Exola DAC

Barryroe Site Survey

Appropriate Assessment Screening and Natura Impact Statement

Ref: P1229-04-01

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Abbreviations

AA	Appropriate Assessment
cSAC	Candidate Special Area of Conservation
DCHG	Department of Culture, Heritage and the Gaeltacht (formerly Department of Arts, Heritage and the Gaeltacht; DAHG)
dB	Decibel
DCCAE	Department for Communications, Climate Action and the Environment
DCENR	Department for Communications, Energy and Natural Resources (now DCCAE)
DEHLG	Department for Environment, Heritage and Local Government
EC	European Commission
EIA	Environmental Impact Assessment
EU	European Union
Exola	Exola DAC
Hz	Hertz
IROPI	Imperative Reasons of Overriding Public Interest
IWDG	Irish Whale and Dolphin Group
kHz	Kilohertz
km	Kilometre
LSE	Likely Significant Effect
m	Metre
MBES	Multi-beam echosounder
NIS	Natura Impact Statement
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine and Fisheries Service
NPWS	National Parks and Wildlife Service
Pa	Pascal
PE	Parabolic Equation
PTS	Permanent Threshold Shift
rms	Root mean square
SAC	Special Area of Conservation
SBES	Single-beam echosounder
SEL	Sound Exposure Level
SEL_{cum}	Cumulative sound exposure level
SEL 1/11	Standard Exploration Licence 1/11
SPA	Special Protection Area

SPL	Sound Pressure Level
SSS	Side Scan Sonar
Subacoustech	Subacoustech Environmental Ltd
TS	Threshold Shift
TTS	Temporary Threshold Shift
USBL	Ultra Short Baseline

1 Introduction

1.1 Project Background

Exola DAC, a wholly owned subsidiary of Providence Resources P.l.c. (hereafter referred to as 'Exola') is proposing to conduct a site survey within the Barryroe licence area (SEL 1/11); situated in the North Celtic Sea Basin approximately 43 kilometres (km) south east of the closest coastline at Ballymacshoneen, Butlerstown North, County Cork on the south coast of Ireland.

The site survey will comprise a seabed and shallow geophysical survey and an environmental baseline and habitat assessment survey to be conducted over three survey areas, encompassing four potential well locations, within two separate survey vessel activity areas at the Barryroe location, as illustrated in Figure 1.1, together with a single environmental control point located approximately 10 km to the east-southeast. The two survey vessel activity areas cover a total area of approximately 99 km^2 (25 km^2 and 74 km^2 respectively) and allow for a 1 km buffer around the survey areas within which the survey vessel may manoeuvre during line turns and during equipment deployment and recovery.

The survey vessel is anticipated to be working on location for approximately 16 days, excluding transit, port calls and weather downtime. Operations are proposed to take place sometime between the 1st April 2019 and 30th November 2019, subject to regulatory approval and vessel availability. If the survey has not commenced within this timeframe, the operations will be undertaken sometime between 1st February 2020 and 30th November 2020, again subject to regulatory approval and vessel availability.

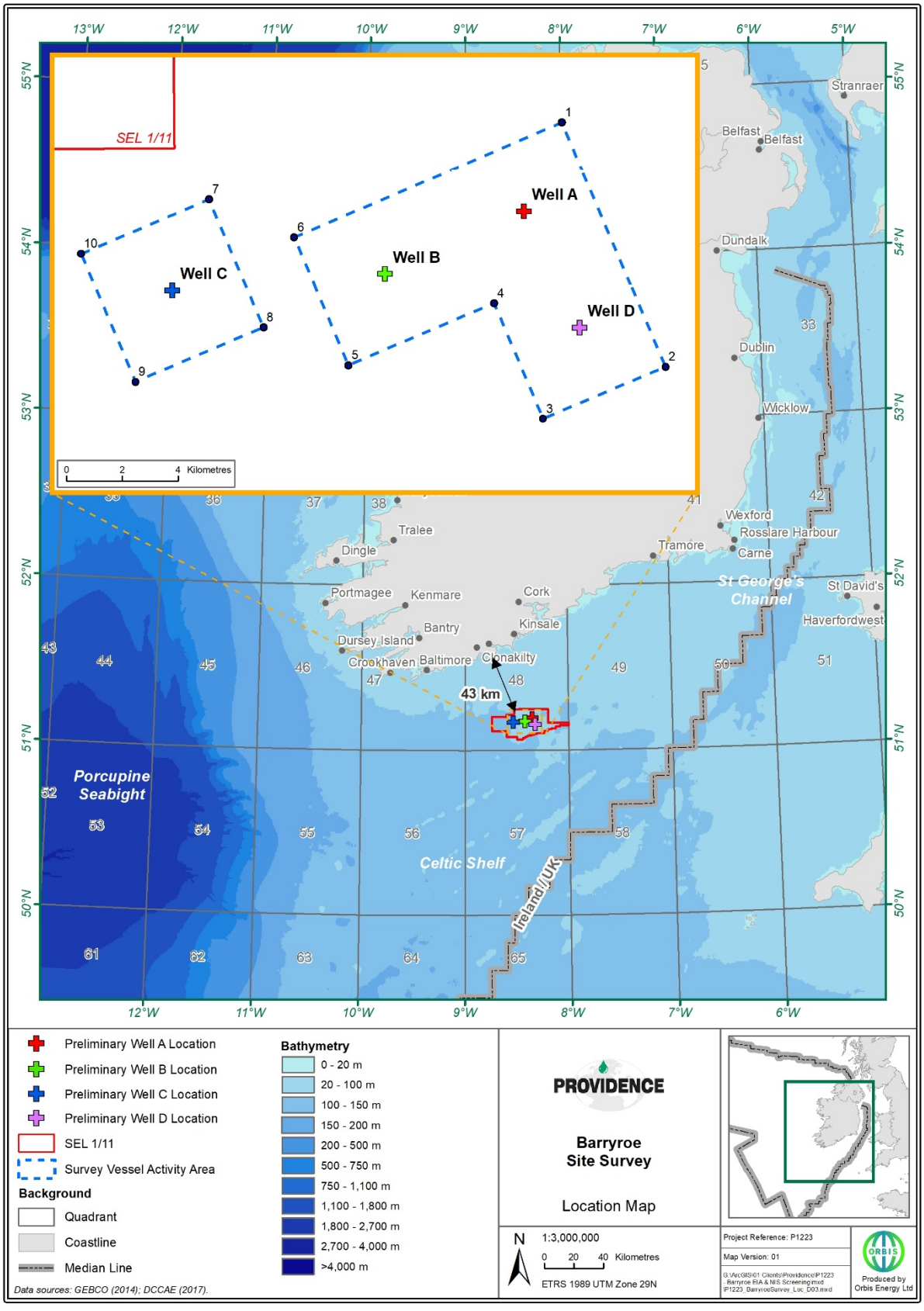
The key objective of the site survey is to collect data to inform the planning process for an appraisal drilling programme at Barryroe. Specifically, the site survey aims to:

- Accurately determine water depths and provide information on depth of sediments overlying chalk bedrock and to identify and map any chalk exposures;
- Provide information on seabed and sub seabed conditions to ensure the safe emplacement and operation of a semi-submersible drilling rig at four proposed well locations;
- Provide information on the cultural potential of the survey area, including the location of any shipwrecks or other underwater cultural heritage features;
- Assess the survey area for the presence of any Annex 1 habitats (as defined in the EC Habitats Directive 92/43/EC);
- Obtain environmental baseline samples across the survey area to establish a benchmark for ongoing environmental monitoring as per OSPAR guidelines.

In light of the terms of the Order made by the High Court on 30 January 2019, in High Court Proceedings Record No. 2018/943J.R., in relation to the permission previously granted on 9th October, 2018, Exola is now seeking a new permission for the same type and specification of work, which has now been refined to a smaller area. That application is supported by an updated EIA Screening Report and this Appropriate Assessment Screening and Natura Impact Statement Report

This report is the Appropriate Assessment (AA) Screening and Natura Impact Statement (NIS) which has been prepared to accompany the Application for Approval to Conduct a Geophysical or other Exploration Survey, Site Survey or Route Survey, as required under Part 2 of the Rules & Procedures Manual for Offshore Petroleum Exploration and Appraisal Operations (DCENR, 2014). It should be read in conjunction with the Environmental Impact Assessment (EIA) Screening Report.

Figure 1.1: Barryroe Site Survey Location Map



1.2 Purpose of this Document

The purpose of this document is to provide information to assist the competent authority in determining whether the proposed Barryroe site survey, either standalone or in combination with other plans and projects, in view of best scientific knowledge, is likely to have a significant effect on any European site and, where necessary, consider whether any such effects would affect the integrity of European sites.

European sites in Ireland form part of the Natura 2000 network of marine and onshore nature conservation protected areas that are designated under the EU Habitats Directive (92/43/EEC) and the EU Birds Directive (2009/147/EC) to protect species and habitats of conservation importance. They include Special Areas of Conservation (SACs) and candidate SACs (cSACs) and for the protection of certain habitats (Annex I) and species (Annex II) and Special Protection Areas (SPAs) and proposed SPAs for the protection of qualifying bird species (particularly breeding or overwintering populations). Specific conservation objectives have been developed for European sites in relation to their qualifying interests (i.e. habitats and/or species).

The integrity of a European site is defined as the coherence of the site's ecological structure and function, across the whole of its area, which enables it to sustain the habitat, complex of habitats and/or population of species for which the site has been designated. An adverse effect on integrity is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant features as it did at the time of designation.

This document has been prepared with reference to:

- Managing Natura 2000 Sites, The provisions of Article 6 of the Habitats Directive 92/43/EEC (European Commission, 2018);
- Appropriate Assessment under Article 6 of the Habitats Directive; Guidance for Planning Authorities. Circular NPW 1/10 & PSSP 2/10 (DEHLG, 2010);
- 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 (European Commission, 2001);
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC (European Commission, 2007);
- Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014);
- Marine Nature Impact Statements in Irish Special Areas of Conservation: A working document (DAHG, 2012).

1.3 Structure of this Document

This document consists of both an AA Screening (presented in Section 4) and a NIS (presented in Section 5) for the proposed Barryroe site survey. The proposed Barryroe site survey operations are described in Section 3.

The AA Screening outlines the information required for the competent authority to screen for AA and determine whether the proposed Barryroe site survey, either standalone or in combination with other plans and projects, in view of best scientific knowledge, is likely to have a significant effect on any European site.

The AA Screening has concluded that it is not possible to rule out, as a matter of scientific certainty, that the proposed Barryroe site survey operations will not have a likely significant effect on a European site(s). A NIS has therefore been prepared as a precautionary measure to inform and assist the competent authority, in carrying out its AA to determine whether or not the proposed Barryroe site survey operations will adversely affect the integrity of European sites either alone or in combination with other plans and projects, taking into account the conservation objectives of the European sites.

2 The Appropriate Assessment Process

2.1 Overview

The EU Birds and Habitats Directives outline Member States' obligations in relation to nature conservation management, and the management of European sites in particular. A key protection strategy for these sites is to consider the possible implications of any plan or project on the conservation objectives and qualifying features of any European site before a consent can be granted. All plans or projects must therefore take into consideration, whether alone or in combination with other plans or projects, whether there is likely to be a significant effect on the conservation objectives of the site.

The obligation to undertake an AA derives from Article 6(3) of the Habitats Directive, which for the purposes of the application for permission to conduct the Barryroe site survey is transposed into Irish legislation by the European Communities (Birds and Natural Habitats) Regulations 2011.

Article 6(3) is concerned with the strict protection of sites, while Article 6(4) is the procedure for allowing derogation from this strict protection in certain restricted circumstances. Both involve a number of steps and tests that need to be applied in sequential order.

Article 6(3) of the Habitats Directive 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 and 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 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".

Article 6(4) states:

"If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest."

There are four steps or stages in the AA process as follows:

- Stage 1 – Appropriate Assessment Screening: this stage determines whether the plan or project either alone or in-combination with other plans and projects is likely to have a significant effect on a European site(s);
- Stage 2 – Appropriate Assessment: where likely significant effects are identified during stage 1, stage 2 determines, whether in view of the European's site's conservation objectives, the plan or project would have an adverse effect (or risk of adverse effect) on the integrity of the site. If not, the plan can proceed.
- Stage 3 – Alternative Solutions: if it cannot be shown during stage 2 that the plan or project will avoid an adverse effect on the integrity of a site, stage 3 requires an examination of alternative solutions.
- Stage 4 – Imperative Reasons of Overriding Public Interest (IROPI): if, during stage 3, it is not possible to identify alternative solutions that would avoid an adverse effect on integrity, it will be necessary to establish IROPI.

This report is prepared in relation to Stage 1 AA Screening and Stage 2 Appropriate Assessment only.

2.2 Stage 1 – Appropriate Assessment Screening

The Stage 1 AA Screening examines the likely significant effects of a plan or project, either alone or in combination with other plans or projects, upon a European site and considers whether, on the basis of objective scientific evidence, it can be concluded that, in view of best scientific knowledge and the conservation objectives of relevant European sites, that there are no significant effects or that there are not likely to be significant effects on a European site.

The assessment comprises four steps:

- Step 1 - Determining whether the project or plan is directly connected with or necessary to the management of the site;
- Step 2 - 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 European site;
- Step 3 - Identifying the potential effects on the European site;
- Step 4 - Assessing the likely significance of any effects on the European site.

It is noted that the proposed Barryroe site survey is not directly connected with or necessary to the management of any European site, and so is not excluded from the AA Screening process on this basis.

If it can be demonstrated during the Stage 1 AA Screening that the proposed project or plan is not likely to have a significant effect, whether alone or in combination with other projects or plans, on the conservation objectives of a European site, then a Stage 2 Appropriate Assessment (AA) will not be required. It is important to note that there is a requirement to apply a precautionary approach to AA screening. Therefore, where effects are possible, certain or unknown at the screening stage, AA will be required. Objective scientific evidence is required in order to screen out the risk of a likely significant effect.

EU and Irish case-law makes it clear that the trigger for AA is a very light one and that the mere probability or risk that a plan or project is likely to have a significant effect is sufficient to make AA mandatory. It is also clear that screening must be carried out in view of the best scientific knowledge.

In light of a recent European Court of Justice case (*People Over Wind and Peter Sweetman v Coillte*, case C-323/17), 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 on that site.

Section 4 of this report is prepared in relation to Stage 1 AA Screening only.

2.3 Stage 2 – Appropriate Assessment

Where likely significant effects are identified during the Stage 1 AA Screening, it is necessary to undertake a Stage 2 AA to determine whether, in view of the European site's conservation objectives, the project or plan would have an adverse effect (or risk of adverse effect) on the integrity of the site. If it can be demonstrated during the Stage 2 AA that the proposed project or plan is not likely to have a significant effect, whether alone or in combination with other projects or plans, on the conservation objectives of a European site, then the plan or project can proceed.

Having ascertained during the Stage 1 AA Screening that it was not possible to rule out, as a matter of scientific certainty, that the proposed Barryroe site survey operations is either likely to have a significant effect on a European site(s), or that any such likelihood is uncertain or cannot be ruled out, a NIS has been prepared as a precautionary measure to inform and assist the competent authority in carrying out its appropriate assessment. .

The NIS, as documented in Section 5 of this report, has reviewed the potential likely significant effects of the proposed Barryroe site survey operations identified during the Stage 1 AA Screening on the integrity of European sites and identified appropriate mitigation measures to ensure that any impacts on the conservation objectives of European sites will be avoided during the proposed Barryroe site survey operations such that there will be no risk of adverse effects on these European sites.

3 Project Description

3.1 Survey Area

The Barryroe survey area is located within Standard Exploration Licence (SEL) 1/11, in the North Celtic Sea Basin (Figure 1.1). Water depths within SEL 1/11 range from around 90 to 110 metres (m) (*GEBCO, 2014*).

The proposed site survey operations at Barryroe will be conducted over three survey areas, targeting four potential well locations:

- 1 x survey area, 8.5 km by 3 km in size, encompassing two potential well locations (labelled 'Well A' and 'Well B');
- 1 x survey area, 3 km by 3 km in size, centred on a potential well location (labelled 'Well C');
- 1 x survey area, 3 km by 3 km in size, centred on a potential well location (labelled 'Well D').

The three site survey areas are located within two separate survey vessel activity areas as shown in Figure 3.1. The two survey vessel activity areas (covering a total area of approximately 25 km^2 and 74 km^2 respectively), allow for a 1 km buffer around the three survey areas within which the vessel may manoeuvre during line turns and during equipment deployment and recovery. Hereafter, these areas are collectively referred to as 'the survey area'.

At its closest point the survey area is approximately 43 km south east of the County Cork coastline on the south coast of Ireland. The nearest international boundary to the survey area is the Ireland / UK median line, which lies approximately 71 km to the south east.

The licence area SEL 1/11 contains existing oil and gas infrastructure operated by PSE Kinsale Energy Limited, namely wells associated with the Seven Heads gas fields and pipelines which connect the Seven Heads field with the Kinsale Head gas field (see Figure 3.1).

Figure 3.1 illustrates the example survey line plans centred on the proposed well locations, the surrounding survey vessel activity areas and proposed environmental sampling stations. Outside of the survey vessel activity areas, additional environmental sampling will be conducted at one control location, located approximately 10 km to the east-southeast as shown on Figure 3.1.

The coordinates for the survey vessel activity areas and proposed well locations are listed in Table 3.1.

Table 3.1: Proposed Barryroe Survey Area Coordinates [1]

Survey Corner (see Figure 1.1)	Latitude	Longitude
Survey Vessel Activity Area		
1	51° 13'23.136"N	8° 19' 46.774" W
2	51° 8' 37.747" N	8° 16' 39.081" W
3	51° 7' 38.558" N	8° 20' 26.636" W
4	51° 9' 53.395" N	8° 21' 55.413" W
5	51° 8' 42.78" N	8° 26' 26.032" W
6	51° 11' 12.138" N	8° 28' 4.795" W
Survey Vessel Activity Area		
7	51° 11' 56.87" N	8° 30' 41.621" W
8	51° 9' 27.451" N	8° 29' 2.627" W
9	51° 8' 25.187" N	8° 33' 0.167" W
10	51° 10' 54.551" N	8° 34' 39.338" W
Proposed Well Locations		
Well A	51° 11' 40.007" N	08° 20' 58.255" W

Survey Corner (see Figure 1.1)	Latitude	Longitude
Well B	51° 10’ 28.562” N	08° 25’ 16.546” W
Well C	51° 10’ 11.034” N	08° 31’ 50.938” W
Well D	51° 09’ 24.28” N	08° 19’ 16.949” W

Notes
[1] ETRS 1989 UTM Zone 29N.

3.2 Site Survey Operations

The proposed site survey will comprise a seabed and shallow soils survey (the geophysical survey scope) and an environmental baseline and habitat assessment survey to be conducted within the two separate survey vessel activity areas as illustrated in Figure 3.1.

3.2.1 Geophysical Survey

The purpose of the geophysical survey is to accurately determine water depths, provide information on depth of sediments overlying chalk bedrock and to identify and map any chalk exposures, and locate and identify any seabed and sub seabed features or obstructions to ensure the safe emplacement and operation of a semi-submersible drilling rig within the survey area.

The data obtained from the geophysical survey will also be analysed to assess the survey area for the presence of any Annex 1 habitats (as defined in the EC Habitats Directive 92/43/EC) and provide information on the cultural potential of the survey area, including the location of any shipwrecks or other underwater cultural heritage features.

The geophysical survey will use the following equipment: side scan sonar, single-beam echosounder and multi-beam echosounder, pinger sub-bottom profiler and magnetometer. This equipment will be hull mounted or towed behind the survey vessel. In addition, a subsea Ultra Short Baseline (USBL) beacon system will be utilised during both the geophysical survey and the environmental baseline and habitat assessment survey to position the survey equipment.

The typical characteristics of the geophysical survey equipment, which are representative of the equipment to be used during the proposed Barryroe site survey operations, are provided below:

- **Dual Frequency Side Scan Sonar**

  Side Scan Sonar (SSS) is used for the mapping of the upper layers of the seabed to determine the texture, topography and character of the seabed and sediments and detect anomalies such as boulders, outcrops, pipelines or reefs. This data is used to assess suitable locations for environmental sampling as well as providing information to conduct an archaeological assessment and indications of any near seabed drilling hazards. SSS emits an acoustic sonar signal towards the seabed that spreads out into a fan shape, or swathe. The SSS then analyses the intensity of the return (or reflectivity) from the seabed, which varies depending on the target characteristics.

  A typical SSS used for site survey activities is a dual frequency Edgetech 4200, operating at 120 and 410 kHz with an expected pulse interval of approximately 200 ms. High frequencies tend to record higher resolution but have a poorer penetration of the seabed and lower frequencies have a greater penetration, therefore dual frequency optimises acquisition. The SSS will be towed subsea behind the survey vessel at a sufficient height in the water column suitable for the penetration of the primary frequency and at a depth to avoid any seabed obstructions.

- **Single-beam Echosounder and Multi-beam Echosounder**

  Single-beam echosounders (SBES) and multi-beam echosounders (MBES) are used to survey bathymetry and seabed topography by emitting pulses of sound that reflect from the seabed and are usually used in conjunction with SSS. Unlike SSS, which measures the strength of the return signal, echosounders measure the time for a signal to return to the transmitter. MBESs produce a fan of beams and can produce high-resolution bathymetry maps of the seabed. The frequency range of a lower frequency MBES system is 70 kHz to 100 kHz, while the typical frequency range of a SBES is 10 to 200 kHz (Genesis, 2011).

For the purposes of this assessment, it is assumed that the following typical echosounder equipment will be used:

- SBES: Kongsberg EA400 operating at 200 kHz at an expected pulse interval of approximately 200 ms;
- MBES: Kongsberg EM710 operating between 70 and 100 kHz at an expected pulse interval of approximately 1500 ms.

The SBES and MBES data will also be used to assess suitable locations for environmental sampling as well as providing information to conduct an archaeological assessment. Both echosounders will be hull-mounted.

- **Pinger Sub-bottom Profiler**

  Geophysical pingers are used to achieve information from the seabed immediately below the surface layers. Pingers offer a very high resolution, but limited penetration dependent upon the seabed sediments (a few tens of metres in mud, much less in sand or rock). Pingers periodically emit a high frequency 'ping' and typically operate on a range of single frequencies between 3.5 - 7 kHz (Genesis, 2011). This data is used to provide information to conduct an archaeological assessment as well as indications of any shallow drilling hazards.

  A typical pinger sub-bottom profiler (SBP) used for site survey activities is the 16 element Kongsberg GeoPulse, operating at 3.5 kHz with an expected pulse interval of approximately 200 ms. The SBP will be hull-mounted.

- **Magnetometer**

  Magnetometers are used to identify magnetic anomalies on the seabed. The equipment takes passive measurements (i.e. does not actively emit a source signal) and will therefore not produce a significant level of noise. The magnetometer will be towed behind the survey vessel.

- **USBL**

  A USBL system is normally used to confirm positioning of underwater equipment. For site survey activities, a typical USBL is the Sonardyne Ranger 2, operating between 26.5 and 33.5 kHz at an expected pulse interval of approximately 500 ms.

Based on the characteristics of the geophysical survey equipment and the location of the proposed survey area in the North Celtic Sea Basin, it has been identified that the underwater noise generated from the equipment (excluding the magnetometer), as well as the survey vessel itself (see Section 3.3) has the potential to injure or disturb sensitive Annex II species (e.g. harbour porpoise, bottlenose dolphin, harbour seal, grey seal and fish), which are qualifying interests of SACs / cSACs on the coastline of Ireland.

In order to assess the expected underwater noise levels from the proposed Barryroe site survey operations and determine whether likely significant effects on European sites are possible, Subacoustech Environmental Ltd (hereafter referred to as 'Subacoustech') was commissioned to carry out underwater noise modelling. The modelling was undertaken in accordance with the recommendations in the National Physical Laboratory Good Practice Guide 133 for Underwater Noise (Robinson *et al.,* 2014).

Modelling of underwater noise is complex and can be approached in several different ways. Subacoustech has chosen to use a numerical approach that is based on two different computational modelling methods, or solvers:

- A parabolic equation (PE) solver for lower frequencies (16 Hz to 125 Hz); and
- A ray tracing solver for higher frequencies (250 Hz and above).

The PE method is widely used within the underwater acoustics community but has computational limitations at high frequencies. Likewise, ray tracing is more computationally efficient at high frequencies but is not suited to calculating low frequencies (Etter, 1991). Choosing both methods provides the most robust model across all frequencies. This study implements these numerical solutions using the dBSea software (v2.2.4).

A wide array of input parameters including bathymetry, sediment data, sound speed and source frequency content have been input into the model to ensure the results are as accurate as possible. The modelling parameters, such as source noise level, the duration of activity operation and its location have been selected to be worst case, to avoid the risk of underestimating an impact.

A summary of the source levels (a measure of the acoustic output of a source) used are provided in Table 3.2. These are considered typical for the equipment which will be used during the proposed Barryroe site survey operations, as detailed above. Alternative equipment (different manufacture or model) would not be expected to have a significant effect on the modelling results.

With regards to Table 3.2, the following different metrics have been reported:

- Sound Pressure Level (SPL) – a logarithmic measure in decibels (dB) of the average pressure level in water, with respect to a standard reference pressure (i.e. one micro-Pascal; µPa). SPL is quoted at a standard range from the source, usually one metre (dB re 1µPa @ 1 metre) and represents the amplitude of a sound's waveform. It may be measured in a number of ways including peak (as per Table 3.2) or peak-to-peak (for short duration sounds) and root mean square (rms) estimates (for continuous sounds).
- Sound Exposure Level (SEL) – a measure of sound energy over a given duration, i.e. time integral of instantaneous sound pressure squared, normalised to a 1 second period (i.e. dB re 1 μPa^2s) taking into account the interval and repeat rate of multiple pulse sources. This allows the total acoustic energy contained in events lasting a different amount of time to be compared on a like for like basis. SEL is based on the assumption that sounds of equivalent energy will have similar effects on the auditory systems of exposed individuals, even if they differ in SPL, duration and/or temporal exposure pattern (Genesis, 2011).

Table 3.2. Typical SPL_{peak} and SEL source levels for the noise sources considered for this study[1]

Noise Source	Sound Type [2]	Frequency Range	SPL_{peak} source level (dB re 1 µPa @ 1m)	SEL source level (dB re 1 μPa^2s @ 1m)
USBL	Impulsive	26.5 kHz - 33.5 kHz	206.3	154.6
SBES	Impulsive	200 kHz	227.0	180.0
MBES	Impulsive	70 kHz - 100 kHz	224.9	169.5
SSS	Impulsive	120 kHz & 410 kHz	210.0	163.0
SBP	Impulsive	3.5 kHz	223.5	176.7
Vessel [3]	Non-impulsive	< 1 kHz	N/A	151.1

[1] Source levels have been derived using data from manufacturers, vessel contractors and from measurements of similar equipment from Subacoustech's noise measurement database.

[2] Underwater sound has been categorised by NMFS (2018) as impulsive and non-impulsive. Impulsive sources produce sounds that are typically transient, brief (less than 1 second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay. Non-impulsive sources produce sounds that can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak sound pressure with rapid rise/decay time that impulsive sounds do.

[3] The continuous noise produced by a vessel is not conducive to the SPL_{peak} metric or criteria and so this noise source is considered using SEL.

All the geophysical sound sources are directional, as the sound is designed to be discharged directly down towards the seabed. The source levels detailed in Table 3.2 therefore represent the level of sound directly under the source. Especially with high frequency sources, the sound that will 'leak' to the side is a fraction of this level. A conservative correction for this directivity has therefore been applied to the geophysical sounds in the modelling.

As previously noted, the survey equipment is expected to be operational at the same time along with survey vessel noise. Subacoustech has created a source level and frequency input for the concurrent noise source scenario by combing the frequency spectra. This results in an SEL source level of 182.0 dB re 1 μPa^2s @ 1 m; like vessel noise the combined source is considered non-impulsive.

The modelling has been undertaken at two locations for the various noise sources at the east and west edges of the proposed Barryroe survey area. Although the survey vessel will be constantly moving during the survey activities, this extreme selection of location, assuming that all of the noise emitted is from a single location at the sides of the site, provides a worst case assessment.

The results of the modelling are discussed in Sections 4 and 5 of this report. The metrics and criteria that have been used in this study to assess environmental effects on relevant marine species from underwater noise are derived from the latest guidance from the U.S. National Marine and Fisheries Service (NMFS) (2018) concerning underwater noise and its effects on marine mammals (refer to Section 4.4), and Popper *et al.* (2014) for the impacts of noise on species of fish. Although the Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014) recommends using the marine mammal noise exposure criteria proposed by Southall et al. (2007), the NMFS (2018) guidelines have been used for this study as they represent more up-to-date thinking by many of the Southall et al. (2007) authors and are based on the best available research on the effects of noise on marine mammals.

It should be stressed that while the modelling results present specific ranges at which impact thresholds are met, these ranges should be considered worst case in determining whether receptors will experience environmental effects during the proposed Barryroe site survey operations.

3.2.2 Environmental Baseline and Habitat Assessment Survey

The survey area will be assessed for habitats and / or species of conservation importance such as Annex I habitats or evidence of any species or habitats on the OSPAR List of Threatened and / or Declining Species (OSPAR, 2019). Any potentially sensitive habitats identified from anomalies on the geophysical survey data (e.g. MBES and SSS) will be investigated (ground-truthed) using high-resolution video or camera stills.

Seabed (benthic) samples will also be taken using a day grab, box corer or dual Van Veen grab, as appropriate. These samples will be used to ground-truth geophysical and visual survey data, provide information on benthic faunal community composition and physico-chemical characteristics of the sediments including particle size distribution, total organic matter content, heavy and trace metals content and hydrocarbon content.

Environmental seabed images will be taken by means of a digital stills deep water camera system with a dedicated strobe and video lamps, mounted within a stainless steel frame. A USBL positioning beacon (refer to Section 3.2.1 for details on the typical characteristics of this equipment) will be attached to the camera frame. Footage will be viewed in real time via an armoured coaxial cable, assisting in the control of the digital stills camera. This allows for shot selection, in the event that the system records a sediment change or feature at the seafloor.

Seabed photographs will be taken at each environmental station using a hover and drift technique at appropriate intervals. This technique allows the frame to move progressively along the seabed as the vessel traverses the work area on its thrusters or drifts. The images will be captured remotely using the surface control unit and stored on the camera's internal memory card. Video footage will be overlaid with time, position and depth, and recorded directly onto PC hard drive. On completion, photographs will be downloaded onto a PC via a USB download cable and copied onto a Hard Disk Drive.

Figure 3.1 shows the provisional location of 53 environmental stations (labelled 'sample locations'). There are 13 stations surrounding each proposed well location; however, it should be noted that the number and location of seabed sampling stations will be defined by the number of habitats delineated by the geophysical survey. A control station will also be sampled in an area not expected to be impacted by the proposed drilling operations, approximately 10 km east-southeast of the proposed well locations.

It is estimated that approximately $1m^2$ of seabed will be disturbed at each sampling location when obtaining the seabed samples, equating to a total area of $53m^2$. The potential for this disturbance to result in LSE on European sites is assessed in Section 4.

It is not anticipated that use of the camera system during the proposed Barryroe site survey will result in any LSE on European sites. The impact of the underwater noise emitted by the USBL on European sites is assessed in Section 4.

3.3 Survey Vessel

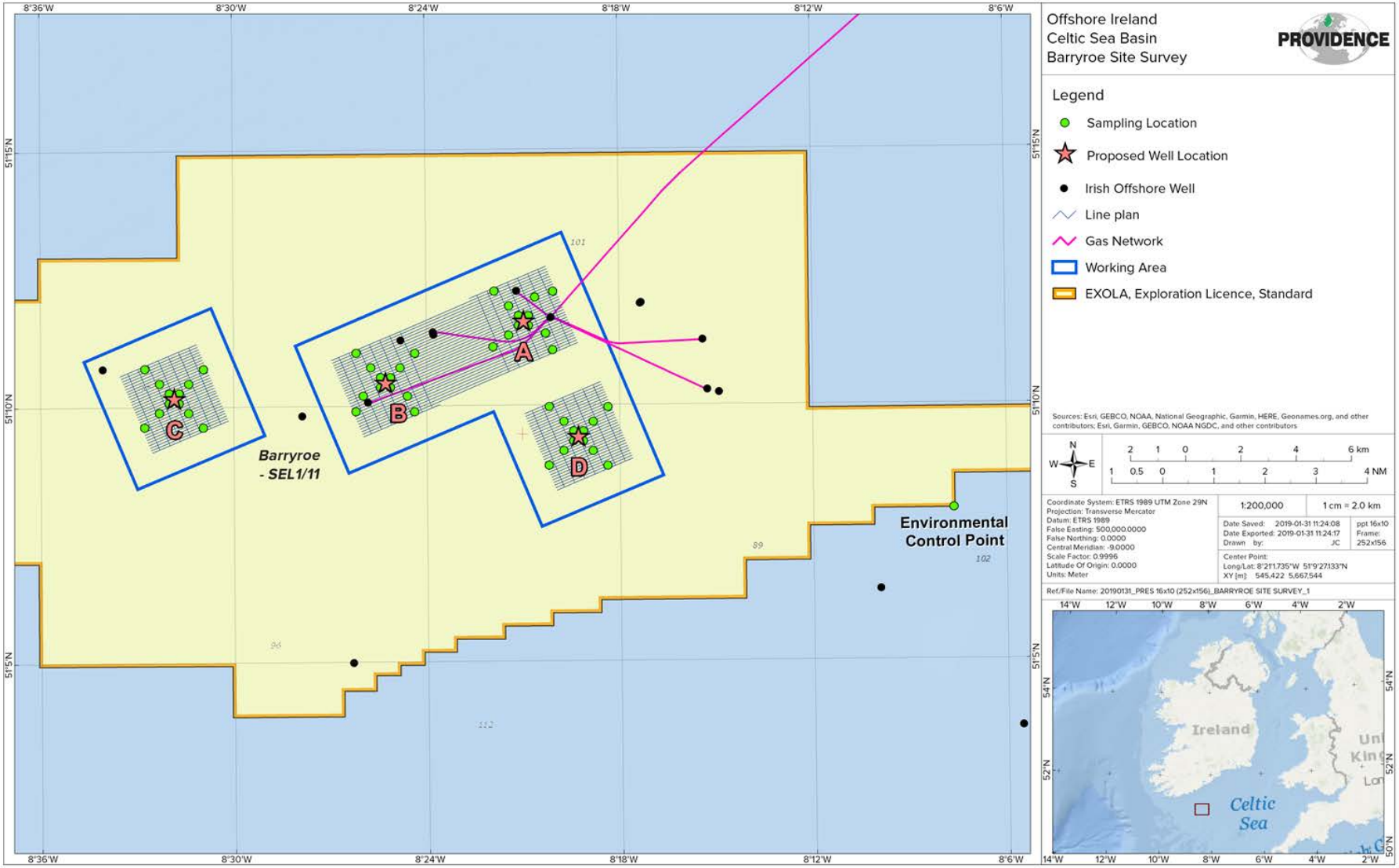
The survey vessel proposed to be used for the Barryroe site survey is the MV Kommandor. Prior to the commencement of the proposed site survey operations, if this vessel is no longer available, Exola reserve the right to seek approval from the Department for Communications, Climate Action and the Environment (DCCAE) to use an alternative equivalent survey vessel. The change in vessel will not impact on any of the conclusions drawn in this report.

3.4 Survey Schedule

The anticipated duration of the survey is approximately 16 working days (excluding transit, port calls and weather downtime). It should be noted that the geophysical survey will take approximately 6 days to complete, with the remaining time (approximately 10 days) spent collecting the environmental data (grab samples and photography). The USBL beacon system and possibly the echosounders will also be used during the environmental survey.

The proposed site survey operations are proposed to take place sometime between the 1st April 2019 and 30th November 2019, subject to regulatory approval and vessel availability. If the survey has not commenced within this timeframe, the operations will be undertaken sometime between 1st February 2020 and 30th November 2020, again subject to regulatory approval and vessel availability.

Figure 3.1: Provisional location of proposed survey lines, seabed samples and proposed future well locations identified as A, B, C & D



4 Stage 1 – Appropriate Assessment Screening

4.1 Introduction

This section contains the information required for the competent authority to screen for AA and determine whether the proposed Barryroe site survey, either standalone or in combination with other plans and projects, in view of best scientific knowledge, is likely to have a significant effect on any European site. Specifically, it aims to:

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

4.2 Potential Impacts on European Sites

A key factor in the consideration as to whether or not a particular European site is likely to be affected by the proposed Barryroe site survey operations is its physical distance from the proposed survey area. The Guidelines for Planning Authorities (*DEHLG, 2010*) state that the AA process should include:

- Any European site within or adjacent to the plan or project area;
- Any European site within the likely zone of impact of the plan or project. This must be evaluated on a case-by-case basis with reference to the nature, size and location of the project, and the sensitivities of the ecological receptors, and the potential for in combination effects.

As illustrated in Figure 4.1, the proposed Barryroe site survey operations will not be undertaken within or immediately adjacent to any designated or proposed European sites. A large number of European sites with marine interest features are, however, located along the southern and south western coastline of Ireland, the closest of which (the Seven Heads SPA) is situated approximately 41 km north west of the proposed survey area.

For the proposed Barryroe site survey operations are to have a significant effect on these European sites there must be a pathway between the proposed survey area and the European site or its features and the European site or its features must be located within the likely zone of impact.

Table 4.1 lists those activities which could result in potential environmental impacts on receptors relevant to European sites, based on a review of the nature and duration of the proposed site survey operations and the receiving ecological environment, and identifies whether any European sites require screening.

Figure 4.1. Location of SEL 1/11 and European Sites

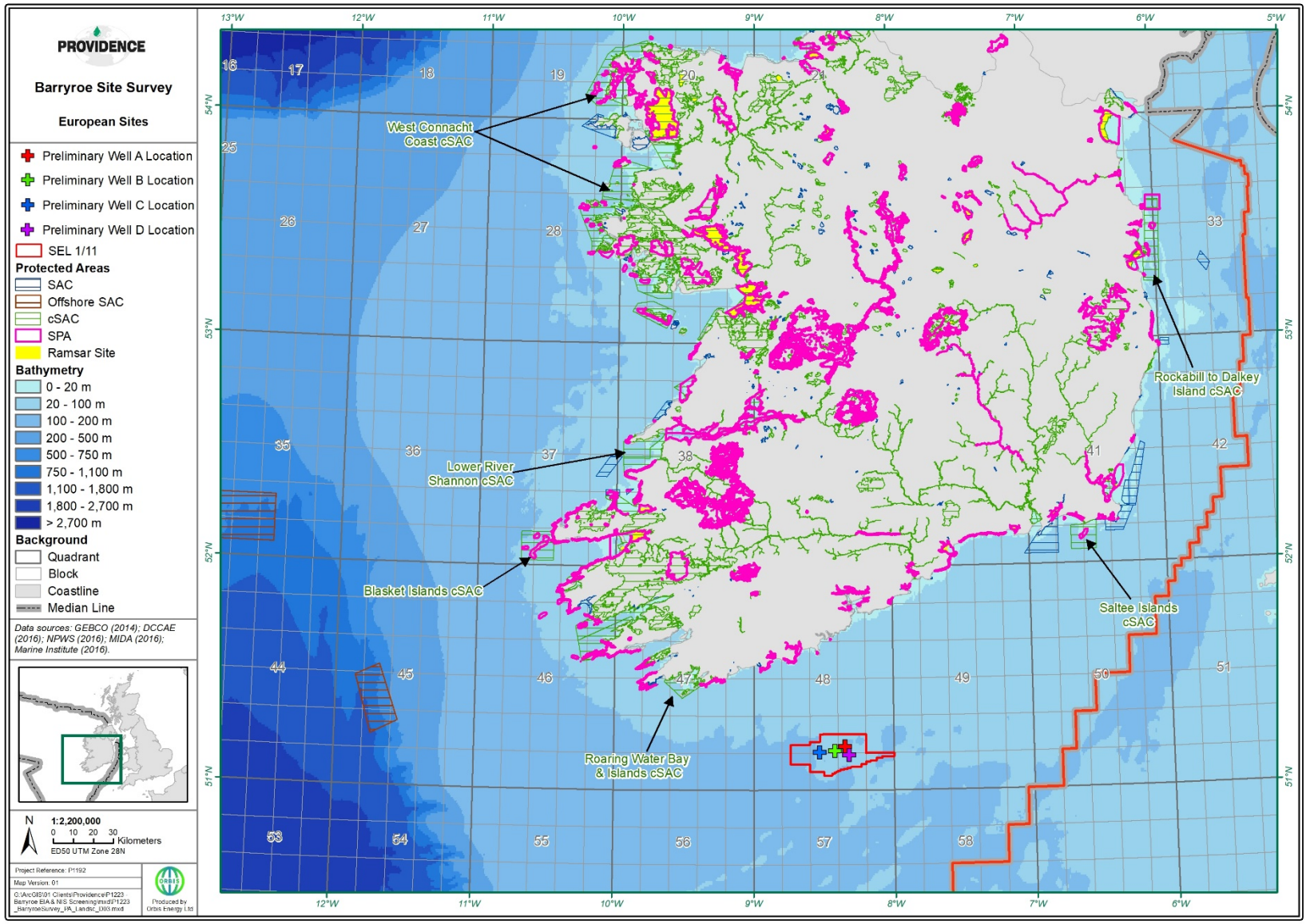


Table 4.1. Summary of the Potential Environmental Effects Resulting from the Proposed Barryroe Site Survey Operations on Receptors Relevant to European Sites

Source of Impact	Description of Potential Environmental Effects	Receptors Relevant to European Sites	Is it possible to screen out likely significant effects (LSE)?
Physical Presence of Survey Vessel and Equipment	There is a risk of injury to marine mammals from collision with the survey vessel or equipment.	Coastal SACs / cSACs - harbour porpoise, bottlenose dolphin, harbour seals, grey seals	Yes - The presence of the survey vessel will only marginally increase the level of overall vessel activity within and adjacent to the proposed survey area. As the survey vessel is not expected to regularly exceed 5 knots, it will be travelling below the speed threshold where most lethal and serious injuries occur (Laist *et al.,* 2001). It is therefore very unlikely that a marine mammal will collide with the slow moving vessel and therefore no LSE on European sites are predicted.
	There is the potential for seabirds to be disturbed by the physical presence of the survey vessel and equipment, resulting in them being displaced from their foraging areas.	Coastal SPAs – seabirds	Yes - Seabirds from nearby coastal SPAs may forage within the proposed survey area. In particular guillemot and kittiwake from the Old Head of Kinsale SPA, located approximately 46 km to the north of the survey area, may be present as guillemot mostly forage within 50 km of their colonies (Natural England, 2012a), whilst the mean maximum foraging range for kittiwake is 60 km (Natural England, 2012b). In a worst case scenario, the presence of the survey vessel and equipment could prevent or reduce access to foraging seabirds within an area totalling 99 km^2, although it is considered highly unlikely that the entire survey area would be unavailable throughout the duration of the proposed site survey operations, which are relatively short in duration (16 days). Seabird counts of kittiwake and guillemot from the ObSERVE Aerial survey occurred across all areas of Irish waters, with the highest densities observed in the Irish Sea (Rogan *et al.*, 2018). This indicates that there is sufficient alternative seabird foraging habitat in the wider area to accommodate any seabirds temporarily displaced from the survey area and therefore there will be no LSE on the qualifying interests of coastal SPAs.
Seabed Disturbance	Seabed sampling (day grab, box cores or dual Van Veen grab) will be undertaken at 53 sampling locations potentially impacting seabed communities. It is estimated that approximately 1m^2 of seabed will be disturbed at each sampling location when obtaining the seabed samples, equating to a total area of 53m^2.	Offshore SACs – Annex I reef habitat	Yes - The closest offshore European site is the Haig Frais SAC, which is located approximately 99 km south east of the proposed survey area in UK waters. There is therefore no pathway to adversely affect a European site or its features (i.e. no connectivity exists).

Source of Impact	Description of Potential Environmental Effects	Receptors Relevant to European Sites	Is it possible to screen out likely significant effects (LSE)?
Underwater Acoustic Emissions	Underwater acoustic emissions will be generated from the proposed geophysical survey equipment, as well as the survey vessel itself. Many marine species are vulnerable to anthropogenic noises that may disrupt their ability to perceive their surrounding environment. Underwater noise modelling predicts that for high-frequency cetaceans (i.e. harbour porpoise) the NMFS (2018) Permanent Threshold Shift (PTS) threshold, where unrecoverable hearing damage may occur, may be exceeded out to a worst case distance of 190 m from the SBES noise source, which equates to an area of approximately 0.1 km^2. The zone of potential injury to mid-frequency cetaceans (i.e. bottlenose dolphin) is predicted to be less than 10 m from all the noise sources. Modelling also predicts that cetaceans may experience behavioural change effects out to a worst case distance of 11 km from the combined noise sources (based on NOAA (2013) thresholds), which equates to an area of approximately 380 km^2. With regards to fish, underwater noise modelling predicts that the SBES and SBP noise operations will result in the largest impact ranges, with Category III fish experiencing temporary threshold shift (TTS; i.e. recoverable hearing loss) out to a worst case distance of 30 m from the source (based on Popper *et al.* (2014) thresholds), which equates to an area of approximately 0.003 km^2. All other noise sources feature rapid attenuation, resulting in impact ranges to fish of less than 10 m.	Coastal SACs / cSACs - harbour porpoises, bottlenose dolphins, harbour seals, grey seals, fish, otters.	**No– SACs with harbour porpoises, bottlenose dolphins and grey seals as qualifying interests cannot be screened out of this assessment in relation to the effects of underwater noise emissions.** As a precautionary approach, it is assumed that harbour porpoises and bottlenose dolphins could travel from coastal European sites and pass through the ensonified area during the proposed site survey operations. The European sites screened into this assessment on this basis are Roaringwater Bay and Islands cSAC, Lower River Shannon cSAC, Blasket Islands cSAC, West Connacht Coast cSAC and Rockabill to Dalkey Island cSAC. Grey seals may forage up to 200 km from their haul-out sites (McConnell et al., 1999). The following SACs for which grey seals are a qualifying interest are located within 200 km of the proposed survey area and have therefore been screened into this assessment: Roaringwater Bay and Islands cSAC, Saltee Islands cSAC and Blasket Islands cSAC. The other relevant receptors have been screened out from this assessment in terms of underwater noise emissions for the following reasons: • Harbour seals usually forage within 40 to 50 km of their haul-out sites (SCOS, 2014). There will be no LSE on European sites as the nearest SAC with harbour seals selected as a qualifying feature is approximately 89 km from the proposed survey area, coupled with the small zone of impact from the proposed operations (90 m or less from the noise sources) and the fact that the estimated at-sea usage of this species in the vicinity of the proposed survey area is very low (with a mean of up to 1 individual per 25 km^2 at any given time) (Russel *et al,.* 2017).. • There are four Annex II fish species for which SACs have been designated in Irish waters: Atlantic salmon, river lamprey, sea lamprey and twaite shad (NPWS, 2018). The nearest European site with Annex II fish species as a qualifying interest is the Blackwater River (Cork/Waterford) cSAC, located approximately 86 km to the north east. However, due to the likely migration routes of these fish species only low numbers are likely to pass through the ensonified area during the proposed site survey operations and these individuals will not remain in the area. Atlantic salmon migrate through Irish waters, travelling northwards along the west coast to Greenland and the

Source of Impact	Description of Potential Environmental Effects	Receptors Relevant to European Sites	Is it possible to screen out likely significant effects (LSE)?
	The SBP noise operations also result in pinnipeds experiencing TTS out to a worst case distance of 90 m from the source (based on NMFS (2018) thresholds), which equates to an area of approximately 0.03 km^2. All other noise sources feature rapid attenuation, resulting in impact ranges to pinnipeds of less than 10 m. With regards to birds, based on the current understanding of avian hearing physiology, hearing is not considered to be a useful mechanism for birds underwater (Popper and Hawkins, 2012).		Norwegian Sea and modelling of known migration routes suggests little salmon activity in the waters of the southern Irish coast (Mork *et al.,* 2012). Twaite shad and allis shad migrate to the sea to feed but are predominantly limited to coastal waters (Nexen, 2018). For fish species, the potential zone of impact from the proposed site survey operations will be limited to a distance of 30m or less from the noise sources. Consequently, any potential effect on diadromous fish would be localised, of short duration and only likely to affect a very small number of individuals. There is also no evidence that any displacement would have any long-term effect on migratory behaviour (DECC, 2011). As such, underwater noise emissions are considered not to be a mechanism for potential LSE on fish from coastal SACs / cSACs on the Irish coast. • Otters do not venture far offshore or spend considerable periods of time in the marine environment (JNCC, 2019). As such, there will be no LSE on these species.
		Coastal SPAs - birds	Yes - The risk of underwater impact to diving birds is greater when using intense impulsive noise sources, such as piling, seismic arrays or explosives as diving seabirds are drawn in to feed on disorientated and deceased fish in the vicinity of the source (Gitschlag and Herczeg, 1994; Aguilar de Soto and Knight, 2016) Acoustic emissions such as those generated by the proposed site survey operations are not known to cause fatalities or result in variation in the abundance of birds seen at nesting sites (DCENR, 2015). In view of the conservation objectives of relevant European sites, no LSE to the qualifying interests of coastal SPAs are predicted due to underwater noise emissions.
		Offshore SACs – Annex I reef habitat	Yes – Austin *et al.,* 2014 concluded that physical or physiological injury or disturbance to cold water corals from seismic surveys is unlikely and Battershill *et al.,* 2007 found no evidence of long term damage or disturbance to tropical coral reefs from seismic surveys. The proposed Barryroe site survey operations will only utilise acoustic sound sources, resulting in significantly lower sound levels than those observed with seismic airguns. In addition, the closest offshore SAC with Annex I reef selected as a qualifying interest is located

Source of Impact	Description of Potential Environmental Effects	Receptors Relevant to European Sites	Is it possible to screen out likely significant effects (LSE)?
			approximately 99 km south east of the proposed survey area. Therefore, no LSE on European sites are predicted.
Atmospheric Emissions	It is estimated that 262 tonnes of carbon dioxide equivalent (CO_2 eq) will be generated during the proposed site survey operations as a result of combustion of hydrocarbons for power generation by the survey vessel (Exola, 2019). Whilst there may be locally elevated concentrations of gases, in the immediate vicinity of the survey vessel, these will be short-lived given the exposed offshore location of the survey which will promote the rapid dispersion of emissions.	None	Yes - There is no pathway to adversely affect a European site or its features.
Routine Marine Discharges	It is estimated that a maximum of approximately 131,200 litres (131 m^3) of waste water (grey and black water) will be generated over the duration of the survey period (i.e. 16 days). Other routine marine discharges generated from the survey vessel will include macerated food waste, bilge water and ballast water. These discharges could reduce water quality and result in toxicity effects on marine fauna.	Coastal SACs / cSACs - harbour porpoises, bottlenose dolphins, harbour seals, grey seals, fish, otters Coastal SPAs – birds	Yes - Given the offshore location of the survey area, any routine discharges from the vessel will rapidly disperse, resulting in very localised and short term impacts to the marine environment. Therefore, no LSE to the qualifying interests of coastal SACs / cSACs / SPAs are predicted due to routine marine discharges.
Solid Waste	A small amount of solid waste (estimated to be less than 5 tonnes) will be produced on board the vessel during the proposed site survey operations. Solid waste	None	Yes - There is no pathway to adversely affect a European site or its features as solid waste will be appropriately stored on the vessel and returned to shore for handling in accordance with the Sea Pollution (Prevention of Pollution by Garbage from Ships) Regulations 2012.
Accidental Release	There is a risk of an accidental spill of diesel fuel or other utility fluid being released to the marine environment through accidental damage to the survey vessel as a result of collision with another vessel. This could lead to lead to toxic effects on	Coastal SACs / cSACs - harbour porpoises, bottlenose dolphins, harbour seals, grey seals, fish, otters and marine habitats	Yes - The likelihood of a collision occurring is remote due to the various positioning systems / automatic identification system (AIS) / radar on the survey vessel. Diesel is a light oil and once spilt it is likely to remain on the sea surface and be subject to high rates of evaporation as it has a large percentage of light and volatile compounds (ITOPF, 2011). Given the offshore location of the survey area, impacts on plankton, benthos, pelagic species and seabed habitats are

Source of Impact	Description of Potential Environmental Effects	Receptors Relevant to European Sites	Is it possible to screen out likely significant effects (LSE)?
	marine fauna, a reduction in water quality and degradation of habitats.	Coastal SPAs – birds Offshore SACs – Annex I reef habitat	unlikely to be significant because the primary impact will be at the sea surface and any hydrocarbons entering the water column will be rapidly and widely dispersed (BEIS, 2017). As such, the only potentially significant impact resulting from a release of diesel would be if large numbers of rafting seabirds were oiled. However, due to the size of spill which could occur from the survey vessel (estimated as a worst case to be 281m^3) significant effects at the population level are considered unlikely, particularly as seabird counts from the ObSERVE Aerial survey indicate that high densities of seabirds are also found in other offshore areas around Ireland (Rogan *et al.*, 2018). No LSE to the qualifying interests of offshore SACs / coastal SACs / cSACs / SPAs are therefore predicted due to accidental releases.

4.3 European Sites Requiring Further Assessment

Based on the assessment detailed in Table 4.1, it is concluded that the only pathway from the proposed Barryroe site survey operations likely to give rise to a significant effect on European sites is the underwater noise generated from the geophysical survey equipment, as well as from the survey vessel itself.

The following six European sites have been identified as requiring further assessment in order to determine whether LSE can be ruled out, based on the potential for impacts to occur from underwater noise emissions:

- Roaringwater Bay and Islands cSAC;
- Lower River Shannon cSAC;
- Saltee Islands cSAC;
- Blasket Islands cSAC;
- West Connacht Coast cSAC;
- Rockabill to Dalkey Island cSAC.

The above listed European sites are labelled in Figure 4.1.

Table 4.2, below, details the qualifying interests of these sites which are likely to be significantly effected by the underwater noise generated from the proposed Barryroe site survey operations, along with the site's corresponding conservation objectives.

Table 4.2. European Sites Requiring Stage 1 AA Screening

<table>
<tr><th>European Site</th><th>Distance from Survey Area</th><th>Site Description</th><th>Qualifying Interest(s) Screened into the Assessment</th><th>Relevant Conservation Objectives</th></tr>
<tr><td rowspan="2">Roaringwater Bay and Islands cSAC (site code 000101)</td><td rowspan="2">64 km NW</td><td rowspan="2">Roaringwater Bay, Co. Cork, is a wide, shallow bay located on the south-west coast of Ireland. The site supports diverse marine and terrestrial habitats, five of which are listed under Annex I the Habitats Directive; Large Shallow Inlets and Bays, Reefs, Vegetated Sea Cliffs, Dry Heath, and Sea Caves. Otter (Lutra lutra), grey seal (Halichoerus grypus) and harbour porpoise (Phoca vitulina), all mammal species listed on Annex II of the Habitats Directive, occur within the site (NPWS, 2015a). Of note is that no Site Management Plan has been produced for this site.</td><td>Harbour porpoise</td><td>To maintain the favourable conservation condition of harbour porpoise in Roaringwater Bay and Islands cSAC, which is defined by the following list of attributes and targets:
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use</td></tr>
<tr><td>Disturbance</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site</td></tr>
</table></td></tr>
<tr><td>Grey seal</td><td>To maintain the favourable conservation condition of grey seal in Roaringwater Bay and Islands cSAC, which is defined by the following list of attributes and targets:
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use</td></tr>
<tr><td>Breeding behaviour</td><td>Breeding sites</td><td>The breeding sites should be maintained in a natural condition</td></tr>
<tr><td>Moulting behaviour</td><td>Moult haul-out sites</td><td>The moult haul-out sites should be maintained in a natural condition</td></tr>
<tr><td>Resting behaviour</td><td>Resting haul-out sites</td><td>The resting haul-out sites should be maintained in a natural condition</td></tr>
<tr><td>Population composition</td><td>Number of cohorts</td><td>The grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually</td></tr>
<tr><td>Disturbance</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the grey seal population at the site</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>European Site</th><th>Distance from Survey Area</th><th>Site Description</th><th>Qualifying Interest(s) Screened into the Assessment</th><th>Relevant Conservation Objectives</th></tr>
<tr><td>Lower River Shannon cSAC (site code 002165)</td><td>126 km NW</td><td>This site is designated due to the presence of a number of marine and terrestrial Annex I habitats including: sandbanks, mudflats, coastal lagoons, salt meadows, reefs, vegetated sea cliffs and alluvial forests. In addition, Annex II species that are qualifying species of this site include the freshwater pearl mussel, sea lamprey, brook lamprey, river lamprey, salmon, common bottlenose dolphin (Tursiops truncates) and otter (NPWS, 2015b). No Site Management Plan for the region has been published.</td><td>Bottlenose dolphin</td><td>To maintain the favourable conservation condition of bottlenose dolphin in Lower River Shannon cSAC, which is defined by the following list of attributes and targets:
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use</td></tr>
<tr><td>Habitat use: critical areas</td><td>Location and hectares</td><td>Critical areas, representing habitat used preferentially by bottlenose dolphin, should be maintained in a natural condition</td></tr>
<tr><td>Disturbance</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site</td></tr>
</table></td></tr>
<tr><td>Saltee Islands cSAC (site code 000707)</td><td>147 km NE</td><td>Saltee Islands cSAC comprises two islands, Great Saltee and Little Saltee and the surrounding waters, located off the south west coast of Ireland. The site supports a range of marine Annex I habitats including: tidal mudflats and sandflats, large shallow inlets and bays, reefs, vegetated sea cliffs and sea caves. The Annex II species grey seal is also a qualifying feature of this site (NPWS, 2015c). No Site Management Plan for the region has been published.</td><td>Grey seal</td><td>To maintain the favourable conservation condition of grey seal in the Saltee Islands cSAC, which is defined by the following list of attributes and targets:
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use</td></tr>
<tr><td>Breeding behaviour</td><td>Breeding sites</td><td>The breeding sites should be maintained in a natural condition</td></tr>
<tr><td>Moulting behaviour</td><td>Moult haul-out sites</td><td>The moult haul-out sites should be maintained in a natural condition</td></tr>
<tr><td>Resting behaviour</td><td>Resting haul-out sites</td><td>The resting haul-out sites should be maintained in a natural condition</td></tr>
<tr><td>Population composition</td><td>Number of cohorts</td><td>The grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>European Site</th><th>Distance from Survey Area</th><th>Site Description</th><th>Qualifying Interest(s) Screened into the Assessment</th><th>Relevant Conservation Objectives</th></tr>
<tr><td></td><td></td><td></td><td></td><td><table><tr><td>Disturbance</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the grey seal population at the site</td></tr></table></td></tr>
<tr><td rowspan="2">Blasket Islands cSAC (site code 002172)</td><td rowspan="2">160 km NW</td><td rowspan="2">Blasket Islands cSAC, located offshore of the Dingle peninsula is designated due to the presence of a number of marine and terrestrial Annex I habitats including: reefs, vegetated sea cliffs, dry heath and sea caves. In addition, Annex II species that are qualifying interests of this site include grey seal and harbour porpoise (NPWS, 2015d). No Site Management Plan for the region has been published.</td><td>Harbour porpoise</td><td>To maintain the favourable conservation condition of harbour porpoise in Blasket Islands cSAC, which is defined by the following list of attributes and targets:<table><tr><th>Attribute</th><th>Measure</th><th>Target</th></tr><tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use</td></tr><tr><td>Disturbance</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site</td></tr></table></td></tr>
<tr><td>Grey seal</td><td>To maintain the favourable conservation condition of grey seal in Blasket Islands cSAC, which is defined by the following list of attributes and targets:<table><tr><th>Attribute</th><th>Measure</th><th>Target</th></tr><tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use</td></tr><tr><td>Breeding behaviour</td><td>Breeding sites</td><td>The breeding sites should be maintained in a natural condition</td></tr><tr><td>Moulting behaviour</td><td>Moult haul-out sites</td><td>The moult haul-out sites should be maintained in a natural condition</td></tr><tr><td>Resting behaviour</td><td>Resting haul-out sites</td><td>The resting haul-out sites should be maintained in a natural condition</td></tr></table></td></tr>
</table>

<table>
<tr><th>European Site</th><th>Distance from Survey Area</th><th>Site Description</th><th>Qualifying Interest(s) Screened into the Assessment</th><th>Relevant Conservation Objectives</th></tr>
<tr><td></td><td></td><td></td><td></td><td><table><tr><td>Disturbance</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the grey seal population at the site</td></tr></table></td></tr>
<tr><td>West Connacht Coast cSAC (site code 002998)</td><td>274 km NW</td><td>West Connacht Coast cSAC, covers a significant areas of the marine waters off the coasts of Mayo and Galway counties. The site is designated due to the presence of Annex I species bottlenose dolphin and the site is a key habitat for the species within the region and Irish waters as a whole (NPWS, 2015e). No Site Management Plan for the region has been published.</td><td>Bottlenose dolphin</td><td>To maintain the favourable conservation condition of common bottlenose dolphin in West Connacht Coast cSAC, which is defined by the following list of attributes and targets:<table><tr><th>Attribute</th><th>Measure</th><th>Target</th></tr><tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use</td></tr><tr><td>Disturbance</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the bottlenose dolphin population at the site</td></tr></table></td></tr>
<tr><td>Rockabill to Dalkey Island cSAC (site code 003000)</td><td>275 km NE</td><td>Rockabill to Dalkey Island cSAC extends from Rockabill to Frazer Bank and includes a variety of dynamic inshore and coastal waters in the western Irish Sea. The site is designated for the presence of Annex I reef habitat and Annex II species harbour porpoise (NPWS, 2015f). No Site Management Plan for the region has been published.</td><td>Harbour Porpoise</td><td>To maintain the favourable conservation condition of harbour porpoise in Rockabill to Dalkey Island cSAC, which is defined by the following list of attributes and targets:<table><tr><th>Attribute</th><th>Measure</th><th>Target</th></tr><tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use</td></tr><tr><td>Disturbance</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site</td></tr></table></td></tr>
</table>

4.4 Assessment of Potential Likely Significant Effects

The purpose of this section is to assess whether the proposed Barryroe site survey, either individually or in combination with other plans and projects, is likely to have a significant effect on the European sites. As identified in Section 4.2, the underwater noise generated by the proposed Barryroe site survey operations is likely to have a significant effect on three marine mammal species (harbour porpoise, bottlenose dolphin and grey seal), which are qualifying interests of a number of cSACs along the coast of Ireland (refer to Section 4.3).

4.4.1 Identifying the Zone of Impact

Marine Mammal Assessment Criteria

Marine mammals, in particular, cetaceans, rely almost exclusively on sound for navigating, foraging, breeding and communicating (Clark 1990; Edds-Walton 1997; Tyack and Clark 2000). The extent to which intense underwater sound might adversely impact a species is dependent upon the incident sound level, sound frequency, duration of exposure and/or repetition rate of the sound wave (see, for example, Hastings and Popper, 2005).

The frequency at which marine mammals can detect noise is species-specific. Table 4.3 presents the functional hearing group for harbour porpoise, bottlenose dolphin and grey seal and the associated estimated hearing range, as classified by NMFS (2018).

Table 4.3. Cetacean Hearing Groups and their Generalised Hearing Range (NMSF, 2018)

Species	Hearing Group	Generalised Hearing Range
Bottlenose dolphin	Mid-frequency cetacean	150 Hz – 160 kHz
Harbour porpoise	High-frequency cetaceans	275 Hz -160 kHz
Grey seal	Phocid pinnipeds (underwater)	50 Hz - 86 kHz

When marine mammals are exposed to intense sound, an elevated hearing threshold may occur, known as a threshold shift (TS). If the hearing threshold returns to the pre-exposure level after a period of time, the TS is known as a temporary threshold shift (TTS). If the threshold does not return to the pre-exposure level, it is known as a permanent threshold shift (PTS) and is considered to result in injury (Finneran *et al.,* 2000; Southall *et al.,* 2007).

For impulsive noise, such as that generated by the proposed geophysical survey equipment (see Table 3.2, Section 3.2.1), NMFS (2018) presents unweighted SPL_{peak} and cumulative weighted sound exposure level (SEL_{cum})[1] criteria for PTS, where unrecoverable hearing damage may occur and TTS, where a temporary, recoverable reduction in hearing sensitivity may occur. To account for the fact that different species groups use and hear sound differently, the thresholds in the weighted SEL_{cum} metric incorporate auditory weighting functions. As dual metrics, NMFS considers onset of PTS to have occurred when either one of the two metrics is exceeded. For non-impulsive noise, such as that generated by the survey vessel, only SEL_{cum} criteria are presented. This criteria is summarised in Table 4.4.

[1] SEL can be computed for multiple pulses or signals to generate a value equivalent to a single exposure for the cumulative sound energy (SELcum).

Table 4.4. NMFS (2018) PTS and TTS Onset Thresholds for Relevant Marine Mammal Hearing Groups

Hearing Group	Impulsive Noise		Non-impulsive Noise
	Unweighted SPL_{peak} (dB re 1 µPa)	Weighted SEL_{cum} (dB re 1 µPa^{2}s)	Weighted SEL_{cum} (dB re 1 µPa^{2}s)
PTS Criteria			
Mid-frequency cetaceans	230	185	198
High-frequency cetaceans	202	155	173
Phocid pinnipeds (underwater)	218	185	201
TTS Criteria			
Mid-frequency cetaceans	224	170	178
High-frequency cetaceans	196	140	153
Phocid pinnipeds (underwater)	212	170	181

Marine mammals may also experience behavioural impacts. Examples of behavioural responses include orientation or attraction to or from the noise source, increased alertness, modification of their own sound production characteristics, change in movement or diving behaviour, temporary change in habitat use and, in severe cases, panic, fleeing, or stranding behaviour, which may indirectly result in injury or death. In addition, exposure to noise sources may also mask intra-species communications and other biologically important sounds (DAHG, 2014). It is noted that some animals or individuals may not exhibit any avoidance when exposed to a certain sound source, this may not mean they have not detected the sound, but that they may be habituated to it, or it may just be innate differences in their general behavioural responses (Southall *et al.,* 2007).

NMFS (2018) does not provide behavioural thresholds for marine mammals. Instead, behavioural disturbance criteria for marine mammals based on the interim guidance from NOAA (2013) have been used in this study. These are:

- 160 dB re 1 µPa (Unweighted SPL root mean squared; SPL_{RMS}[2]) – behavioural disturbance for impulsive noise;
- 120 dB re 1 µPa (Unweighted SPL_{RMS}) – behavioural disturbance for continuous (non-impulsive) noise.

Underwater Noise Modelling Results

PTS / TTS Impact Ranges

The predicted (worst case) maximum PTS and TTS impact ranges for high-frequency cetaceans (i.e. harbour porpoise), mid-frequency cetaceans (i.e. bottlenose dolphin) and phocid pinnipeds (underwater) (i.e. grey seal) for the various noise sources associated with the proposed Barryroe site survey operations are summarised in Table 4.5. It can be seen from this that the results showed that the SBES and SBP operations, and subsequently the combined noise scenario, result in the largest impact ranges. The worst case PTS impact ranges are for high-frequency cetaceans (i.e. harbour porpoise) out to a distance of 190 m from the SBES noise source. The worst case TTS impact ranges are also for high-frequency cetaceans (i.e. harbour porpoise) out to a distance of 5.8 km from the SBP noise source. The majority of the other noise sources considered are predominantly high frequency and, as such, feature rapid attenuation that results in impact ranges of 10 m or less. The exception to this is the SBP noise operations which result in a worst case TTS impact range for pinnipeds (i.e. grey seals) out to a distance of 90 m.

[2] Root mean square (rms) sound pressure level measures the total sound intensity, then divides it by the duration of the signal (Genesis, 2011).

Table 4.5: Predicted maximum impact ranges to the NMFS (2018) PTS and TTS criteria for cetaceans

Noise Source	Maximum Predicted Impact Range		
	High-frequency cetacean (i.e. harbour porpoise)	Mid-frequency cetacean (i.e. bottlenose dolphin)	Phocid pinnipeds (underwater) (i.e. grey seal)
NMFS (2018) PTS Criteria			
USBL	10 m	< 10 m	< 10 m
SBES [1]	190 m	< 10 m	< 10 m
MBES [1]	80 m	< 10 m	< 10 m
SSS	10 m	< 10 m	< 10 m
SBP	40 m	< 10 m	< 10 m
Vessel	< 10 m	< 10 m	< 10 m
Combined	10 m	< 10 m	< 10 m
NMFS (2018) TTS Criteria			
USBL	270 m	< 10 m	< 10 m
SBES [1]	480 m	10 m	< 10 m
MBES [1]	650 m	< 10 m	< 10 m
SSS	150 m	< 10 m	< 10 m
SBP	5.8 km	< 10 m	90 m
Vessel	< 10 m	< 10 m	< 10 m
Combined	310 m	10 m	< 10 m

[1] In practise, the model is likely to have significantly over estimated the potential impact as a much lower noise level will be present to the side (i.e. off-axis) of the SEBS / MBES.

Behavioural Impact Ranges

The predicted worst case behavioural impact ranges to cetaceans are presented in Table 4.6. It can be seen from this that the largest impact ranges are predicted from the SBP noise source, with behavioural change effects potentially experienced out to a distance of 11 km, which equates to an area of approximately 380 km^2. For the combined sources; the largest predicted ranges are similar to the largest of the single source impact ranges, as this single source (the SBP) dominates the combined source level.

Table 4.6: Predicted maximum impact ranges to the NOAA (2013) behavioural criteria for cetaceans

Noise Source	Maximum Predicted Impact Range
USBL	230 m
SBES	570 m
MBES	560 m
SSS	240 m
SBP	11 km
Vessel	190 m
Combined	11 km

4.4.2 Assessment of Potential Impacts on Marine Mammals

To determine the likelihood of impact from the underwater noise generated by the proposed Barryroe site survey operations, the number of animals that may be present within the predicted worst case impact zones at any one time has been calculated using the density and abundance estimates for harbour porpoise and bottlenose dolphin in the Celtic Sea from the ObSERVE Aerial project (Rogan *et al.,* 2018) (see Table 4.7).

Table 4.7. Estimated number of animals experiencing PTS / TTS onset or behavioural changes as a result of the proposed Barryroe site survey operations

Species	The Celtic Sea (Stratum 4) [1]				Max number of animals subject to PTS / TTS / Behavioural Onset [2]		% of reference population potentially affected	
	Density - summer (animals per km^2)	Density – winter (animals per km^2)	Abundance – summer (individuals)	Abundance – winter (individuals)	Summer	Winter	Summer	Winter
PTS Onset								
Harbour porpoise	0.227	0.060	14,189.8	3,752.0	< 0.03	< 0.007	< 0.0002	< 0.0002
Bottlenose dolphin	0.075	0.514	4,717	32,432	< 0.00003	< 0.0002	< 0.0000005	< 0.0000005
TTS Onset								
Harbour porpoise	0.227	0.060	14,189.8	3,752.0	< 25	< 7	< 0.2	< 0.2
Bottlenose dolphin	0.075	0.514	4,717	32,432	< 0.00003	< 0.0002	< 0.0000005	< 0.0000005
Behavioural Change Onset								
Harbour porpoise	0.227	0.060	14,189.8	3,752.0	< 87	< 23	< 0.7	< 0.7
Bottlenose dolphin	0.075	0.514	4,717	32,432	< 29	< 196	< 0.7	< 0.7

[1] Average density estimates from Rogan *et al.,* 2018 for the S4 stratum (The Celtic Sea area).
[2] Calculated as the density estimate x PTS / TTS / behavioural changes onset area (worst case).

The equivalent data is not available for grey seals, but models of marine usage by greys seals in Ireland indicate that the estimated at-sea usage of this species in the vicinity of the proposed survey area is very low (with a mean of up to 1 individual per 25 km^2 at any given time) (Russel *et al,.* 2017). Based on this, less than 0.00002 grey seals are likely to be present within the PTS onset area, less than 0.002 grey seals may be present within the TTS onset area and less than 16 grey seals may be present within the area where behavioural changes may be experienced.

It can be concluded that whilst the presence of harbour porpoise, bottlenose dolphin and grey seal in the potential zone of impact at the time the proposed Barryroe site survey operations cannot be ruled out, the number of individual animals that could experience PTS (i.e. result in an injury) is extremely small, particularly in the context of the percentage of the population in the Celtic Sea that may be affected.

For bottlenose dolphin and grey seal the number of individuals that may experience TTS (where a temporary, recoverable reduction in hearing sensitivity may occur) is also extremely small. A slightly higher number of harbour porpoise may experience TTS; however, the number is still small in the context of the percentage of the population in the Celtic Sea that may be affected.

It is acknowledged that a greater number of individuals may exhibit some form of change in behaviour for the period in which they encounter sound from the proposed site survey operations, but the numbers are still low when compared to the abundance of the species in the Celtic Sea.

Southall et al., 2007 notes that it is the repeated or sustained disruption of behaviours such as feeding or communication that is likely to have a significant effect on vital rates (e.g. reproductive capacity, life expectancy). However, behavioural changes such as moving away from an area for short periods of time, reduced surfacing time, masking of communication signals or echolocation clicks, vocalisation changes and separation of mothers from offspring for short periods, do not necessarily imply that detrimental effects will result for the animals involved (JNCC, 2010). The period during which marine mammals may encounter sound from the proposed Barryroe site survey operations is relatively short, given the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete). Individuals are therefore likely to move out of the zone of impact once the operations have commenced. Any behavioural impacts will be short term and temporary and will cease once the survey operations have been completed. For example, previous studies have shown that although short-term avoidance to seismic surveys activities has been observed in harbour porpoises, effects were short-lived as individuals returned to the survey area within hours of sound source ceasing (Thompson *et al.,* 2013).

Of note is that none of the noise sources from the proposed Barryroe site survey operations are of a significant enough level to cause impacts directly within the coastal cSACs, the closest of which (the Roaringwater Bay and Islands cSAC) is located approximately 64 km to the north west of the proposed survey area. However, in order to determine whether any of the individuals potentially present within the zone of impact could have travelled from one of the coastal cSACs, the distribution of each species of interest within each of the six cSACs are discussed below.

Potential Impacts to Harbour Porpoise

Roaringwater Bay and Islands cSAC

The conservation status of harbour porpoise within the Roaringwater Bay and Islands cSAC is Favourable.

Observations have shown that harbour porpoise are regular in the waters of Roaringwater Bay, the population has been estimated (in 2008) to be 117-201 individuals (NPWS, 2014). Most observations are in the autumn, when more than 100 individual harbour porpoise have been recorded in a day (NPWS, 2014).

A survey of harbour porpoise in Ireland estimated that harbour porpoise density within Roaringwater Bay and Islands cSAC was approximately 1.24 animals per km^2 (Berrow et al., 2008), but was significantly lower along the Cork coast at approximately 0.54 animals per km^2. More recent data from the ObSERVE Aerial project (Rogan *et al.,* 2018) recorded harbour porpoises over a large spatial area offshore Ireland during the summer months, but noted a more coastal distribution in winter, although the coastal areas (such as strata 8 located to the north of the proposed survey area) were found to be important for harbour porpoises during both summer and winter periods. While the south west part of the Celtic Sea (over the North Celtic Sea Basin) had high numbers of sightings and was predicted as an area of high abundance, the eastern part of the Celtic Sea, although likely containing suitable habitat for harbour porpoise, had relatively few sightings (Rogan *et al.,* 2018).

As the Roaringwater Bay and Islands cSAC is located approximately 64 km to the north west of the proposed survey area, it is not possible to conclude that any individuals potentially present within the zone of impact would not have travelled from the cSAC. However, the number of harbour porpoises potentially experiencing PTS as a result of the proposed site survey operations is estimated to be less than 0.03 in the summer and less than 0.007 in the winter (see Table 4.7), equivalent to around 0.03 % and 0.006 % of the population of harbour porpoise in the cSAC, respectively (assuming as a precautionary approach that the site supports 117 individuals). It is also acknowledged that harbour porpoises may experience TTS or behavioural changes as a result of the proposed site survey operations, but these impacts would be temporary with individuals recovering once the operations have ceased. In addition, the period during which these individuals may encounter sound from the

proposed Barryroe site survey operations is relatively short, given the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete), and individuals are likely to move out of the zone of impact once the operations have commenced.

Based on the above, it is therefore concluded that underwater noise emissions from the proposed Barryroe site survey operations will not result in LSE on harbour porpoises at a population level. However, it is not possible to rule out as a matter of scientific certainty that individual harbour porpoises will not be impacted by the underwater emissions. For that reason, it is concluded that a Stage Two AA is required. A Natura Impact Statement (NIS) has therefore been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA as to whether or not the proposed project will adversely affect the integrity of the Roaringwater Bay and Islands cSAC either alone or in combination with other plans and projects, taking into account the conservation objectives of the cSAC.

Blasket Islands cSAC

The conservation status of harbour porpoise within the Blasket Islands cSAC is Favourable.

The known population of harbour porpoise associated with this site are estimated at 267–477 individuals (DAHG, 2013).

Data from the recent ObSERVE Aerial project (Rogan *et al.,* 2018) recorded harbour porpoises over a large spatial area offshore Ireland during the summer months, but noted a more coastal distribution in winter, although the coastal areas (such as strata 8 located to the north of the proposed survey area) were found to be important for harbour porpoises during both summer and winter periods. While the south west part of the Celtic Sea (over the North Celtic Sea Basin) had high numbers of sightings and was predicted as an area of high abundance for harbour porpoise, the eastern part of the Celtic Sea, although likely containing suitable habitat for harbour porpoise, had relatively few sightings (Rogan *et al.,* 2018).

As the Blasket Islands cSAC is located approximately 160 km to the north west of the proposed survey area, it is not possible to conclude that any individuals potentially present within the zone of impact would not have travelled from the cSAC. However, the number of harbour porpoises potentially experiencing PTS as a result of the proposed site survey operations is estimated to be less than 0.03 in the summer and less than 0.007 in the winter (see Table 4.7), equivalent to around 0.01 % and 0.003 % of the population of harbour porpoise in the cSAC, respectively (assuming as a precautionary approach that the site supports 267 individuals). It is also acknowledged that harbour porpoises may experience TTS or behavioural changes as a result of the proposed site survey operations, but these impacts would be temporary with individuals recovering once the operations have ceased. In addition, the period during which these individuals may encounter sound from the proposed Barryroe site survey operations is relatively short, given the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete), and individuals are likely to move out of the zone of impact once the operations have commenced.

Based on the above, it is therefore concluded that underwater noise emissions from the proposed Barryroe site survey operations will not result in LSE on harbour porpoises at a population level. However, it is not possible to rule out as a matter of scientific certainty that individual harbour porpoises may be impacted by the underwater emissions. For that reason, it is concluded that a Stage Two AA is required. A NIS has therefore been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA as to whether or not the proposed project will adversely affect the integrity of the Blasket Islands cSAC either alone or in combination with other plans and projects, taking into account the conservation objectives of the cSAC.

Rockabill to Dalkey Island cSAC

The conservation status of harbour porpoise within the Rockabill to Dalkey Island cSAC is Favourable.

The Rockabill to Dalkey Island cSAC contains a known population of 138-349 individuals (Berrow and O'Brien, 2013). However, the size, community structure and distribution or habitat use of harbour porpoise inhabiting Rockabill to Dalkey Island cSAC are not well understood. There is currently no detailed information available on individual or group movements by harbour porpoise within or into/out of the site, nor is it known whether individuals/groups of the species demonstrate any faithfulness to the site (i.e., site fidelity or residency) (NPWS, 2011c).

A survey of harbour porpoise in Ireland estimated that harbour density within Rockabill to Dalkey Island cSAC was 1.19-2.03 per km^2 (Berrow et al., 2008). Wall et al. (2013) observed that harbour porpoise are generally less often encountered in the Celtic Sea than in the Irish Sea. However, as noted above, more recent data from the ObSERVE Aerial project (Rogan *et al.,* 2018) recorded harbour porpoises over a large spatial area offshore Ireland during the summer months, with a more coastal distribution in winter, although the coastal areas (such as strata 8 located to the north of the proposed survey area) were found to be important for harbour porpoises during both summer and winter periods. While the south west part of the Celtic Sea (over the North Celtic Sea Basin) had high numbers of sightings and was predicted as an area of high abundance, the eastern part of the Celtic Sea, although likely containing suitable habitat for harbour porpoise, had relatively few sightings (Rogan *et al.,* 2018).

As the Rockabill to Dalkey Island cSAC is located approximately 275 km to the north east of the proposed survey area, it is unlikely but not impossible that any individuals potentially present within the zone of impact would have travelled from the cSAC. The number of harbour porpoises potentially experiencing PTS as a result of the proposed site survey operations is estimated to be less than 0.03 in the summer and less than 0.007 in the winter (see Table 4.7), equivalent to around 0.02 % and 0.005 % of the population of harbour porpoise in the cSAC, respectively (assuming as a precautionary approach that the site supports 138 individuals). It is also acknowledged that harbour porpoises may experience TTS or behavioural changes as a result of the proposed site survey operations, but these impacts would be temporary with individuals recovering once the operations have ceased. In addition, the period during which these individuals may encounter sound from the proposed Barryroe site survey operations is relatively short, given the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete), and individuals are likely to move out of the zone of impact once the operations have commenced.

Based on the above, it is therefore concluded that underwater noise emissions from the proposed Barryroe site survey operations will not result in LSE on harbour porpoises at a population level. However, it is not possible to rule out as a matter of scientific certainty that individual harbour porpoises may be impacted by the underwater emissions. For that reason, it is concluded that a Stage Two AA is required. A NIS has therefore been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA as to whether or not the proposed Barryroe site survey operations will adversely affect the integrity of the Rockabill to Dalkey Island cSAC either alone or in combination with other plans and projects, taking into account the conservation objectives of the cSAC.

It should be noted that bottlenose dolphins have also been recorded at this site, although due to data deficiencies none are listed as qualifying interests and no local population estimates have been made.

Potential Impacts to Bottlenose Dolphin

West Connacht Coast cSAC

The conservation status of bottlenose dolphin within the West Connacht Coast cSAC is Favourable.

The West Connacht Coast population of bottlenose dolphins is described as resident within the cSAC, with groups of dolphins being present in the wider Connemara-Mayo region throughout the year. Surveys conducted in the summers of 2013 and 2014 estimate the population at 140-296 individuals. The majority of recorded encounters have taken place within 5 - 6km of the mainland and, based on the available data, it is currently considered that the population of dolphins inhabiting the West Connacht Coast cSAC is more coastal in its habits (DAHG, 2015).

Therefore, as the West Connacht Coast cSAC is located approximately 274 km to the north west of the proposed survey area, there is unlikely to be any interaction between the proposed site survey operations and bottlenose dolphins from this cSAC in terms of underwater noise emissions, particularly given the predicted worst case impact ranges. However, it is not possible to rule out as a matter of scientific certainty that individual bottlenose dolphins may be impacted by the underwater emissions. For that reason, it is concluded that a Stage Two AA is required. A NIS has therefore been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA as to whether or not the proposed Barryroe site survey operations will adversely affect the integrity of the West Connacht Coast cSAC either alone or in combination with other plans and projects, taking into account the conservation objectives of the cSAC.

It should be noted that harbour porpoise, harbour seal and grey seal have also been recorded within the West Connacht Coast cSAC, although due to data deficiencies none are listed as qualifying interests and no local population estimates have been made (DAHG, 2015).

Lower River Shannon cSAC

The conservation status of bottlenose dolphin within the Lower River Shannon cSAC is Favourable.

O'Brien et al. (2009) used photo-identification techniques to study the movements of bottlenose dolphins around the Irish coast. No dolphins from the Shannon Estuary were recorded outside that immediate area, suggesting that the dolphins identified from Shannon Estuary do not range far beyond the Lower River Shannon cSAC and do not mix with other, more transient, populations found around the Irish coast. The population of bottlenose dolphin within the Lower River Shannon cSAC is estimated at 107 individuals (Berrow *et al.,* 2010).

Therefore, as the Lower River Shannon cSAC is located approximately 126 km to the north west of the proposed survey area, there is unlikely to be any interaction between the proposed site survey operations and bottlenose dolphins from this cSAC in terms of underwater noise emissions, particularly given the predicted worst case impact ranges. However, it is not possible to rule out as a matter of scientific certainty that individual bottlenose dolphins may be impacted by the underwater emissions. For that reason, it is concluded that a Stage Two AA is required. A NIS has therefore been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA as to whether or not the proposed Barryroe site survey operations will adversely affect the integrity of the Lower River Shannon cSAC either alone or in combination with other plans and projects, taking into account the conservation objectives of the cSAC.

Potential Impacts to Grey Seal

Blasket Islands cSAC

The conservation status of grey seal within the Blasket Islands cSAC is Favourable.

The Blasket Islands cSAC has a large grey seal population (648-833 breeding in 2005; one-off moult count of 989 seals in 2007) (DAHG, 2013). Cronin et al., (2011) used tagging and telemetry techniques to study the movements of grey seals that were hauled-out at Great Blasket Island (within the Blasket Islands cSAC). The average foraging range was found to be approximately 50 km from haul-out sites. Despite there being a large variation of trip extent (with trips up to 511 km being recorded) this almost exclusively took place to the north of Blasket Islands cSAC, where grey seals appeared to travel between haul-out sites on the south-west, west and north-west coasts of Ireland and haul-out sites on the west coast of Scotland. Grey seal distribution was found to be lower in the waters off the southern and western coast of Ireland, likely due to a lack of undisturbed and suitable coastal habitat for breeding.

Given the above, and the fact that the proposed survey area is located approximately 160 km to the south east of the Blasket Islands cSAC, away from the seal's direction of travel to the north, there is unlikely to be any interaction between the proposed site survey operations and grey seals from this cSAC in terms of underwater noise emissions. However, it is not possible to rule out as a matter of scientific certainty that individual grey seals may be impacted by the underwater emissions. For that reason, it is concluded that a Stage Two AA is required. A NIS has therefore been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA as to whether or not the proposed Barryroe site survey operations will adversely affect the integrity of the

Blasket Islands cSAC either alone or in combination with other plans and projects, taking into account the conservation objectives of the cSAC

Saltee Islands cSAC

The conservation status of grey seal within the Saltee Islands cSAC is Favourable.

The Saltee Islands population of grey seal is one of the few breeding populations in eastern Ireland. Surveys estimate the breeding population at 734-571 individuals. The grey seal population peaks at the site during the yearly breeding (September-December) and moulting (November-March) seasons.

At-sea usage maps for the UK and Ireland based tagging data indicate that although grey seals are present in waters off the southern coast of Ireland, abundance is concentrated in the coastal waters around southeast Wexford (Saltee Islands cSAC) and southwest Cork (Roaringwater Bay and Islands cSAC) rather than in the offshore waters surrounding the proposed survey area (Jones *et al.,* 2015).

However, as the survey area is located approximately 147 km to the south west of the Saltee Islands cSAC and based on the fact that grey seals can forage up to 200 km from their haul-out sites (McConnell et al., 1999), it is not possible to conclude that any individuals potentially present within the zone of impact would not have travelled from the Saltee Islands cSAC.

The number of grey seal potentially experiencing PTS as a result of the proposed site survey operations is estimated to be less than less than 0.00002 (see Section 4.4.1 above), equivalent to around 0.000004 % of the population of grey seal in the cSAC (assuming as a precautionary approach that the site supports 571 individuals). It is also acknowledged that grey seals may experience TTS or behavioural changes as a result of the proposed site survey operations, but these impacts would be temporary with individuals recovering once the operations have ceased. In addition, the period during which these individuals may encounter sound from the proposed Barryroe site survey operations is relatively short, given the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete), and individuals are likely to move out of the zone of impact once the operations have commenced.

Based on the above, it is therefore concluded that underwater noise emissions from the proposed Barryroe site survey operations will not result in LSE on grey seals at a population level. However, it is not possible to rule out as a matter of scientific certainty that individual grey seals may be impacted by the underwater emissions. For that reason, it is concluded that a Stage Two AA is required. A NIS has therefore been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA as to whether or not the proposed Barryroe site survey operations will adversely affect the integrity of the Saltee Islands cSAC either alone or in combination with other plans and projects, taking into account the conservation objectives of the cSAC.

Roaringwater Bay and Islands cSAC

The conservation status of grey seal within the Roaringwater Bay and Islands cSAC is Favourable.

The Roaringwater Bay and Islands cSAC hosts a breeding population of grey seal of approximately 116-149 seals and a minimum of 254 individuals were recorded during the 2007 moulting season (NPWS, 2011). It is likely that seals in the Bay are linked to larger Celtic Sea populations of these species.

At-sea usage maps for the UK and Ireland based tagging data imply that although grey seals are present in the waters off the southern coast of Ireland, abundance is concentrated in the coastal waters around southeast Wexford (Saltee Islands cSAC) and southwest Cork (Roaringwater Bay and Islands cSAC) rather than in the offshore waters surrounding the proposed survey area (Jones *et al.,* 2015).

However, as the proposed survey area is located approximately 64 km to the south east of the Roaringwater Bay and Islands cSAC and based on the fact that grey seals can forage up to 200 km from their haul-out sites (McConnell et al., 1999), it is not possible to conclude that any individuals potentially present within the zone of impact would not have travelled from the Roaringwater Bay and Islands cSAC.

The number of grey seal potentially experiencing PTS as a result of the proposed site survey operations is estimated to be less than 0.00002 (see Section 4.4.1 above), equivalent to around 0.00002 % of the

population of grey seal in the cSAC (assuming as a precautionary approach that the site supports 116 individuals). It is also acknowledged that grey seals may experience TTS or behavioural changes as a result of the proposed site survey operations, but these impacts would be temporary with individuals recovering once the operations have ceased. In addition, the period during which these individuals may encounter sound from the proposed Barryroe site survey operations is relatively short as the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete) and individuals are likely to move out of the zone of impact once the operations have commenced.

Based on the above, it is therefore concluded that underwater noise emissions from the proposed Barryroe site survey operations will not result in LSE on grey seals at a population level. However, it is not possible to rule out as a matter of scientific certainty that individual grey seals may be impacted by the underwater emissions. For that reason, it is concluded that a Stage Two AA is required. A NIS has therefore been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA as to whether or not the proposed Barryroe site survey operations will adversely affect the integrity of the Roaringwater Bay and Islands cSAC either alone or in combination with other plans and projects, taking into account the conservation objectives of the cSAC.

4.5 Potential for In Combination Effects

Exola is aware of the following consented or planned projects which have the potential to have an in-combination or cumulative effect with the proposed Barryroe site survey operations:

- PSE Kinsale Energy Limited plan to decommission the Kinsale Area gas fields and facilities, located in the Celtic Sea approximately 15 km north east of the Barryroe survey area. The decommissioning work will occur following cessation of production, which is scheduled to occur between 2020 and 2021. However, no LSE arising from the in combination effects with other projects are predicted on the European sites, with these having been screened out of the assessment in light of the short term (16 days) and temporary nature of the proposed Barryroe site survey operations and the fact that the two projects will not occur concurrently.
- Nexen Petroleum U.K. Ltd plans to drill a single exploration well in the Iolar prospect in the Porcupine Basin approximately 337 km south west of the Barryroe survey area. The well will be drilled using a floating drill ship with the earliest start date for drilling operations being April 2019. The total duration of the drilling and suspension/abandonment operations is expected to be 100 to 150 days and therefore the drilling operations could coincide with the proposed Barryroe site survey operations. During the proposed Iolar drilling operations underwater noise will be generated by both the drill ship and a proposed Vertical Seismic Profile (VSP) survey. Nexen (2018) has calculated that the worst case behavioural change impact zones to cetaceans resulting from continuous noise (drilling / drill ship / support vessel) and impulsive noise (VSP) sources are 590 m and 2,795 m respectively. In comparison, the worst case behavioural change impact zone to cetaceans resulting from proposed Barryroe site survey operations is 11 km. Given the distance between the two projects, coupled with the short duration of both the VSP (8 – 12 hours) and the proposed site survey operations (16 days); no LSE arising from in combination effects are predicted on European sites even if the two projects were ongoing at the same time.
- Eni Ireland BV is planning to conduct a site survey, scheduled between June and September 2019, targeting the Dunquin South formation in the Porcupine Basin, approximately 256 km to the west of the Barryroe survey area. However, given the distance between the two proposed survey areas no LSE arising from in combination effects are predicted on European sites even if the two surveys were ongoing at the same time.
- The Marine Institute is planning to conduct hydrographic and geophysical surveys in the Celtic Sea and Atlantic Ocean as part of the INFOMAR Programme (Integrated Mapping for the Sustainable Development of Irelands Marine Resource) between April and October 2019. However, no LSE arising from the in combination effects with other projects are predicted on the European sites, in light of the short term (16 days) and temporary nature of the proposed Barryroe site survey operations even if the two projects were ongoing at the same time.

- Vermillion Exploration and Production Ireland Limited is planning to conduct a site survey campaign of inspection, repair and maintenance, scheduled between July and September 2019, covering the entire Corrib offshore pipeline and umbilical system from the landfall valve site in Glengad, Co Mayo to the Corrib wells in the Slyne-Erris Basin, approximately 380 km to the north and west of the proposed Barryroe survey area. However, given the distance between the two proposed survey areas no LSE arising from in combination effects are predicted on European sites even if the two surveys were ongoing at the same time.
- Nexen Petroleum U.K. Ltd is planning to conduct a site survey, scheduled between August and September 2019, targeting Licence Option 16/23 in the Slyne-Erris Basin, approximately 375 km to the north and west of the proposed Barryroe survey area. However, given the distance between the two proposed survey areas no LSE arising from in combination effects are predicted on European sites even if the two surveys were ongoing at the same time.
- Eni Ireland BV is planning to conduct a 3D seismic survey, scheduled for approximately 45 days between July 2019 and October 2020, targeting Frontier Exploration Licence 12/18 in the southern Porcupine Basin, approximately 235 km to the west of the proposed Barryroe survey area. This survey may be operated by 3rd party seismic contractor (e.g. Searcher Seismic, ION Geophysical, TGS or CGG). However, given the distance between the two proposed survey areas no LSE arising from in combination effects are predicted on European sites even if the two surveys were ongoing at the same time.
- Europa Oil and Gas is planning to conduct three site surveys targeting their Inishkea, Edgeworth and Kiely East prospects, scheduled between May and September 2019, in the Slyne-Erris, and Southern Porcupine Basins, approximately 390 km, 200 km and 316 km to the north and west of the proposed Barryroe survey area respectively. However, given the distance between the proposed survey areas no LSE arising from in combination effects are predicted on European sites even if the Europa Oil and Gas surveys were ongoing at the same time as the proposed Barryroe site survey.

All future planned activities will be the subject of separate applications for approval submitted to DCCAE, during which any potential in-combination LSE on European sites would need to be considered.

In addition, Exola acknowledges that the licence area SEL 1/11 contains existing oil and gas infrastructure, namely wells associated with the Seven Heads gas fields and pipelines which connect the Seven Heads field with the Kinsale Head gas field (refer to Section 3.1). However, as the proposed site survey operations will have little interaction with the seabed, limited to seabed sampling only, and given the time which has lapsed since the last drilling activity within SEL 1/11, no in combination LSE on European sites are predicted.

Exola do not know of any other offshore work programmes scheduled to take place at the same time as or immediately before or after the proposed Barryroe site survey operations that would result in combination LSE on European sites.

4.6 AA Screening Conclusions

This Stage 1 AA Screening has been undertaken so as to ensure that the competent authority is enabled to make an informed Screening Decision about whether the proposed Barryroe site survey operations, either standalone or in combination with other plans and projects, in view of best scientific knowledge, are likely to have a significant effect on any European site.

Based on the nature and duration of the proposed site survey operations and the zone of impact of potential effects, this screening assessment has concluded that the only pathway resulting in connectivity between the proposed Barryroe survey area and European sites is the underwater noise generated from the geophysical survey equipment, as well as from the survey vessel itself, which has the potential to impact relevant qualifying interests.

The worst-case sound levels predicted for the noise sources to be used during the proposed Barryroe site survey operations are not of a significant enough level to cause impacts to relevant qualifying interest species directly within any European sites. However, given the wide foraging range of marine

mammals, it has been determined that it is possible that harbour porpoises, bottlenose dolphins and grey seals could be present within the zone of impact of the proposed survey operations.

It has therefore been concluded on the basis of objective information that the possibility of significant effects from the proposed Barryroe site survey operations on the Roaringwater Bay and Islands cSAC, Lower River Shannon cSAC, Saltee Islands cSAC, Blasket Islands cSAC, West Connacht Coast cSAC and Rockabill to Dalkey Island cSAC cannot be ruled out. Having ascertained during the AA Screening that it is not possible to rule out, as a matter of scientific certainty, that the proposed site survey operations are either likely to have a significant effect on these European sites, or that any such likelihood is uncertain or cannot be ruled out, a NIS has been prepared (see Section 5 of this report) as a precautionary measure to inform and assist the competent authority, in carrying out its AA as to whether or not the proposed Barryroe site survey operations will adversely affect the integrity of European sites either alone or in combination with other plans and projects, taking into account the conservation objectives of the European sites.

All impacts which can be screened out during this Stage 1 AA Screening have been so screened and only those which could not be screened out have been carried through to the Stage 2 assessment.

5 Stage 2 – Natura Impact Statement

5.1 Introduction

This section of the report presents the NIS which has been prepared as a precautionary measure to inform and assist the competent authority in carrying out its AA to determine whether or not the proposed Barryroe site survey operations will adversely affect the integrity of those European sites screened into Stage 2 of the AA process.

This NIS examines and analyses, in light of the best scientific knowledge, with respect to those European sites within the zone of influence of the proposed Barryroe site survey operations (as identified in Section 4.3), how the underwater noise emissions generated from the geophysical survey equipment, as well as from the survey vessel itself, could impact on the European sites' qualifying interest species and whether the predicted impacts would adversely affect the integrity of the European sites.

Mitigation measures are set out in Section 5.3 and ensure that any impacts on the conservation objectives of European sites will be avoided during the proposed Barryroe site survey operations such that there will be no risk of adverse effects on these European sites.

5.2 Impacts to Marine Mammals from Underwater Noise

As detailed in Section 4.4, the LSE on individual harbour porpoises, bottlenose dolphins and grey seals from coastal cSACs may be impacted by the underwater noise emissions generated during the proposed Barryroe site survey operations and therefore could not be ruled out from further assessment at the screening stage.

Marine mammals rely on sound to communicate, protect themselves, locate prey, navigate and understand their surroundings and maintain social structures (DAHG, 2014; DOSITS, 2017). The mammalian inner ear is the most sensitive organ to noise exposure and is the most at risk to sound-derived damage (Southall *et al.,* 2007). As noted in Section 4.4.1, when marine mammals are exposed to intense sound, an elevated hearing threshold may occur, known as a threshold shift (TS). If the hearing threshold returns to the pre-exposure level after a period of time (i.e. the impact is reversible), the TS is known as a temporary threshold shift (TTS). If the threshold does not return to the pre-exposure level, it is known as a permanent threshold shift (PTS) (Finneran *et al.,* 2000; Southall *et al.,* 2007). In addition, marine mammals may also experience behavioural impacts. Examples of behavioural responses include orientation or attraction to or from the noise source, increased alertness, modification of their own sound production characteristics, change in movement or diving behaviour, temporary change in habitat use and, in severe cases, panic, fleeing, or stranding behaviour, which may indirectly result in injury or death. Exposure to noise sources may also mask intra-species communications and other biologically important sounds (DAHG, 2014).

Further information on each of the above mentioned qualifying interest species has been provided below in order to understand the nature and extent of the impacts and then to identify suitable mitigation measures to avoid or reduce impacts such that adverse impacts on European sites will not arise.

5.2.1 Harbour Porpoise

Harbour porpoise has been observed in all inshore and offshore waters around the Irish coastline (Berrow *et al.,* 2010; O'Donnell *et al.*, 2016; IWDG, 2018). This species was the most common frequently recorded toothed cetacean in Irish waters during the recent ObSERVE Aerial survey (Rogan et al., 2018) and was the second most frequently sighted in both the Celtic Sea Herring Acoustic Survey and Irish Whale and Dolphin Group (IWDG) records (O'Donnell *et al.*, 2016; IWDG, 2018). The overall conservation status of the harbour porpoise in Irish waters is considered to be favourable (NPWS, 2013).

Sightings of harbour porpoise are more common in the summer months, with the Celtic Sea recording the second highest harbour porpoise densities in Ireland during the ObSERVE Aerial surveys (0.227 animals per km^2) after the Irish Sea (Rogan *et al.,* 2018). This decreases to 0.060 animals per km^2 in winter with no sightings recorded in the Celtic Sea in winter 2016-2017 (Rogan *et al.,* 2018). Harbour

porpoises have previously been recorded within the vicinity of the proposed Barryroe survey area during marine mammal surveys (Reid et al., 2003; Wall, 2013; IWDG, 2011; Rogan *et al.,* 2018).

Harbour porpoise feed on a wide range of fish species, but mainly small shoaling species from demersal or pelagic habitats (Santos and Pierce, 2003). During an examination of 73 harbour porpoises, it was revealed that 98% of the stomach contained various species of fish such as herring, mackerel, sprat, pollack, hake, sardines, and sand eels (Rogan, 2009).

In Ireland, the following three cSACs are designated due to the presence of harbour porpoises, all of which have been screened into this assessment:

- Roaringwater Bay and Islands cSAC located approximately 64 km north west of the proposed Barryroe survey area;
- Blasket Islands cSAC located approximately 160 km north west of the proposed Barryroe survey area;
- Rockabill to Dalkey Island cSAC located approximately 271 km north east of the proposed Barryroe survey area.

As documented in Section 4.3, the conservation objective for harbour porpoise as a qualifying interest species of these cSACs is to maintain the favourable conservation condition of this Annex II species. NPWS has confirmed that no Site Management Plans have been produced for these sites to date.

Section 4 of this report has identified that harbour porpoise could be subject to physical injury and/or behavioural disturbance during the proposed Barryroe site survey operations as a result of underwater noise emissions generated from the geophysical survey equipment, as well as from the survey vessel itself, and that this may impact on the conservation objectives of the above listed European sites.

The modelled worst case predicted impact ranges for harbour porpoise can be summarised as follows:

- PTS could occur out to a distance of 190 m from the SBES noise source, although the model is likely to have significantly over estimated the potential impact as a much lower noise level will be present to the side (i.e. off-axis) of the SEBS);
- TTS could occur out to a distance of 5.8 km from the SBP noise source;
- Behavioural disturbance could occur out to a distance of 11 km from the SBP noise source.

Given the wide ranging nature of harbour porpoise it is not possible to conclude that no individuals would be present with the zone of impact during the propose site survey operations. Table 5.1 therefore estimates the maximum number of harbour porpoise individuals that could potentially experience PTS / TTS as a result of the proposed Barryroe site survey operations with reference to the percentage population of harbour porpoises within each of the cSACs.

Table 5.1: Summary of the maximum number of harbour porpoise individuals potentially experiencing PTS / TTS as a result of the proposed Barryroe site survey operations

Impact	Max number of affected animals[1]		Approx. % of cSAC population potentially affected[2]					
			Roaringwater Bay and Islands cSAC		Blasket Islands cSAC		Rockabill to Dalkey Island cSAC	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
PTS Onset	< 0.03	< 0.007	0.03	0.006	0.01	0.003	0.02	0.005
TTS Onset	< 25	< 7	21	6	9	3	18	5

[1] Calculated as the density estimate (based on Rogan *et al.,* 2018 data for the S4 stratum - The Celtic Sea area) x PTS / TTS onset area

[2] See Section 4.4.2 for population estimates (where a range has been given the lower figure has been used as precautionary approach)

It can be seen from Table 5.1 that the number of harbour porpoise individuals that may experience PTS as a result of the proposed Barryroe site survey operations, based on the reference population of each cSAC, is small enough that there would be no LSE at the population level.

It is acknowledged that a greater number of harbour porpoise individuals may experience TTS as a result of the proposed site survey operations, but these impacts would be temporary with individuals recovering once the operations have ceased and therefore there would be no LSE at the population level. The period during which individuals may encounter sound from the proposed Barryroe site survey operations is relatively short, given the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete), and individuals are likely to move out of the zone of impact once the operations have commenced.

Harbour porpoises may also experience behavioural changes during the proposed site survey operations. Short-term avoidance has been observed in harbour porpoises as a result of seismic survey activities, but effects were short-lived as individuals returned to the survey area within hours of the sound source ceasing (Thompson *et al.,* 2013). As an airgun will not be utilised for the proposed Barryroe site survey, the source levels from the geophysical survey equipment are significantly lower than levels observed with seismic airguns and therefore it is expected that any impacts would be reduced. As harbour porpoise are highly mobile and widespread throughout Irish waters and the proportion of available habitat affected by the underwater noise emissions generated from the proposed site survey operations is very small, temporary displacement from the zone of impact will not result in LSE at the population level.

During the proposed Barryroe site survey operations there is also the potential for indirect effects on harbour porpoises due to changes in prey (fish) species distribution and/or abundance. Underwater noise modelling predicts that impacts to fish will be in a localised area, in close proximity to the source, therefore no LSE are predicted on the harbour porpoise at a population level due to changes in prey resources.

However, given that there is a risk of auditory injury, it is possible that the conservation objectives of the Roaringwater Bay and Islands cSAC, Blasket Islands cSAC and Rockabill to Dalkey Island cSAC; namely to maintain the favourable conservation status of the Annex II qualifying interest species for which these cSACs are designated, could be impacted. Mitigation measures are therefore required to ensure LSE do not arise (refer to Section 5.3).

5.2.2 Bottlenose Dolphin

Bottlenose dolphins are recorded all around the Irish coast, although the species is mainly seen along the west coast (Reid *et al.,* 2003; IWDG, 2015b). During the ObSERVE Aerial surveys, bottlenose dolphins were the most frequently sighted cetacean species, with sightings occurring in every stratum of the study area. In the Celtic Sea, sightings of bottlenose dolphin were observed in greater numbers in the winter than in summer (Rogan *et al.,* 2018).

The overall conservation status of the bottlenose dolphin is considered to be favourable (NPWS, 2013a).

Bottlenose dolphin primarily feed on inshore bottom dwelling fish, although they will also eat salmon, plaice, eels, small sharks, rays, hermit crabs, shrimps and mullet (Reid *et al.*, 2003; Berrow *et al.*, 2010).

Distinct populations of bottlenose dolphins are recognized in Irish waters; the offshore, inshore and Shannon estuary populations (Wall, 2013; IWDG, 2015b). There are two resident populations; one at the mouth of the River Shannon and another off the west Connacht coast. Both these areas have been designated as cSACs due to the presence of bottlenose dolphins and have therefore been screened into the assessment:

- Lower River Shannon cSAC is located approximately 126 km to the north west of the proposed survey area
- West Connacht Coast cSAC is located approximately 274 km to the north west of the proposed survey area.

A small apparently resident group of bottlenose dolphin have also been seen regularly at the outer Cork Harbour (Wall, 2013; NPWS, 2015b).

As documented in Section 4.3, the conservation objective for bottlenose dolphins as a qualifying interest species of the above listed cSACs is to maintain the favourable conservation condition of this Annex II species. NPWS has confirmed that no Site Management Plans have been produced for these sites to date.

Section 4 of this report has identified that bottlenose dolphins could be subject to physical injury and/or behavioural disturbance during the proposed Barryroe site survey operations as a result of underwater noise emissions generated from the geophysical survey equipment, as well as from the survey vessel itself, and that this may impact on the conservation objectives of the above listed European sites.

The modelled worst case predicted impact ranges for bottlenose dolphin can be summarised as follows:

- PTS could occur within less than 10m from all noise sources;
- TTS could occur out to a distance of 10 m from all noise sources;
- Behavioural disturbance could occur out to a distance of 11 km from the SBP noise source.

As detailed in Section 4.4.2, work by O'Brien et al. (2009) suggests that the dolphins identified from Shannon Estuary do not range far beyond the Lower River Shannon cSAC and do not mix with other, more transient, populations found around the Irish coast. The West Connacht Coast population of bottlenose dolphins is also described as resident within the cSAC, with groups of dolphins being present in the wider Connemara-Mayo region throughout the year. Given the distance between the above mentioned cSACs and the proposed Barryroe survey area, it is therefore unlikely there will be any interaction between the proposed site survey operations and bottlenose dolphins from these cSACs. However, it is not possible to rule out as a matter of scientific certainty that individual bottlenose dolphins may be present within the zone of impact.

Table 5.2 estimates the maximum number of bottlenose dolphin individuals potentially experiencing PTS / TTS as a result of the proposed Barryroe site survey operations with reference to the percentage population of bottlenose dolphins within each of the cSACs.

Table 5.2: Summary of the maximum number of bottlenose dolphin individuals potentially affected by the proposed Barryroe site survey operations

Impact	Max number of affected animals[1]		Approx % of cSAC population potentially affected[2]			
			Lower River Shannon cSAC		West Connacht Coast cSAC	
	Summer	Winter	Summer	Winter	Summer	Winter
PTS Onset	< 0.00003	< 0.0002	0.00002	0.0001	0.00002	0.0001
TTS Onset	< 0.00003	< 0.0002	0.00002	0.0001	0.00002	0.0001

[1] Calculated as the density estimate (based on Rogan *et al.,* 2018 data for the S4 stratum - The Celtic Sea area) x PTS / TTS onset area

[2] See Section 4.4.2 for population estimates (where a range has been given the lower figure has been used)

It can be seen from Table 5.2 that the number of bottlenose dolphin individuals that may experience PTS or TTS as a result of the proposed Barryroe site survey operations, based on the reference population of each cSAC, is small enough that there would be no LSE at the population level.

Bottlenose dolphins may also experience behavioural changes during the proposed site survey operations, but the period during which individuals may encounter sound is relatively short, given the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete). Individuals are likely to move out of the zone of impact once the operations have commenced and will return to the area once the operations have ceased. As any behavioural impacts will be short term and temporary and will cease once the survey operations have been completed, no LSE are predicted.

During the proposed Barryroe site survey operations there is also the potential for indirect effects on bottlenose dolphins due to changes in prey (fish) species distribution and/or abundance. Underwater noise modelling predicts that impacts to fish will be in a localised area, in close proximity to the source,

therefore no LSE are predicted on the bottlenose dolphin at a population level due to changes in prey resources.

However, given that there is a risk of auditory injury, it is possible that the conservation objectives of the Lower River Shannon cSAC and West Connacht Coast cSAC; namely to maintain the favourable conservation status of the Annex II qualifying interest species for which these cSACs are designated, could be impacted. Mitigation measures are therefore required to ensure LSE do not arise (refer to Section 5.3).

5.2.3 Grey Seal

Grey seals are known to have colonies located around the south and south west coast of Ireland and are predominantly found in inshore waters over the Irish Shelf in water depths less than 200 m deep (Wall, 2013). Grey seals generally breed in Irish Waters from September to December and shed their fur during the spring months, remaining ashore for the majority of this time (NPWS, 2018a).

Grey seals will alter their diet according to prey availability but they primarily feed on fast moving fish species if available, such as cod, herring, whiting and sand eels, and bottom dwelling cephalopods. If these species are not present in sufficient quantities then they will catch bottom dwelling prey, including squid, crustaceans, flatfish and lobsters (NPWS, 2013).

Models of marine usage by greys seals in Ireland indicate that the estimated at-sea usage of this species in the vicinity of the proposed site survey area is very low (with a mean of up to 1 individual per 25 km^2 at any given time) (Russel *et al,.* 2017). Haul-out count data collected between 1996 and 2015 indicates that small numbers (up to 10 individuals) of grey seals haul-out on the coastline around Cork, approximately 48 km north of the proposed Barryroe survey area (Russel *et al.,* 2017).

The overall status of the grey seal population in Ireland is considered to be favourable given current knowledge of the species' population size, distribution, ecology and prevailing pressures on the species (NPWS, 2013a).

In Ireland, 10 cSACs are designated due to the presence of grey seals (NPWS, 2018a). As grey seals may forage up to 200 km from their haul-out sites (McConnell et al., 1999) the following three cSACs have been screened into the assessment:

- Blasket Islands cSAC located approximately 160 km north west of the proposed survey area;
- Saltee Islands cSAC located approximately 147 km north east of the proposed survey area;
- Roaringwater Bay and Islands cSAC located approximately 64 km to the north west of the proposed survey area.

As detailed in Section 4.3, the conservation objective for grey seals as a qualifying interest species of the above listed cSACs is to maintain the favourable conservation condition of this Annex II species. NPWS has confirmed that no Site Management Plans have been produced for these sites to date.

Section 4 of this report has identified that grey seals could be injured or experience a temporary, recoverable reduction in hearing sensitivity during the proposed Barryroe site survey operations as a result of underwater noise emissions generated from the geophysical survey equipment, as well as from the survey vessel itself, and that this may impact on the conservation objectives of the above listed European sites.

The modelled worst case predicted impact ranges for grey seals can be summarised as follows:

- PTS could occur within less than 10m from all noise sources;
- TTS could occur out to a distance of 90m from the SBP noise source.

As detailed in Section 4.4.2, at-sea usage maps for the UK and Ireland based tagging data indicate that although grey seals are present in waters off the southern coast of Ireland, abundance is concentrated in the coastal waters around southeast Wexford (Saltee Islands cSAC) and southwest Cork (Roaringwater Bay and Islands cSAC) rather than in the offshore waters surrounding the proposed survey area (Jones *et al.,* 2015). In addition, studies have shown that grey seals that haul-out at Great Blasket Island almost exclusively forage to the north of the Blasket Islands cSAC. It is therefore unlikely

there will be any interaction between the proposed site survey operations and grey seals from the above listed cSACs. However, it is not possible to rule out as a matter of scientific certainty that individual grey seals will not be present within the zone of impact.

Table 5.3 estimates the maximum number of grey seal individuals potentially experiencing PTS / TTS as a result of the proposed Barryroe site survey operations with reference to the percentage population of bottlenose dolphins within each of the cSACs.

Table 5.3: Summary of the maximum number of grey seal individuals potentially affected by the proposed Barryroe site survey operations

Impact	Max number of affected animals[1]	Approx. % of cSAC population potentially affected[2]		
		Blasket Islands cSAC	Saltee Islands cSAC	Roaringwater Bay and Islands cSAC
PTS Onset	< 0.00002	0.000003	0.000004	0.00002
TTS Onset	< 0.002	0.0003	0.0004	0.002

[1] Calculated as the density estimate (based on Russel *et al.,* 2017 estimated at-sea usage data) x PTS / TTS onset area

[2] See Section 4.4.2 for population estimates (where a range has been given the lower figure has been used)

It can be seen from Table 5.3 that the number of grey seal individuals that may experience PTS or TTS as a result of the proposed Barryroe site survey operations, based on the reference population of each cSAC, is small enough that there would be no LSE at the population level.

Grey seals may also experience behavioural changes during the proposed site survey operations, but the period during which individuals may encounter sound is relatively short, given the majority of geophysical equipment will only be used for 6 days (the USBL beacon system and possibly the SBES/MBES will also be used during the environmental survey predicted to take approximately 10 days to complete). Individuals are likely to move out of the zone of impact once the operations have commenced and will return to the area once the operations have ceased. As any behavioural impacts will be short term and temporary and will cease once the survey operations have been completed, no LSE are predicted.

During the proposed Barryroe site survey operations there is also the potential for indirect effects on grey seals due to changes in prey (fish) species distribution and/or abundance. Underwater noise modelling predicts that impacts to fish will be in a localised area, in close proximity to the source, therefore no LSE are predicted on the bottlenose dolphin at a population level due to changes in prey resources.

However, given that there is a risk of auditory injury, it is possible that the conservation objectives of the Blasket Islands cSAC, Saltee Islands cSAC and Roaringwater Bay and Islands cSAC; namely to maintain the favourable conservation status of the Annex II qualifying interest species for which these cSACs are designated, could be impacted. Mitigation measures are therefore required to ensure LSE do not arise (refer to Section 5.3).

5.3 Mitigation Measures

Exola and its survey contractor will adhere to the DAHG Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014), which outlines the risk reduction measures to be considered in order to minimise the potential effects of man-made sound sources, including those from geophysical acoustic surveys, on the natural ecology of marine mammal species.

The measures that will be adopted by Exola for the proposed Barryroe site survey operations to minimise and/or eliminate the likely effects of anthropogenic sound on marine mammal species are summarised below:

- Two qualified Marine Mammal Observers (MMOs) will be appointed to monitor marine mammals and log all data according to the standardised forms provided in the DAHG Guidance and provide an MMO report to the Regulatory Authorities;

- Acoustic surveying will not commence if marine mammals are detected within a 500 m radius around the acoustic sources (referred to as the Monitored Zone);
- Sound-producing survey activities will only be commenced in daylight hours where effective visual monitoring, as determined by the MMO, can be achieved;
- For sound-producing survey activities, as water depths across the proposed survey area are less than 200 m, pre-start-up monitoring will be conducted by the MMO at least 30 minutes before any activity using the acoustic sources is due to commence. Sound-producing survey activity using the acoustic sound sources will not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO. This pre-start monitoring will be followed by the soft-start procedure;
- Commencement of sound-producing survey activities will be undertaken using a 'soft-start' (ramp-up and gradual increase in energy/noise source) procedure for any equipment where the output peak SPL exceeds 170 dB re 1µPa at 1 metre. The build-up of acoustic energy output will occur in consistent stages to provide a steady and gradual increase in power (over a period of 20 minutes). Where the power of acoustic noise sources cannot be increased gradually, due to operational parameters of the device, the device will be switched "on" and 'off" in a consistent sequential manner for a period of 20 minutes prior to commencement of the full necessary output;
- Where a soft-start procedure is employed, the delay between the end of the soft-start and the start of the survey will be minimised to prevent unnecessary high-level sound introduction;
- Where there is a break in sound output (e.g. in the event of equipment failure, shut-down etc.) from the acoustic sources for more than 30 minutes, all soft-start procedures must be undertaken before activity can recommence;
- Full reporting on MMO operations and mitigation measures undertaken must be provided to the relevant Regulatory Authorities in accordance with the DAHG Guidance.

5.4 Residual Impacts

The mitigation measures outlined out in Section 5.3 above will ensure that any impacts on the conservation objectives of European sites will be avoided during the proposed Barryroe site survey operations such that there will be no risk of adverse effects on these European sites and therefore residual impacts will not arise.

5.5 Potential for In Combination Effects

Exola is aware of the following consented or planned projects which have the potential to have an in-combination or cumulative effect with the proposed Barryroe site survey operations:

- PSE Kinsale Energy Limited plan to decommission the Kinsale Area gas fields and facilities, located in the Celtic Sea approximately 15 km north east of the Barryroe survey area. The decommissioning work will occur following cessation of production, which is scheduled to occur between 2020 and 2021.
- Nexen Petroleum U.K. Ltd plans to drill a single exploration well in the Iolar prospect in the Porcupine Basin approximately 337 km south west of the Barryroe survey area. The well will be drilled using a floating drill ship with the earliest start date for drilling operations being April 2019. The total duration of the drilling and suspension/abandonment operations is expected to be 100 to 150 days.
- Eni Ireland BV is planning to conduct a site survey, scheduled between June and September 2019, targeting the Dunquin South formation in the Porcupine Basin, approximately 256 km to the west of the proposed Barryroe survey area.
- The Marine Institute is planning to conduct hydrographic and geophysical surveys in the Celtic Sea and Atlantic Ocean as part of the INFOMAP Programme (Integrated Mapping for the Sustainable Development of Ireland's Marine Resource) between April and October 2019.

- Vermillion Exploration and Production Ireland Limited is planning to conduct a site survey campaign of inspection, repair and maintenance, scheduled between July and September 2019, covering the entire Corrib offshore pipeline and umbilical system from the landfall valve site in Glengad, Co Mayo to the Corrib wells in the Slyne-Erris Basin, approximately 380 km to the north and west of the proposed Barryroe survey area.
- Nexen Petroleum U.K. Ltd is planning to conduct a site survey, scheduled between August and September 2019, targeting Licence Option 16/23 in the Slyne-Erris Basin, approximately 375 km to the north and west of the proposed Barryroe survey area.
- Eni Ireland BV is planning to conduct a 3D seismic survey, scheduled for approximately 45 days between July 2019 and October 2020, targeting Frontier Exploration Licence 12/18 in the southern Porcupine Basin, approximately 235 km to the west of the proposed Barryroe survey area. This survey may be operated by 3rd party seismic contractor (e.g. Searcher Seismic, ION Geophysical, TGS or CGG).
- Europa Oil and Gas is planning to conduct three site surveys targeting their Inishkea, Edgeworth and Kiely East prospects, scheduled between May and September 2019, in the Slyne-Erris, and Southern Porcupine Basins, approximately 390 km, 200 km, and 316 km to the north and west of the proposed Barryroe survey area respectively.

As detailed in Section 4.5, the potential for in combination effects on European sites will not arise in light of the short term (16 days) and temporary nature of the proposed Barryroe site survey operations, coupled with the distance between the proposed survey area and the above listed projects and / or the fact that the projects will not occur concurrently.

All future planned activities will be the subject of separate applications for approval submitted to DCCAE, during which any potential in-combination LSE on European sites would need to be considered.

In addition, Exola acknowledges that the licence area SEL 1/11 contains existing oil and gas infrastructure, namely wells associated with the Seven Heads gas fields and pipelines which connect the Seven Heads field with the Kinsale Head gas field (refer to Section 3.1). However, as the proposed site survey operations will have little interaction with the seabed, limited to seabed sampling only, and given the time which has lapsed since the last drilling activity within SEL 1/11, no in combination LSE on European sites are predicted.

Exola do not know of any other offshore work programmes scheduled to take place at the same time as or immediately before or after the proposed Barryroe site survey operations that would cause in combination LSE on European sites.

5.6 NIS Conclusions

This NIS has been prepared as a precautionary measure as it was not possible during the AA Screening to rule out, as a matter of scientific certainty, that the proposed Barryroe site survey operations will not have a likely significant effect on European sites.

As detailed in Section 4, based on the nature and duration of the proposed site survey operations and the zone of impact of potential effects, it was concluded that the underwater noise generated from the geophysical survey equipment, as well as from the survey vessel itself, theoretically has the potential to impact harbour porpoise, bottlenose dolphin and grey seals, which are qualifying interest species of the Roaringwater Bay and Islands cSAC, Lower River Shannon cSAC, Saltee Islands cSAC, Blasket Islands cSAC, West Connacht Coast cSAC and Rockabill to Dalkey Island cSAC.

This NIS has examined and analysed, in light of the best scientific knowledge, with respect to the above-mentioned European sites (and the relevant qualifying interest species of these sites) within the zone of influence of the proposed site survey operations, the potential impact sources and pathways, how these could impact on the sites' qualifying interests and whether the predicted impacts would adversely affect the integrity of the European sites.

Mitigation measures have been identified which ensure that any impacts on the conservation objectives of European sites will be avoided during the proposed site survey operations such that there will be no risk of adverse effects on these European sites.

It has been objectively concluded following an examination, analysis and evaluation of the relevant information, including in particular the nature of the predicted impacts from the proposed site survey operations and with the implementation of the mitigation measures proposed, that the proposed Barryroe site survey will not pose a risk of adversely affecting (either directly or indirectly) the integrity of any European site, either alone or in combination with other plans or projects, and there is no reasonable scientific doubt in relation to this conclusion.

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