Vermilion Exploration & Production Ireland Ltd

Corrib Subsea Inspection, Maintenance and Infrastructure Renewal Surveys 2019

Natura Impact Statement

660841

April 2019

RSK GENERAL NOTES

Project No.: 660841

Title: Corrib Subsea Inspection, Maintenance and Infrastructure Renewal Surveys 2019 – Natura Impact Statement

Client: Vermilion Exploration & Production Ireland Limited (Vermilion)

Date: 15th April 2019

Office: Bristol

Status: Final for issue

Authorised by:	Andrew Bendell	**Project Manager**	**Date:**	**15-4-2019**
Authorised by:	David Watson	**Project QA Rep**	**Date:**	**15-4-2019**

AB	DW/JN	15-4-2019	E	Final	For issue
AUTHOR	**CHECKED**	**DATE ISSUED**	**ISSUED POST / ELECTRONIC**	**REV**	**PURPOSE OF ISSUE**

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1 EXECUTIVE SUMMARY

This Natura Impact Statement provides an assessment of the potential environmental impacts of a programme of offshore infrastructure inspection, maintenance, and infrastructure renewal works geophysical and visual survey, in relation to European Protected Sites. The works programme includes geophysical and visual inspection surveys of the Corrib main offshore gas export pipeline and sections of the umbilical, water outfall pipeline, and infield flowlines and umbilicals. This document is a statutory requirement and has been prepared in accordance with Irish governmental guidance in order to support an Appropriate Assessment should the competent authority decide that such an assessment is required. It is the opinion of the authors of this assessment that all impacts are however screened out of requiring an Appropriate Assessment.

An outline of the Appropriate Assessment (AA) process is provided in the introduction to this report, while Section 3 provides a background to the Corrib Gas development and outline details of the proposed works.

The assessment considers a range of potential impacts (associated with the proposed activities) alongside the qualifying features (conservation objectives) of a number of relevant European Protected Sites in the Natura 2000 network.

2 INTRODUCTION

2.1 Purpose of this document

This Natura Impact Statement (NIS) provides an assessment of the potential environmental effects of proposed inspection, maintenance, and infrastructure renewal surveys of the P3 wellhead at the Corrib offshore gas field and the full length of the main offshore gas export pipeline and sections of the umbilical, the Bellanaboy Bridge Gas Terminal (BBGT) treated surface water outfall pipeline, and infield flowlines and umbilicals, in relation to European protected ('Natura 2000') sites. The document provides the information necessary for the competent authority to undertake an Appropriate Assessment to assess the effects of the project against the qualifying features (conservation objectives) of nearby or relevant Natura 2000 sites.

This has been prepared in accordance with the Birds and Natural Habitats Regulations[1] (SI 477 of 2011) and current guidance of the National Parks and Wildlife Service (NPWS) as described in 'Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities (Department of Environment, Heritage and Local Government[2], 2009 (as revised February 2010)'.

The approach and methodology in assessing the environmental implications of the proposed activities for this NIS has been undertaken with due regard to the EPA 'Advice Notes for Preparing Environmental Impact Statements' (2015); EPA 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (2017); and the Chartered Institute of Ecology and Environmental Management's Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Coastal and Marine (CEEM, 2018).

The ecological characteristics of European sites in the vicinity of the proposed survey activities are described in Section 4 of this document, followed by an initial screening of impacts, and then an assessment of likely effects, and residual impacts on European sites in Section 6. Conclusions are set out in section 7.

The document provides an initial impact screening assessment for offshore survey activities followed by an assessment of impacts, which are scheduled to take place during the summer months of 2019. This document outlines the information required in order to assess whether or not the proposed activities, either when taken alone or in combination with any other offshore works, are likely to have a significant effect on a European site.

This assessment takes cognisance of the CJEU judgement in Case C-323/17 *People Over Wind & anor. v. Coillte,* which ruled that "*it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project"*

By undertaking the impact assessment in a stepwise manner in relation to the habitats and species of these sites, together with their conservation objectives, this document seeks to inform the screening process required at the first stage of the process pursuant to Article 6.3 of the EU Habitats Directive and also to provide full and detailed information as required for the second stage, that of Appropriate Assessment should the competent authority decide that such an assessment is required.

2.2 The stages of Appropriate Assessment

The requirement for appropriate assessment is set out in Article 6(3) of the EU Habitats Directive (92/43 EEC)[3], which states:

'Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.'

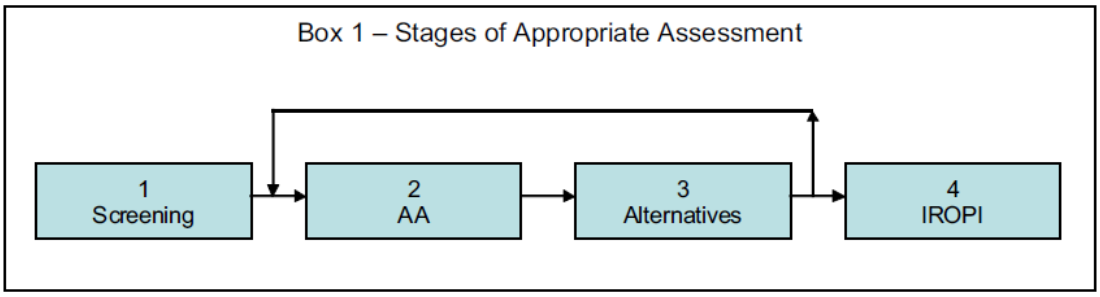
Should a decision be reached to the effect that it cannot be said with sufficient certainty that the proposed annual inspection and maintenance survey of the Corrib subsea infrastructure is not likely to have significant effects on the Natura 2000 sites, then, as is stated above, it is necessary and appropriate to carry out an Appropriate Assessment of the implications of the proposed activity for the European sites in view of their conservation objectives.

The guidance for Appropriate Assessment (NPWS, 2009, revised February 2010) states:

"AA is an impact assessment process that fits within the decision-making framework and tests of Articles 6(3) and 6(4) and, for the purposes of this guidance, it comprises two main elements. Firstly, a ***Natura Impact Statement – i.e. a statement of the likely and possible impacts of the plan or project on a Natura 2000 site (abbreviated in the following guidance to "NIS")*** *must be prepared. This comprises a comprehensive ecological impact assessment of a plan or project; it examines the direct and indirect impacts that the plan or project might have on its own or in combination with other plans and projects, on one or more Natura 2000 sites in view of the sites' conservation objectives. Secondly, the competent authority carries out the AA, based on the NIS and any other information it may consider necessary. The AA process encompasses all of the processes covered by Article 6(3) of the Habitats Directive, i.e. the screening process, the NIS, the AA by the competent authority, and the record of decisions made by the competent authority at each stage of the process, up to the point at which Article 6(4) may come into play following a determination that a plan or project may adversely affect the integrity of a Natura 2000 site".*

The European Commission's guidance promotes a fours stage process, as set out in Box 1 below (Figure 2-1), to complete the Appropriate Assessment, and outlines the tests required at each stage. Stages 1 and 2 deal with the main requirements for assessment under Article 6(3). Stage 3 may be part of Article 6(3) or a necessary precursor for Stage 4.

Figure 2-1: Stages of Appropriate Assessment



This NIS includes the ecological impact assessment and testing required under the provisions of Article 6(3) by means of the first stage of Appropriate Assessment, the screening process (as set out in the EU Guidance documents).

The NIS also provides the information required for the Competent Authority to complete the Appropriate Assessment (Stage 2) should this be necessary and appropriate in their opinion. An evaluation of alternatives has also been provided to demonstrate that all feasible alternatives for the proposed development had been considered and that the option with the least ecological impacts has been selected.

The first stage of an Appropriate Assessment is the screening exercise, which is undertaken to determine if it is necessary to proceed with further stages.

The Department of the Environment, Heritage and Local Government's [4]guidance (2009) revised February 2010)) states:

"Screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Article 6(3):

- *whether a plan or project is directly connected to or necessary for the management of the site; and*
- *whether a plan or project, alone or in combination with other plans and projects, is likely to have significant effects on a European site in view of its conservation objectives.*

If the effects are deemed to be significant, potentially significant, or uncertain, or if the screening process becomes overly complicated, then the process must proceed to Stage 2 (AA). Screening should be undertaken without the inclusion of mitigation, unless potential impacts clearly can be avoided through the modification or redesign of the plan or project, in which case the screening process is repeated on the altered plan. The greatest level of evidence and justification will be needed in circumstances when the process ends at screening stage on grounds of no impact."

Section 5 comprises the required assessment as laid out in the screening sections and screening matrix of the guidance documentation[5] (Stage 1 of the AA process). While Section 6 assesses the impacts (if any) on the integrity of Natura 2000 sites (Stage 2 of the AA process).

With regard to the screening process (Stage 1), EU Commission guidance[6] states:

"This stage examines the likely effects of a project or plan, either alone or in combination with other projects or plans, upon a Natura 2000 site and considers whether it can be objectively concluded that these effects will not be significant. This assessment comprises four steps:

- *determining whether the project or plan is directly connected with or necessary to the management of the site;*
- *describing the project or plan and the description and characterisation of other projects or plans that in combination have the potential for having significant effects on the Natura 2000 site;*
- *identifying the potential effects on the Natura 2000 site;*
- *assessing the significance of any effects on the Natura 2000 site".*

2.3 Previously Assessed Activities

Offshore and nearshore pipeline surveys have been assessed previously in the Offshore Supplementary Update Report (RSK, 2010) and have been undertaken as assessed and approved under the 2011 Section 40 Consent.

A Natura Impact Screening Statement (NISS, EACS, 2015) was submitted as part of the Consent to Operate application in 2015. This considered the future activities associated with the offshore pipeline and concluded that "the operation of the Corrib Pipeline when taken either individually or in combination with other plans of projects is not likely to have any significant effect on any European site". The conclusion concurred with those of previous assessments and approvals were given by the Minister following his Department's consultations with prescribed bodies and assessment by external consultants. The previous assessments included those submitted between 2013 and 2018 a number of Natura Impact Screening Statements (NISS) that were submitted to the Department of Communications, Energy, and Natural Resources (DCENR[7]) (from 2016 these were submitted to the Department for Communications, Climate Action and the Environment (DCCAE) for the approval of offshore surveys. These screening reports took into consideration the potential impacts on the West Connacht Coast SAC, the designation of which was notified (2012) subsequent to the 2011 Section 40 Consent, as well as other European sites in the wider locality, with the potential to be affected by the survey activities.

Marine mammal monitoring carried out in relation to offshore activities subsequent to the Offshore Supplementary Report (RSK, 2010) and the 2011 Section 40 Consent is described in four marine mammal monitoring reports describing the annual monitoring undertaken by the Coastal and Marine Research Centre (CMRC) of University College Cork (Anderwald et al., 2011; 2012, Haberlin et al., 2013, Culloch et al., 2014).

In addition to the NISS reports (described above) submitted in support of applications for surveys of the offshore pipeline, a Natura Impact Statement was submitted for an Ocean Bottom Cable (OBC) seismic survey of the Corrib Gas Field (to support the Appropriate Assessment process for the West Connacht Coast SAC) (2013).

Vermilion is committed to the reduction of environmental impacts throughout the Corrib Development and will implement best practice with respect to marine mammals throughout any activities along the offshore pipeline route (including in the vicinity of the West Connacht Coast SAC). The procedures implemented for their

protection are in compliance with all requirements imposed on the Corrib Development by the statutory agencies.

[1] SI 477 of 2011 European Communities (Birds and Natural Habitats) Regulations 2011

[2] As of 2016 the Department of Environment, Heritage and Local Government is known as the Department of Housing, Planning, Community, and Local Government

[3] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, as amended by Council Directive 97/62/EC

[4] As of 2016 the Department of Environment, Heritage and Local Government is known as the Department of Housing, Planning, Community, and Local Government

[5] EC (2018): European Commission. Managing Natura 2000 Sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, (21-11-18) C (2018) 7261 Final. Commission Notice Brussels

[6] Paragraph 3.1 of 'Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological Guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC (Nov. 2001)

[7] From 2016 the DCENR is known as the Department of Communications, Climate Action and the Environment (DCCAE)

Furthermore, Article 42 of S.I 477 of 2011 European Communities (Birds and Natural Habitats) Regulations 2011 stipulates that screening for Appropriate Assessment of a plan or project not directly connected with or necessary to the management of a European Site shall be carried out by the competent authority to assess, in view of best scientific knowledge and in view of the conservation objectives of the site, if that plan or project, individually or in combination with other plans or projects is likely to have a significant effect on the European site.

2.4 Alternatives

The primary objectives of the proposed subsea inspection, maintenance and infrastructure renewal surveys is to inspect and assess pipeline/umbilical and other subsea infrastructure integrity by way of annual monitoring, using a range of techniques, which may determine the requirements of future maintenance works. In addition, it is proposed also that the wellhead structure at well P3 will be repaired, which will require the opening of the well head protection cover. The operator is committed to an annual survey using visual means and low intensity geophysical techniques. The survey methodology has been chosen following the evaluation of a number of alternatives from different prospective contractors. The techniques and equipment that have been selected are based on their data acquisition performance and low ecological impact. The survey work scope and methodology has been developed in order to comply with statutory requirements for offshore working. These will be discussed further in the assessment of likely effects (Sections 5 and 6).

2.5 Consideration of significance

In terms of significance, the NPWS Guidance (2010) uses an EC definition as follows:

"… any element of a plan or project that has the potential to affect the conservation *objectives of a Natura 2000 site, including its structure and function, should be considered significant (EC, 2006)". Other guidance documents also discuss significance criteria, some in more detail than others. The Dutch Guidance*[8] *(translated, Neumann, 2004) discusses a number of criteria in relation to habitats and species population.*

In general, significance indicators might include:

- impact on Annex I habitat (including loss or reduction in size - percentage relative to the overall area of the habitat in the Natura site; impairment of function);
- fragmentation of habitat or population (depending upon the duration or permanence);
- disturbance (noise, light etc. – distance from disturbance, duration of disturbance);
- effect on species populations (direct or indirect damage to size, breeding patterns etc), and;

- changes in water quality.

To summarise the significance issue, it is useful to quote from Morris (2008) who describes significance in the context of the Habitats Directive as follows:

"...Within the Habitats Regulations, significance is quite different. It is used as a coarse filter and the test is a question over the possibility that there will be a significant effect on a key receptor that determines the conservation status of a European site. Thus, determining whether there will be a 'likely significant effect' does not imply that there will be such an effect or even that such an effect is more likely than not; it simply flags the need to test the issues and then make a judgement of the pathways and mechanisms imposed by a project on the designated wildlife interest. This test best equates to the screening and scoping opinions sought for an EIA but is confined to the Natura 2000 and Ramsar interest rather than wider environmental or nature conservation issues".

2.6 Consideration of integrity

In order to assess the likely impacts and ascertain whether a significant impact on the integrity of the Natura site(s) is likely to occur as a result of the proposed development, should the appropriate assessment process be deemed to apply, it is necessary to consider what constitutes the integrity of a Site as referred to in Article 6(3). The document Managing Natura 2000 Sites, The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (2000) (Updated November 2018) gives clear guidance in this regard and states:

"The integrity of the site involves its constitutive characteristics and ecological functions. The decision as to whether it is adversely affected should focus on and be limited to the habitats and species for which the site has been designated and the site's conservation objectives".

Integrity has been discussed and defined in various ways in guidance documentation and the literature. For example, Treweek (1999) discusses biological integrity and ecosystem health and refers to three generally accepted criteria: systematic indicators of ecosystem functional and structural integrity; ecological sustainability or resilience (relating to the ability of a system to withstand "natural" or anthropogenic stresses); and absence of detectable symptoms of ecosystem disease or stress. A similar, but less academic, approach is adopted by the various guidance documents with a number of definitions proposed.

[8] Translated from Publication of Dutch State Printers in book: 'Praktijkboek Habitattoets' , 2004 (F. Neumann en H. Woldendorp, SDU)

3 PROPOSED ACTIVITIES

3.1 Background – an overview of the Corrib Gas Development

The Corrib natural gas field is located approximately 65 kilometres offshore from the closest coast of north west County Mayo. This gas field has been developed as a subsea 'tie-back' facility, connected by a pipeline to an onshore processing terminal located approximately 9 kilometres inland.

All of the statutory permits and consents necessary to develop the Corrib gas field and associated facilities and infrastructure were in place at the end of 2004 when construction commenced. By November 2009 the offshore production facilities had been installed and the 83 km offshore section of the Corrib pipeline between the field and the landfall had been laid. To allow the connection of the Corrib development with the national gas distribution network the 150 km Galway to Mayo pipeline was completed in 2006 and is now connected to the Terminal. Construction of the 8.3 km onshore section of the Corrib pipeline from the initial landfall at Glengad to the BBGT was completed in 2015.

Following the consent to operate at the end of 2015, the development was fully commissioned, and went into operation at the end of 2015 when first gas was achieved.

3.2 Survey of the main export pipeline, umbilical, BBGT treated surface water outfall pipeline, and infield flowlines and umbilicals

The 2019 survey programme will involve a geophysical and visual survey of the bulk of the Corrib subsea infrastructure between the Corrib Field and the landfall at Glengad, Co. Mayo. The survey will inspect and assess pipeline/umbilical integrity, and is being undertaken to monitor seabed assets, which may determine the requirements of future maintenance works. It is proposed also that the Wellhead structure at well P3 will be repaired, which will require the opening of the well head protection cover. This discrete workscope at P3 will require a visual survey, but no acoustic geophysical survey is planned as part of this and so is therefore not assessed further in this submission. This submission will focus on the impacts associated with the inspection and maintenance survey of the main export pipeline and associated infrastructure. The survey will be carried out by two vessels (one for inshore waters and one for offshore) using a combination of acoustic survey techniques, namely multibeam echo sounder (MBES), sub-bottom profiler, and side-scan sonar. In addition, a visual survey using underwater video/camera imagery (inshore) and ROV (offshore) will also be undertaken. A range of other sensors may also be used as part of the survey including: Sound Velocity Probes (SVPs) (used to calibrate acoustic survey equipment); pipe tracker, imaging sonar and Obstacle Avoidance Sonar; as well as navigation / positioning sensors including a subsea Ultra Short Baseline

(USBL) beacon system, an altimeter, Motion Reference Unit (MRU), Inertial Navigation System (INS) and Doppler Velocity Log (DVL).

The proposed workscope will comprise three main components:

- A subsea inspection and maintenance and infrastructure renewal survey programme of the subsea facilities using ROV and vessel mounted equipment deployed from the Construction / ROV Survey Support Vessel *Edda Sun*. This vessel will be responsible for the survey covering the area of the Corrib offshore field assets as well as seabed infrastructure as far inshore as Broadhaven Bay.
- A subsea inspection and maintenance survey programme of the subsea infrastructure using vessel deployed equipment from the inshore survey vessel *Leah-C*. This vessel will be responsible for the inshore parts of the survey, primarily within Broadhaven Bay as far as the inshore limit of safe navigation.
- The *Edda Sun* will also undertake a repair programme to the Corrib Central Manifold P3 wellhead, which will require the opening of the wellhead protection cover. No use of acoustic survey equipment is planned during the repair programme at P3.

The inshore and offshore elements of the work programme will investigate features such as free-spanning and scouring, and pipeline burial depth and integrity, as well as cathodic protection measures. The offshore elements of the survey programme will also include the P3 wellhead structure remedial works but no use of acoustic survey equipment is planned during the repair itself. As described above, a large offshore survey support vessel will undertake the offshore parts of the survey, while an inshore survey vessel will carry out the inshore elements of the survey. Both surveys will cover the area of the Corrib Field along the full extent of the offshore pipeline route (also covering selected sections of the main control umbilical), the BBGT water outfall pipeline, and other seabed infrastructure) as far inshore as the limit of navigation close to the landfall at Glengad (Figure 3-2).

3.2.1 Primary acoustic survey equipment

Details of the survey equipment proposed for the *Leah-C* (inshore) and *Edda Sun* (offshore) are presented in Table 3-1. In offshore areas, the majority of geophysical survey equipment will be mounted to the ROV of the *Edda Sun*, while in inshore areas equipment will be attached directly to the hull of the *Leah-C* (with the exception of the side-scan sonar transducers on the inshore survey, which will be deployed from a towfish).

Table 3-1: Proposed principal survey equipment specification and operational frequency ranges for the proposed 2019 survey programme

Vessel	Specification	Operating frequency range
Leah-C (Vessel mounted)	**Preferred Option**: Innomar SES2000: **Alternative Option**: Kongsberg - Geoacoustics TR-1075D Sub Bottom Profiler	3 to 8 kHz 3 – 8 kHz
	Preferred Option: Teledyne Reson Seabat 7125 dual head Multibeam echo sounder **Alternative Option:** Various	200 kHz - 400 kHz Typical operation between 350 and 400 kHz 190 kHz – 420 kHz
	Preferred Option: Klein 3000H Dual Frequency Side-scan sonar **Alternative Option:** Various dual frequency options	dual frequency 445 and 900 kHz
Edda Sun (ROV mounted)	Reson Seabat 7125 dual head Multibeam echosounder	400 kHz
	Kongsberg MS1000 – Obstacle avoidance sonar	675 kHz
	RDI Workhorse Doppler Velocity Log	1200 kHz
	Valeport MVS Sound Velocity Sensor	2.5 MHz
	Tritech SK704 altimeter	500 kHz
	Vessel single beam echo sounder	38 kHz – 200 kHz (Typically operates at 50kHz)
	HiPAP vessel USBL system	21 -31 kHz
	TSS 440 – Pipe tracker	Negligible strength of magnetic field
	Vessel Doppler Velocity Log	2 MHz

For both the inshore and offshore survey components a range of other equipment for navigation/positioning and calibration will also be used that will have an acoustic signature. A Valeport Sound Velocity Probe will be deployed occasionally throughout the surveys to provide salinity, conductivity, temperature and sound velocity depth information. These probes operate at an extremely high frequency of around 2.5 MHz at a very low level of intensity. This allows periodic calibration of the primary acoustic

survey sensors. Both vessels are also likely to have single beam depth echosounders (operating at around 50 kHz) and an Ultra Short Baseline (USBL beacon system for maintaining position and communications with any deployed equipment. USBL systems operate at a frequency of between 21 and 31 kHz at a very low intensity. The ROV on the offshore vessel will likely utilise a Doppler Velocity Log (DVL) for accurate positioning and speed determination. This operates at a very high frequency of 2 MHz also at negligible intensity. The ROV will also be equipped with an altimeter, which operates at a relatively high frequency of 500 kHz, at a low level of source intensity.

The following sections provide additional discussion regarding the primary acoustic survey equipment proposed for the subsea inspection, maintenance and infrastructure renewal survey programme.

3.2.1.1 MBES

MBES is a transducer-based piece of equipment. A transducer is an antenna that converts electrical energy into sound waves and vice versa. MBES are also commonly used to create densely-sampled digital terrain models that can be used to further define topography and assist in oil and gas field development phases, when planning the location of wellheads, platforms, and pipelines, and in maintenance activities which require detailed seabed information.

MBES, like other sonar systems, transmit sound energy and analyse the return signal (echo) that has bounced off the seafloor or other objects. This is done by emitting sound waves from directly beneath a ship's hull (or similar) to produce fan- shaped coverage of the seafloor. The MBES system records the time for the acoustic signal to travel from the transmitter (transducer) to the seafloor (or object) and back to the receiver. MBES produce a “swath” of soundings (i.e. depths) to ensure full coverage of an area. The coverage area on the seafloor is dependent on the depth of the water, with coverage typically being two to four times the water depth.

The MBES equipment will be hull mounted on the *Leah-C* for the inshore survey in the confined waters of Broadhaven Bay, while it is likely to be mounted to the ROV of the *Edda Sun* for the offshore section of the survey. ROV mounting for the deeper water sections of the survey will result in a relatively short distance between the acoustic source and the seabed, providing for the acquisition of high resolution seabed data.

3.2.1.2 Sub-bottom profiler

Sub-bottom profiler systems are used to identify and measure the various marine sediment layers that exist below the sediment/water interface. These acoustic systems use a technique that is similar to single beam echo sounders and emit an acoustic signal vertically downwards into the water and a receiver monitors the return signal reflected off the seafloor. Some of the acoustic signal will penetrate the seabed and be reflected when it encounters a boundary between two layers that have different acoustic impedance. Acoustic impedance is related to the density of the material and the rate at which sound travels through the material. When there is a change in acoustic impedance, part of the transmitted sound is reflected. The system uses this reflected energy to record a profile of the marine sediment layers beneath. The sub-bottom profiler will be used only on the inshore component of the survey, deployed from the *Leah-C*.

3.2.1.3 *Side-scan sonar*

Side-scan sonar is used to determine the texture, topography and character of the seabed sediments and to detect features such as boulders, outcrops, pipelines, wellheads and other equipment lying on, attached to, or buried immediately beneath the seafloor. A side-scan transmits sound energy and analyses the return signal (echo) that has bounced off the seafloor or other objects. Side-scan sonar typically consists of three basic components: towfish or hull mounted transducer, transmission cable, and topside processing unit.

In a side-scan, the transmitted energy is formed into the shape of a fan that sweeps the seafloor from directly under the towfish or vessel hull to either side, typically to a distance of 100 metres (depending on factors including water depth, and signal strength). The strength of the return echo is continuously recorded, creating a "picture" of the ocean bottom. For example, objects that protrude above the seabed create a dark area (strong return) and shadows from these objects are light areas (little or no return). Side-scan sonar is typically used in conjunction with multibeam to meet full bottom coverage specifications. Side-scan sonar will only be used for the inshore component of the survey, deployed from the *Leah-C.*

It should be noted that the acoustic sources proposed for the survey are a number of orders of magnitude lower in intensity than those used in conventional seismic surveys.

3.2.1.4 *Soft start*

Soft start procedures will be used in offshore and inshore areas.

In accordance with NPWS (2014) guidance, soft start procedures will be required for survey work within Broadhaven Bay, as soft start for acoustic surveys is required for surveys within bays, inlets or estuaries and within 1,500 m of the entrance of enclosed bays/inlets/estuaries or as advised by the relevant Regulatory Authority. However, in line with environmental best practice, soft start procedures will be followed throughout the extent of the survey route.

A soft start, or ramp up, procedure is the process whereby sound output into the marine environment is gradually increased from the lower range of the equipment's operating range lower intensity), to the full output necessary to carry out the activity. If the intensity cannot gradually be increased from a low level to operational levels, then the equipment can be switched on and off in a sequential manner for a few seconds at a time for a soft start / ramp up period of 20 minutes prior to the equipment being used for operations (NPWS, 2014).

3.3 Schedule

Total data acquisition period for the pipeline and umbilical survey will be approximately 2 weeks in duration (dependent on weather conditions), with the survey taking place for both vessels during the summer months of 2019 (June – September).

3.4 Vessels

A large offshore ROV and construction support vessel the *Edda Sun* (Table 3-2, Figure 3-1) will provide ROV and survey capability for the subsea inspection, maintenance and infrastructure engineering surveys. Principal survey equipment will be attached to, and operated by, the ship's ROV. The ROV also provides video and still image recording capabilities.

This vessel will cover the offshore elements of the survey programme via her ROV capabilities. The *Leah-C*, a small multipurpose inshore vessel (Table 3-2, Figure 3-1), will be used to undertake all survey works in inshore areas. Principal survey equipment (with the exception of the side-scan sonar) will be attached directly to the hull of the *Leah-C,* and underwater video and still imagery will also be captured.

The determination of 'offshore' and 'inshore' areas, for the purposes of this document, has assumed a boundary at a water depth of approximately 20 m below Chart Datum, however, the location of this boundary may be refined closer to the time of the survey. The offshore vessel would therefore be responsible for the survey of the subsea infrastructure covering the area of the Corrib Field to within Broadhaven Bay, while the *Leah-C* would limit its survey operations to within the Bay itself in depths of 20 m or less and would cover the section of the routes close to the landfall at the limit of safe navigation.

Table 3-2: Inspection, maintenance and infrastructure renewal survey vessel specifications

Parameter	Specification	
Name	*Leah-C*	*Edda Sun*
Owner	Michael Callaghan, Killybegs Co. Donegal – operated by Belcross Enterprises	Østensjø Rederi A/S
Survey main contractor	Bibby Hydromap	Fugro
Type	Multipurpose inshore vessel	Multipurpose Survey and Construction Support Vessel
Length (overall)	11 m	88.8 m
Draught (Mean)	1.2 m	6.6 m
Tonnage (Gross)	8.5 t	4953 t

Leah-C

Edda Sun

Figure 3-1: Vessels proposed for the inspection, maintenance and infrastructure renewal survey programme

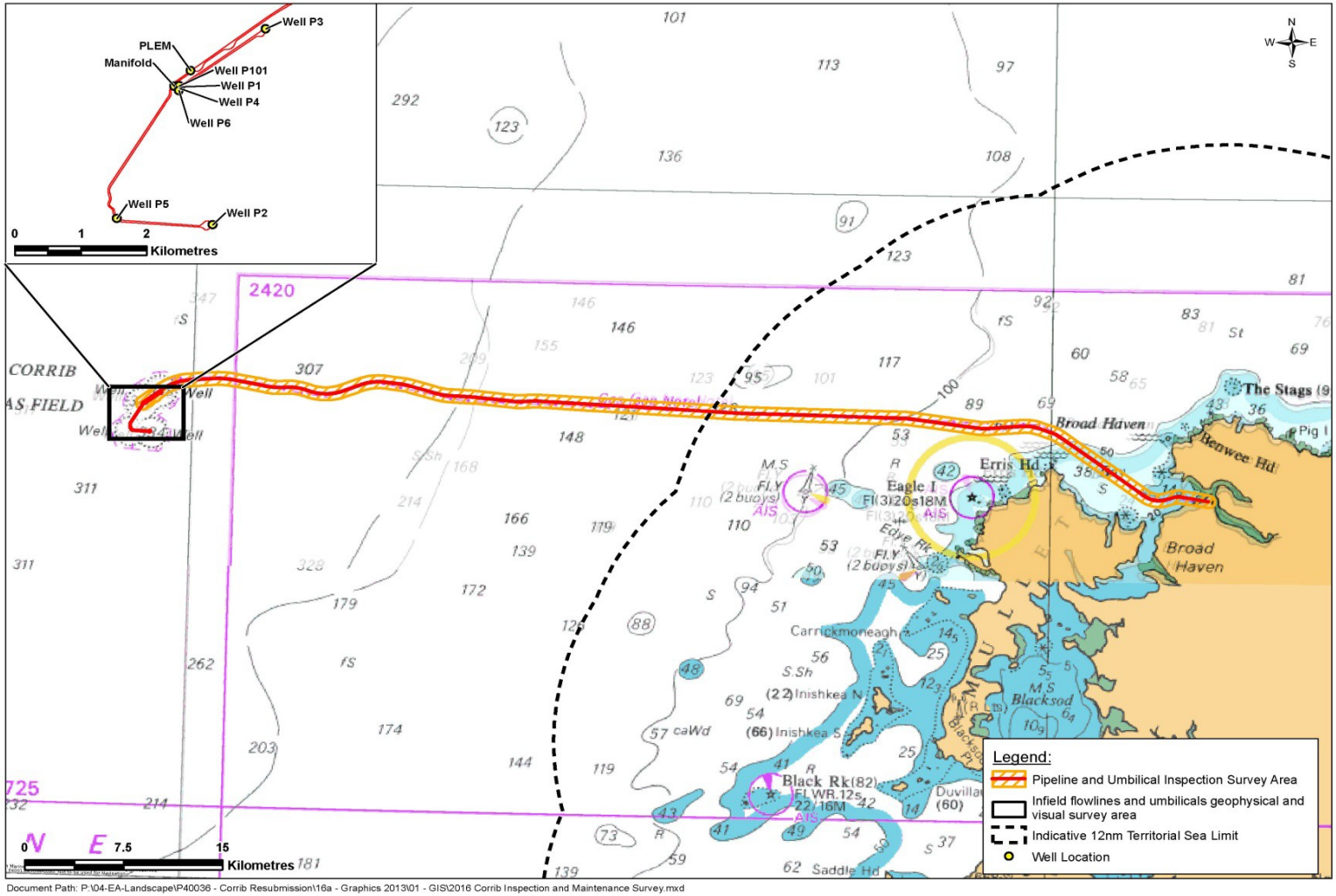


Figure 3-2: Approximate location of the proposed 2019 survey programme, relative to the Corrib Field, main export pipeline and umbilical route.

4 EUROPEAN SITES

4.1 Introduction

European sites are a network (Natura 2000) of marine and terrestrial conservation areas established under the 1992 Habitats Directive, with the aim of providing protection to threatened species and habitats throughout Europe. These sites comprise Special Areas of Conservation (SACs), designed for the protection of certain habitats (Annex I) and species (Annex II), and Special Protection Areas (SPAs), for the protection of qualifying bird species. Specific conversation objectives have been developed for European sites in relation to their qualifying interests – habitats and/or species. These are published on the website of the National Parks and Wildlife Service of the Department of Arts, Heritage and the Gaeltacht (www.npws.ie), and are considered below.

4.2 European sites in the vicinity of the Corrib Development

Appropriate Assessment requires consideration of the European sites in the vicinity of the proposed activities on the Corrib development. Such sites are listed below together with the features for which they are designated (Table 4-1). The location of these sites in relation to the pipeline route and Corrib Field are shown in Figure 4-1.

The characteristics of these European sites are presented in section 4.3.

Table 4-1: European sites within the vicinity of the activities

Designation	Site name (site code)	Qualifying interests	Approximate distance from site to survey area at closest point (km)
SAC	Broadhaven Bay (000472)	Mudflats and sandflats not covered by seawater at low tide (habitat) Large shallow inlets and bays (habitat) Reefs (habitat) Atlantic salt-meadows *Glauco-Puccinellietalia maritimae* Submerged or partly submerged sea caves (habitat)	**Overlap (0 km)**
	Glenamoy Bog Complex (000500)	Salmon *Salmo salar* Vegetated sea cliffs of the Atlantic and Baltic coasts (habitat) Slender green feather-moss *Drepanocladus vernicosus*	**0 km**

Designation	Site name (site code)	Qualifying interests	Approximate distance from site to survey area at closest point (km)
SAC		Petalwort *Petalophyllum ralfsii* Marsh saxifrage *Saxifraga hirculus* Machairs (habitat) Natural dystrophic lakes and ponds (habitat) Northern Atlantic wet heaths with *Erica tetralix* (habitat) *Juniperus communis* formations on heaths or calcareous grasslands (habitat) Blanket bog (*active only) (habitat) Transition mires and quaking bogs (habitat) Depressions on peat substrates of the Rhynchosporion (habitat)	
	Erris Head (0001501)	Vegetated sea cliffs of the Atlantic and the Baltic coasts Alpine and Boreal heaths	**2 km**
	Inishkea islands (000507)	Grey seal *Halichoerus grypus* Petalwort *Petalophyllum ralfsii* Machairs (habitat)	**19 km**
	Duvillaun Islands (0000495)	Grey seal *Halichoerus grypus*	**22 km +**
	West Connacht Coast (002998)	Bottlenose dolphin *Tursiops truncatus*	**c. 1 km**

	Mullet / Blacksod Bay Complex (000470)	Mudflats and sandflats not covered by seawater at low tide (habitat) Large shallow inlets and bays (habitat) Reefs (habitat) Salicornia and other annuals colonising mud and sand (habitat) Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (habitat) Fixed coastal dunes with herbaceous vegetation (grey dunes) (habitat) Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) (habitat) Machairs (* in Ireland) (habitat) Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation (habitat) Alkaline fens (habitat) Otter *Lutra lutra* Petalwort *Petalophyllum ralfsii*	**c. 10km**

Designation	Site name (site code)	Qualifying interests	Approximate distance from site to survey area at closest point (km)
SPA	Blacksod Bay / Broadhaven (004037)	Great Northern Diver *Gavia immer* Light-bellied Brent Goose *Branta bernicla hrota* Common Scoter *Melanitta nigra* Red-breasted Merganser *Mergus serrator* Ringed Plover *Charadrius hiaticula* Sanderling *Calidris alba* Dunlin *Calidris alpina* Bar-tailed Godwit *Limosa lapponica* Curlew *Numenius arquata* Sandwich Tern *Sterna sandvicensis* Dunlin *Calidris alpina schinzii* Wetland and Wintering Waterbirds	**0 km**
	Termoncarragh Lough and Annagh Machair (004093)	Corncrake *Crex crex* Greenland White-fronted Goose *Anser albifrons flavirostris* Barnacle Goose *Branta leucopsis* Whooper Swan *Cygnus cygnus* Lapwing Vanellus vanellus Chough *Pyrrhocorax pyrrhocorax* Dunlin *Calidris alpina schinzii* Wetland and Waterbirds	**10 km**
	Mullet peninsula (004227)	Corn crake *Crex crex*	**10 km**
	Stags of Broadhaven (004072)	Storm Petrel *Hydrobates pelagicus* Leach's Storm-petrel *Oceanodroma leucorhoa*	**10 km**
	Illanmaster (004074)	Storm Petrel *Hydrobates pelagicus*	**11.5 km**
	Inishglora and inishkeeragh (004084)	Storm Petrel *Hydrobates pelagicus* Cormorant *Phalacrocorax carbo* Shag *Phalacrocorax aristotelis* Lesser Black-backed Gull *Larus fuscus* Herring Gull *Larus argentatus* Arctic Tern *Sterna paradisaea* Barnacle Goose *Branta leucopsis*	**13 km**

Designation	Site name (site code)	Qualifying interests	Approximate distance from site to survey area at closest point (km)
	Inishkea islands (004004)	Shag *Phalacrocorax aristotelis* Ringed Plover *Charadrius hiaticula* Sanderling *Calidris alba* Purple Sandpiper *Calidris maritima* Turnstone *Arenaria interpres* Common Gull *Larus canus* Herring Gull *Larus argentatus* Arctic Tern *Sterna paradisaea* Little Tern *Sterna albifrons* Barnacle Goose *Branta leucopsis* Dunlin *Calidris alpina schinzii*	**19 km**
	Duvillaun Islands (004111)	Fulmar *Fulmarus glacialis* Storm Petrel *Hydrobates pelagicus* Barnacle Goose *Branta leucopsis*	**22 km+**

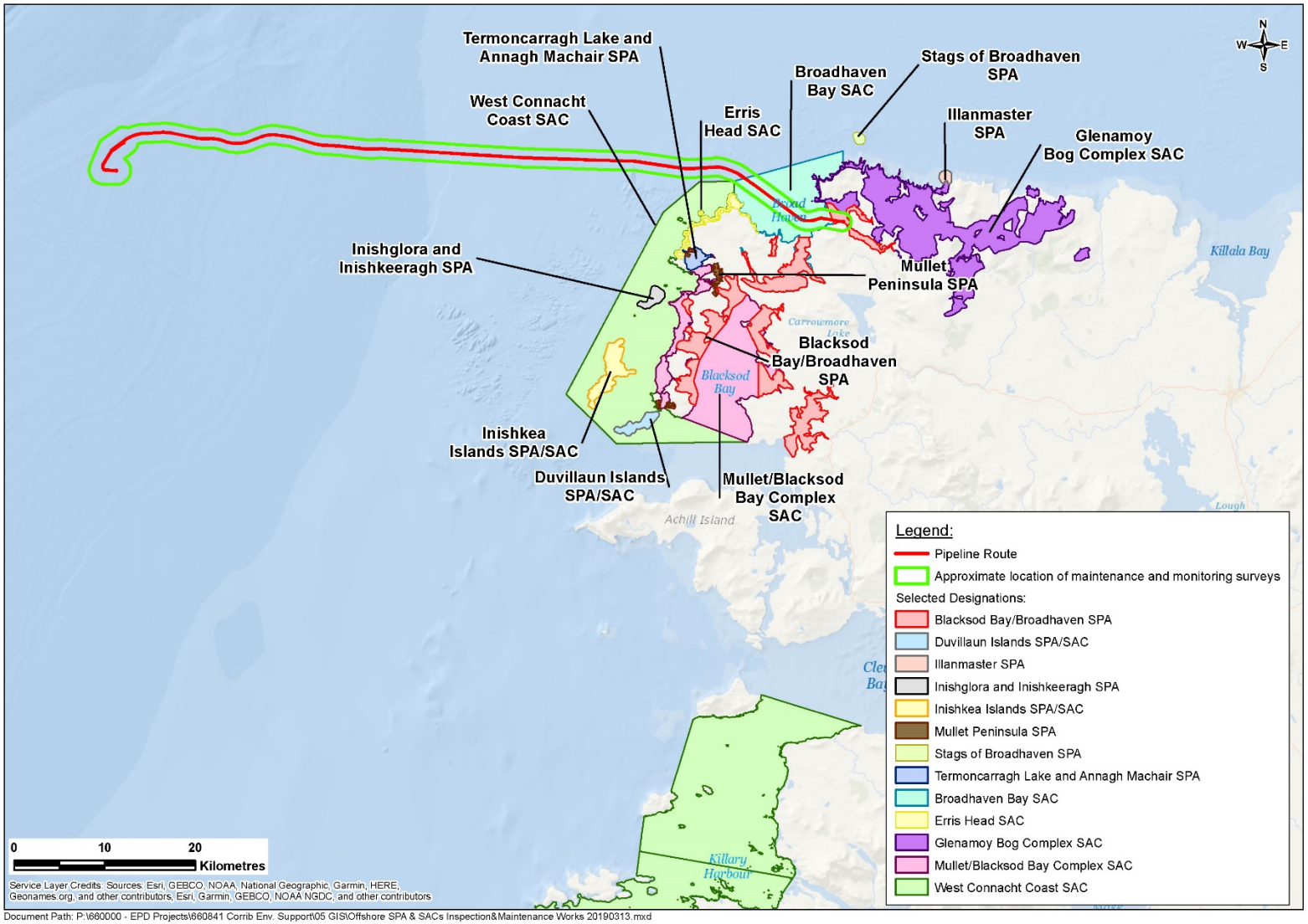


Figure 4-1: European sites in proximity to the proposed inspection, maintenance and infrastructure renewal survey programme.

4.3 Characteristics of European sites

The following sections describe the ecological features of the European sites in the vicinity of the Corrib Development. The following conservation objectives apply to all sites:

"The overall *aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.*

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

> *its natural range, and area it covers within that range, are stable or increasing, and the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.*

The favourable conservation status of a species is achieved when:

> *population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis."*

Conservation objectives for the European sites in the Natura 2000 network are published on the website of the National Parks and Wildlife Service of the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (http://www.npws.ie/). A summary of each of the European sites is set out below along with the conservation objectives identified for each site.

4.3.1 Special Areas of Conservation (SACs)

4.3.1.1 Broadhaven Bay SAC

In addition to the qualifying interests listed in Table 4-1, the site synopsis for Broadhaven Bay SAC notes the presence of a number of breeding and wintering bird populations, including golden plover, bar tailed godwit, sandwich tern, common tern and arctic tern.

Nine cetacean species have been recorded in the SAC during dedicated monitoring studies undertaken since 2001 (Anderwald et al., 2012; Culloch et al., 2014).

The conservation objectives for this site NPWS (2014 a) are to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species (as detailed in Table 4-1) for which the SAC has been selected. The main conservation objectives for the pertinent qualifying habitat *Large shallow inlets and bays* [1160] are to ensure the stability or growth of the permanent habitat as well as to maintain the favourable conservation condition of a number of community complexes in a natural condition: as described below:

- Coarse sediment to sandy mud with *Pygospio elegans*
- Sand with *Angulus tenuis*
- Sand to coarse sediment with crustaceans and *Polyophthalmus pictus*
- Subtidal sand with polychaetes
- Fucoid dominated reef
- Subtidal reef

In addition to maintaining the above community complexes in their natural condition, there is the potential for *Zostera* dominated seabed communities within Broadhaven Bay, and potentially within the qualifying feature *Large shallow inlets and bays* (limited to the area to the south of the pipeline route, within the shelter of Ballyglass (as shown in Figure 4-1), The *Zostera* communities within Broadhaven Bay have the following conservation objectives:

- Maintain the extent of the *Zostera* dominated community, subject to natural processes
- Conserve the high quality of *Zostera* dominated community, subject to natural processes

4.3.1.2 Glenamoy Bog Complex SAC

The Glenamoy Bog Complex is an extensive, mainly terrestrial, site dominated by low-level undulating blanket bog and a fringe of high sea-cliffs. The SAC includes Sruwaddacon Bay and Rossport Bay to the north, which are also within the Blacksod Bay / Broadhaven SPA. Sruwaddacon Bay is a shallow tidal inlet which forms an integral part of the Glenamoy River salmonid fishery.

As well as being designated for a number of terrestrial features (Table 4-1), the SAC is designated for salmon, which migrates annually through Sruwaddacon Bay to and from the Glenamoy River catchment. Downstream migration of salmon smolts occurs between mid April and early May, while the upstream migration of adult salmon occurs after late July.

The conservation objectives (NPWS, 2017) are to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been designated (as described in Table 4-1).

4.3.1.3 Erris Head SAC

The Erris Head SAC is an approximately 15 km area of sea cliffs, plus adjoining habitats, which are mainly terrestrial but also includes 200 m of sea at the base of the cliffs. In addition to the qualifying interests in Table 4-1, the site synopsis notes the site is of conservation interest due to the presence of several Annex I EU Birds Directive species and some breeding seabirds.

The conservation objectives (NPWS, 2016) are to maintain or restore the favourable conservation condition of the Annex I habitat(s) for which the SAC has been designated (as described in Table 4-1).

The site overlaps with Mullet Peninsula SPA and Termoncarragh Lake and Annagh Machair SPA. It also adjoins Broadhaven Bay SAC and West Connacht Coast SAC. The conservation objectives for these sites ought also to be taken into consideration when considering this site as required.

4.3.1.4 West Connacht Coast SAC

The West Connacht Coast SAC is a large candidate marine SAC (66,016 ha) adjacent to the Mullet peninsula and Mayo coastline. The SAC is situated approximately 1 km from the proposed operations area at its closest point and is designated on the basis of its importance for bottlenose dolphin.

Bottlenose dolphin occur within the site throughout the year and the area comprises a key habitat for the species both regionally and within Irish waters as a whole. The NPWS site synopsis notes that the SAC may contain a minimum of 123, and possibly up to 150-200, individuals. The SAC is known to be used for a variety of activities including foraging and resting. Adults closely accompanying calves are commonly observed in summer and autumn months.

The conservation objectives (NPWS, 2015 a) are to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been designated (as described in Table 4-1).

4.3.1.5 Mullet / Blacksod Bay Complex SAC

The Mullet / Blacksod Bay Complex SAC is a large coastal site that comprises much of the Mullet Peninsula, the sheltered waters of Blacksod Bay and the low-lying sandy coastline from Belmullet to Kinrovar. The site character is strongly influenced by the Atlantic Ocean and the exposed location of much of the site results in a terrestrial landscape dominated by blown sand and largely devoid of trees. The underlying bedrock is principally metamorphic schist and gneiss. The site displays an excellent range of coastal and marine habitats.

The conservation objectives (NPWS, 2014 b) are to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been designated (as described in Table 4-1).

The site overlaps with the Blacksod Bay/Broadhaven SPA, Termoncarragh Lake and Annagh Machair SPA and Mullet Peninsula SPA. It also adjoins West Connacht Coast SAC. The conservation objectives for these sites ought also to be taken into consideration when considering this site as required.

4.3.1.6 Inishkea Islands SAC

The Inishkea islands are two large islands situated off the coast of the Mullet Peninsula, Co. Mayo. The islands are recognised for terrestrial habitats and ornithological interest. In addition, the grey seal *Halichoerus grypus* is a qualifying interest for the SAC owing to the importance of the islands as a breeding site. It has been is estimated by O' Cadhla & Strong (2007) that the grey seal population using Inishkea North may be greater than 900 animals, which contributed to over 20% of all animals recorded during the nationwide survey.

The conservation objectives (NPWS, 2015 b) are to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been designated (as described in Table 4-1).

This will be achieved by ensuring that there are no restrictions to the animals range within the SAC, and also to conserve their breeding and resting and moulting haul out sites within the SAC in a natural condition.

4.3.1.7 Duvillaun Islands SAC

The Duvillaun Islands SAC comprises a group of uninhabited marine islands, rocks and reefs, located approximately 3 km off the southern tip of the Mullet Peninsula in Co. Mayo.The islands are recognised for their ornithological interest. In addition, the grey seal *Halichoerus grypus* is a qualifying interest for the SAC owing to the importance of the islands as a breeding site in combination with the Inishkea Islands.

The conservation objectives (NPWS, 2013) are to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been designated (as described in Table 4-1).

This will be achieved by ensuring that there are no restrictions to the animals range within the SAC, and also to conserve their breeding and resting and moulting haul out sites within the SAC in a natural condition.

4.3.2 Special Protection Areas (SPAs)

Eight coastal SPAs, designated for a range of qualifying bird species, are located within the vicinity of the survey area. Given the ability to fly, and the large foraging distances of some species (e.g. gannet), it is possible that birds contributing to SPAs beyond the immediate survey area (and that shown in Figure 4-1) have the potential to be impacted. Conversely, several of the bird species contributing to SPAs immediately adjacent to the survey area (e.g. Brent geese at Broadhaven) are highly unlikely to have any potential of being impacted. Further consideration of birds and SPAs is made in Sections 5 and 6.

All eight coastal SPA's share the same primary conservation objective, which is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for the respective SPA sites.

4.3.2.1 *Blacksod Bay / Broadhaven Bay SPA*

This SPA comprises all the inner parts of Broadhaven Bay and includes various sheltered bays of Blacksod Bay. Both these regions are situated in the extreme north- west of Co. Mayo. Interstitial sand and mudflats are exposed during low tide, supporting a well-developed ecosystem that includes polychaetes, bivalves and crustaceans. Open sand flats are present at the low-lying margin of the salt-marshes, supporting flora such as Glasswort and Seablite. Sandy and shingle beaches are also present.

The site contains salt marshes that are situated on a peat substrate, providing roosts for a high diversity of wintering waterfowl and has been described as one of the most important wetland complexes in the west. The environment supports five nationally important waterfowl populations, including:

- Great Northern Diver *(Gavia immer*)
- Red-breasted Merganser (*Mergus serrator*)
- Bar-tailed Godwit (*Limosa lapponica*)
- Ringed Plover *(Charadruis haiticula*) – 3% of the national population
- Dunlin (*Calidris alpine)*

On Inishderry Island, there is a nationally important colony of Sandwich Tern located on the site, as well as Common Tern, Arctic Tern. Localized populations of Little Tern have been documented in the past. A colony of Black-headed Gulls also lives in this area.

Seven of the regular species that occur at the site are listed on Annex I of the EU Birds Directive. These are:

- Great Northern Diver
- Red-throated Diver
- Golden Plover
- Bar-tailed Godwit (*Limosa lapponica*)
- Sandwich Tern (*Sterna sadvicensis*)
- Common Tern
- Arctic Tern

The conservation objective (NPWS, 2014 c) is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:

- Wintering populations of Great Northern Diver, Light-bellied Brent Goose (*Branta bernicla hrota),* Common Scoter *(Melanitta nigra*), Red-breasted Merganser *(Mergus serrator*), Ringed Plover (*Charadruis hiaticula*), Sanderling (*Calidris alba*) Dunlin (*Calidris alpine*), Bar-tailed Godsit (*Limosa lapponica*), Curlew (*Numenius arquata)*
- Breeding populations of Sandwich Tern *(Sterna sandvicensis*)
- Wetlands.

4.3.2.2 *Termoncarragh Lough and Annagh Machair SPA*

Termoncarragh Lough is a shallow, coastal lake on the north-west side of Mullet Peninsula that is fringed with swamp vegetation and sporadically edged with marsh and fen. The site is particularly important with regards to wetlands and wetland bird species, and the area is a SPA under Annex I of the EU Birds Directive for the following species:

- Barnacle Goose *(Branta leucopsis*)
- Whooper Swan (*Cygnus cygnus)*
- Greenland White-fronted Goose (*Anser albifrons flavirostris*)
- Corncrake *(Crex crex)*
- Chough (*Pyrrhocorax pyrrhocorax)*
- Lapwing (*Vanellus vanellus)*
- Dunlin (*Calidris alpina schinzii)*

The lake and surrounding area are particularly important as a wintering ground, supporting the largest Barnacle Goose population in the country. Whooper swan visit the site during autumn and spring, with approximately 300 individuals overall. Other wintering species in the area include Greenland White-fronted Goose, Golden Plover, Teal, Mallard and Ringed Plover, as well as the Mute Swan.

The conservation objectives (NPWS, 2018 a) are to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (eight species listed above) and to maintain or restore the favourable conservation condition of the wetland habitat at Termoncarragh Lake and Annagh Machair SPA as a resource for the regularly-occurring migratory waterbirds that utilise it

4.3.2.3 *Mullet peninsula SPA*

The Mullet Peninsula SPA consists of three separate areas within the peninsula, which is low-lying and exposed. The main habitat consists of grassland. The site is designated a SPA because of the population of breeding Corncrake (*Crex crex*). Furthermore, it is one of the few sites along the coast that is regularly utilized by the species. Corncrake is listed on the 2010 International Union for Conservation of Nature (IUCN) Red List of Threatened Species, as well as listed under Annex I of the EU Birds Directive.

The objectives (NPWS, 2018 b) are to maintain or restore the favourable conditions of the bird species listed as Special Conservation Interests for this SPA:

- Corncrake (*Crex crex*)

4.3.2.4 *Illanmaster SPA*

Illanmaster is a steep, rocky island, rising to 107 m and topped with a maritime grassy sward, situated just off the north Co. Mayo coast. The SPA site comprises the island and the surrounding seas to a distance of 500 m, with the southern boundary of the site adjoining the mainland shoreline.

The site is a SPA under the EU Birds Directive due to the presence of an internationally important population of Storm Petrel (*Hydrobates pelagicus*), which is one of the largest populations in the region. Other species that have been recorded breeding at the site are Fulmar, Puffin, Great Black-backed Gull and Black Guillemot. The site is also visited by

a small flock of wintering Barnacle Geese (*Branta leucopsis*), which, along with the Storm Petrel, is listed on Annex I of the EU Birds Directive.

The objectives (NPWS, 2018 c) are to maintain or restore the favourable conditions of the bird species listed as Special Conservation Interests for this SPA:

- Storm Petrel (*Hydrobates pelagicus*)

4.3.2.5 Stags of Broadhaven SPA

The Stags of Broad Haven are a group of four precipitous rocky islets, rising to almost 100 m, located about 2 km north of Benwee Head, Co. Mayo. The surrounding seas to a distance of 500 m are included in the site.

The site is a SPA under the EU Birds Directive for the following species:

- Storm Petrel (*Hydrobates pelagicus*)
- Leach's Storm-petrel (*Oceanodroma leucorhoa*)

The Stags are of particular importance owing to the presence of the only known colony of Leach's Petrel in Ireland, as well as a nationally important population of Storm Petrel. Both Leach's Petrel and Storm Petrel are listed on Annex I of the E.U. Birds Directive. Other species that breed at the site include Fulmar, Kittiwake, Puffin, Herring Gull and Great Black-backed Gull.

The objectives (NPWS, 2018 d) are to maintain or restore the favourable conservation conditions of the bird species listed as Special Conservation Interests for this SPA:

- Storm Petrel (*Hydrobates pelagicus*)
- Leach's Storm-petrel (*Oceanodroma leucorhoa*)

4.3.2.6 Inishglora and Inishkeeragh SPA

Inishglora and Inishkeeragh are two islands approximately 1.5-3km west of the Mullet Peninsula and are part of a larger group of islands that consist of the Inishkeas and the Duvillauns. Both islands are low-lying and support maritime grassland vegetation and serve as a wintering site for Barnacle Geese.

The site is a SPA under Annex I of the EU Birds Directive for the following species:

- Storm Petrel (*Hydrobates pelagicus)*
- Barnacle Goose (*Branta leucopsis)*
- Arctic Tern (*Sterna paradisaea)*
- Cormorant (*Phalacrocorax carbo)*
- Shag (*Phalacrocorax aristotelis)*
- Lesser Black-backed Gull (*Larus fuscus)*
- Herring Gull (*Larus argentatus)*

Storm Petrel uses the islands as an established breeding site, and the islands are of national importance with regards to Arctic Tern. Other bird species (not listed) include Herring Gull, Greater Black-backed Gull, Common Gull and Black Guillemot. Barnacle

Geese are also present, as they use the islands as a good feeding habitat as well as for protection.

Aside from the ornithological interest, the islands are also an important breeding site for Grey Seals (which are listed under Annex II of the EU Habitat Directive).

The objectives (NPWS, 2018 e) are to maintain or restore the favourable conditions of the bird species listed as Special Conservation Interests for this SPA:

- Storm Petrel *(Hydrobates pelagicus)* - Breeding
- Cormorant *(Phalacrocorax carbo)* – Breeding
- Shag *(Phalacrocorax aristotellis)* – Breeding
- Lesser Black-backed Gull*(Larus fuscus)* – Breeding
- Herring Gull *(Larus argentatus)* – Breeding
- Arctic Tern *(Sterna paradisaea)* – Breeding
- Barnacle Goose *(Branta leucopsis)* - Wintering

4.3.2.7 Inishkea islands SPA

The Inishkea Islands also has great ornithological importance, as it serves as a main breeding ground for seabirds, some of which are listed on Annex I of the EU Birds Directive. The conservation objectives (NPWS, 2018 f) are to maintain or restore the favourable conditions of the bird species listed as Special Conservation Interests for this SPA:

- Shag (*Phalacrocorax aristotelis*)
- Ringed Plover (*Charadrius hiaticula*)
- Sanderling (*Calidris alba*)
- Purple Sandpiper (*Calidris maritima*)
- Turnstone (*Arenaria interpres*)
- Common Gull (*Larus canus*)
- Herring Gull (*Larus argentatus*)
- Arctic Tern (*Sterna paradisaea*)
- Little Tern (*Sterna albifrons*)
- Barnacle Goose (*Branta leucopsis*)
- Dunlin (*Calidris alpina schinzii*)

Other, non-listed bird species include Great Black-backed Gull, Black- headed Gull and Black Guillemot. The Islands also support important concentrations of breeding Oystercatcher, and Lapwing.

Furthermore, the Islands act as a main wintering site for Barnacle Goose and hold internationally important numbers. Nationally important concentrations of Golden Plover have also been recorded.

4.3.2.8 *Duvillaun Islands SPA*

The Duvillaun Islands SPA comprises a group of uninhabited marine islands, rocks and reefs, located approximately 3 km off the southern tip of the Mullet Peninsula in Co. Mayo. The surrounding seas, where seabirds forage, bathe and socialise are included within the designated site boundaries.

The Duvillaun Islands are of importance for both breeding and wintering birds, some of which are listed on Annex I of the EU Birds Directive. The conservation objectives (NPWS, 2018 g) are to maintain or restore the favourable conditions of the bird species listed as Special Conservation Interests for this SPA:

- Storm Petrel *(Hydrobates pelagicus)* – Breeding
- Fulmar (*Fulmaris glacialis*) – Breeding
- Barnacle goose (*Branta leucopsis*) – Wintering

Other bird species that are supported within the Duvillaun Islands include Peregrine Falcon, Ringed Plover, Oystercatcher, Rock Pipit, Skylark, Wheatear, Raven, Shag, Herring Gull, Great Black-backed Gull and Common Gull.

5 APPROPRIATE ASSESSMENT SCREENING

5.1 Introduction

This section provides the information necessary for the Competent Authority to screen for AA and determine whether the proposed inspection, maintenance, and infrastructure renewal surveys of the Corrib pipeline and other subsea infrastructure, in view of best scientific knowledge, are likely to have a significant effect on nearby or relevant European (Natura 2000) sites. Specifically, it aims to:

- Provide information on, and assess the potential for the proposed survey operations to significantly impact European sites;
- Determine whether the proposed survey activities, alone or in combination with other projects, are likely to have significant effects on European sites in view of their qualifying features (conservation objectives).

5.2 Potential Impacts on European sites

The seven coastal SACs and eight coastal SPAs described in the previous section may have qualifying features that are screened into, or out of, the AA. The following sections discuss the aspects of the project that may impact the qualifying features of the European sites:

- Physical presence of the geophysical survey vessels and equipment;
- Acoustic surveys and associated general vessel activity;
- Routine emissions and discharges during vessel operations;
- Accidental fuel oil spillage.

A statement about which qualifying features of the relevant European sites with the potential for environmental impacts are screened into the assessment below (Section 6).

5.2.1 Physical presence of survey vessels and equipment

The physical presence of the geophysical survey vessels, ROV, MBES, sub-bottom profiler, side-scan sonar, or stills/video camera system results in the potential for interaction with marine mammals (disturbance / risk of collision) and seabirds (disturbance resulting in displacement from foraging areas).

In regard to interaction with marine mammals in coastal SACs (such as the bottlenose dolphin or grey seal) activities will be temporary, with the duration at sea for vessels minimised, and confined to as small an area as possible. For any reduction in Annex IV species abundance from an area, rapid repopulation is likely, as responses by marine

mammals is likely to be behavioural and temporary in nature. No changes in overall species abundances are anticipated.

The likelihood of collision with animals is considered extremely low, as vessels will operate in accordance to relevant codes of conducts and at low speeds. The likelihood of interaction (such as entanglement) is low as, with the potential exception of the side-scan sonar towfish on the inshore survey, acoustic survey equipment will be mounted directly to the hull of the *Leah-C*, or to the ROV of the *Edda Sun*. Therefore, it is unlikely that the physical presence of vessel or equipment will traumatise or interact with marine mammals.

Seabirds will occur at the Corrib Field and along the survey route. Depending on the foraging range of the species involved, these birds could contribute to the designation of SPAs which are either close to the proposed survey area or much further away. Broadhaven Bay SPA has an important breeding colony of Sandwich terns and these birds could be present in the area of the proposed works at a similar time to when works are taking place. In a worst case scenario, the presence of the survey vessels and equipment could prevent or reduce access to foraging seabirds. However, activities will be temporary, with the duration of the survey minimised, and confined to as small an area as possible, making it unlikely that the entire survey area would be unavailable for the scheduled duration. Seabird counts from the ObSERVE aerial surveys (Rogan et al., 2018) suggest that there is sufficient alternative foraging habitat in the wider area to accommodate any temporarily displaced seabirds. Therefore, it is unlikely that the physical presence of vessel or equipment will displace seabirds permanently.

5.2.1.1 Screening Outcome

In view of the best scientific knowledge and in view of the conservation objectives of the sites, the physical presence of the survey vessels and equipment, when taken either individually or in combination with other plans or projects will not have a likely significant effect on any European site. Only the Broadhaven Bay SAC is within the survey activity area and none of the qualifying species of this SAC are likely to be affected by the physical presence of the survey vessels and equipment.

5.2.2 Acoustic surveys and associated general vessel activity

The potential effects of underwater sound on different marine biota is a key environmental concern. The noise and disturbance resulting from the acoustic surveys and the associated general vessel activity (particularly within Broadhaven Bay) are considered the primary potential impacts as a result of the proposed activities.

An animal's ability to detect sounds produced by anthropogenic activities depends on their auditory hearing range and on levels of natural ambient or background sound. Wind, precipitation, vessel traffic, and biological sources all contribute to ambient sound. Table 5-1 shows various anthropogenic sources and received levels of sound in the marine environment.

Table 5-1: Anthropogenic sound sources and received levels of sound in the marine environment (adapted from: Evans & Nice, 1996; Richardson et al., **1995, in IOSEA2 (ERT/Aqua-Fact International Services, 2007))**

Activity	Frequency range (kHz)	Average source level (dB re 1µPa-m)	Estimated received level at different ranges (km) by spherical spreading[a]			
			0.1 km	1 km	10 km	100 km
High resolution geophysical survey; pingers, side-scan, echo sounder	10 to 200	<230	190	169	144	69
Low resolution geophysical seismic survey; seismic air gun	0.008 to 0.2[b]	248	210[c]	144[c]	118[c]	102[d]
			208	187	162	87
Production drilling	0.25	163	123	102	77	2
Jack-up drilling rig	0.005 to 1.2	85 to 127	45 to 87	24 to 66	<41	0
Semi-submersible rig	0.016 to 0.2	167 to 171	127 to 131	106 to 110	81 to 85	6 to 10
Drill ship	0.01 to 10	179 to 191	139 to 151	118 to 130	93 to 105	18 to 30
Large merchant vessel	0.005 to 0.9	160 to 190	120 to 150	99 to 129	74 to 104	<29
Military vessel	-	190 to 203	150 to 163	129 to 142	104 to 117	29 to 42
Super tanker	0.02 to 0.1	187 to 232	147 to 192	126 to 171	101 to 146	26 to 71

a Spherical spreading is calculated here using the formula presented in IOSEA2(ERT/Aqua-Fact International Services, 2007).

b Seismic surveys produce occasional sounds with frequencies of 1 to 22 kHz (Evans, 1998) c Actual measurements in St George's Channel, Irish Sea.

d Extrapolated figure as presented by Evans & Nice, 1996.

5.2.2.1 Propagation

In general, sound sources that have high sound pressure levels and low frequency (i.e. large air gun array seismic sources) will travel the greatest distances underwater. The spread of low frequency sound in the sea is efficient, with little loss due to attenuation (i.e. due to absorption and scattering). Conversely, high frequency sources (such as those emitted from geophysical survey equipment, such as MBES) tend to have greater attenuation over distance. The process is non-linear with the rate of absorption varying roughly as the square of the frequency. The overall degree of attenuation is also dependent on the pressure, temperature and salinity.

Additional to the transmission loss through attenuation, spherical spreading loss (the reduction in intensity caused by the spreading of waves into an ever increasing space) results in signal intensity dropping quickly.

Overall the intensity of sound waves decay exponentially and although low-level signals

travel for long distances, higher amplitude waves lose much of their energy very close to the sound source (Gisiner, 1998).

5.2.2.2 Characteristics of proposed sound sources

The proposed programme will result in a degree of acoustic disturbance to marine life from geophysical (acoustic) and visual surveys as well as the associated vessel and ROV operations.

During the deployment of the principal survey transducers (MBES, sub-bottom profiler, and side-scan sonar) there exists the potential for marine life to be disturbed or displaced. In order to assess the potential impacts of the operation of this survey equipment on key receptor species, the characteristics of the sound source are considered from each of the principal survey sources.

MBES

MBES is proposed for use along the entire length of the offshore pipeline/umbilical/ BBGT water outfall pipeline route, between the manifold at the Corrib field to the landfall. The MBES system proposed for use in shallow water on the *Leah-C*, and in offshore areas on the *Edda Sun*, will operate at a relatively high frequency range (between 200 and 400 kHz although typically operating between 350 and 400 kHz), compared to lower frequencies units designed for deeper water works.

The MBES system used for the offshore survey using the *Edda Sun* will be mounted on an ROV, allowing for the use of the equipment at a higher frequency (400 kHz) than could be otherwise used from a vessel mounted device in deeper waters areas, such as those present in the vicinity of the Corrib Field.

Based on the proposed models of MBES (see Table 3-1), the peak source level expected, or maximum amplitude, will be in the range of 223 dB re: 1µPa @1 m.

Sub-bottom profiler

A sub-bottom profiler system is proposed for use to assess pipeline burial depth and integrity within Broadhaven Bay, to be deployed from the *Leah-C*. The system proposed for use on the Leah-C will operate at a relatively low frequency range (3 – 8 kHz). This frequency range lies outside of the hearing range of some toothed whales (particularly beaked whales) and porpoise species, although overlaps with that of baleen whales and a range of toothed whale species and pinnipeds. Based on the specifications of equipment in Table 3-1, the peak source level is expected to be in the range of 214 dB re: 1µPa @1 m.

The risk to cetaceans and pinnipeds from the use of low frequency acoustic equipment such as this is reduced by the orientation of the transducers (hull mounted in relatively shallow water on the *Leah-C*), whereby the equipment will be directed downwards to the seabed, reducing the area impacted by noise. In addition, the pulse duration of sub-bottom profilers is extremely short, in the order of tens to hundreds of milliseconds (Nedwell et al, 2008). A sub-bottom profiler is not proposed for deployment from the ROV of the Edda Sun for the offshore component of the surveys.

Side-scan sonar

The proposed side-scan sonar equipment to be used on the inshore survey can operate at a range of frequencies depending on water depth, ranging from between 445 and 900 kHz. The selection of frequency will depend on water depth, with lower frequencies typically recommended for deeper water, and higher frequencies for shallower depths (It is important to note however that the *Leah-C* will typically only be operating at relatively shallow depths). Operating at a frequency of between 445 - 900 kHz the maximum expected amplitude will be c. 200- 230 dB re: 1µPa @1 m.

The range of frequencies 445-900 kHz available on this equipment are considered to be outside of the peak hearing thresholds for most cetaceans and pinnipeds (Richardson et al., 1995; Southall et al. 2007). In addition to spreading loss for acoustic propagation in the water column, high frequency acoustic energies are more quickly absorbed through the water column than sounds with lower frequencies.

Other acoustic survey equipment

The obstacle avoidance sonar and altimeter systems proposed for use on the *Edda Sun* ROV are described in Table 3-1 and operate at a relatively high frequency (500 – 675 KHz) compared to that of much of the other equipment used.

These high frequencies are outside of the peak hearing thresholds of most cetaceans and pinnipeds, with ~500 kHz being beyond even the upper limit of harbour porpoises peak hearing threshold (Richardson et al., 1995; Southall et al. 2007).

The Sound Velocity probes operate at a very high frequency and at an extremely low sound pressure intensity level that would not be detectable to any receptor animals, while the USBL beacons operating at a much lower frequency (in the range 21-31 kHz) are within the range of hearing for small cetaceans and pinnipeds. However, these are also operating at a very low sound pressure intensity level compared with equipment that operates in a similar range such as the sub-bottom profiler (the USBL transponders are for communicating a position relative to the survey vessel); therefore, the acoustic pulses from these are not considered likely to cause undue disturbance to those animals.

In addition to spreading loss for acoustic propagation in the water column, high frequency acoustic energies are more quickly absorbed through the water column than sounds with lower frequencies. Again, most of the sound energy generated is likely to be orientated downwards towards the seabed. Due to these factors the use of ROV acoustic equipment is considered to result in a negligible risk of an injury or disturbance to cetaceans.

5.2.2.3 Screening Outcome

In view of the best scientific knowledge and in view of the conservation objectives of the European sites, the potential for acoustic disturbance from acoustic surveys and associated general vessel activity, when taken either individually or in combination with other plans or projects could potentially disturb mobile species. Owing to the foraging ranges of certain seabirds, it is not possible to say with certainty whether or not such species would be present at the time of survey, therefore the potential for impact cannot be ruled out. It is known from the ObSERVE aerial surveys from 2015-2016 that certain

species are present throughout the summer, however the areas of survey activities, particularly offshore, are regarded to have lower densities of seabirds than areas to the north and south (Rogan et al. 2018). Therefore, it is considered unlikely that such activities would result in any significant effect on these species.

A number of the SACs in the vicinity of the proposed activities are unlikely to be affected by acoustic disturbance owing to the nature of their qualifying features. Marine mammals, however, are considered to be key receptors that have the potential to be affected by underwater noise, for example, grey seals (Inishkea Islands, Duvillaun Islands SACs) and bottlenose dolphins (West Connacht Coast SAC) (Table 4-1). Although Annex IV species of marine mammals such as harbour porpoise and bottlenose dolphins are not qualifying species of the Broadhaven Bay SAC, the potential impacts of underwater noise also require further consideration due to their known presence in the vicinity. The grey seal is also known to be present in Broadhaven Bay SAC. However, from monitoring of similar surveys over the past three years, bottlenose dolphins, grey seals and harbour porpoise are all present in the immediate area during these surveys (RSK, 2016; 2018; 2019), and it is considered unlikely that such activities would result in any significant effect on these species.

Atlantic salmon in the Glenamoy Bog Complex SAC must also be taken into consideration, however, salmonids (e.g. salmon and trout, including sea trout) are thought to be relatively insensitive to sound (Nedwell et al., 2003, 2006). Salmon are also highly mobile and a relatively large fish and are easily able to undertake avoidance behaviour and return following cessation of the survey activities.

5.2.3 Routine emissions and discharges during vessel operations

Atmospheric emissions (primarily exhaust gases) and routine marine discharges (macerated food, grey water, bilge water and ballast water) will be released by the survey vessels during the vessel operation. The atmospheric emissions may result in locally elevated concentrations of gases in the immediate vicinity of the survey vessels, but they will be temporary given the rapid dispersion of emissions in the exposed locations of the surveys.

The routine marine discharges could reduce water quality and result in toxicity effects on marine fauna. However, relatively small quantities will be generated, and these will disperse rapidly resulting in localised and temporary impacts to the marine environment.

5.2.3.1 Screening Outcome

In view of the best scientific knowledge and in view of the conservation objectives of the sites, routine emissions and discharges during vessels operation, when taken either individually or in combination with other plans or projects will not have a likely significant effect on any European site. None of the qualifying features of the SACs and SPAs are likely to be impacted by routine emissions and discharges.

5.2.4 Accidental fuel oil spillage

As with any marine-based operation, an accidental fuel oil spillage along the survey route, particularly from the larger *Edda Sun* offshore survey vessel, could potentially result in a spill that could impact the coastline. Such a spill could result in a reduction of water quality and degradation of habitats, resulting in impacts on qualifying habitats and species. However, such spillages occur rarely and the likelihood of impact is commensurately very low.

5.2.4.1 Screening Outcome

In view of the best scientific knowledge and in view of the conservation objectives of the sites, as accidental fuel oil spillage is a risk-based event, when taken either individually or in combination with other plans or projects, it could have a likely significant effect on any European site. All marine operations carry the risk of an accidental fuel oil spill. However, in the context that the likelihood of such a spillage occurring is considered to be very low it is therefore considered unlikely in terms of the potential for impact on European sites and their qualifying interests.

5.3 AA Screening Conclusions

No habitats are likely to be significantly affected by the potential impacts assessed here and so in view of the best scientific knowledge and in view of the conservation objectives of the sites, the proposed activities when taken either individually or in combination with other plans or projects are unlikely to have a significant effect on any European site, where habitats are the main qualifying features.

Based on the duration and nature of proposed survey activities and the zone of potential impact, the main potential impact on any European site is the effects of underwater noise generated from the acoustic surveys and associated vessel activity on key receptor species (qualifying features). It has been concluded, on the basis of objective information (survey activities carried out since 2010, with monitoring showing no impacts), that significant effects on the conservation objectives of Inishkea Islands, Duvillaun Islands, West Connacht Coast, Broadhaven Bay and Glenamoy Bog Complex SACs, as well as the coastal SPAs listed in Table 4-1, are unlikely.

In respect of a fuel oil spillage, this would be accidental and therefore an unpredictable event, the likelihood of such a spillage occurring is therefore considered to be very low and hence considered unlikely in terms of the potential for impact on European sites and their qualifying interests.

As a result of the above assessment, which takes account of the best scientific knowledge – including in the light of monitoring these activities over a period of years - and the conservation objectives of each European site, it is considered that the proposed survey operations either individually or when taken in combination with other plans or projects, are not likely to have a significant effect on any European site.

6 IMPACT ASSESSMENT IN SUPPORT OF STAGE 2: APPROPRIATE ASSESSMENT

6.1 Introduction

This section of the NIS has been prepared to inform and assist the competent authority, should it decide to proceed to an appropriate assessment to determine whether or not the proposed survey activities will adversely affect the integrity of European sites.

This section presents, in light of best scientific knowledge, the assessment of underwater noise impacts, generated by the acoustic surveys and associated general vessel activity, on European sites' qualifying interest species, and whether these impacts affect the conservation objectives of any European sites and thus adversely affect the integrity of these sites.

Consideration is also given to routine emissions and discharges during vessel operations and accidental fuel oil spillages, as although significant impacts on the conservation objectives of European sites are unlikely, best practice includes protocols and procedures that are required for statutory compliance. In the context of the judgment in CJEU Case C-323/17 (People over Wind) it is not clear whether such statutory requirements are considered as to be mitigation or standard best marine practice.

6.2 Potential impacts on European sites

This section considers the potential impacts arising from the proposed surveys, as discussed above, and further considers whether any such impact has the capacity to adversely affect the integrity of any European site.

6.2.1 Impacts of noise on key receptor species

As discussed above in Section 5, there are various potential effects of exposure to sound from anthropogenic activities that can be characterised as pathological, physiological or behavioural. Criteria can be established for zones of influence based on ambient sound levels, absolute hearing thresholds of the species of interest, slight changes in behaviour of the species of interest (including habituation), stronger disturbance effects (e.g. avoidance), temporary hearing impairment (TTS) and permanent hearing impairment (PTS), or other physical damage.

Southall et al. (2007) carried out an extensive review of the available literature and formulated scientific recommendations for marine mammal exposure criteria, based on the peak pressure known or assumed to elicit the onset of TTS.

For mid frequency hearing cetaceans, which includes bottlenose dolphins (auditory sensitivity range estimated at 150 Hz to 160 kHz), the sound pressure level (SPL) for injury was set at 230 dB re 1μPa (peak). The sound exposure level (SEL) for injury is given as 198 dB re 1 μP^2-s. For pinnipeds in water Southall et al. (2007) gives the SPL threshold for injury at 218 dB re: 1 μPa (peak), and the SEL for injury is given as 186 dB re 1 μP^2-s.

The fundamental difference between these two parameters is that SPL can be an instantaneous value and SEL is the total noise energy to which the mammal is exposed during a given duration: 1 second in this case. It should be stressed that no marine mammal mortality or damage to tissue has been documented for exposure to geophysical acoustic surveys, and that the exposure level for injury is a theoretical value extrapolated from experimental data. Also, it is recognised that many variables affect the nature and extent of responses to a particular stimulus. Such variables may include the recent experience of marine mammals with the sound stimulus, and their current activity (e.g. feeding vs. migrating).

6.2.1.1 Bottlenose dolphins in West Connacht SAC

One way of estimating the level of effect on marine mammals is to consider species specific hearing audiograms, and to identify areas where the anthropogenic sound source level frequencies overlap with them. A calculated audiogram for the bottlenose dolphin and harbour porpoise is presented in Figure 6-1.

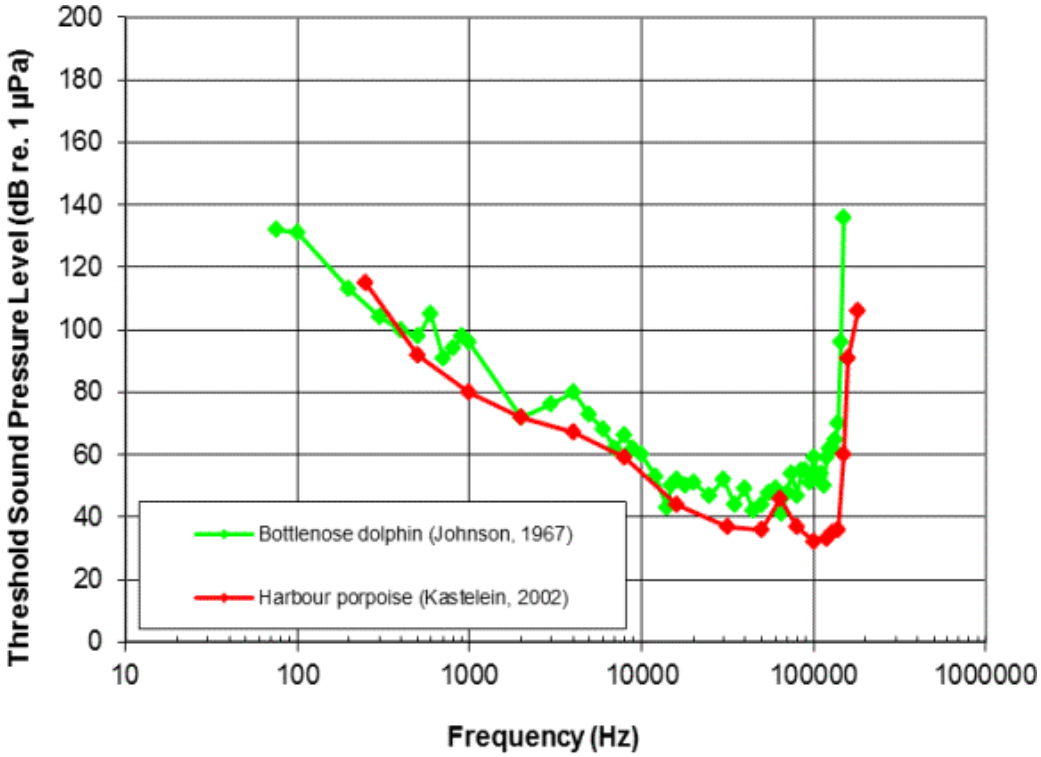


Figure 6-1: Bottlenose dolphin and harbour porpoise hearing threshold audiogram

The acoustic energy proposed for MBES (200 or 400 kHz on the *Leah-C* (typically operating around 350-400 kHz) and 400 kHz for ROV deployed MBES system on the *Edda Sun*), ROV positioning equipment (500 to 675 kHz) in offshore areas, and side-scan sonar in inshore areas (likely to be in the range 445-900kHz), are emitted at frequencies that are largely outside the range of hearing for bottlenose dolphins (Figure 6-1) and are therefore unlikely to have a significant effect on the species. The audiogram in Figure 6-1 shows that the sound pressure level (SPL) required to be perceived to the dolphin at 100 kHz is around 50 dB re1Pa. The maximum SPL at 1m distance for the side scan sonar proposed for the survey is estimated to be approximately 225 dB re 1µPa.

The acoustic energy from the sub bottom profiler used on the inshore survey has a frequency range of 3 – 8 kHz (Table 3-1). This is within the hearing range of the bottlenose dolphin close to the peak sensitivity for this species (~15-20 kHz). The audiogram in Figure 5-1 shows that the sound pressure level (SPL) required to be perceived to the dolphin at 10 kHz is about 60 dB re1Pa. The maximum SPL at 1m distance for the sub bottom profiler proposed for the survey is estimated to be approximately 214 dB re 1µPa.

The sound energy generated by the use of the sub-bottom profiler will be directed downwards to the seabed (hull mounted on the *Leah-C*), and the pulse duration of sub-bottom profilers is extremely short, in the order of tens to hundreds of milliseconds (Nedwell et al, 2008). Despite the energy dropping off rapidly from the source, the noise is likely to be perceived by dolphins outside of the immediate vicinity of the survey (i.e. tens of kilometres away from the survey).

The maximum amplitude (based on the model of sub bottom profiler) which may arise from these activities of ~214 dB re: 1µPa @1m will drop exponentially due to spherical spreading and attenuation. Extrapolating values from Table 5-1, it is expected that dB levels will have dropped to approximately 174 by 0.1 km, 153 at 1 km (closest point of

the West Connacht Coast SAC to the survey route), 127 at 10 km, and 53 at 100 km through spherical spreading alone.

The calculated source level value of 153 dB re: 1µPa @1m (at 1 km from the sound source) is well below both the SEL and SPL for injury to mid frequency hearing cetaceans. Considering this, and the natural avoidance behaviour of the species, injury/distress is unlikely, as an animal would need to be located in the very small zone of ensonification above the SEL, close to the sound source, and stay in that zone for a period of time.

The maximum amplitude of the side-scan sonar equipment proposed for deployment from the *Leah-C* is expected to be approximately 225 dB re: 1µPa @1 m. These source levels are slightly higher than that for the assessed sub bottom profiler. It is expected that these amplitudes would only be achieved at the equipment's higher operating frequencies (outside the limits of hearing of bottlenose dolphins). At ~ 225 dB re: 1µPa @1 m the maximum amplitude would be expected to drop exponentially due to spherical spreading and attenuation (as shown in Figure 6-1). A further extrapolation of the values from Table 5-1 for the maximum source levels for the side-scan sonar would result in dB levels of around 184 dB at 0.1 km, 164 dB at 1 km (closest point of the West Connacht Coast SAC to the survey route), 139 dB at 10 km, and 64 dB at 100 km. These reductions in amplitude would be the result of spherical spreading alone.

These losses would likely be increased due to the fact that the maximum amplitude of 225 dB re: 1µPa @1 m is expected at frequencies at the higher operational ranges of the equipment typically used for the purposes of the survey (around 500-600 kHz, but up to 900 kHz). At these frequencies the losses through absorption and attenuation are anticipated to be greater.

Where the various survey equipment is operated at lower frequencies, the survey may be audible to bottlenose dolphins in the West Connacht Coast SAC, and therefore may cause localised short-term impacts on behaviour, possibly resulting in avoidance at close proximities. Nonetheless the employment of industry standard best environmental practice protocols at all times, including soft starts, the use of Marine Mammal Observers (MMO's), and the following of the guidance in the Vessel Operators Code-of-Conduct (Document No. COR-14-SH-0227, 2018) - as required by the statutory agencies will further reduce the likelihood of potential impacts.

Exposure to any such impacts will be of short duration, with the surveys expected to take c.2 weeks. Survey effort will move along the route in a linear fashion, substantially reducing the duration of potential exposure at any given location.

Noise from vessels is also likely to be of low amplitude and frequency (Table 5-1) and unlikely to reach the SEL for Bottlenose dolphins even at very close proximity.

As concluded in Section 5 above, the potential impacts described above are not considered to have any likely significant effect on the conservation objectives for this species for the European site in question (West Connacht Coast SAC) when the described statutory-required protocols for the protection of these species are applied. It is considered therefore, that the potential impacts of underwater noise on bottlenose dolphins will not adversely affect the integrity of the West Connacht Coast SAC.

6.2.1.2 Annex IV species in Broadhavan Bay SAC

Higher frequency cetaceans such as harbour porpoise may be sensitive to some of the lower frequencies of the survey equipment (MBES). Estimates provided by Nedwell et

al., (2008) using comparable MBES specifications (maximum source level of 220 dB re: 1µPa @1 m and an operating frequency of 200kHz) and using harbour porpoise as being the worst case scenario and a 90 dBht ((dB values above hearing threshold) strong avoidance impact criterion (Nedwell et al*.,* 2008)), it was estimated a strong avoidance reaction might occur at around 30 m from the sound source. Again, considering the natural avoidance behaviour, the peak source level of the sound source and the SPL and SEL for injury it is unlikely that injury would occur. It should be noted that the proposed peak source level of 223 dB re: 1µPa @1 m is a maximum and will also drop exponentially due to spherical spreading and greater attenuation of high frequencies.

Exposure to any impacts will be of short duration, as the survey will take place during a relatively short window.

Smaller personnel transfer and guard vessels may also operate in addition to the primary survey vessels (previously considered). Smaller vessels such as an outboard motor driven Rigid Inflatable Boat (RIB) have been estimated to produce a source level of around 150 dB re 1 µPa-m) @ 1m at a frequency in the range 400 – 800 Hz (Richardson et al., 1995 cited in Nedwell et al., 2008). The inshore survey vessel *Leah-C*, is an inboard-engine vessel, and its engines will impart underwater noise at a lower frequency to that of an outboard driven RIB, while the engines and plant noise from the *Edda Sun* will produce underwater noise at a considerably lower frequency.

These sound source levels are likely to result in sound levels that would potentially be perceived by any Annex IV species of cetacean that happened to be within Broadhaven Bay SAC and could result in avoidance behaviour if in very close proximity. Impacts are considered to constitute a minor impact. All vessels operating within Broadhaven Bay will follow the Vessel Operators Code of Conduct (Document No. COR-14-SH-0227, 2018) for vessels to minimise interactions with marine mammals. The inshore survey vessel (*Leah-C*), will where possible, survey from inshore (close to the landfall) to offshore so as to avoid a scenario where animals actively avoiding the sound source are not inadvertently fleeing into constrained waters.

When the required protocols described here are applied, the potential impacts of underwater noise are not considered to have any likely significant effect on the conservation objectives of the European site in question (Broadhaven Bay SAC) and will therefore not adversely affect the integrity of Broadhaven Bay SAC.

6.2.1.3 Grey seals in Inishkea Islands and Duvillaun Islands SACs

Figure 6-2 presents an audiogram for grey seals.

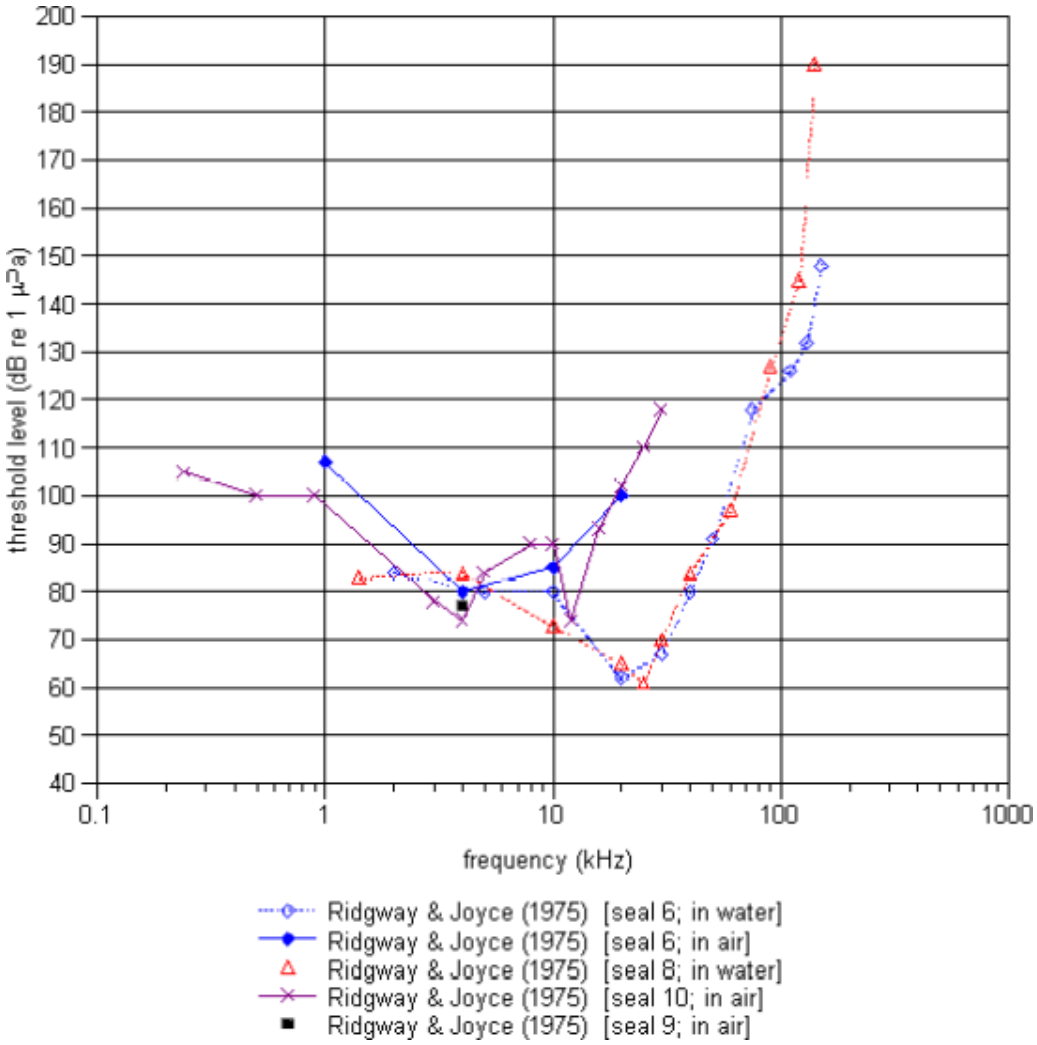


Figure 6-2: Audiogram for grey seal (Nedwell et al., 2004)

Pinnipeds have a hearing range typically between 75 Hz and 75 kHz, with peak sensitivity within that range between 20-30 kHz above a threshold level of approximately 60 dB re 1 µPa. The audiogram shows that the upper limits of frequency that could be detected by grey seals is close to 100 kHz. This would therefore mean that the acoustic energy for the MBES, and the side-scan sonar, and much of the ROV positioning equipment (Table 3-1) is outside the upper frequency range of grey seal hearing.

The frequency range proposed for the sub bottom profiler proposed for the inshore survey will, however, coincide with the hearing range of grey seals. The USBL transponders and vessels single-beam depth sounders on the offshore survey may also be audible to seals, however due to the very low intensity at which this equipment operates, impacts are considered negligible.

Even though energy levels drop off rapidly from the source, the noise from the sub-bottom profiler could be detected by seals tens of kilometres distant from the survey, and closer to the source it is likely that responses in the form of avoidance would be exhibited (Thompson, 1998).

Studies dedicated to the effect of noise from acoustic survey on seals are limited, despite seals being recognised as having good underwater hearing. Of the few dedicated studies

undertaken, Thompson (1998) provides an assessment of the physiological responses of grey and harbour seals to airguns. The study showed that harbour seals exhibited fright responses when a sound source (source levels of 215 to 224 dB) was switched on, followed by strong avoidance behaviour. The seals also stopped feeding during this time. The behaviour of the harbour seals soon returned to normal after the sound source was switched off. Similar avoidance responses were recorded in grey seals at similar exposure levels, with seals changing from foraging behaviour to transiting away from the sound source. The grey seals were recorded as returning to normal behaviour within two hours of the sound source ceasing.

The maximum amplitude of the sub bottom profiler proposed for deployment on the *Leah-C* is 214 dB re: 1µPa @1 m and the amplitude will drop off rapidly from the source. Using the extrapolated values from Table 5-1, it is expected that dB levels will have dropped to approximately 117 dB at 19 km (distance from the Inishkea Islands SAC to the survey route at its closest point) through spherical spreading alone. This value is well below both the SPL and SEL for injury provided by Southall et al. (2007), and therefore the potential for injury to seals from the acoustic sound sources proposed for this survey is extremely low.

The maximum amplitude of the proposed side-scan sonar equipment is 225 dB re: 1µPa @1 m (when operating at around 500-600 kHz). The typical operating frequencies of 445-900 kHz for the inshore survey are well outside the audible range for grey seals. Using the extrapolated values in Table 5-1, the source levels would be expected to drop to approximately 128 dB at 19 km (distance from the Inishkea Islands SAC boundary to the survey route at its closest point) through spherical spreading alone. This value is well below both the SPL and SEL for injury provided by Southall et al. (2007). As the Duvillaun Islands SAC boundary is even further away from the survey route (22 km at its closest point) source levels would be expected to drop to further. These values are likely to be further reduced through increased absorption and attenuation associated with source levels at higher frequencies, and therefore the potential for injury to seals from the acoustic sound sources proposed for this survey is considered to be extremely low. It should further be noted that since both the sub-bottom profiler and side-scan sonar are both proposed for use only on the inshore components of the survey (deployed from the *Leah-C*), all survey effort will be within Broadhaven Bay, and as such will further reduce the potential for propagation of underwater noise from these activities to disturb receptor species of seals within the Inishkea Islands or Duvillaun Islands SACs.

Exposure to any impacts will be of short duration. The survey works are expected to take only around 2 weeks in duration, with the survey effort constantly moving along the pipeline route in a linear fashion so that exposure at any given location is minimal. All vessels operating within Broadhaven Bay will follow the Vessel Operators Code of Conduct (Document No. COR-14-SH-0227, 2018) to minimise interactions with marine mammals. The inshore survey will, where possible, survey from inshore (close to the landfall) to offshore so as to avoid a scenario where animals actively avoiding the sound source are not inadvertently fleeing into constrained waters.

The offshore sections of the surveys (in particular at the Corrib Field) will largely occur at considerable distances offshore and will not deploy a sub-bottom profiler or side-scan sonar equipment. As a result, the likelihood for injury or disturbance to seals is reduced, as the frequency of occurrence of seals decreases with increasing distances from areas of known coastal sensitivity.

As stated above in Section 5, in view of the conservation objectives for this species, the predicted impacts described above are not likely to have a significant effect on the qualifying interests of the European sites in question (Inishkea Islands and Duvillaun Islands SACs). It is considered therefore that the potential impacts of underwater noise on grey seals would not adversely affect the integrity of these or any other European site.

6.2.1.4 Seabirds in the coastal SPAs

Although impacts to birds (and the SPAs to which they may contribute) from the proposed works are considered highly unlikely, they are briefly considered here.

Seabirds will occur at the Corrib Field and along the survey route, and it is probable that some of these individual birds are those that that collectively contribute to the designation of an SPA. Depending on the foraging range of the species involved, these birds could contribute to the designation of SPAs which are either close to the proposed survey area (and shown in Figure 4-1, e.g. Inishglora and Inishkeeragh) or much further away. For example, gannets are reported as having a maximum foraging range of 640 km, which could therefore encompass individuals from SPAs in Scotland. Broadhaven Bay has an important breeding colony of Sandwich terns (*Sterna sandvicensis*) and these birds could be present in the area of the proposed works at a similar time to when works are taking place. Terns are surface feeding and very shallow diving and the impacts of acoustic surveys would not be expected to cause injury, however the disturbance either directly or indirectly to prey species of fish could potentially result in minor, non- significant impacts as described in the following section.

However, the potential exposure of birds to underwater noise varies greatly with their feeding ecology. Some species may be at higher risk to noise sources either because a) they enter the water by plunge diving directly from the air (e.g. gannets) and therefore may not be able to detect noise prior to exposure; and b) they spend a relatively long time underwater and/or dive to a deep depth (e.g. auks, scoter). Other species of seabird (such as terns, gulls and shearwaters) only have very shallow diving depths and/or spend a short time underwater, thereby inherently minimising any exposure. Many species of wader and wildfowl that contribute to SPAs are unlikely to be affected, as they do not fully immerse their bodies in water when they are feeding (e.g. by wading or dabbling; examples contributing to the Inishkea Islands SPA designation include ringed plover, sanderling, purple sandpiper, turnstone, barnacle goose and dunlin).

Even for those species that are potentially at higher risk to noise exposure (e.g. auks), such exposure will be inherently minimised by the nature of the survey and the locations in which it is taking place. Factors inherently reducing risk (several of which are also applicable to marine mammals and fish) are summarised below:

- Natural flight response: most surface-diving diving birds (such as auks and scoter) will, in response to moving vessels, fly out of the way, due to natural evasion behaviour. This will therefore increase the distance between them and the highest sound levels;
- Exposure to sound: as noted, the sound pressure levels from the survey's acoustic sources are expected to attenuate rapidly in water. Furthermore, surface-based acoustic sources will target sound directly downwards to the seabed, and in a narrow band or cone. To be subjected to maximum noise levels, birds would therefore have to be very close to the sound source. In practice this would require them to be either near the ROV (close to the seabed and therefore highly unlikely or not possible; see

below), or almost directly under the hull of the moving vessel or towfish in the case of the inshore survey. Both of these scenarios are considered unlikely. The soft start procedure will allow animals to move away from the area, or curtail a deep dive, in response to gradually increasing sound levels.

- Water depths for much of the survey offshore (outside Broadhaven Bay): the peak source noise levels from the ROV will be largely restricted to near the seabed in deep water (>150m). This depth is far beyond the maximum diving depths of the majority of the seabirds that might occur in the region (e.g. gannets and eider duck 40m; black guillemots 50m; puffins 70m; BirdLife International, 2014). Two species (the guillemot and the razorbill have greater maximum diving depths (of 180m and 140m respectively, with maximum recorded dive times of over 3.5 minutes for guillemot), although the mean depths for these species are significantly shallower (90m and 40m respectively) (BirdLife International, 2014). It would therefore be highly unlikely that any bird would be in close proximity to the noise source in deeper water (especially given soft-start procedure noted above); even if this was to occur, no injury would be expected to occur given that no fatalities of diving seabirds were recorded as a result of seismic surveys using much greater sound levels from the equipment (see below).

In addition to the above factors, it is considered highly improbable that seabirds will be impacted by the proposed work programme (using standard and widely-used survey equipment) given that there is some evidence that diving seabirds are not especially vulnerable to the much greater sound levels experienced as a result of airguns firing during seismic surveys. In a risk assessment for seismic surveys offshore from Ireland, Turnpenny and Nedwell (1994) cited research (Stemp, 1985) that considered the effects of seismic surveys on three seabird species; this concluded that no fatalities resulted, and any variations in abundance were within natural variation. A further study found no effect of seismic activity on movements and diving of long-tailed ducks in the North Pacific (*Clangula hyemalis*) (Lacroix et al. 2003).

The predicted impacts described above are considered unlikely to have a significant effect on the conservation objectives for diving seabird species for the European sites in question. Therefore, the potential impacts associated with underwater noise on seabirds are not considered to adversely affect the integrity of any of the coastal SPAs in the vicinity of the Corrib development.

6.2.1.5 Fish species in Glenamoy Bog Complex SAC

As for seabirds described in the previous section above, although significant impacts to certain fish species (and consequently the integrity of the SACs for which they may contribute) from the proposed survey are considered highly unlikely, they are briefly considered here.

Of the Annex II fish species that occur in Ireland and have marine life history stages (i.e. river lamprey, sea lamprey, twaite shad, allis shad, Atlantic salmon), only the Atlantic salmon contributes to the designation of an SAC near the proposed survey area (i.e. the Glenamoy Bog Complex). It is possible that salmon will occur in inshore areas during the time of the proposed survey, and within relatively close proximity to acoustic survey sound sources.

However, significant impacts to salmon are considered highly unlikely, given knowledge on the known sensitivity of various fish species to underwater noise. Although some fish

species (whose auditory apparatus are closely linked with the swimbladder, such as herring) are considered to be of high sensitivity (Nedwell et al., 2004), salmonids (e.g. salmon and trout, including sea trout) are thought to be relatively insensitive to sound (Nedwell et al., 2003, 2006). Salmon are also highly mobile and relatively large, and therefore easily able to undertake avoidance behaviour and return following cessation of the survey. The use of Soft-Start procedures will provide ample time for salmon to avoid the sound source prior to the equipment reaching full intensity.

The potential impacts described above are considered unlikely to have any significant effect on the conservation objectives for this species for the European site in question (Glenamoy Bog Complex SAC) particularly given that Soft-Start procedures will be applied. Therefore, the potential impacts of underwater noise on salmon are not considered to have the potential to adversely affect the integrity of the Glenamoy Bog Complex SAC.

6.2.1.6 Conclusion

In view of the best scientific knowledge and in view of the conservation objectives of the designated sites, these proposed survey operations when taken either individually or in combination with other plans or projects, will not have a likely significant effect on any European site as a consequence of underwater noise or disturbance resulting from the works.

Impacts to the European sites in closest proximity to the proposed activities that have the potential to be impacted have been predicted as not significant. Given the nature of the impact sources, it is not expected that any residual impacts would result in significant impacts to designated features of other European sites in the wider locality or on their conservation objectives.

Therefore, as there are no residual impacts of underwater noise on the conservation objectives of any of the European sites in the vicinity of the Corrib development, the integrity of these sites is not expected to be adversely affected.

6.2.2 Other potential impacts

As previously mentioned, fuel oil spillage along the survey route, particularly from the larger *Edda Sun* offshore survey vessel, could potentially result in a spill. The likelihood of such an event occurring is considered to be very low. All vessels will have appropriate spill contingency plans in place to deal with such events with the aim of reducing environmental damage as far as possible. In addition, no fuelling of vessels will be undertaken within the boundaries of the SAC's. Vessel fuelling will take place in port. All deck machinery will only be refuelled within a bunded area.

While it is accepted that a deposit of fuel oil within the SACs could have a significant effect on the designated sites, including their qualifying interests for which the sites were selected, the protocols and procedures in place to prevent this occurrence and the low probability of such a deposit occurring mean that the overall significance of this impact is determined as very unlikely (minor).

Impacts from the vessels in terms of standard emissions and discharges during operation will be minimised where possible. Emissions will be minimised through regular maintenance of all engines onboard, in line with Maritime Registry of Shipping (MRS), MARPOL 73/78 Annex VI (as appropriate) and other similar requirements. Vessel

discharges will also be managed in accordance with the requirements of MARPOL 73/78 as appropriate.

6.2.2.1 Conclusion

In view of the best scientific knowledge and in view of the conservation objectives of the site, these activities when taken either individually or in combination with other plans or projects will not have a likely significant effect on any European site.

Impacts from other impact sources to the European sites in closest proximity to the proposed activities have been predicted as not significant. Given the nature of the impact sources, it is not expected that any residual impacts would result in significant effects on designated features of other European sites in the wider locality or on their conservation objectives.

Therefore, as there are no residual impacts of the proposed survey activities on the conservation objectives of any of the European sites in the vicinity of the Corrib development, the integrity of these sites will not be adversely affected.

6.3 Cumulative impacts

It is recognised that the scheduling of the inshore and offshore surveys may result in a degree of unavoidable overlap between the two programmes. However, this overlap will be of as short duration as possible and will also mean that the overall duration of disturbance from the combined programme is shortened. It is also anticipated that the two surveys (inshore and offshore) will not be in close proximity for a long period when operating survey equipment.

At present there are no other known projects in the vicinity of the proposed activities which could, together with the proposed activities, create cumulative effects on the designated features of European (Natura 2000) sites in the vicinity of the proposed survey activities.

Therefore, there are not expected to be any cumulative impacts that would adversely affected the integrity of European sites in the vicinity of the Corrib development.

7 CONCLUSION

As a result of the assessment undertaken in support of Stage 2 of the AA process, which takes account of the best scientific knowledge and the conservation objectives of each European site, it can be determined that the proposed survey operations either individually or when taken in combination with other plans or projects, are not likely to have a significant effect on a European site.

If it is decided that it is necessary to carry out an appropriate assessment under Article 6.3 of the EU Habitats Directive, it is the view of the authors of this NIS that based on the scientific evidence presented (including the monitoring undertaken since the surveys began), that the proposed survey operations will not adversely affect the integrity of the European sites in the vicinity and in the wider location or on any other designated site, when taken individually or when taken in combination with the other plans or projects and there is no reasonable scientific doubt in this regard.

The conservation objectives for the Special Areas of Conservation (i.e. the habitats and species for which they have been selected) will not be compromised by the proposed survey operations, and there will be no likely significant effect on the European sites in the Natura 2000 network either when taken individually or when taken in combination with the other plans or projects.

However, if it is decided that, it is necessary to carry out an appropriate assessment under Article 6(3) of the EU Habitats Directive, this NIS provides the requisite information to ground such an assessment. In the context of such an assessment it is the considered view of the authors of this NIS that the proposed survey operations will not adversely affect the integrity of any European sites or on any other designated site and there is no reasonable scientific doubt in this regard.

The conservation objectives for the Special Protection Areas (i.e. the species for which they have been selected) will not be compromised by the proposed survey operations, and there will be no likely significant effect on the European sites in the Natura 2000 network either when taken individually or when taken in combination with the other plans or projects.

However, if it is decided that, it is necessary to carry out an appropriate assessment, this NIS provides the requisite information to ground such an assessment. In the context of such an assessment it is the considered view of the authors of this NIS that the proposed survey operations will not adversely affect the integrity of any European sites or on any other designated site and there is no reasonable scientific doubt in this regard.

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