure 2.2. illustrates the well design and main dimensions.

The drilling of the exploration well will be conducted in a number of phases. The first is the drilling or jetting of a hole through the surface of the seabed, a process known as spudding. Well sections of decreasing diameter are then drilled using a drill string; this is a long section of pipe, or many pipes connected together, that terminates in a drill bit, which grinds through the seabed and formations beneath. The drill string also passes a drilling fluid, called drilling mud, down into the well to keep the drill bit cool and lubricated during drilling and to aid in the suspension and removal of drill cuttings. This first section is the widest of all the sections that will be drilled; each subsequent section that is drilled will be of successively reduced diameter.

The first step in the sequence of drilling activities will be to jet the 36" diameter top hole section into the seabed, into which the 36" conductor pipe will be cemented. The second section (26") will then be drilled through the conductor and will be lined with a 20" casing to provide stability to the well. The casing of these sections, firmly cemented in place, will then provide a firm structural support for subsequent casing strings and the installation of the blowout preventer (BOP) safety equipment. Once the BOP has been installed, a surface riser will connect the wellhead and BOP with the drill ship, thus providing a conduit to return the mud and cuttings from the deeper sections of the well back to the drill ship.

The deeper 20", 17½", 12¼" and 8½" sections of the well will then be drilled with the drilling fluids circulated back to the drill ship. A 16" liner and 13⅝" x 13⅜" and 9⅝" x 9⅞" casings and will be installed and cemented in place for the third, fourth and fifth sections in the drilling sequence, respectively (Figure 2.2).

2.6 Mud System and Cuttings Discharge

Drilling fluid/mud fulfils a number of functions such as lubrication and cooling of the drill bit, suspension and transport of rock cuttings to the surface, and the provision of 'weight' (hydrostatic pressure) to counter-balance formation pressure. The main options in the selection of drilling muds are water-based muds (WBM) and oil based mud (OBM). The selection of drilling muds is typically dictated by the anticipated down-hole geological conditions, and OBM types have a particular application for drilling, for example, water-soluble zones or high temperature wells that dehydrate WBMs. The planned Iolar exploration well will be drilled using both WBM and OBM

The first two sections of the well (36" and 26") will be drilled before a marine riser is installed. This means that all drilling fluids, rock cuttings and residual cement returns from these sections will be discharged directly onto the seabed in the immediate vicinity of the well. These sections will be jetted/drilled using seawater and pre-hydrated bentonite sweeps (a type of WBM).

The deeper sections (20", 17½", 12¼" and 8½") will be drilled using OBM. The mud will be pumped downhole and then circulated back to the surface via the annulus (the space between the drill stem and the wall of the bore hole) and through the BOP stack and the marine riser back to the drill ship. All OBM drilling cuttings and associated residual OBM will then be skipped and shipped to shore for management and disposal.

Table 2.3 provides an estimate of the amounts of cuttings and WBM that will be generated/used and subsequently discharged into the sea, as was modelled to inform this ERA. It is worth noting that what was modelled is now more than what is expected from the current well design, and therefore the values presented in Table 2.3 are a conservative, worst case estimate.

Figure 2.2 Schematic of the expected well design for Iolar exploration well

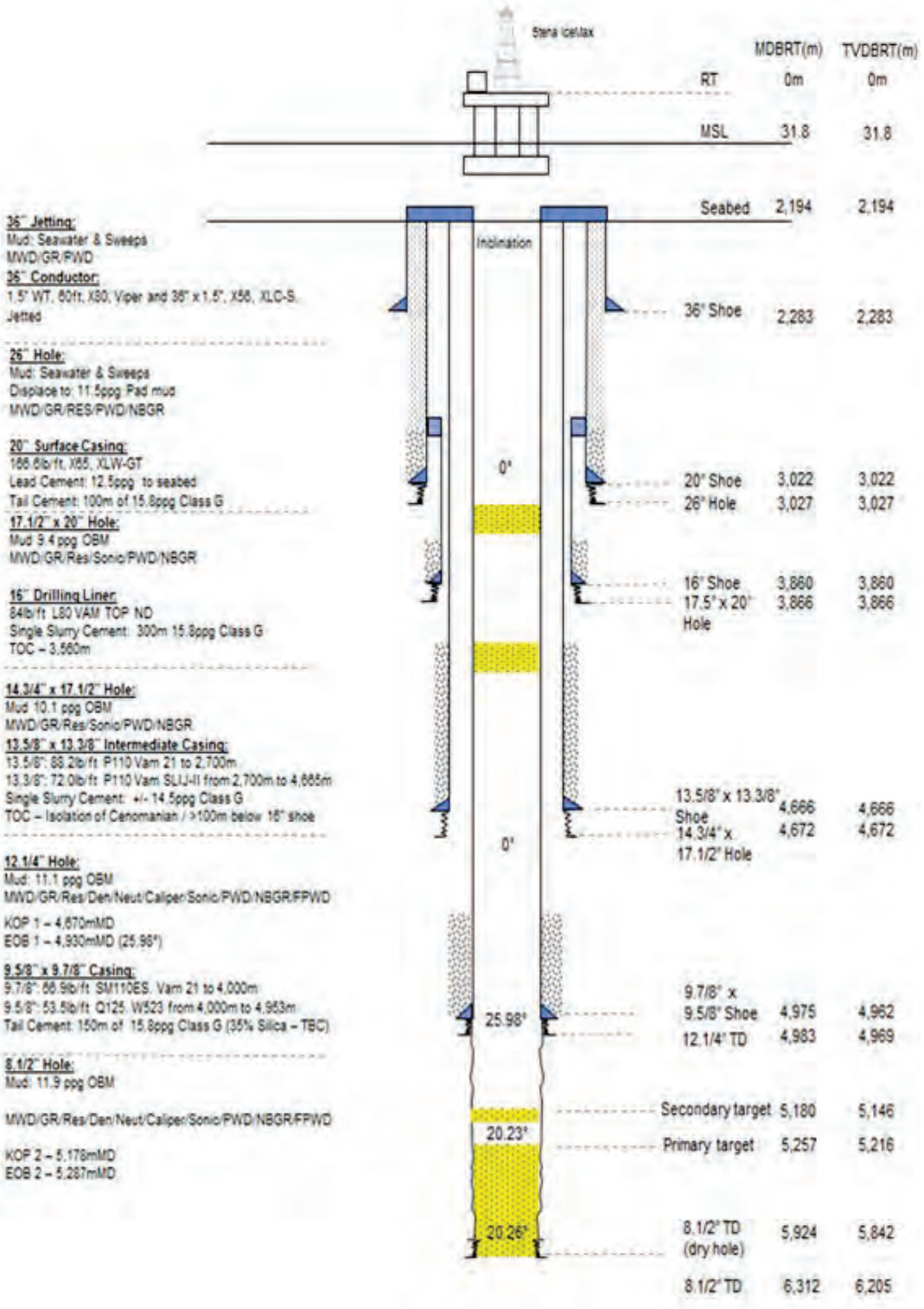


Table 2.3 Cuttings and mud generation and discharge volumes

Section	Discharge point	Cuttings discharged (te)	Type of drilling mud
42"	Seabed	941	WBM
26"	Seabed	2,168	WBM
20"	n/a	0	OBM
17½"	n/a	0	OBM
12¼"	n/a	0	OBM
8½"	n/a	0	OBM

2.7 Cementing and Other Chemicals

The steel casings run into each of the well sections will be cemented in place by circulating cement through the gap between the casing and surrounding formation. During cementing operations, it is normal practice to use a certain amount of excess cement to ensure the integrity of the cement job. It is therefore likely that a small amount of cement will be deposited on the seabed around the wellhead when cementing in place the 36" conductor and the 20" casing, before the BOP is installed. However, the amount discharged in this fashion will be minimised by the cementing method used and visual monitoring of the operation by a remotely operated vehicle (ROV).

During the subsequent cement jobs there will be no cement returns to seabed or surface. When cleaning up the cement unit after each of the cementing operations is completed, heavily diluted residual cement slurry will be discharged to sea.

The specific chemicals and additives used during drilling will be dependent upon the mud composition, which in turn will be determined by the down-hole conditions encountered whilst drilling. All chemicals will be selected on their technical specifications as well as for their potential environmental impacts, which will be assessed using the CHARM risk assessment model where appropriate. The results of this process are submitted in a PUDAC, 60 days prior to planned operations in line with the Rules and Procedures Manual. Additional chemicals will be stored on the drill ship to deal with any contingencies such as stuck drill pipe or loss of circulation

2.8 Vertical Seismic Profiling

Vertical seismic profiling (VSP) may be required for the exploration well. VSP is a survey technique used to establish the geological structure of the formations through which the well passes, and to confirm (or ground-truth) the information available from previous wider scale surface seismic survey data. The technique generates energy waves by compressed air from an airgun array (the source), these being directed at the geological strata downhole. The activity uses a small airgun array, comprising an air gun volume of similar to 250 cu inch, 2000 psi, and with a maximum shot rate of 10 secs. During VSP operations, four to five receivers are positioned in a section of the wellbore and the airgun array is discharged into the water column approximately five times at 20 second intervals. The generated sound pulses are reflected through the seabed and recorded by the receivers to generate a profile of the wellbore. This process is repeated as required for different stations in the wellbore and a typical VSP operation can take between 6 to 12 hours to complete, depending on the wellbore's depth and number of stations being profiled. The VSP source is expected to generate a noise level around 220 dB re 1uPa (RMS SPL) @ 1 m, with the majority of the noise concentrated at low (<100 Hz) frequencies.

VSP activities will be undertaken from the drill ship at the end of the drilling and no additional VSP survey vessel is anticipated to be used during the planned activities. Once the survey is complete, the data can be used by reservoir engineers to firm up interpretations of formation structure and topography.

2.9 Well Abandonment

Once drilling and VSP are complete, the exploration well will be permanently plugged and abandoned. Mechanical and cement plugs will be placed along the well, plugging off all points where hydrocarbons could possible enter the wellbore, thus isolating them from surface. The wellhead will be severed and pulled a minimum of 3 m below the seabed in accordance with the PAD Rules and Procedures Manual (PAD, 2014). Cutting and pulling of the 36" conductor, 20" casing and 16" liner will be required. Prior approval of the plugging and abandonment of the well will be obtained from PAD as per the Rules and Procedures Manual (PAD, 2014).

3 ENVIRONMENTAL BASELINE

3.1 Introduction

The Project is located within quadrant 52 and FEL 3/18, within ICES sub-division area VIIk in the western side of the Porcupine Seabight 232.4 km off the south-west coast of Ireland, in water depth of 2,162 m (Figure 1.1). This region is characterised by several physical, climatic and oceanographic features, which combine to form one of the most biologically productive areas of the eastern North Atlantic Ocean. The region supports numerous fish, seabird and cetacean species and there are sensitive benthic habitats in the area, several of which are of conservation importance.

The Project lies within the Irish Offshore Strategic Environmental Assessment area 2 (IOSEA2) conducted in 2007 for the Porcupine Basin area, and the later IOSEA5 carried out in 2015 covering the whole of Ireland's offshore area. Alongside these SEAs and numerous existing studies and data sources of the Porcupine Seabight and west of Ireland marine environment, this environmental baseline has been informed by a number of Nexen commissioned studies for the Project area. These are:

- A metocean report for the proposed Iolar well location (Fugro, 2017a);
- A geophysical, geotechnical and environmental survey of the proposed Iolar location (reported in Fugro, 2017b, 2017c). The survey was undertaken in July 2017 and consisted of a shallow geophysical survey over a 5 x 1.8 km wide area, centred on the proposal Iolar well location, alongside environmental grab samples and video and stills transects around the proposal Iolar well location;
- A consent to locate for the proposed Iolar well location which included the identification of shipping routes passing the Iolar location (Anatec,2018); and
- A pre-drilling fisheries study (Sinbad, 2017).

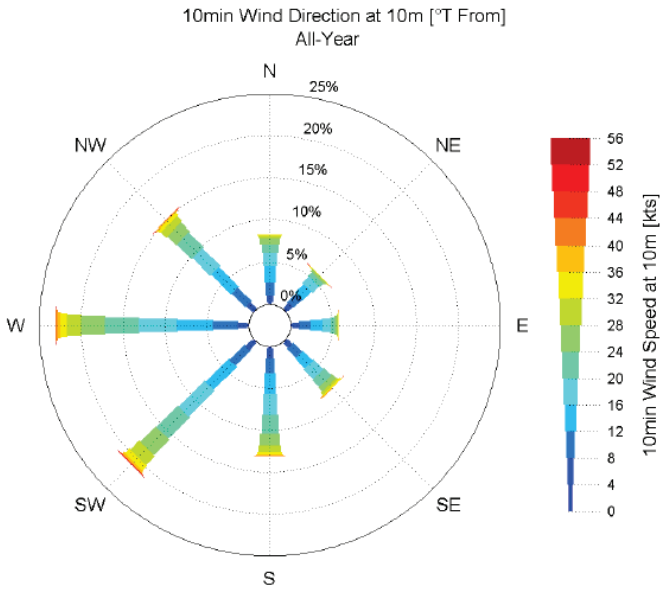
This environmental baseline provides a description of the aspects of the environment which have the potential to be affected by the Project. Therefore, the description largely focuses on the offshore deep-water environment of the Porcupine Seabight, alongside the south and west coast of Ireland, due to the potential risk of an oil spill from an accidental event in these areas.

3.2 Physical environment

3.2.1 Weather and sea conditions

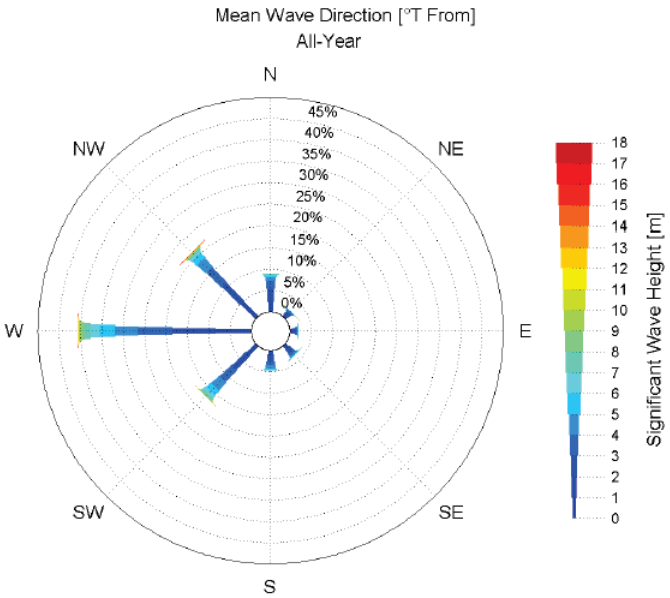
Winds throughout the Porcupine Basin are extremely variable in both direction and speed, owing to the frequent passage of Atlantic depressions into the area from the mid North Atlantic. Most frequently, winds blow from the west to south-west (Figure 3.1). However, when a stationary anti-cyclone develops 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. 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. (Fugro, 2017a).

Figure 3.1 Annual Wind Rose for the Project location at 50° 53’ 32.8122’’ N, 13° 21’ 20.5582’’ W (Fugro, 2017a).



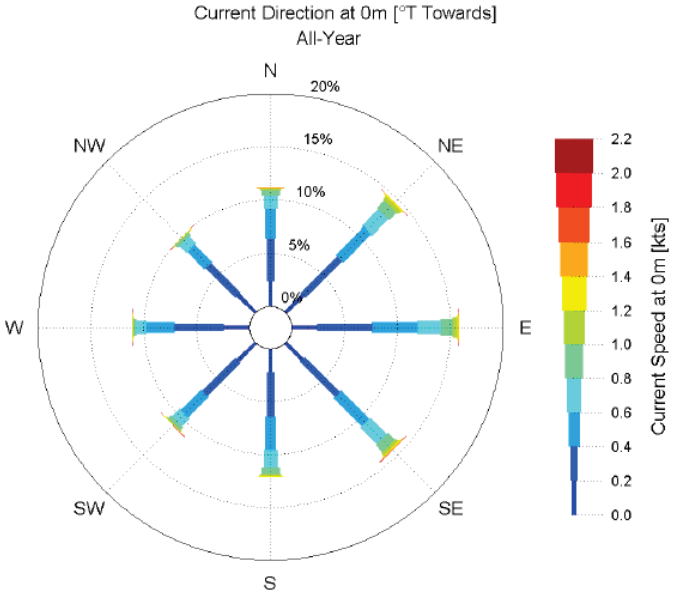
The sea states experiences in and around the Porcupine Basin are amongst the highest and/or roughest of all the coastal waters bordering the British Isles. Wave heights vary seasonally, with the highest, more variable waves (≥ 15 m) experiences during the winter (December to March) and shorter, less variable waves (of up to 10 m) evident during summer (June to September). Wave energy is at its highest during the months of October through March (Fugro, 2017). Wave predominate from the west largely between 1 and 5 m in height but they have been recorded at heights of over 17 m (Figure 3.2; Fugro 2017a).

Figure 3.2 Annual Wave Rose for the Project location at 50° 53’ 32.8122’’ N, 13° 21’ 20.5582’’ W (Fugro, 2017a)



Surface currents at the Project location come from all directions, the majority of which are very low between 0.2 and 0.6 knots (Figure 3.3, Fugro 2017a). The underlying general pattern of oceanic water mass circulation around Ireland's Atlantic margin is indicated in Figure 3.4, including the near surface current from north to south from the northern edge of the Porcupine Seabight to the Porcupine Abyssal Plain (DCENR, 2015). Deep-water currents bring Arctic water southwards beyond the continental slope (DCENR, 2015).

Figure 3.3 **Annual current rose for the Project location at 50° 53' 32.8122'' N, 13° 21' 20.5582'' W (Fugro, 2017a)**



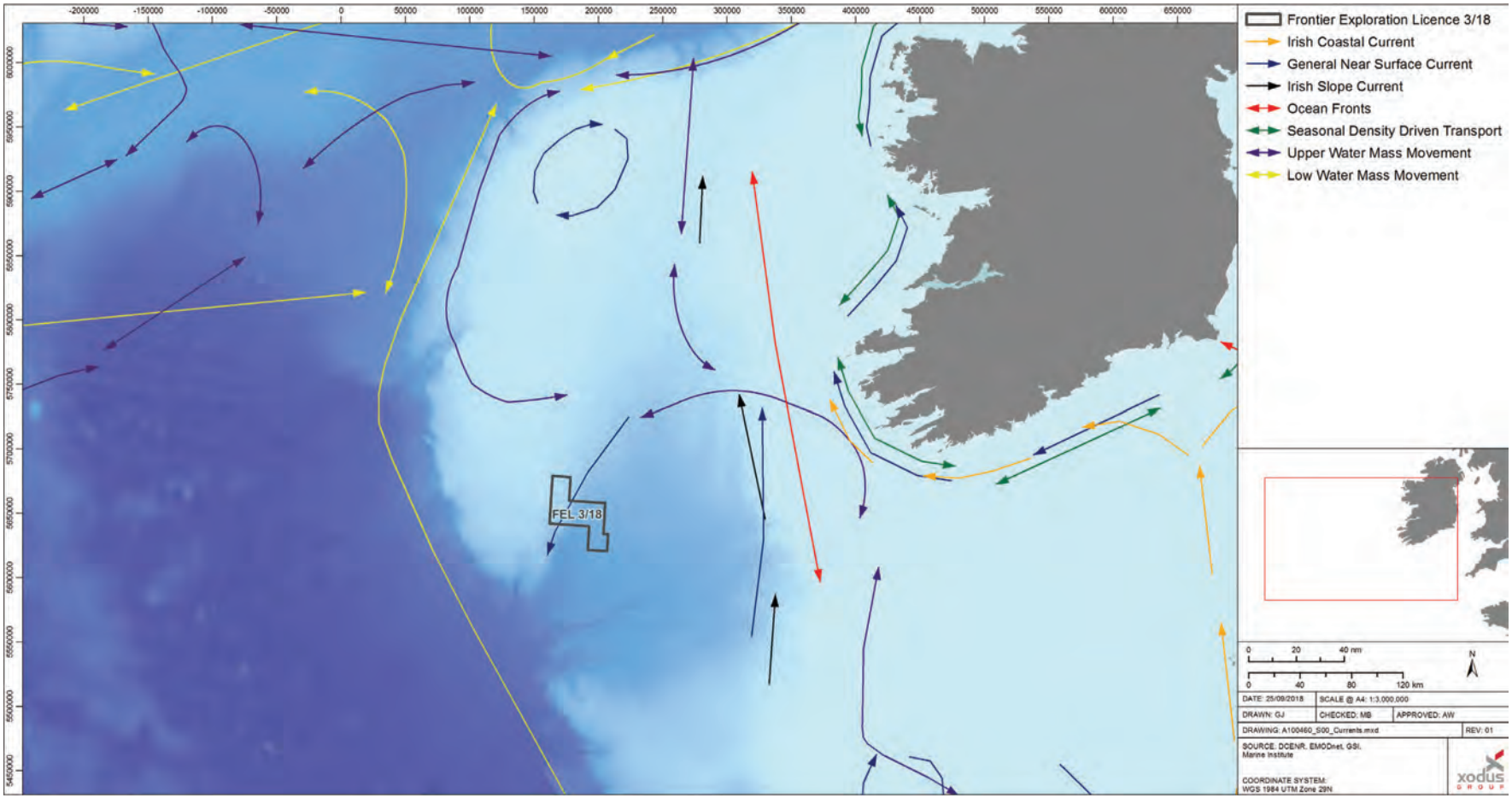
3.2.2 Bathymetry

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 on a regional scale is shown in Figure 1.1. The Porcupine Seabight is a deep water embayment opening into the Porcupine Abyssal Plain, and is flanked to the east by the Celtic Sea continental shelf, to the north and west by the Slyne Ridge and Porcupine Bank, and to the south by the Goban Spur. Water depths range from 200 m on the edges of the continental shelf down to 3,000 m at its opening onto the Porcupine Abyssal Plain. The Project is located on the western side of the Porcupine Seabight and towards the eastern flank of the Porcupine Bank.

The recent site survey showed that the seabed around the proposed Iolar well location has a gentle gradient (generally less than 2º), with a depth of 2,162 m (below LAT) at the proposed well location (Fugro 2017b).

Figure 3.4 Large-scale water mass circulation around Ireland's Atlantic Margin



3.2.3 Seabed conditions

3.2.3.1 Seabed type

The seabed environment to the south-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.

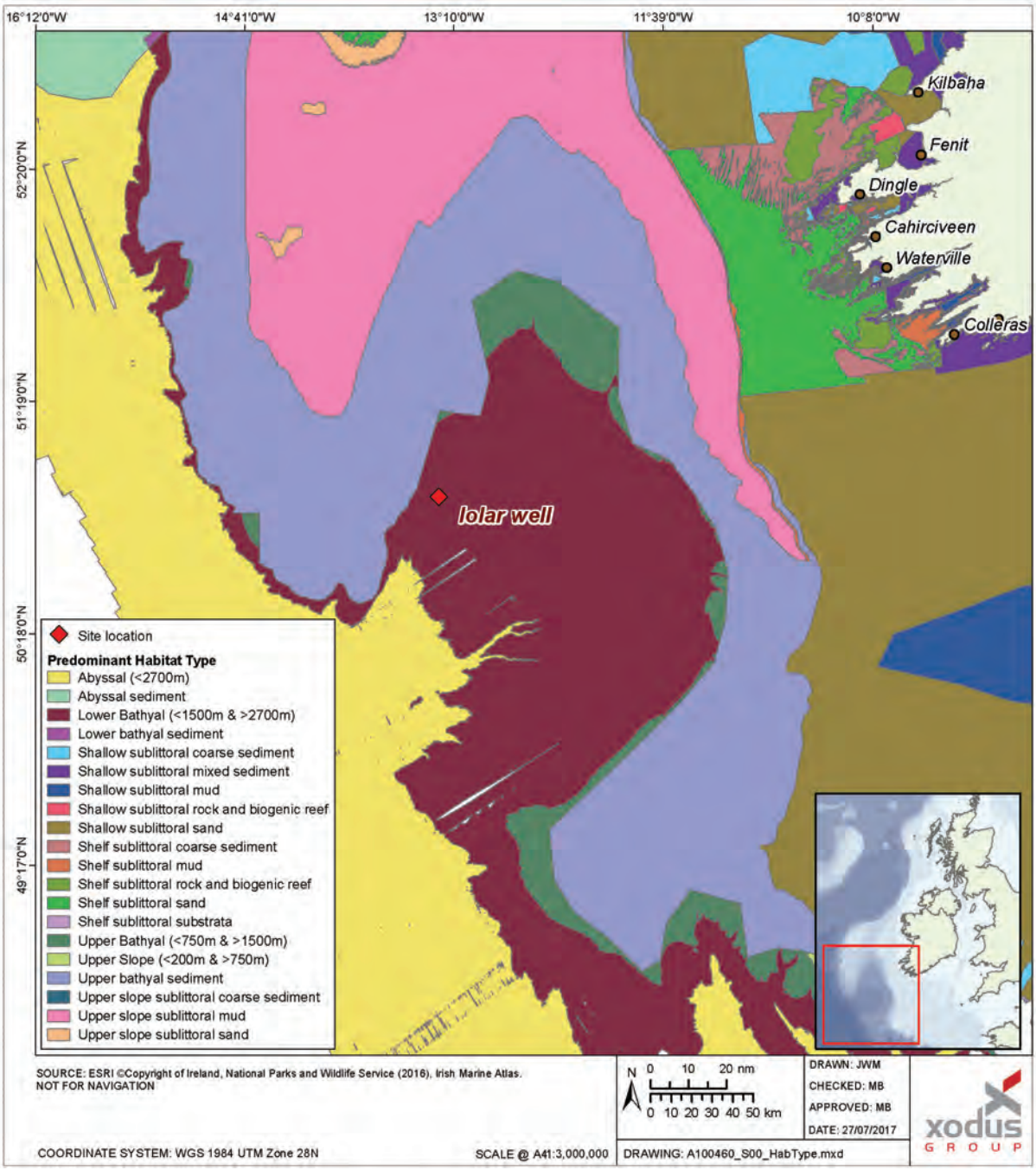
Surface sediments in the Porcupine Seabight generally become finer with increasing water depth and consist of clayey sands overlying silty clays (DCENR, 2007). Glacial rock debris as well as debris dumped from steam ships (clinker and coal residues) also occur (DCENR, 2007).

A number of benthic habitat mapping programmes have been conducted in Irish waters including the European Marine Observation and Data Network (EMODnet) and collated European Nature Information System (EUNIS) Habitats as reported in DCENR (2015). However, the outputs from these habitat mapping programmes do not extend to the deeper waters of the Porcupine Seabight including the Project location. The Marine Institute provides predictive seabed habitat mapping which is reported in the Ireland's Marine Atlas under the Marine Strategy Framework Directive (MSFD) Predominant Habitat type (Marine Institute, 2017). This mapping programme, although high level, predicts the seabed habitats within the Project are as 'lower bathyal' (Figure 3.5).

The sediments are highly varied across the Irish continental shelf, but on the shelf to the west of the Porcupine Basin, habitats are broadly mapped as sand (INFOMAR, 2017). Towards the Porcupine Basin the sediments become finer with depth, being classified as mud or deep-sea mud to approximately 500 m, the current lower limit of available seabed classification (EUSeaMap, accessed 2016; DCENR, 2007).

Fugro (2017b) reported that the seabed sediments around the Iolar well location were generally homogenous and were classified as mud. Fugro (2017b) assigned the seabed around the Iolar well location EUNIS main habitat 'Deep-sea mud' (seabed images of the sediment, alongside associated fauna are displayed in Section 3.3.2 below). The analyses of sediment grab samples collected during the site survey showed a high proportion of fines at all stations, ranging from 83.2 to 85.4%, with all stations classified as very poorly sorted fine silt (Fugro, 2017c).

Figure 3.5 MSFD Predominant Habitat Type in the vicinity of the Project (Marine Institute, 2017)



3.2.3.2 Seabed features

As outlined in the IOSEA5 reports (DCENR, 2015), seabed features identified in the Porcupine Seabight region include carbonate mounds and iceberg plough marks, cold-water coral reefs, deep sea sponge aggregations and pockmarks (Figure 3.6).

3.2.3.2.1 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 is speculation still 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. Figure 3.6 shows the currently known distribution of carbonate mounds and other seabed features listed as under threat and/or in decline (OSPAR, 2014).

With regards to FEL 3/18, the nearest defined mound provinces (OSPAR, 2010a) within the Porcupine Basin are the Belgica Mound Province and the Hovland Mound Province located at 119 km and 135 km from the Project, respectively. No carbonate mound features were reported at the proposed well location in the recent surveys (Fugro, 2017b; 2017c).

3.2.3.2.2 Biogenic reefs (cold-water coral reefs)

Certain benthic organisms are particularly important in providing suitable substrata 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 above). Cold-water coral reefs qualify as 'reef' habitat under Annex I of the EU Habitats Directive and *Lophelia pertusa* reefs are also classified as OSPAR threatened/declining features or species (OSPAR, 2008); hence such habitats are a conservation priority.

In the Porcupine Seabight, 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 recent 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 *Lophelia pertusa* reefs in the Irish continental margin. The outputs of the model indicate a low probability of *Lophelia pertusa* reef presence in FEL 3/18, particularly at the location of the Iolar well (Figure 3.7). The outputs of this model are supported by the results of the recent survey around the proposed well location, during which no cold water coral reef structures were observed in the photograph or video data. Therefore, cold water corals are not believed to be present around the Iolar well location (Fugro, 2017b, 2017c).

Figure 3.6 Seabed features around the Porcupine Seabight

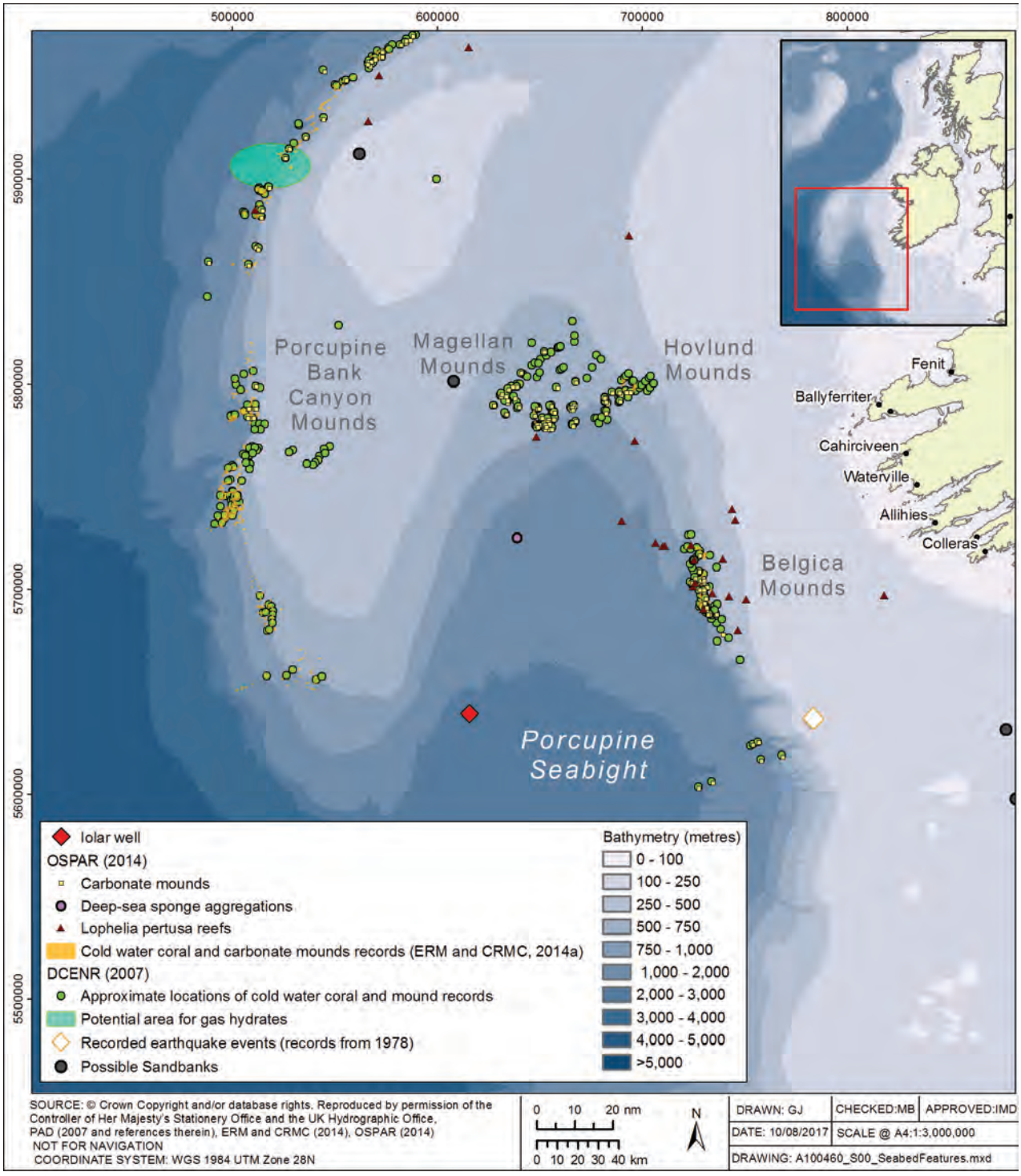
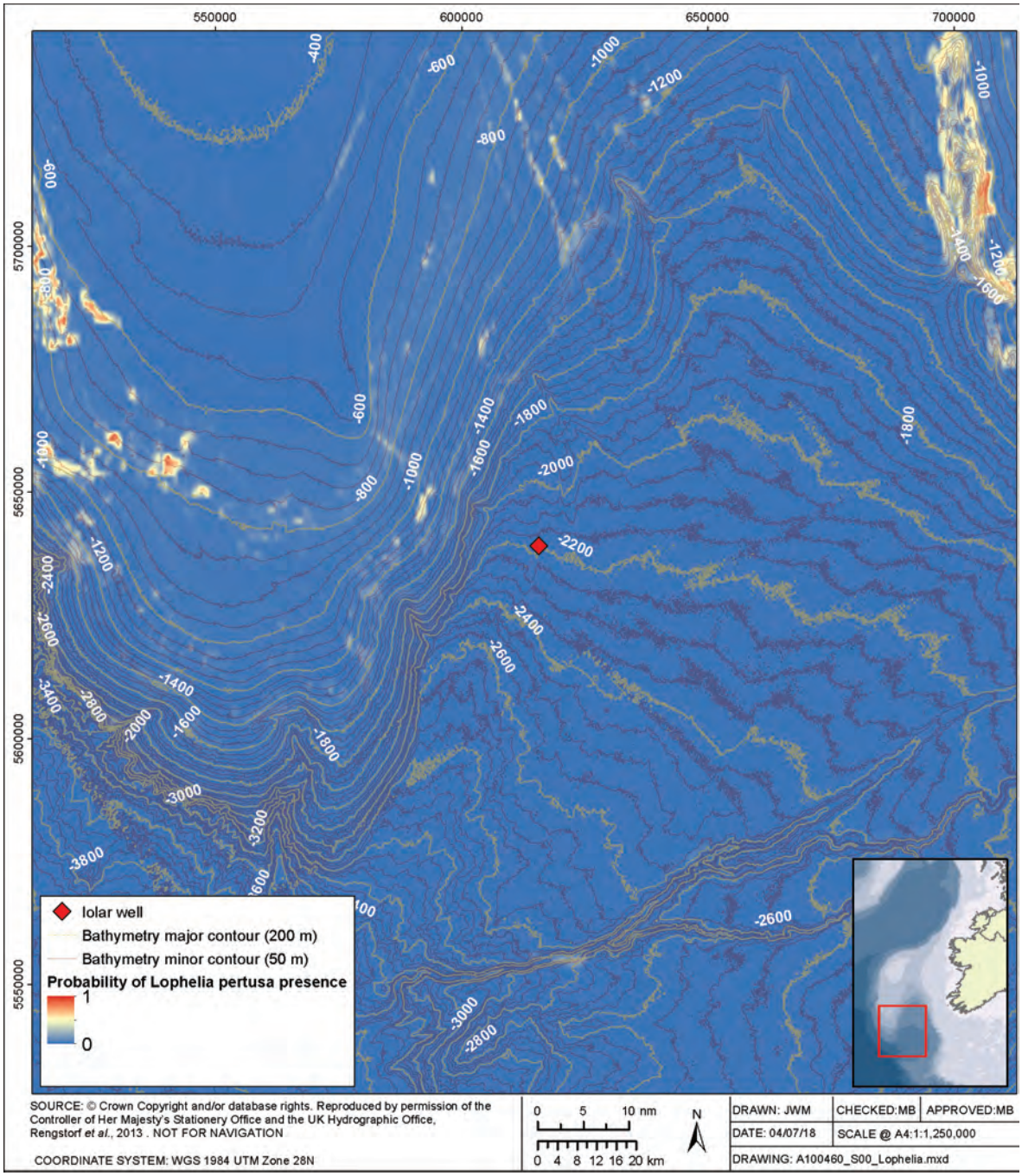


Figure 3.7 High-resolution *Lophelia pertusa* habitat suitability modelling Rengstorf *et al.*, (2013)



3.2.3.2.3 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 250-1,300m (Bett and Rice, 1992), where the water temperature ranges from 4-10°C and there is moderate current velocity (0.5 knots). They are on the OSPAR list of threatened/declining features or species (OSPAR, 2008) and there is a single mapped record of this feature within the Porcupine Seabight that is to the north of the Project area (Figure 3.6; OSPAR, 2014).

Deep-sea sponges were not observed in any density along the video transects taken by Fugro (2017b) around the proposed Iolar well location. However, a species known to form deep sea sponge aggregations (*Pheronema* sp.), was potentially observed in very small amounts along three of the transects. However, as they were seen only very rarely, Fugro (2017b) concluded that the area does not fulfil the overall criteria required under OSPAR guidelines for deep-sea sponge aggregations (OSPAR, 2010b).

3.2.3.2.4 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 (Hartley Anderson, 2005, from 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.

The Porcupine Seabight region has been strongly influenced by glacial processes and evidence for iceberg ploughmarks has been recorded on the shelf and slope of the Porcupine Bank (northern and eastern sides). Channels and canyons also occur on the eastern flank of the Porcupine Seabight, particularly on the steepest slopes, and transport sediment downslope from the Celtic and Irish shelves (DCENR, 2007).

Sandbanks have also been reported in the West of Ireland offshore waters, although these have not been reported on the seabed in the vicinity of the Project (DCENR, 2007).

None these other seabed features were observed during the recent survey of the Iolar proposed well location (Fugro, 2017b).

3.2.3.3 Seabed sediment chemical conditions

Fugro (2017c) collected sediment grab samples around the proposed Iolar well location. These samples were analysed for the chemical properties including sediment hydrocarbons and metals. Total hydrocarbon (THC) concentrations across the survey area were low, ranging from 1.0 μgg^{-1} to 2.0 μgg^{-1}, with a mean of 1.6 μgg^{-1}, suggesting low anthropogenic input. Values at all stations were lower than the concentration values reported for the Celtic Sea offshore area (<5 μgg^{-1}) and toward the lower end of the range of concentration values reported by DCENR (2015) (Fugro, 2017c).

The current 'Coordinated Environmental Monitoring Programme' (CEMP) guidance for the heavy metals focuses on cadmium, mercury and lead. All metal concentrations at all stations were below or in line with the IOSEA4 concentration range values for the area (DCENR, 2015), apart from zinc which was above the concentration range at all stations. All the concentrations of metals analysed were below their ERL (Effects Range Low) threshold value (Fugro, 2017c).

3.3 Biological Environment

3.3.1 Plankton

Plankton is comprised of microscopic plants (phytoplankton) and animals (zooplankton). Phytoplankton 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. 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 along in a band of nutrient rich cool water along the shelf edge.

In the Porcupine Seabight the phytoplankton community is dominated by dinoflagellates *Ceratium fusus* and *Ceratium furca*. The majority of the remaining phytoplankton are diatoms including *Thalassionema nitzchioides*, 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 *Calanus finmarchicus*. There is a lot of overlap in the distribution of these two species in the southern IOSEA5 area despite traditionally exhibiting a strong geographical divide associated with seawater temperature. *C. finmarchicus* typically occupies colder more northern waters whilst *C. helgolandicus* is more abundant in warmer southerly waters. In the waters to the west of Ireland, and indeed throughout the North West Atlantic there has been a northward spread of temperate species including *C. helgolandicus*, *Pseudocalanus elongates*, *Evadne* spp. and *Podon* spp. and 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 in the Porcupine Seabight area.

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 diversity include water depth, water temperature, sediment type, 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: *Amphiura* community and a *Chamelea gallina* community. The *Amphiura* community includes the brittlestars *Amphiura filiformis, Amphiura chiajei* and the bivalve mollusc *Chamelea gallina*. This community generally occurs in the muddier sediments and is well represented in Irish waters. The *Chamelea gallina* community is often found with other bivalves such as *Fabulina* spp., *Mactra* spp. and the brittle star *Amphiura brachiata*. However, this benthic assemblage is typically associated with coastal sands.

Data on the benthic communities of the upper Porcupine Seabight (1,500+ m) are limited. The limited surveys conducted have reported Sipuncula (cylindrical shaped worms known as “peanut worms”) and Echinoidea (sea urchins) as abundant taxa at depths of 900 m in the upper Porcupine Seabight (DCENR, 2007). Deep sea sponge aggregations have been reported at water depths of 1,000-1,500 m on the upper Porcupine Seabight (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).

As outlined in Section 3.2.3 the recent survey around the proposed Iolar well location classified the sediments as the EUNIS biotope complex ‘deep sea mud’ which is described as Bathyal and abyssal benthic habitats with substrates predominantly of yellowish or blue-grey mud, relatively consistent, whose population is extremely sparse. This biocoenosis[3] is characterised by constant homothermy[4] and an almost total absence of light’. Fugro (2017c) reported observations of burrows and holes throughout the survey area. The larger burrows are thought to have been created by fauna such as burrowing anemones (Ceriantharia), crustaceans

[3] Biological community

[4] Constant temperature

and sea pens. Polychaete worms are also expected to have created many of the holes observed. Additionally, tracks across the surface of the sediment were observed and thought likely to be created by a variety of fauna, including sea cucumbers (Holothuroidea), the faecal deposits of which were occasionally observed, however very rarely the animal itself. Sea pen and burrowing benthic megafauna communities are listed on the OSPAR list of threatened and declining species and habitats (OSPAR, 2008), this is discussed further below (Section 3.3.2.1). Figure 3.8 displays images of the seabed and benthic mega fauna observed during the survey around the Iolar location.

From the infaunal grab samples collected, a rich and diverse macrofaunal community was observed with a total of 82 taxa and 593 individuals. Although Fugro (2017c) suggested that the macrofaunal community was under sampled, with between 63 and 66% of the areas total faunal diversity detected by the sampling undertaken. In terms of species, crustacea accounted for 47% of the faunal diversity, followed by annelids (27%) and molluscs (18%). However, in terms of abundance, molluscs were the most abundant accounting for 47% of the benthic abundance, followed by polychaetes (27%) and crustaceans (24%). The macrofaunal communities were similar between stations and multivariate analysis indicated the presence of a single ecological macrofaunal community. The bivalve *Mircogloma* was the most abundant throughout the survey area, followed by the gastropod family Philinidae and the polychaete *Galathownia fragilis*.

3.3.2.1 Sea pens and burrowing megafauna

Fugro (2017c) observed elements of the OSPAR threatened and declining habitat 'Sea pen and burrowing benthic megafauna communities' throughout the survey area. To determine if the community observed was that of the OSPAR threatened and declining habitat Fugro undertook an assessment of the stills and photography obtained to assess the abundance and density of the sea pens and burrowing megafauna (some examples of the images assessed are displayed in Figure 3.8).

The sea pen *Pennatula phosphorea* was observed on three of the transects, but in relatively low numbers. Large burrowing megafauna such as the Norway lobster (*Nephrops norvegicus*) were not observed, and the large burrows seen, did not appear to be as large as might be expected for this species. The burrows were thought more likely to have been constructed by deep-sea crustaceans such as large amphipods or crabs.

Overall, Fugro (2017c) concluded that their assessment would suggest that the area has the potential to contain the OSPAR threatened and declining habitat 'Sea pen and burrowing benthic megafauna communities'. However, even though small sea pens were seen across the area, many of the burrows/holes were equally likely to be attributable to burrowing anemones, small crustacea and polychaetes. Prominent megafaunal burrows and mounds as defined by for this habitat, were also not observed. Fugro (2017c) considered it unlikely that the area will fulfil the overall criteria required under OSPAR guidelines for this threatened and declining habitat.

Figure 3.8 Images of burrows and burrowing megafauna around the proposed Iolar well location (Fugro 2017c)

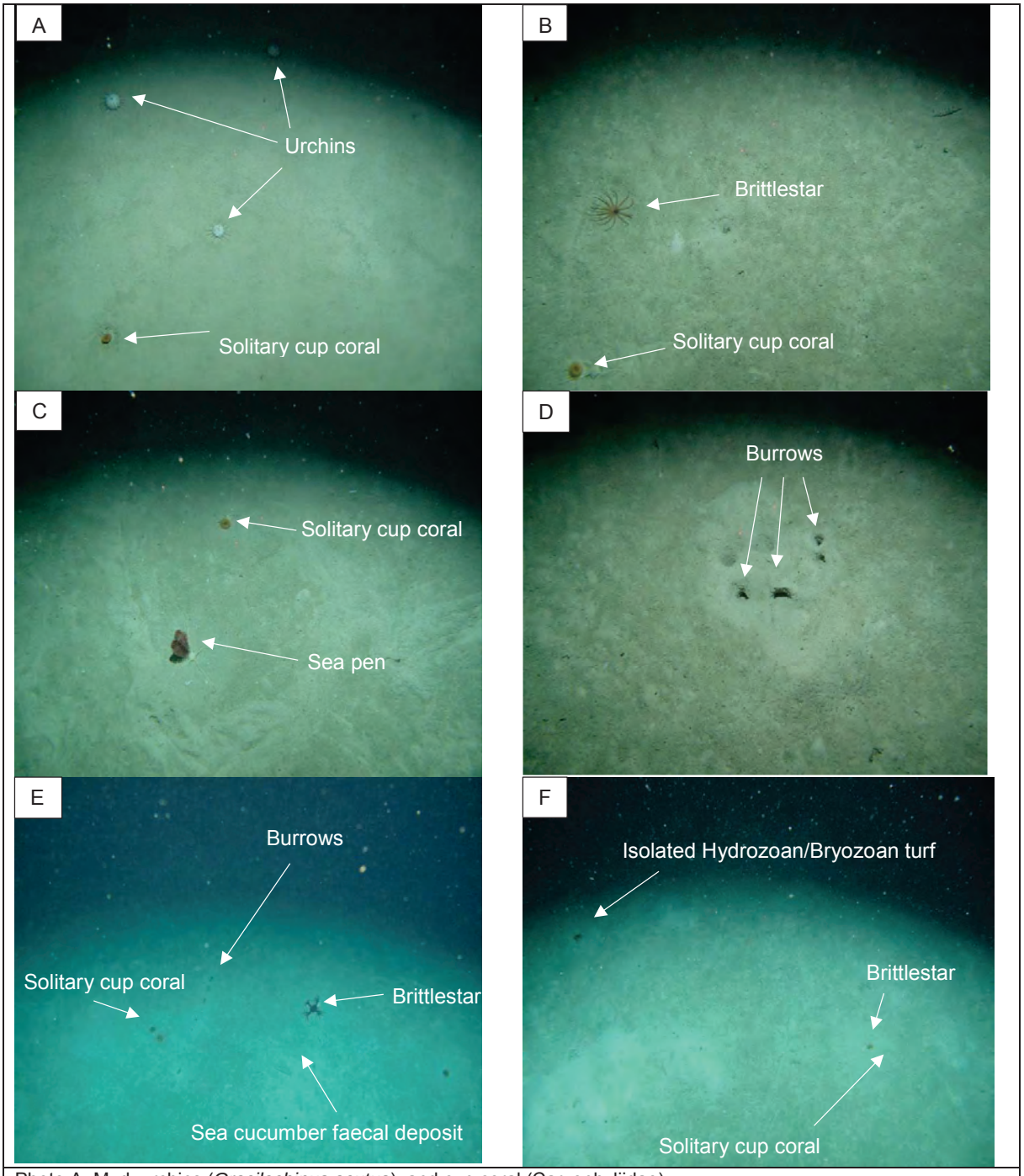


Photo A: Mud; urchins (*Gracilechinus acutus*), and cup coral (Caryophyliidae)
Photo B: Mud; anemone (Ceriantharia), cup coral (Caryophyliidae), brittlestar (Ophiuroidea)
Photo C:; Mud; sea pen, (*P. phosphorea*), brittlestar (Ophiuroidea), cup coral (Caryophylliidae)
Photo D: Mud; cluster of large faunal burrows
Photo E: Mud; faunal burrows, brittlestar (Ophiuroidea), cup coral (Caryophylliidae), Sea cucumber spiral faecal deposit
Photo F: Mud with brittlestar (Ophiuroidea), and cup coral (Caryophylliidae)

3.3.3 Fish and shellfish

3.3.3.1.1 Shelf water species

Waters to the west of Ireland support a diverse community of fish and shellfish species. Sediment type, water temperature and water depth generally determines fish species distribution in shelf and coastal waters (RPS Group, 2017).

Many commercially important species are present over the shelf area and some occur over the shelf edge at approximately 250 m. Pelagic species that may be present in the water column include mackerel *Scomber scombrus*, herring *Clupea harengus*, Norway pout *Trisopterus esmarkii*, blue whiting *Micromesistius poutassou*, sprat *Sprattus sprattus* and saithe *Pollachius virens* (semi-pelagic). These species occur seasonally in the water column, typically migrating to and from spawning and feeding grounds in large shoals at different times of year (DCENR, 2015).

Around the edges of the Porcupine Basin, sediment type varies from sand with varying levels of coarse material to mud and sandy mud, and become finer with depth. Sandy substrata provide habitat for sandeels, flatfish, anglerfish and smaller gadoids, hake, plaice and dabs, while mud and clayey sediments host burrowing crustaceans such as *Nephrops norvegicus,* and some flatfish species in coarse sediments, species of elasmobranchs, cod, haddock, whiting and gurnard and scallops may be found (RPS Group, 2017).

3.3.3.1.2 Deep-water species

The Project is located at approximately 2,200 m water depth, in an environment characterised by low light levels and low temperatures slowing down productivity and growth rates, where species living have a low level of fecundity and are highly vulnerable to disturbance (RPS Group, 2017). In the meso-pelagic zone, between 200 and 1,000 m water depth, Myctophidae (lanternfish) and Gonostomatidae (anglemouths/bristlemouths) are the most abundant fish species. The most abundant deep-water fish species (200 – 1,000 m) that occur in the Porcupine Seabight area are lanternfish (Myctophidae), anglemouths (Gonostomatidae), orange roughy *Hoplostethus atlanticus*, roundnose grenadier *Coryphaenoides rupestris*, black scabbard fish *Aphanopus carbo*, Greenland halibut *Reinhardtius hippoglossoides* and tusk *Brosme brosme* (DCENR, 2015).

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. Although there has not been any historic sampling within FEL 3/18, outputs from the study can be useful in providing an indication of the types of species likely to be present at different depth ranges within FEL 3/18. Priede *et al.* (2010) reported over 70 species within the 1,000 - 2,400 m depth range and found that demersal species richness was highest between 800 and 2,500 m water depth with a significant peak around 1,500 to 1,600 m. Species recorded include various species of *Macrouridae* (grenadiers), *Notacanthidae* (spiny eels) and *Alepocephalidae* (slickheads).

Several species of deep water sharks are present in the Porcupine Seabight area with Portuguese dogfish *Centroscymnus coelolepis*, leafscale gulper shark *Centrophorus squamosus* and Squalidae spp. 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, catshark and dogfish species. Although observed along the west coast of Ireland, no basking sharks have been sighted within FEL 3/18 (DCENR, 2007).

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 of FEL 3/18 (DCENR, 2015).

A number of migratory species may be present in the Irish offshore waters. The Atlantic salmon *Salmo salar,* listed in the Annex II of the EU's Habitats Directive, spends part of its lifecyle in freshwater and part in the marine environment. The Atlantic salmon population migrating through Irish waters travels northwards along the west coast of Ireland to reach Greenland and the Norwegian Sea (RPS Groups, 2017). The trout *Salmo trutta* also goes at sea to feed, but are mostly found in coastal waters. The European eel *Anguilla anguilla* spends the early stages of its life in estuaries. Adults move to sea in autumn and some reach the Sargasso

Sea to mate and die (RPS Group, 2017). The species twaite shad *Alosa fallax* and the allis shad *Alosa alosa* are both Annex II species under the Habitats Directive, but their migratory path is limited to coastal areas. Migratory fish species are therefore highly unlikely to be present in significant numbers in the vicinity of the Project.

3.3.3.1.3 Spawning and nursery grounds

Coull *et al*. (1998) and Ellis *et al.* (2012) have reported that FEL 3/18, in which the Project is located, is a spawning ground for blue whiting *Micromesistius poutassou*, horse mackerel *Trachurus trachurus* and mackerel *Scomber scombrus*. The continental slope in the vicinity of the FEL 3/18is used by anglerfish *Lophius piscatorius*, common skate *Dipturus batis*, ling *Molva molva* European hake *Merluccius merluccius*, mackerel *Scomber scombrus*, ling *Molva molva*, spurdog *Squalus acanthias* and whiting *Merlangius merlangus* as nursery ground. *Nephrops* also use the continental shelf and slope surrounding FEL 3/18 and off the west coast of Ireland as spawning and nursery ground (Coull *et al*., 1998). However, the limits of the *Nephrops* spawning and nursery grounds are the upper continental slope and were not found as deep as the Project area (DCENR, 2015). They are present in soft muddy sediments of the Irish continental shelf and towards the shelf break, with the main concentrations of larvae found in deeper waters (DECNR, 2015). The seasonal distribution of spawning and nursery grounds in the area is detailed in Table 3.1.

Spawning areas for most species are not rigidly fixed and fish may spawn either earlier or later from year to year. In addition, the mapped spawning areas represent the widest known distribution of spawning activities given current knowledge and should not be seen as rigid unchanging descriptions of presence or absence (Coull *et al*, 1998). Therefore, it is likely that spawning for these species covers a much wider area.

Table 3.1 Spawning and nursery areas surrounding FEL 3/18 (Coull *et al*., 1998; Ellis *et al*., 2012, Marine Institute, 2009)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish	N	N	N	N	N	N	N	N	N	N	N	N
Blue whiting	N	N	N	N/PS	N/PS	N	N	N	N	N	N	N
Common skate	N	N	N	N	N	N	N	N	N	N	N	N
European hake	N	N	N/S	N/S	N/S	N/S	N/S	N	N	N	N	N
Horse mackerel	N/S	N/S	N/S	N/S	N	N	N	N	N	N	N	N
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	N	N	N/S	N/S	N/PS	N/PS	N/S	N	N	N	N	N
Nephrops	N/S	N/S	N/S	N/S	N/S	N/S	N/PS	N/PS	N/PS	N/S	N/S	N/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
N = Nursery; S = Spawning; PS = Peak spawning												

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 in the Porcupine Seabight is shown in Table 3.2.

Petrels and shearwater species are the most pelagic seabird species and spend weeks to months at sea covering vast distances. In the FEL 3/18 area the dominant species are the northern fulmar *Fulmarus glacialis*, European storm petrel *Hydrobates pelagicus*, Leech's storm petrel *Oceanodroma leucorhoa*, great shearwater *Puffinus 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. Northern fulmar prefers offshore waters on the shelf and along the continental slope.

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; however, these are typically observed around the Rockall Trough and Porcupine Bank to the north and north-west of FEL 3/18 (DCENR, 2015).

The great skua *Catharacta skua* is the most widely distributed skua species off the coast of Ireland. It is most abundant in spring and summer in the Porcupine Bank area. The Pomarine skua *Stercorarius pomarinus* have a migratory route along the west coast of Ireland, where they seem to loosely follow the shelf break (DCNER, 2015).

Northern gannets *Morus bassanus* use the shelf edge and continental shelf off the west coast of Ireland to forage. The pomarine skua *Stercorarius pomarinus*, and the rarer long-tailed skua *S. longicaudus* both of which are migrant species, are likely to be present in the Project area.

Gulls are typically coastal species but some travel further offshore in association with fishing vessels. They are unlikely to be observed in the FEL 3/18 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 FEL 3/18area (DCENR, 2015).

Terns are summer visitors to Ireland where they breed. Arctic tern *Sterna paradisaea* is the most pelagic bird species recorded in the IOSEA 5 study area, 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 FEL 3/18 (DCENR, 2015).

Table 3.2 Seasonal presence of seabirds in the vicinity of FEL 3/18 (DCENR, 2015)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern fulmar												
Wilson's storm petrel												
Great shearwater												
Northern gannet												
Pomarine skua												
Long tailed skua												
Great skua												
Herring gull												
Lesser black-backed gull												
Greater black-backed gull												
Black-legged kittiwake												
Common tern												
Arctic tern												
Atlantic puffin												

Blue shading = presence; grey shading = absence

3.3.5 Marine mammals

3.3.5.1 Cetaceans

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 region (Table 3.3). The continental shelf is

generally more productive due to the nutrient upwelling that provide food for plankton and where higher densities of fish are found.

There are a number of species that 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 possibility 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 (RPS Group, 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 (Wall *et al*., 2013, Kowarski *et al*, undated).

The findings of various studies relative to FEL 3/18are presented in Table 3.3 below.

Table 3.3 Description of occurrence of cetaceans in the vicinity of FEL 3/18 (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)

Species	Distribution	Seasonality
Atlantic white-sided dolphin *Lagenorhyncus acutus*	The Atlantic white-sided dolphins are 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.	Present all year, with peaks of sightings in summer and autumn around the south-west coast of Ireland
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. This discrepancy between studies might be due to increased survey efforts during summer months.
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).	Present all year, with peaks of sightings in May.
Common dolphin *Delphinus Delphinus*	Common dolphins also known as the short beaked common dolphins, 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).	Present all year, with peaks of sightings in summer around the south-west coast of Ireland.

Species	Distribution	Seasonality
Cuvier's beaked whale ***Ziphius cavirostris***	Preliminary results from the recent mooring detection surveys undertaken as part of the ObSERVE programme have indicated that Cuviers beaked whales occur along the western and south edge of the porcupine bank including around the Project location (Kowarski *et al*, undated). Historically there have been only six confirmed sightings of Cuvier's beaked whale in British and Irish waters, although strandings are not uncommon (DCENR, 2007). Strandings have mainly occurred along the western seaboard of Britain and Ireland (Berrow *et al*., 2010). O'Cadhla *et al*. (2004) recorded one individual over the Porcupine Basin.	Most sighting records were taken in summer months, which may be influenced by increased survey effort in this season.
False killer whale ***Pseudorca crassidens***	O'Cadhla *et al*. (2004) reported false killer whale sightings in the southern region of the Porcupine Basin between June and November.	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).	Evidence from Irish strandings and sightings suggest that they occur through summer months and late winter onwards.
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.	Most sightings records occur between June and September, which may be due to increased survey efforts (IWDG, 2017).
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.	Most sighting records take place in summer months, but they also seem to use there are between November and March as a migration corridor.
Killer whale ***Orcinus orca***	Killer whales have been reported to be present in the IOSEA2 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).	Studies suggest that they may occur in the IOSEA year-round, although seasonal variation in survey efforts make the seasonal distribution patterns difficult to assess.
Minke whale ***Balaenoptera acutorostrata***	Minke whales are the smallest and most frequently sighted and stranded baleen whale in Irish waters (Berrow *et al*., 2010). Minke whales were recorded as far offshore as the Project in June by Reid *et al*. (2003). DCENR (2007) report that this species is widely distributed along the Atlantic Irish seaboard and is present year round, with most sightings occurring during summer months. O'Cadhla *et al*. (2004) also reported sightings of this species in the vicinity of LO 16/4 during spring months. Peaks in the spring and summer months are thought to be linked to whales foraging on high concentrations of pelagic schooling fish (Wall *et al*., 2013) Minke whales are the smallest and most frequently seen and stranded baleen whale in Irish waters (Berrow *et al*., 2010).	They favour the southwestern Irish waters during late spring and summer (O'Cadhla *et al*., 2004).
Northern bottlenose whale ***Hyperoodon ampullatus***	Northern bottlenose whales are a deep-diving species typically found offshore in waters deeper than 1,000 m. Berrow *et al*. (2010) reported sightings within the Porcupine Seabight. Most sightings are made to the north and west of Ireland, although individuals have been recorded in areas during summer months. It is believed that this species migrates north in spring and south in autumn (DCENR, 2007).	They show a predominant occurrence in Atlantic Margin waters in summer and autumn (O'Cadhla *et al*., 2004).
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	There have been more sightings in summer months, which may be due to increased survey effort (IWDG, 2012), but sightings have been recorded year-round.

Species	Distribution	Seasonality
	that high relative abundances of pilot whales are recorded in the vicinity of deep-water bathymetric features such as sea mounts. However, compared with the Rockall Trough and south of the Goban Spur, relative low densities of pilot whales have been observed in the Porcupine Basin and it is not known whether this is a small resident population or individuals transiting between areas of high density to the north and south. Pilot whales primarily occur in deep waters (500 m+) beyond the Irish Shelf edge (Wall *et al.,* 2013).	
Risso's dolphin ***Grampus griseus***	They 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). Risso's dolphins in Irish waters do not occur in deep-water habitats along the shelf slopes and this is in stark contrast to their reported preference for such habitats elsewhere in the world (Wall *et al*., 2013). However, no sightings have been recorded by Reid *et al*. (2003), Wall *et al.* (2013) or O'Cadhla *et al*. (2004).	This species may be present year-round in the Porcupine Basin.
Sei whale ***Balaenoptera borealis***	It is though 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).	They may be found offshore in the west of Ireland throughout the year.
Sowerby's beaked whale ***Mesoplodon bidens***	Preliminary results from the recent mooring detection surveys undertaken as part of the ObSERVE programme have indicated that Sowerby's beaked whales occur along the western and south edge of the porcupine bank including around the Project location (Kowarski *et al*, undated). Although there are very few confirmed sightings of true Sowerby;s 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).	This species may occur year-round in the Irish Atlantic Margin.
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). O'Cadhla *et al*. (2004) recorded sightings in the vicinity of Project during spring and summer.	There have been more sightings in summer and autumn, which may be due to increased survey effort.
Striped dolphin ***Stenella coeruleoalba***	Striped dolphins tend to reside beyond the continental shelf in depths of greater than 1,000 m. However, it occasionally occurs 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 with higher numbers of records in the southern part of the Porcupine Basin.	There have been more sightings in summer and autumn, which may be due to increased survey effort.
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).	Peak of sightings between June and November in the IOSEA2 area.

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*., 2002) and grey seals several hundreds of kilometres from one haul-out site to another. Although data gaps exist with regards to seal behaviour offshore (DCNER, 2007), given the distances which they are known to travel it is not possible to rule out the possibility of harbour and grey seals being present within FEL 3/18, both travelling through and foraging, albeit in very low numbers.

3.3.6 Marine reptiles

Five species of marine turtle have been recorded in UK and Irish waters (RPS Group, 2017). 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's Habitat European Directive.

The leatherback turtle *Dermochelys coriacea* is the only species reported annually and considered as a regular user of the Irish waters (RPS Group, 2017). 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). 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 (RPS Group, 2017).

The hawksbill turtle *Eretmochelys imbricate* and the green turtle *Chelonia mydas* have been sighted rarely or found stranded in Ireland (RPS Group, 2017).

3.4 Conservation

3.4.1 Coastal protected sites

An extensive network of SACs and SPAs are located along the western coast of Ireland. SACs are designated for the presence of species and habitats of significant ecological importance under the Annex I and II of the EU's Habitats Directive, respectively. SPAs are designated for the protection of bird species of ecological importance under the Annex I of the EU Birds Directive.

The SACs of the Irish coast protect a variety of coastal and marine Annex I habitats and Annex II species, including reefs, caves, cliffs, offshore islands, sand dunes, salt marshes, intertidal bays, beaches and rivers. With regards to the Project location, there are four SACs designated for the wide ranging and/or migratory Annex II marine mammal species of particular interest. The qualifying features and the distance to the Project are described in Table 3.4.

Table 3.4 Coastal SACs located the closest to the Project with marine mammals as qualifying feature of conservation importance

SAC site name [Site code]	Qualifying features	Distance to Project
Blasket Islands SAC [002172]	Harbour porpoise *Phocoena phocoena* Grey seal *Halichoerus grypus*	220 km
Kenmare River SAC [002158]	Harbour seal *Phoca vitulina*	228 km
Roaringwater Bay and Islands SAC [000101]	Harbour porpoise *Phocoena phocoena* Grey seal *Halichoerus grypus*	265 km
Lower River Shannon SAC [002165]	Bottlenose dolphin *Tursiops truncatus*	285 km

The nearest coastal SPAs to the Project are the Skelligs SPA (215 km, Site Code 004007), the Beara Peninsula SPA (222 km, Site Code 004007), the Blasket Islands SPA (225 km, Site Code 004008) and the Puffin Island SPA (226 km, Site Code 004003). The qualifying features under these SPAs are presented in Table 3.5.

Table 3.5 Qualifying interests of the four closest SPAs to the Project

Fulmar *Fulmarus glacialis*
Manx Shearwater *Puffinus puffinus*
Storm Petrel *Hydrobates pelagicus*
Gannet *Morus bassanus*
Kittiwake *Rissa tridactyla*
Guillemot *Uria aalge*
Puffin *Fratercula arctica*
Chough *Pyrrhocorax pyrrhocorax*
Shag *Phalacrocorax aristotelis*
Lesser Black-backed gull *Larus fuscus*
Herring gull *Larus argentatus*
Arctic tern *Sterna paradisaea*
Razorbill *Alca torda*

3.4.2 Offshore protected sites

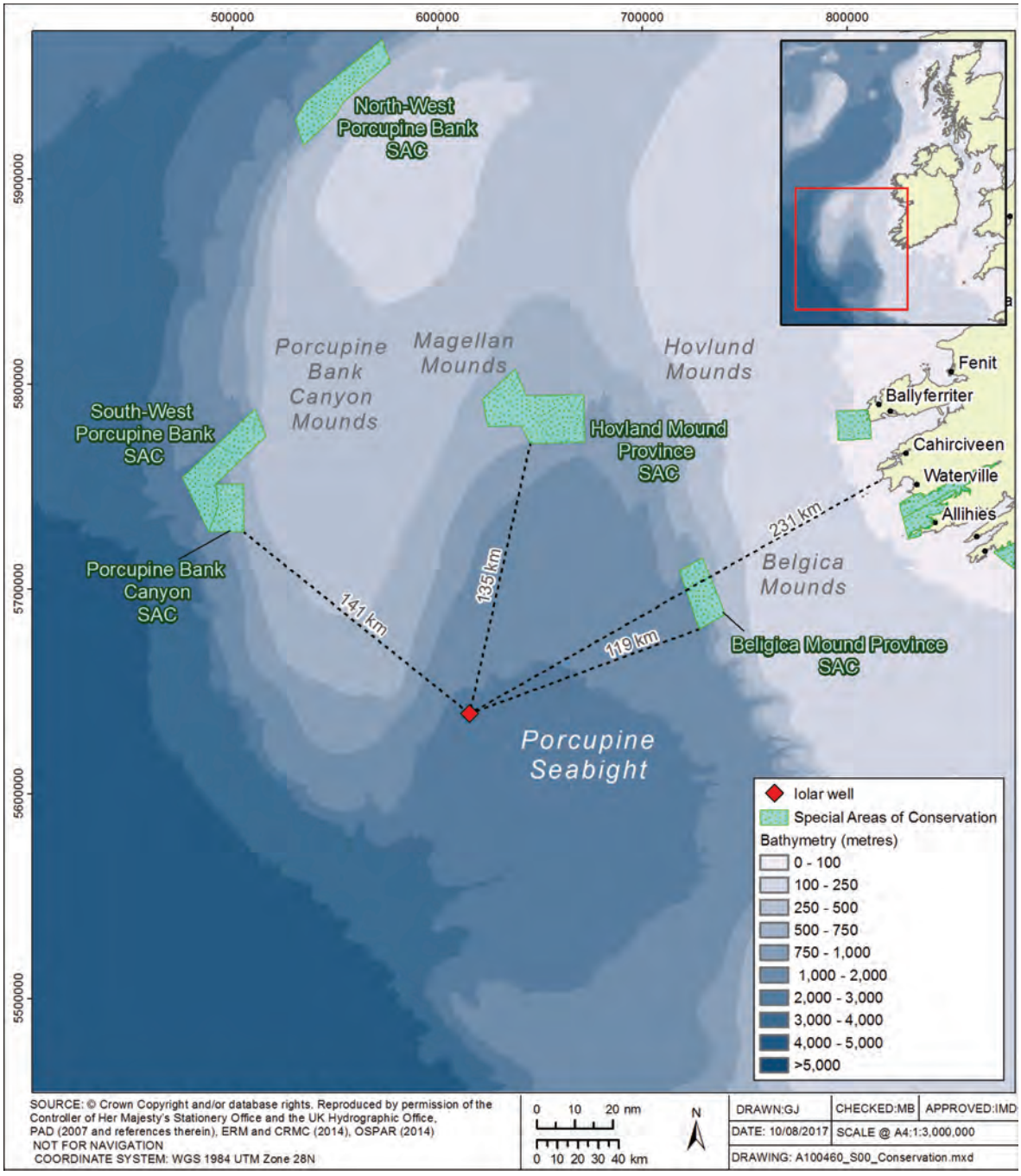
There are six offshore SACs in waters to the west of Ireland, four of which are located in the vicinity of the Porcupine Basin (Figure 3.9). These offshore SACs are all located at more than 100 km from the Project (Table 3.6).

Table 3.6 Designated offshore conservation sites located the closest to the Project

Site Name [Site code]	Distance and direction from the Project	Reason for designation
Hovland Mound Province SAC [002328]	135 km N	Reefs
Belgica Mound Province SAC [002327]	119 km E	Reefs
Porcupine Bank Canyon SAC [03001]	141 km NW	Reefs
South-West Porcupine Bank SAC [002329]	141 km NW	Reefs

The Irish offshore SACs are designated for the protection of reef habitats listed on the Annex I of the EU's 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 (RPS Group, 2017). These coral reefs support a highly biodiverse ecosystem, including communities of anemones, sponges, crustaceans and fish (DAHG, 2014a; 2014b, 2014c). The distribution of carbonate mound structures is shown in Figure 3.5 and discussed in Section 3.2.3.2.1.

Figure 3.9 Conservation sites in the vicinity of the Porcupine Basin



3.4.3 Protected species

The Porcupine Seabight is 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 Project location are highlighted throughout Section 3.3, however for ease of review, key conservation designations for species referred to in Section 3.3 are listed in Table 3.7.

Table 3.7 Designations of protected species in the Porcupine Seabight

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 *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 IUCN Red List. Features on the OSPAR List of Threatened and/or Declining Species and Habitats. Prohibited species under the Common Fisheries Policy. Listed in Annex I of the United Nations Convention on the Law of the Seas. Listed in Appendices I and II of the Bonn Convention on Migratory Species. 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 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.
Chough (*Pyrrhocorax pyrrhocorax)*	Listed in Annex I of the Birds Directive.
Puffin (*Fratercula arctica)*	Listed as migratory species in the EC Birds Directive.

Species	Key applicable designations
Guillemot (*Uria aalge)*	Listed in Annex I of the Birds Directive. Features on the OSPAR List of Threatened and/or Declining Species and Habitats.
Gannet (*Morus bassanus)*	Annex III of the Bern Convention 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. 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. Protected in Ireland under the Wildlife Act 1976 (As Amended).
Grey seal (*Halichoerus grypus*)	Listed in Annex II of the Habitats Directive. 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. Protected in Ireland under the Wildlife Act 1976 (As Amended). 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 Appendix IV of the Habitats Directive.
Loggerhead turtle (*Caretta caretta*)	Listed as vulnerable on the IUCN Red List. Features on the OSPAR List of Threatened and/or Declining Species and Habitats. Protected in Ireland under the Wildlife Act 1976 (As Amended).

3.5 Socio-economic environment

3.5.1 Commercial fisheries

The waters around Ireland are important to both national and international fisheries as they provide some of the most productive fishing grounds in the world. A diverse range of fisheries operates in the shallower waters; however, the number of vessels utilising the deeper waters of the Porcupine Seabight are limited to those with specialist deep-water fishing equipment (DCENR, 2007). Deep-sea fish generally live beyond marginal seas and continental shelves, at depths greater than 400 m. Fish abundances are highest at water depths of 1,000 m to 1,800 m in the Porcupine Basin.

To allow the recording of commercial fisheries catches, the Atlantic Ocean is divided into operational areas. The Project lies within Region 2 of the North East Atlantic Fisheries Commission, within International Council for the Exploration of the Seas (ICES) rectangle 30D6 (Figure 3.11).

A standalone assessment of fishing activity, proximal to the Project, was completed by Sinbad Offshore Services in Q1 2018 (Sinbad, 2018).

The three main fisheries that operate in FEL 3/18, as seen on Figure 3.10 below, include:

> The pelagic sector utilising mainly midwater trawling gear;

> The demersal fisheries consisting of a mixture of gear types including trawling, longlines and gillnets; and

> The demersal *Nephrops* fishery using tangle nets.

Vessel Monitoring Systems (VMS) data collected over the period 2008-2012 have been used by the Marine Institute (2014) to create detailed maps of the distribution of fishing activity by gear type in the Irish EEZ. Figure 3.9 shows that the Project lies outside of the main fishing areas, in an area of very low fishing activity.

Effort within ICES rectangle 30D6 has varied the last 4 years (Figure 3.11a-d). Activity peaked in 2014 where the number of hours vessels spent fishing was over 3,000 compared to just over 200 in 2013. Since this time effort has been very low with only 66 and 15 hours spent fishing in 30D6 in 2015 and 2016 (European Commission, 2018). The peak in the effort is largely due to the arrival of the Albacore tuna fishery (Sinbad, 2018, Table 3.8). This is a fishery which is undertaken by Irish and UK vessels using mid-water trawls and by both Spanish and French vessels using poles and lines. The tuna fishery commences each year in July and typically ends at the end of September (Sinbad, 2018). VMS data (Figure 3.11). shows that the tuna shoals have not entered the 30D6 since 2014. From observations, tuna has remained much further south in the past three years, off the coast of France. However, Tuna is a very mobile fishery which is predetermined by factors such as water temperatures, salinity and availability of food. The movements of the tuna shoals can be over a very wide area of the EEZ, and therefore could be present again in the area in coming years (Sinbad, 2018).

Outside 2014, when the largest landings were for tuna, the majority of landings within ICES rectangle 30D6 in 2015 and 2016 (years for which data is available) are for the Norwegian lobster *Nephrops norvegicus* (Table 3.8, European Commission, 2018).

Table 3.8 Annual landings in ICES rectangle 30D6 (European Commission, 2018)

Common name	Scientific name	Total landings (tonnes)		
		2014	2015	2016
Albacore	*Thunnus alalunga*	436.18		
Thresher shark	*Alopias vulpinus*	0.00001		
Anglerfish	*Lophiidae*			0.12
Atlantic bluefin tuna	*Thunnus thynnus*	1.39		
Blue shark	*Prionace glauca*	0.030		
European hake	*Merluccius merluccius*	0.11	0.11	
Mutton snapper	*Lutjanus analis*	0.03	0.04	
Norwegian lobster	*Nephrops norvegicus*	0.45	2.94	8
European pilchard (Sardine)	*Sardina pilchardus*	0.90		
West coast sole	*Austroglossus microlepis*	0.21		
	Total landings (annual)	**439.39**	**3.09**	**8.12**

Figure 3.10 Fishing gear used by vessels >15 m fishing in the Irish EEZ between 2008 and 2012 (Marine Institute, 2014)

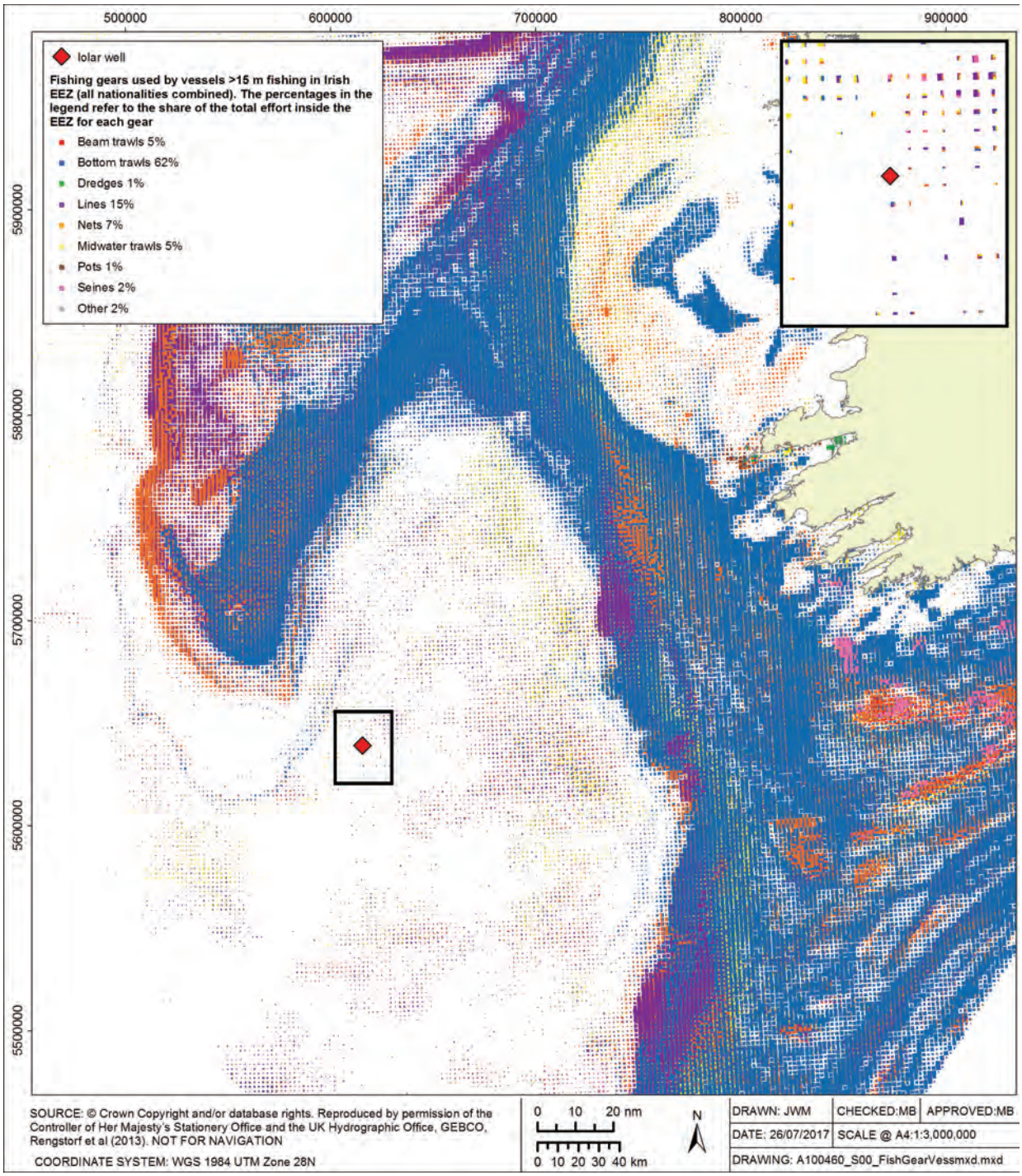


Figure 3.11a VMS data in 30D6 and surrounding ICES rectangles in 2014

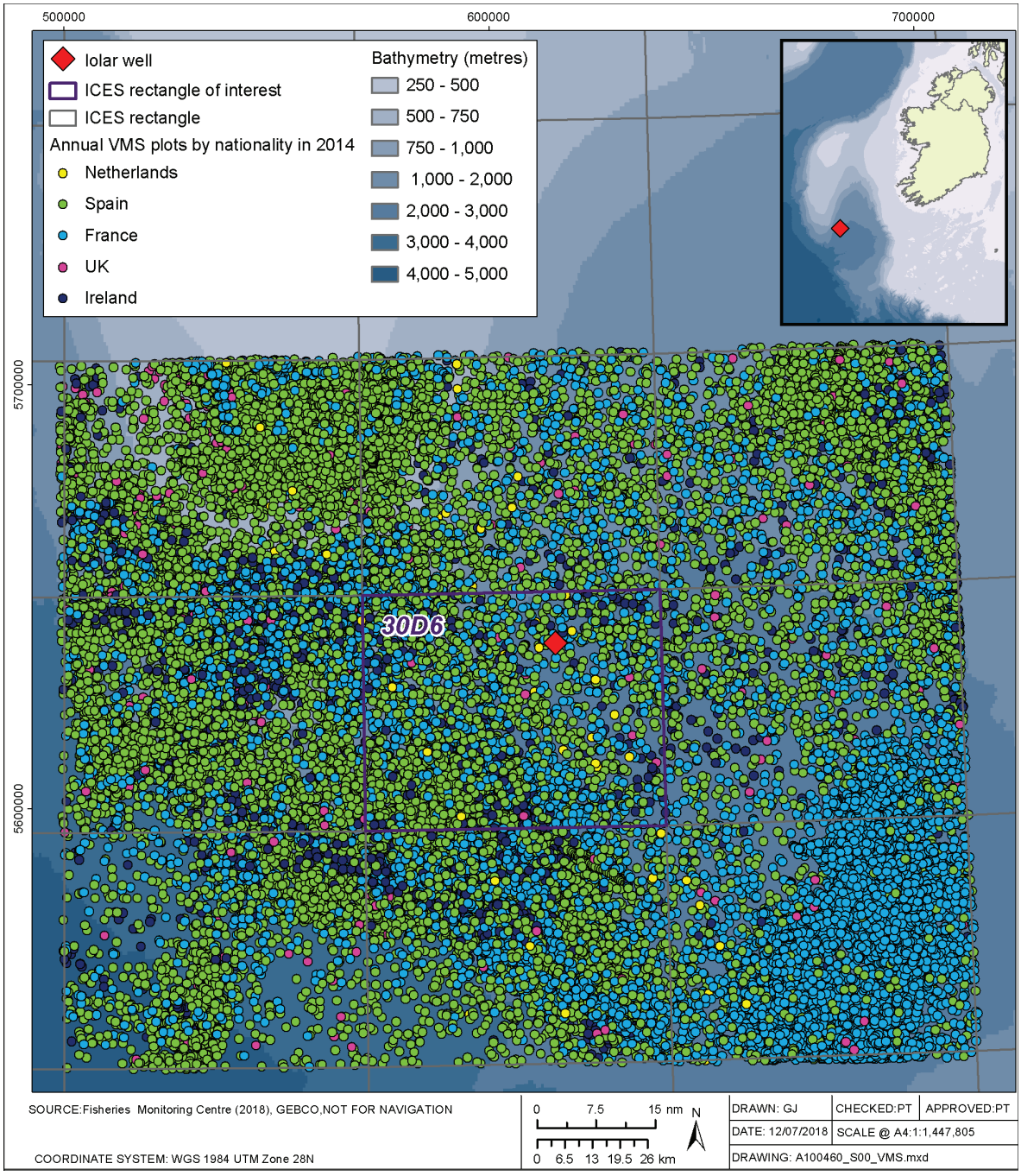


Figure 3.11b VMS data in 30D6 and surrounding ICES rectangles in 2015

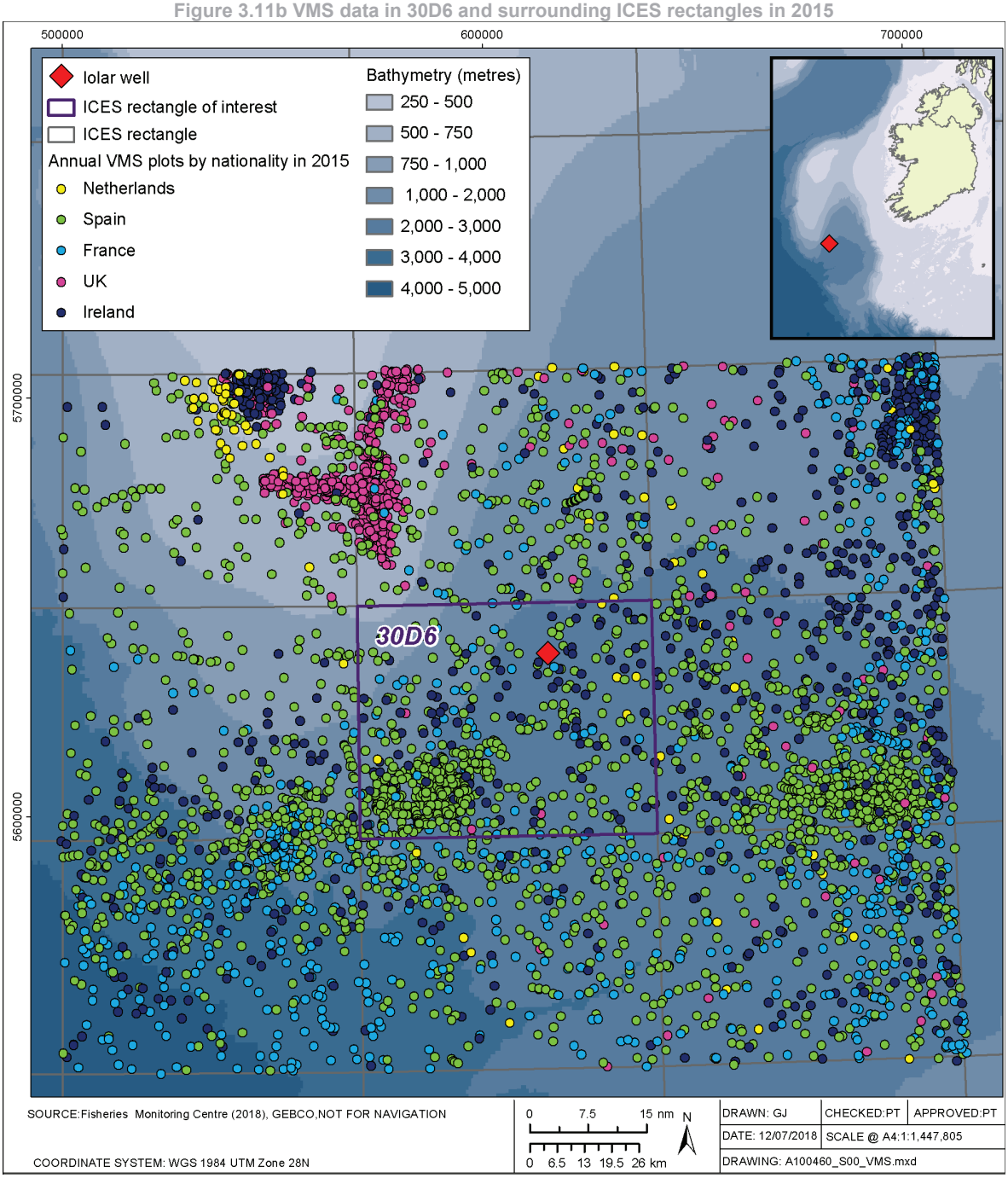


Figure 3.11c VMS data in 30D6 and surrounding ICES rectangles in 2016

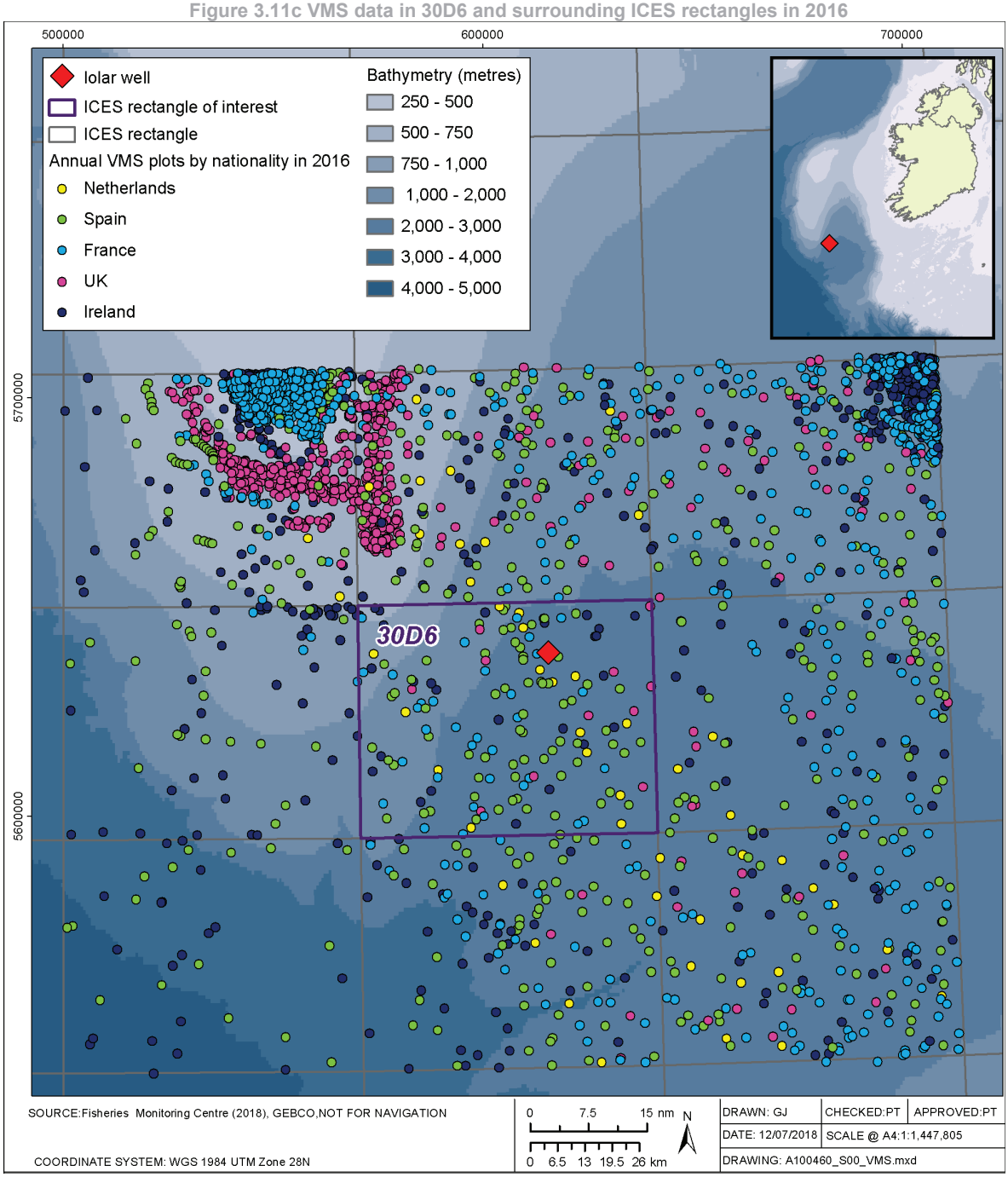
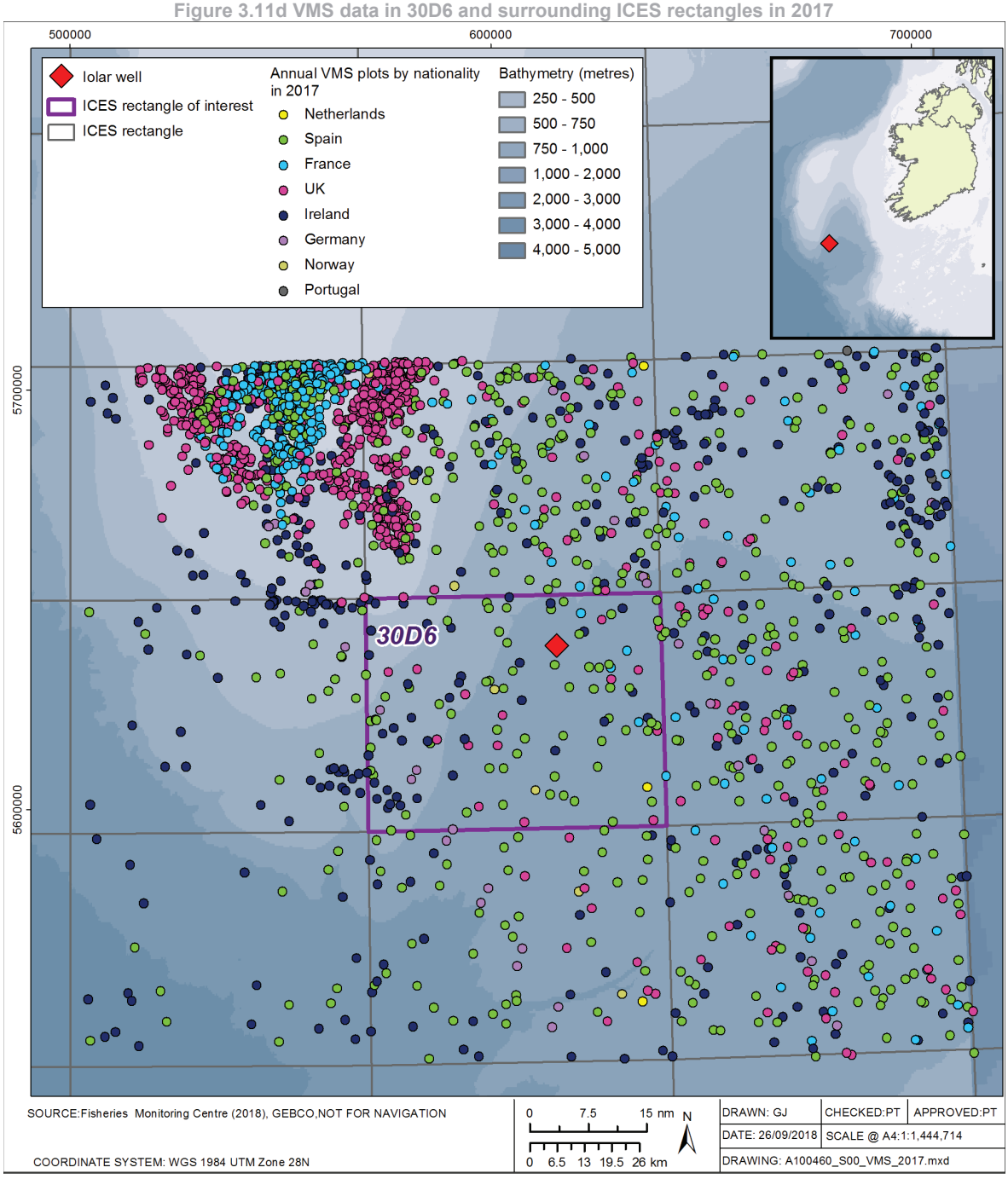


Figure 3.11d VMS data in 30D6 and surrounding ICES rectangles in 2017



3.5.2 Oil and gas activity

A total of 206 wells have been drilled in Irish waters according to data from the PAD Integrated Petroleum Affairs System (IPAS), the most recent to be drilled in the area was the Druid / Drombeg well (53/6-1)(44/23-1) in 2017. This is the closest well to the Project in the Porcupine Basin, operated by Providence but currently in Plug & Abandon (P&A) status (DCENR, 2018). There are no drilling plans currently authorised for 2019.

Adjacent to FEL 3/18, several authorisations are held by different operators, described in Table 3.9 below.

Table 3.9 Oil and Gas Licencing Options (LO) and Exploration Licences (EL) adjacent to FEL 3/18

Operator	Block	Authorisation status	Direction
ExxonMobil Exploration and Production Ireland (Offshore South) Limited	LO16/3 initially, FEL 5/18 from February 2018	Active	West
BP	LO 87/3	Inactive (Licence expired December 1988)	North
ExxonMobil Exploration and Production Ireland (Offshore South) Limited	FEL 2/08	Inactive (Licence expired March 2011)	South
Providence Resources	LO 11/9 initially FEL 2/14 from 2014	Active	East
ExxonMobil Exploration and Production Ireland (Offshore South) Limited	FEL 1/08	Inactive (Licence expired March 2011)	East

3.5.3 Offshore wind farms

There are no wind farms within or in the vicinity of the Project. 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).

3.5.4 Pipelines and telecommunication cables

The closest subsea cables from the Project are located 28 km south namely the Hiberna Atlantic, and 84 km north namely the Hiberna Express (Kis-orca, 2017).

There are no pipelines in the vicinity of the Project (RPS Group, 2017).

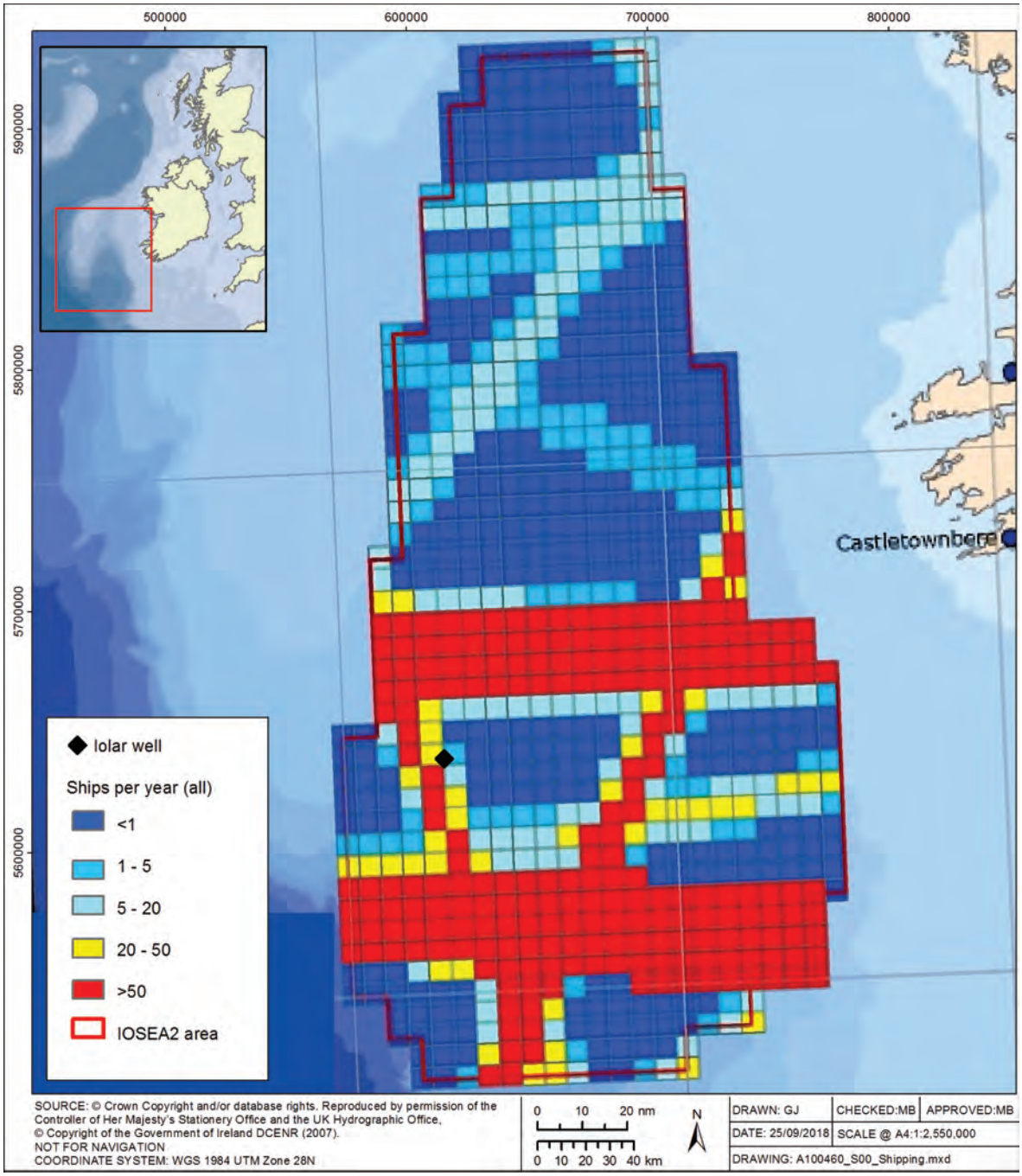
3.5.5 Military activity

There are no military disposal sites or practice or training grounds in the vicinity of the Project (DCENR, 2007).

3.5.6 Shipping

The majority of shipping activity in waters to the west of Ireland are transatlantic sailing between North and South America and European ports based in Ireland, the UK and mainland Europe. The densest area of shipping lies to the south of Ireland in the Celtic Sea (Figure 3.12; DCENR, 2007).

Figure 3.12 Average density of cargo vessels within the IOSEA2 area (DCENR, 2007)



Nexen commissioned Anatec to assess the passing ship collision risk associated with the Project (Anatec, 2018). This study identified five shipping routes used by an estimated 101 vessels per year passing within 10 nautical miles (nm) of the proposed Iolar well location. This corresponds to an average of approximately one vessel every three days. The main vessel type operating within 10 nm of the Iolar location are cargo vessels, with the predominant size being greater than 40,000 DWT. These are outlined in Table 3.10 and displayed in Figure 3.13.

Two of the identified shipping routes pass within 3 nm of the Iolar well location. The nearest is approximately 0.2 nm to the north, which is used by an estimated eight vessels per year between North America and Bristol. The second route is located 2.3 nm to the north and is used by an estimated 12 vessels per year between the Solent and Canada (Anatec, 2018;Table 3.10; Figure 3.13).

Anatec (2018) determined that the shipping traffic levels at the Iolar location are moderate relative to the surrounding area within 10 nm (Figure 3.14)

Figure 3.13 Shipping route positions within 10 nm of the Iolar location (Anatec, 2018)

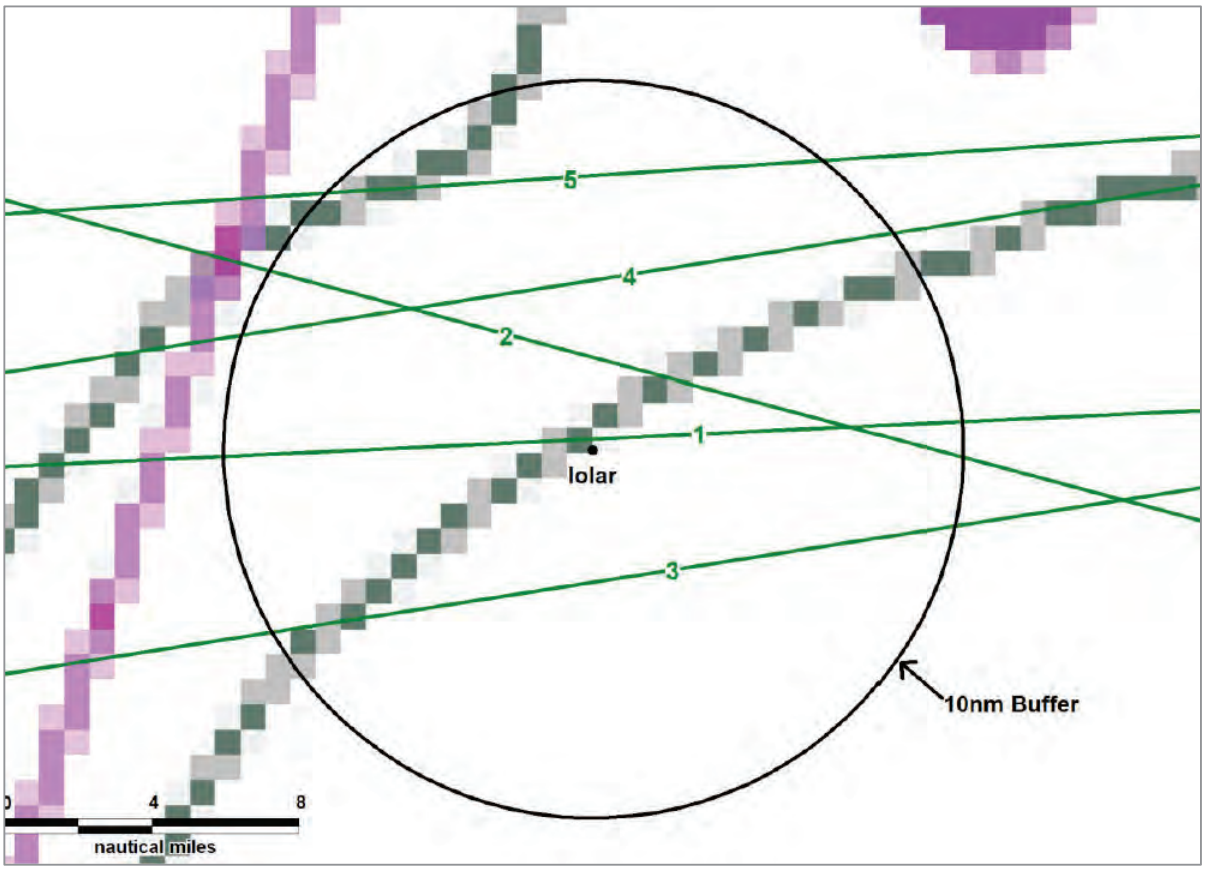


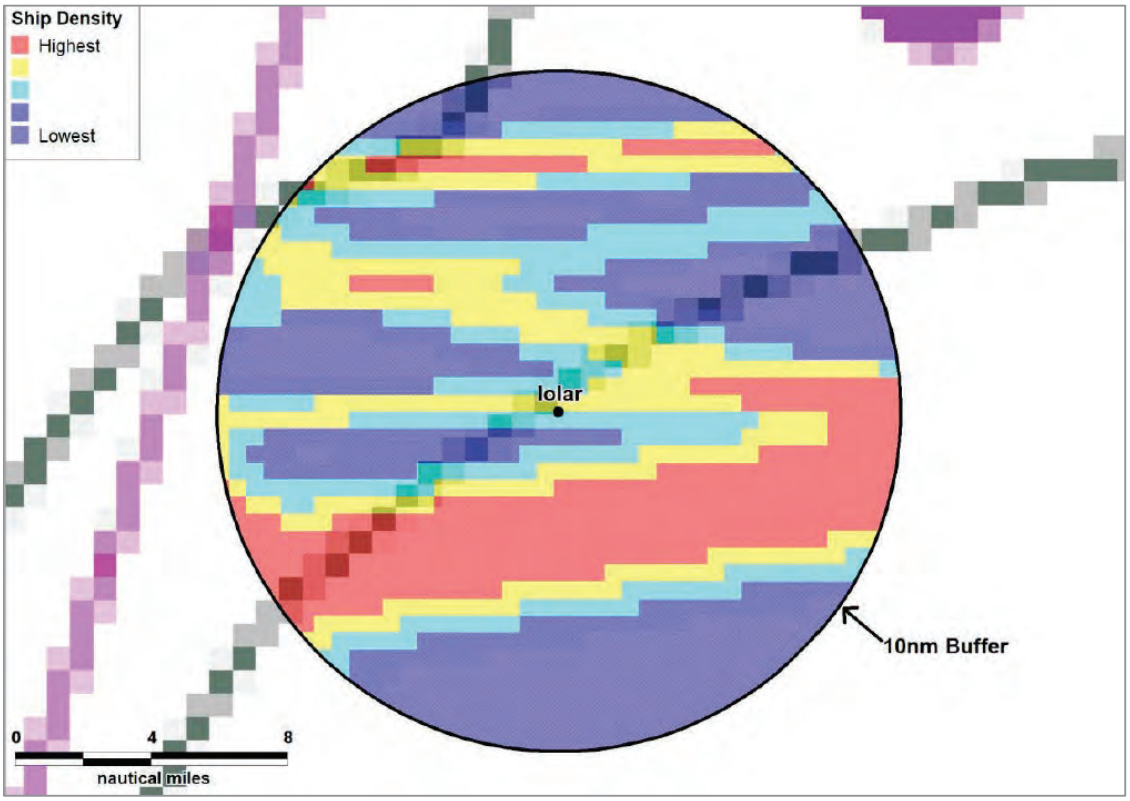
Table 3.10 Ship routes passing within 10 nm of the Iolar location (Anatec, 2018)

Route No.	Description	Vessels per year*	Cargo vessel size (DWT) (no. vessels)	Tanker size (DWT) (no. vessels)
1	America North-Bristol	8	15,000 - 40,000 (4)	15,000 - 40,000 (4)
2	Solent-Canada	12	≥ 40,000 (12)	-
3	Canada-Liverpool**	60	≥ 40,000 (48)	≥ 40,000 (12)
4	Canada-Cork	5	15,000 - 40,000 (5)	-
5	Bristol-America North	16	15,000 - 40,000 (10)	15,000 - 40,000 (6)

*Where annual traffic has been factored between alternatives the values have been rounded to the nearest whole numbers.

** Where two or more routes have identical Closest Point of Approach (CPA) and bearing they have been grouped together. In this case, the description lists the sub-route with the most vessels per year.

Figure 3.14 Shipping density within 10 nm of the Iolar well location (Anatec, 2018).



3.5.7 Archaeology and other infrastructure

The shipwrecks inventory of Ireland includes all know wrecks for the years up to and includes 12,000 records.

The western Irish waters have potential for surviving prehistoric archaeological, feature and deposits associated with periods of low sea level (DCENR, 2015). The sheltered areas close to the coast have the highest potential for surviving archaeological features. However, the deeper waters, wave climate and limited human use reduce the potential for these archaeological remains in the Porcupine Seabight and in the vicinity

of the proposed well. No wrecks or other archaeological features have been identified in survey work at the Iolar well site to date (Fugro, 2017b).

3.5.8 Recreational activities

There is unlikely to be any recreational activity in the operational area due to the distance from the coast and water depth of the area. Deep-sea angling occurs in deep waters however it typically only occurs on the shelf, to depths of 100 m, shallower than the shallowest area of the operational area (DCENR, 2007).

4 ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY

4.1 Introduction

This section describes how the potential environmental impacts associated with the Project have been identified, how Nexen has sought and taken account of the opinions of stakeholders and how these issues have been addressed. Nexen considers environmental risk assessment (ERA) an essential step in good environmental management practice.

Central to a proactive environmental risk assessment is the requirement to identify potential impacts on the environment or other users of that environment, and to consider and 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 Environmental Issues Identification (ENVID)

An environmental issues identification (ENVID) process was used as a tool to support the ERA. An ENVID workshop for Project was held in February 2018 and featured input from Nexen and Xodus Group personnel. The aim of the ENVID process was to define the potential environmental impacts from the Project, based on the knowledge of the Project and the receiving environment, and the potential interactions between the two. The process also aims to identify relevant mitigation measures for potential interactions. The ENVID process broadly weights the relevant factors, including interactions between factors, based on expert judgement and relies on the strengths of a multidisciplinary team.

The overall ENVID and ERA process allows transparent demonstration that environmental considerations have been given due weighting in design decisions. This process has a number of stages:

- ENVID workshop for impact identification and preliminary mitigation identification discussions with the project team;
- Evaluation of impact significance and production of an Environment Impact and Risk Register and ENVID Report;
- Identification/confirmation of mitigation measures, commitments and residual impacts as part of the overall environmental assessment process;
- Finalisation and project sign-off of the Environment Impact and Risk Register and Commitments Register; and
- Ongoing review of the Environment Impact and Risk Register during later phases of the project.

The ENVID workshop was carried out as a team-based exercise used to identify potentially significant environmental impacts at an early stage of a project. It is also used to enable removal or reduction of potential environmental impacts during the design process and/or identify other practicable measures to ensure minimal harm to the environment. ENVID can be used at all stages of a project and can become more detailed over time

Xodus prepared and pre-populated an ENVID matrix in advance of the workshop based on available information on the Project and the environmental sensitivities of the area. Impacts were assessed assuming that routine mitigation and control measures were in place (including industry standard practice, legislative requirements and Nexen procedures) and the requirement for any additional project-specific mitigation discussed.

The objectives of the ENVID workshop were to:

- Review the pre-populated matrix and confirm that all potential environmental interactions and impacts associated with the Project have been identified;
- Review the mitigation and control measures adopted by Nexen;

- Review the impact consequence/likelihood ranking;
- Discuss and identify any additional measures required to eliminate, control or manage the environmental risks/impacts – with a focus on the potentially significant ones; and,
- Identify further actions required, and those who will be responsible for completion of those actions, towards delivery of ENVID outcomes and beyond.

The outcomes and finalised ENVID matrix from the workshop is presented in Appendix A.

The ENVID process focuses on potential environmental impacts and as such does not consider potential impacts to human health. The Project is not expected to result in any potential impacts on human health.

4.3 Assessment of Significance

The determination of significance of an impact is generally subjective, primarily based on professional judgement. A robust scoping and consultation process is therefore important in supporting the determination of significance enabling input from a range of regulators, stakeholders and independent experts. In addition, the use of a defined methodology framework, as outlined below, makes the assessment of environmental significance as objective and transparent as possible.

The methodology applied here is widely used in offshore projects of this nature and scale and is broadly aligned, where relevant, with the draft EPA Guidelines for EIA reports (EPA, 2017).

The significance of any potential impact is determined through the use of a risk assessment approach which employs the following standard risk assessment philosophy of:

Magnitude of potential impact (consequence) x likelihood of occurrence (frequency/probability) = Risk

4.3.1 Consequence

The consequence of each impact (as detailed in Table 4.1) is considered against the following three drivers:

- **Potential environmental impact (E):** Consideration of potential environmental sensitivities and scientific evidence on potential environmental impacts.
- **Stakeholder concern (S):** Consideration of other users (potential conflict/ concern resolution), interest groups, media and the general public (wider concern), and perceived potential impacts; and
- **Regulatory compliance (R):** Consideration of current and anticipated future legislative requirements.

Once each of the three consequences has been assessed, a final single consequence rating for the potential impact (prior to mitigation) must be assigned.

The consequence of each impact considers the quality of effects (positive, neutral or negative), the extent and context of the effects and recoverability.

Table 4.1 Environmental consequence criteria definitions

Category	Regulatory compliance (R)	Potential environmental impact (E)	Stakeholder concern (S)
Severe	Activity prohibited. Likely major breach of regulatory requirements resulting in non-compliance or significant project approval delays.	Regional (widespread) potential impact on the quality or availability of a habitat and/or wildlife with no recovery expected or irreversible alteration (permanent). Long-term effect on the conservation objectives of nationally/internationally protected sites, habitats or populations. Major transboundary effects expected. Major contribution to cumulative effects.	International public concern and extensive international media interest likely. Well established and widely held areas of concern in society, including perception of threat to the global environment. Decrease in the availability or quality of a resource to the extent of affecting over five plus years the wellbeing of the persons using that resource e.g. loss of fishing access or recreational use. Potential major effect on human health.
Major	Possible major breach of specific regulatory consent limits resulting in non-compliance.	Regional (widespread) potential impact on the quality or availability of a habitat and/or wildlife and where recovery may take place over the long term and could involve significant restoration effort. Short-term potential impact on the conservation objectives of nationally/internationally protected sites, habitats or populations. Moderate transboundary effects expected. Moderate contribution to cumulative effects.	National public concern and extensive national media interest likely. Well established and widely held areas of concern in national society. Decrease in the availability or quality of a resource to the extent of affecting over two to five years the wellbeing of the persons using that resource. Potential moderate impact on human health.
Moderate	Possible minor breach of specific regulatory consent limits resulting in non-compliance.	Regional (widespread) change in a habitat or species beyond natural variability with recovery likely within the short-term following cessation of activities, or localised degradation with recovery over the long-term following cessation of potential impact/activity. Potential impact on the conservation objectives of locally important sites or species. Possible transboundary effects. Possible contribution to cumulative effects.	Regional concerns at the community or broad interest group level. Decrease in the availability of a resource to the extent of affecting over one to two years the wellbeing of the persons using that resource. Possible but unlikely effect on human health but may result in or be perceived to result in a minor potential impact.
Minor	Regulatory terms set defined conditions.	Regional (widespread) change in habitats or species which can be seen and measured but is at same scale as natural variability or localised change in a habitat or species beyond natural variability with recovery expected in the short term following cessation of potential impact or activity. Unlikely to contribute to transboundary or cumulative effects.	Issues that might affect individual people or businesses or single interests at the local level. Some local public awareness and concern. A short-term decrease in the availability or quality of a resource likely to be noticed by persons using it but does not affect their well-being.
Negligible	No likelihood of breach of regulatory, corporate or company goals.	Effects unlikely to be discernible or measurable. No contribution to transboundary or cumulative effects.	No noticeable stakeholder concern and only limited public interest. A possible short term decrease in the availability or quality of a resource, which is unlikely to be noticed by persons using it, or those who live in the immediate area, and does not affect their well-being.
Positive	N/a	An enhancement of some ecosystem or population parameter.	No public opposition. Positive public support. An enhancement in the availability or quality of a resource to the extent of potentially benefiting the wellbeing of the persons using that resource or benefiting from it in some way.

4.3.2 Likelihood of occurrence

In order to assess the significance of a potential impact, the overall risk is combined with the likelihood of the potential impact occurring. The likelihood of each impact considers the probability (for unplanned activities), duration or frequency (for planned activities). The frequency and probability categories are defined in Table 4.2 and calculated risk in Table 4.3.

Table 4.2 Probability and or frequency definitions

Frequency/ probability category	Routine (planned) operation frequency	Accidental event (probability)
5	Continuous emission or activity over life of field or development	Likely More than once per year Event likely to occur more than once on the facility
4	Regular emission or activity Once per year for ≤ 6 months OR Once per month for ≤ 15 days Once per day for ≤ 12 hours	Possible One in 10 years Could occur within the lifetime of the development
3	Intermittent emission or activity Once per year for ≤ 1 month OR Once per month for ≤ 3 days OR Once per day for ≤ 2 hours	Unlikely One in 100 years Event could occur within lifetime of 10 similar facilities. Has occurred at similar facilities.
2	One off event or activity over lifetime of development of ≤ 3 months duration OR Once per year for ≤ 5 days OR Once per month for ≤ 8 hours	Remote One in 1,000 years Similar event has occurred somewhere in industry or similar industry but not likely to occur with current practices and procedures.
1	One off event or activity of ≤ 10 days duration	Extremely remote One in 10,000 years Has never occurred within industry or similar industry but theoretically possible.

4.3.3 Potential impact significance

Both significance and likelihood are semi-quantitative representing best judgements on the basis of knowledge and experience available. A matrix allows a consistent basis for presenting such a broad-based risk assessment. Interpretation of the overall risk in terms of potential impact significance can then be undertaken (Table 4.4).

Table 4.3 Potential Environmental Risk

Consequence	Regulatory	Environment	Stakeholder	Likelihood					
				5	4	3	2	1	0
				Continuous / likely	Regular / possible	Intermittent / unlikely	One off event / remote	One off event / extremely remote	Will not occur
Severe	Activity prohibited. Likely major breach in compliance resulting in prosecution	Severe magnitude/sensitivity ranking	International concerns	Severe	Severe	Major	Moderate	Minor	Negligible
Major	Possibly major non-compliance	Major magnitude / sensitivity ranking	National concerns	Severe	Major	Moderate	Minor	Negligible	Negligible
Moderate	Possibly non-compliance	Moderate magnitude /sensitivity ranking	Regional concerns	Major	Moderate	Minor	Minor	Negligible	Negligible
Minor	Regulatory terms or corporate policy set defined conditions	Minor magnitude / sensitivity ranking	Local concerns	Moderate	Minor	Minor	Negligible	Negligible	Negligible
Negligible	No specific statutory control	Negligible magnitude/sensitivity ranking	Individual concerns	Minor	Negligible	Negligible	Negligible	Negligible	Negligible
Positive	N/a	Positive benefit or enhancement	No public interest or improves aspect of community importance	Positive	Positive	Positive	Positive	Positive	Positive

Table 4.4 Potential environmental significance rankings

	Environmental risk	Potential impact significance (as defined under the EIA regulations)
Severe	Elevated risk - requires major consideration in design process and/or operational planning	Considered significant
Major	Elevated risk - requires immediate attention and major consideration in design process and/or operational planning	Considered significant
Moderate	Moderate risk – may require additional control measures or management/communication to maintain risk at less than significant levels	Potentially significant; further assessment required to determine significance.
Minor	Minor risk - however will require some management/commitment to maintain risk at less than significant levels	Not significant
Negligible	No risk - no action required	Not significant
Positive	Positive – to be encouraged	Positive significance

4.4 Stakeholder Consultation

The Nexen engagement process is designed to encourage open and transparent communication and feedback between the company and stakeholders. To inform this, Nexen completes stakeholder assessments to identify potentially affected stakeholders based on the location, timing and potential impacts and opportunities of all proposed activities. The approach to stakeholder engagement for the Project is set out in the project-specific stakeholder engagement plan (SEP). This approach incorporates the requirements of the Rules and Procedures Manual for Offshore Petroleum Exploration and Appraisal Operations (PAD, 2014), including pre-submission consultation, fisheries consultation, notifications to fishermen via IOOA procedures, statutory consultation during the application for approval, and post-approval consultation.

Table 4.5 below summaries some of the key consultation to date.

Table 4.5 Stakeholder consultation summary

Date	Consultees	Key points discussed and outcomes
July 2018	PAD	Update of Project Schedule. Presentation of Project Environmental Sensitivities and outcomes of the ENVID. Timelines for Environmental Approvals Informed on the timelines for the publication of the data from ObSERVE programme.
June 2018	Irish Coast Guard	Nexen and OSRL membership. Presentation of Oil Spill Contingency Plan structure. Discussion on dispersant use including approval route, storage and testing protocols.
May 2018	Irish Coast Guard	Presentation on well plans and Nexen incident command system philosophy. Discussion on the Oil Spill Contingency Plan regulatory approval process

Engagements to date have been completed in line with the above requirements and no material issues have been raised.

4.5 Identification of Aspects Requiring Assessment in the EIA Screening Report

Those aspects that are assessed further in Section 5 include the following:

- The aspects with residual risks judged to be medium or higher (with the adoption of known mitigation measures) during the ENVID (note that no aspects were identified as posing a Major or Severe environmental risk); and
- Those aspects which had one or more criteria (regulatory, environmental, or stakeholder) with a potential consequence of moderate or higher but a significance ranking of minor or lower.