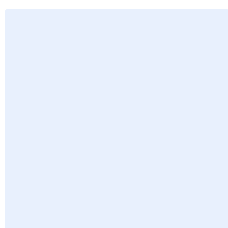


Supplementary Supporting Information for Derogation Licence Allód Energy Ltd.



Client

Allód Energy Ltd.

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Project Title

Derogation Licence

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1 INTRODUCTION

1.1 OBJECTIVE

This supplementary supporting information forms part of an application for a Regulation 54 derogation application to undertake geophysical marine site investigation activities, with the objective of assessing an area in the Celtic Sea for potential hydrogen storage. The proposed investigations will define the extent and internal character of halite rock beneath the seafloor, to assess and de-risk potential suitability for hydrogen storage development in halite (more commonly known as salt).

This derogation application has been prepared by GDG on behalf of Allód Energy Ltd. A Maritime Usage Licence (MUL) Application for the proposed investigations is under consideration by MARA and this derogation application is also supported by information and reports associated with the MUL Application, including:

- Assessment of Impact of the Maritime Usage (AIMU) report (Appendix A of Supporting Information Document)
- Risk Assessment for Annex IV Species (RAAIVS) (Appendix B of Supporting Information Document)

1.2 STATEMENT OF AUTHORITY

This report has been prepared by Joey O'Connor, Principal Marine Environmental Scientist at GDG, specialising in Environmental Impact Assessment and Appropriate Assessment. Joey holds an MSc in Engineering in the Coastal Environment from the University of Southampton and a BSc (Hons) in Marine Science from the University of Galway. He has 17 years' experience as a marine and coastal environmental professional across the public and private sectors, including 10+ years' project and team management experience. Joey has delivered and overseen numerous environmental assessments and consents for infrastructure projects, including ports and offshore and onshore windfarms, and has extensive experience in offshore survey, Marine Protected Area monitoring, and regulatory advisory roles, including as a statutory adviser to the UK government and devolved administrations with the Joint Nature Conservation Committee (JNCC).

This report has been reviewed and approved by Jeannine Dunne, Marine Advisory Director at GDG. Jeannine has rich experience in policy analysis and providing legislative advice across terrestrial and marine domains. In her career over 19 years, Jeannine has become expert in navigating complex legislative systems, ensuring compliance with International, EU, and National environmental and maritime laws. Notably, she played a key role in reforming the regulatory framework and spearheaded the design of technical criteria for Ireland's cutting-edge marine consenting regime. Jeannine's contributions have been vital in fostering marine development while maintaining a balance between industrial growth and environmental protection. She is a contributor to various Statutory and Industry Advisory Groups, actively shaping policies, and initiatives.

2 LOCATION OF LICENCE AREA AND EXTENT OF OPERATIONS

Marine geophysical site investigations are proposed within the area of the Celtic Sea with the objective of assessing the potential suitability of subsurface halite (salt) formations for hydrogen storage. The investigations are designed to define the depth, lateral extent and internal geological character of halite rock beneath the seabed, in order to assess and de-risk the feasibility of potential future hydrogen storage development.

In accordance with Part D of the NPWS derogation tests, the proposed surveys are required for reasons of overriding public interest, including those of a social and economic nature, and are expected to facilitate beneficial consequences of primary importance for the environment. In particular, the investigations support:

- the advancement of low-carbon energy infrastructure and long-duration energy storage solutions critical to national and EU climate and decarbonisation objectives;
- enhanced energy security and system resilience, which are matters of public safety and public interest;
- environmentally responsible planning by enabling the early identification of suitable geological conditions, thereby reducing the risk of adverse environmental effects during any future development phases.

The applicant has conducted a comprehensive assessment of the geology offshore Ireland to identify naturally occurring salt, normally found within rocks of Triassic age (~250 million years old) (Figure 1). After a literature review, the efforts focused off the south coast of Ireland where salt had been identified within historic oil and gas datasets. The study identified the best potential was a large ridge of salt, 1km below the seabed and approximately 80-90 km offshore Cork. This salt ridge is expected to be up to 40km long and 5 km wide.

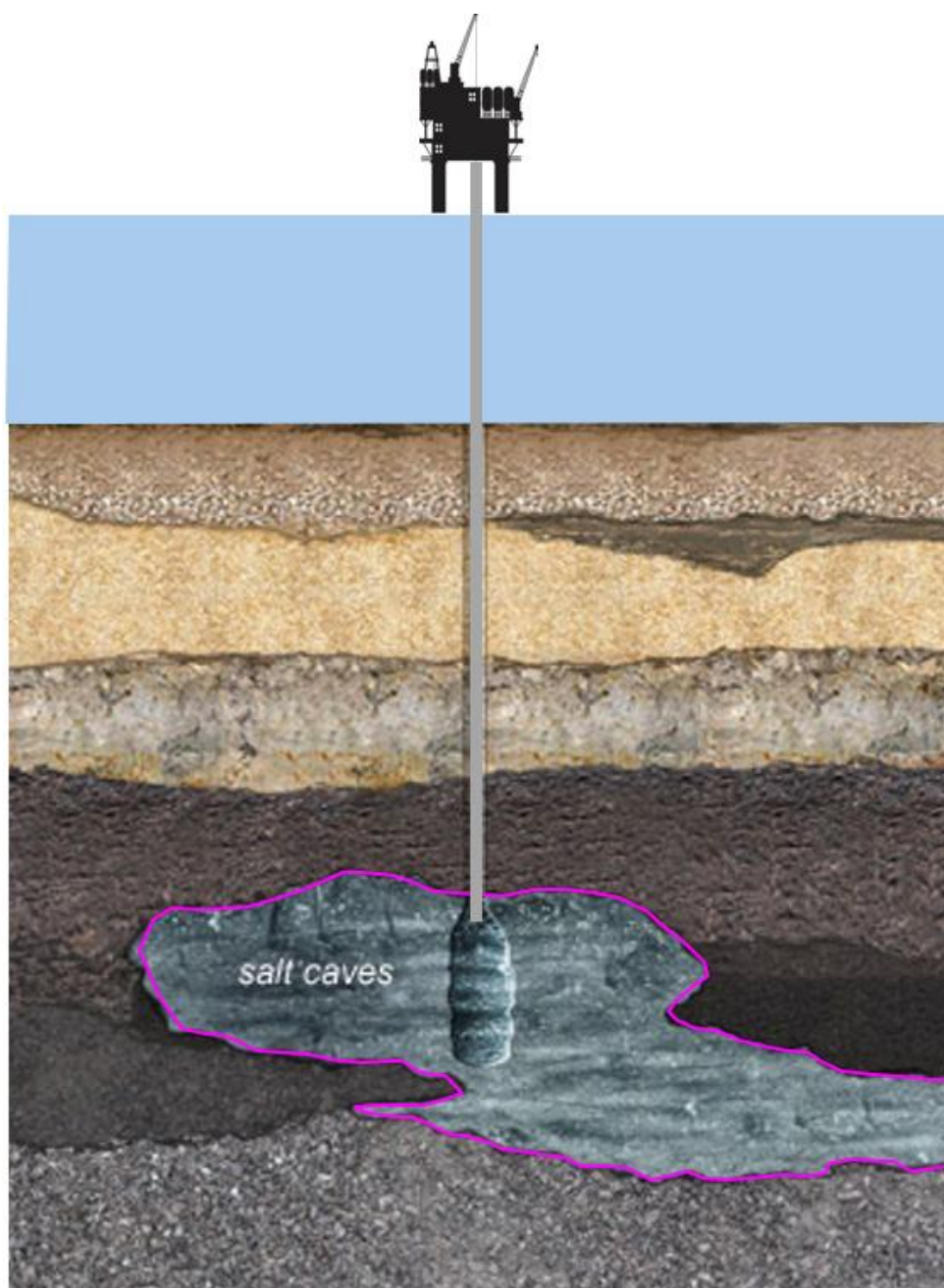


Figure 1 Schematic representation of a salt cavern below the seabed

The SEAI and Geological Survey of Ireland (GSI) funded a study to identify locations for hydrogen storage within salt with results published on the HYSS.ie website (Figure 2 to Figure 4). Analysis of these results yields four high-graded areas of suitable geology. The first between Wexford and Wales, the second coincident with the proposed licence area offshore Cork, and the third and fourth were further south of the second location. Upon review of the constraint maps provided with the SEAI/GSI study, the first location is located within a dense shipping zone and unsuitable for infrastructure development. Locations 2,3 and 4 have low shipping and low fishing densities, but only location 2 has sufficient existing data to provide confidence in the presence of salt – proven at 1,000m to 2,000m below the seabed.

Location 2 was thus chosen as the only viable location for further assessment of the extent and quality of salt for potential development of hydrogen salt cavern storage in Ireland.

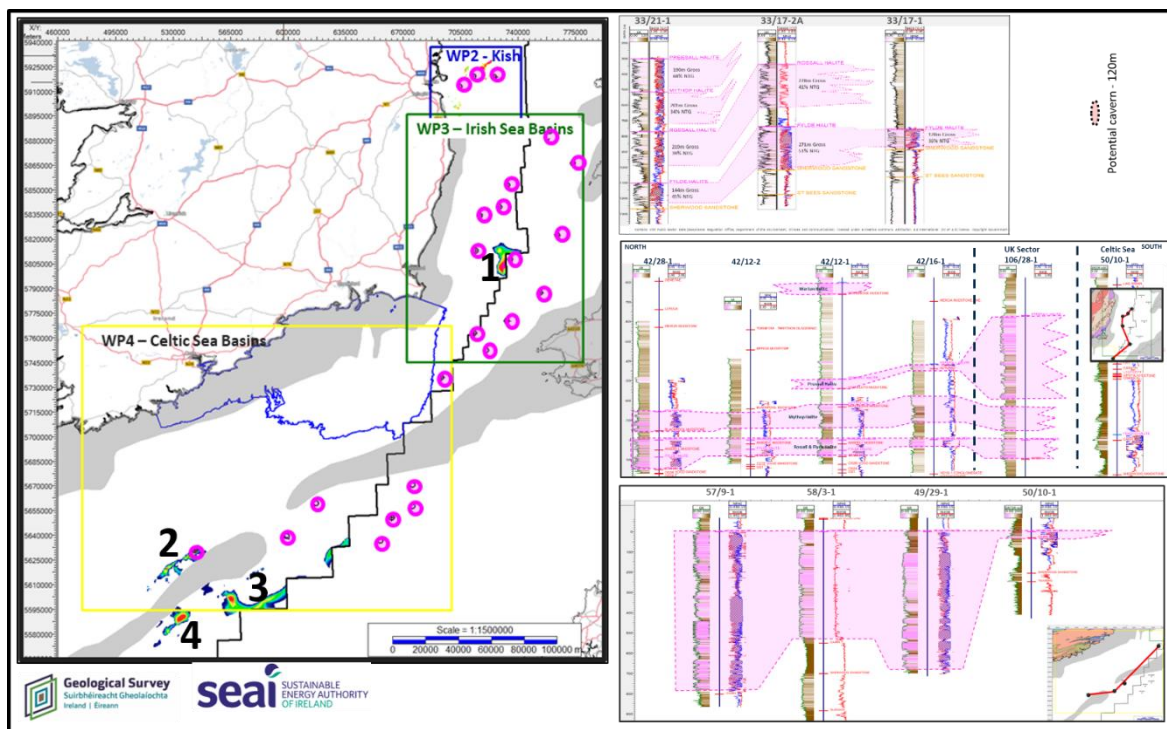


Figure 2 Map and cross-sections showing presence of salt in offshore wells, taken from HYSS.ie final reports.

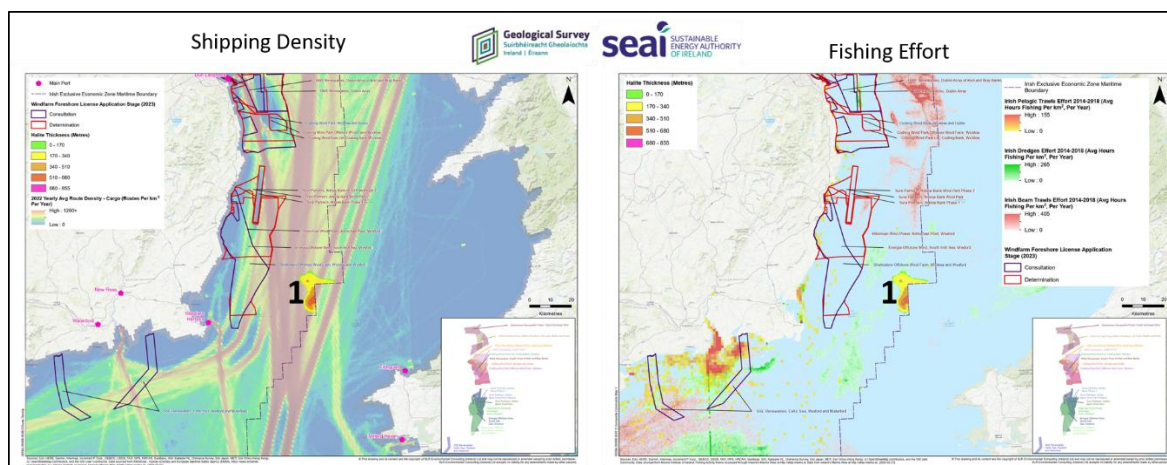


Figure 3 Location of halite southeast of Ireland with shipping density and fishing effort, taken from HYSS.ie final reports

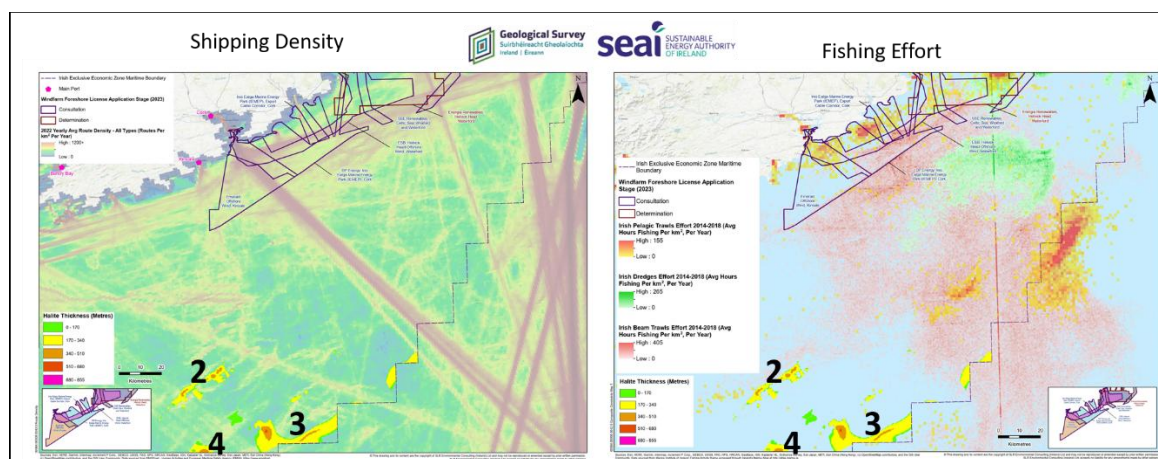


Figure 4 Location of halite south of Ireland with shipping density and fishing effort, taken from HYSS.ie final reports

To determine the viability of salt for salt cavern development, detailed high-resolution imagery is required of the rocks below the seabed. Of particular importance is the shape and thickness of the salt, as well as any internal changes within the salt, as these could render the salt unviable for cavern development. Imaging the base of salt layers is a particularly complex geophysical task due to the velocity of sound within salt versus other rocks.

While the area deemed to be the only viable location for salt cavern development is 40km long and 5km wide, only the core area of the salt is chosen for geophysical surveying, thus reducing the environmental impact of the geophysical surveying to the absolute minimum requirements. To image the core area (approximately 12km x 12km) to a depth of > 1,000m below the seabed, a seismic acquisition method is the only technology available, no other technology can image to this depth.

The Licence Area includes the vessel turning area; the underwater noise producing equipment will target the seismic survey area, which is a 12 km * 12 km area within the Licence Area, not the entire Licence Area. (Figure 5).

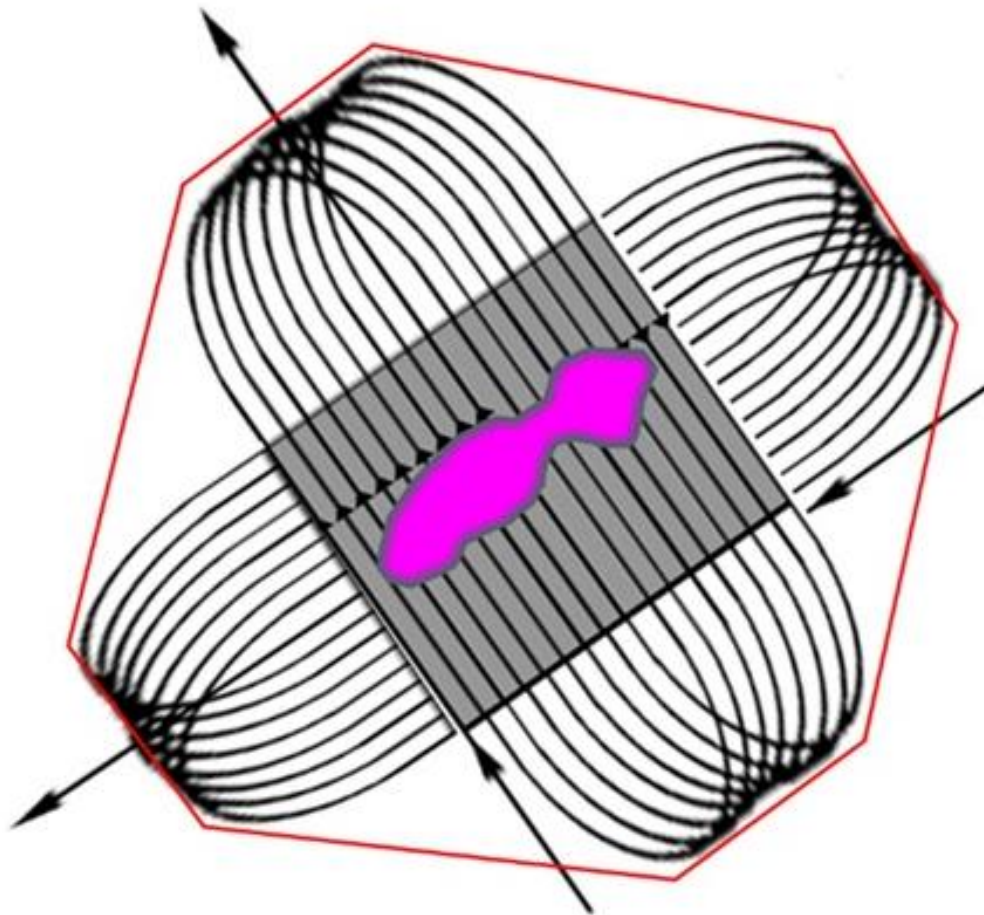


Figure 5 Schematic representation of seismic acquisition over a core area (pink) and the potential vessel movement tracks (black).

The overall Licence Area covers a total area of 1,481 km² and is outlined in red below (**Error! Reference source not found.**).

Error! Reference source not found. also highlights the area of interest for data collection (green) and available data for where similar historic site investigation campaigns were undertaken (blue). The approximate vessel operation areas for these historic survey campaigns (dashed ochre) are shown as these have informed the rationale for the proposed licence area boundary, given the area of interest for data collection shown in green below.

Note all proposed licensable activities will be conducted within the Licence Area below.

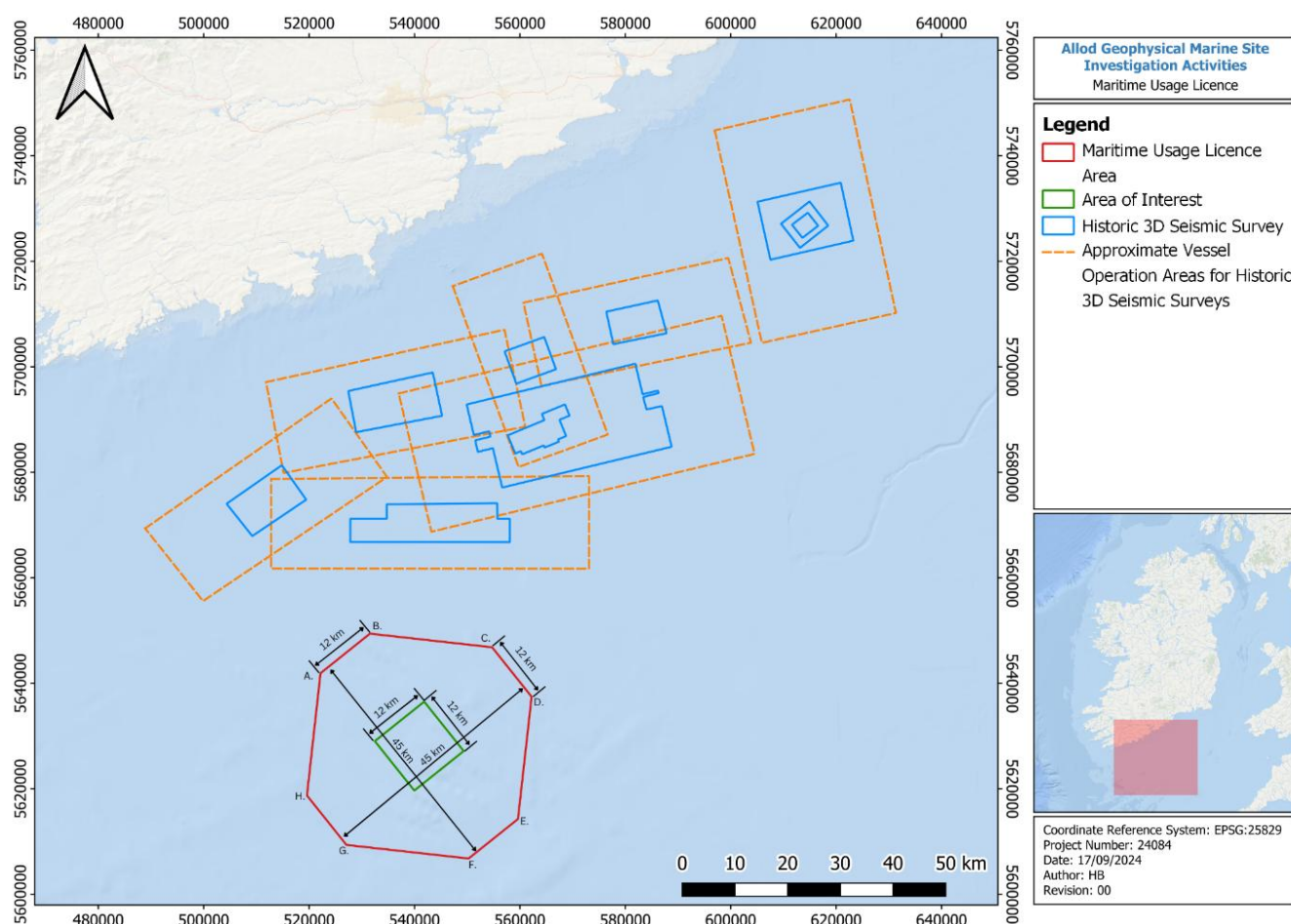


Figure 6 Illustrative Map of Allód Licence Area (red), Area of Interest (Green) and Other Historic Site Investigation Areas (Blue)

The applicant has considered the use of alternative methodologies including geotechnical survey approaches and other geophysical technologies including Sub-Bottom Profiling only. To image the area to the required depth of > 1,000m below the seabed, 3D seismic is the only technology available as no other technology can image to this depth. The objective of imaging halite at approximately 1,000m below the seabed requires this particular method of geophysical surveying technique, no alternatives are available.

The following survey design parameters have also been considered:

Reduced survey intensity

The proposed geophysical survey intends to deploy multiple geophysical tools simultaneously. While this is an increased intensity of equipment, it has been carefully considered and is being proposed to ensure the maximum data is being collected for the deployed vessel effort. It is anticipated that deploying additional geophysical tools will provide additional data earlier in the site evaluation, providing data for environmental analysis (e.g. seabed habitats and archaeological assessments) and removing the requirement for future surveys and their associated emissions (vessel noise, engine emissions) and environmental footprint. Reducing the intensity of this survey would thus have increased cumulative environmental impact.

Alternative equipment configuration

The applicant has reviewed the available equipment configurations within the industry and focused on equipment configurations that maximize the data acquisition on each pass, thus reducing survey effort duration and minimising the period over which noise will be emitted to the marine environment. Smaller towed configurations, which would have a smaller turning circle, were discounted as they require increased number of vessel passes over the proposed area, thus resulting in relatively more acoustic noise and vessel emissions. The proposed configuration requires a larger turning circle than a smaller towed configuration, but results in faster acquisition mode and shorter survey duration. While the proposed area of vessel operations is large (to accommodate the wide turn) the equipment configuration proposed yields lower noise emissions.

Reduced survey footprint

Only the core area of the interpreted salt ridge has been selected for geophysical imaging, thus ensuring minimal environmental impact. The actual acquisition target is significantly smaller than the licence area as the licence area allows for expected vessel manoeuvres with towed equipment.

By applying for this larger area, we are giving clear information to other marine users on the potential wide area of vessel movements associated with the geophysical survey.

Lower intensity acoustic acquisition

The applicant has considered lower intensity acoustic acquisition; comprehensive testing was completed in an adjacent area of the Celtic Sea in 2009, where the airgun intensity was varied down to 3,500cu.in. On-board results witnessed by Galetech's geophysical expert showed that lower intensity airguns resulted in significantly lower depth of penetration/imaging.

As the key objective of this geophysical survey is to image the salt presence and internal characteristics at >1,000m below seabed, the only available technology to meet the project data requirements is an airgun array of c. 4500 cubic inches (cu.in.) volumetric capacity.

The proposed survey thus represents the most efficient survey design, reducing operational time, vessel emissions and duration of noise emissions. This proposed survey has been reduced to the minimal required area, thus ensuring minimal environmental impact.

It should be noted that the last seismic survey conducted in Ireland's offshore waters (TGS Crean 3D) had a target area 20 times larger than this proposed survey.

3 PROPOSED SEISMIC SURVEY ACTIVITY

To effectively image the base of the salt and its internal characteristics, the seismic acquisition must record data approximately 5km beyond the targeted core area. Beyond this area the vessel requires space to conduct wide radius turning operations, thus the MUL application area spans a total of 1,481 km² (148,100 hectares). By applying for this larger area, we are giving clear information to other marine users on the potential wide area of vessel movements associated with the geophysical survey.

The proposed marine geophysical site investigation will be undertaken using a suite of established seismic and non-seismic survey technologies to characterise subsurface geological conditions within the survey area.

Seismic acquisition involves an airgun array emitting low-frequency sounds in a downward direction, to image the geological structure of the below seabed. The proposed survey will involve a 15m x 15m array of approximately 40 small airguns with a combined volumetric capacity of c. 4500 in³ which will generate sound suitable for collecting data about the seabed and subseafloor features. The sound returned from the seabed and subseafloor is recorded by a series of hydrophones encased within streamers which are towed behind the airgun array (



Figure 7).

The survey is anticipated to utilise 10 streamers, each up to 8 km in length, with a 100 m spacing between each streamer, giving a total width of 1 km and total length of up to 8 km, totalling over

10,000 hydrophones which continuously record sound. An offshore seismic vessel will be used (**Error! Reference source not found.**).

As highlighted in Table 3.1 of the RAAIVS (reproduced below as Table 1), sound emitted from the airgun array will be audible to low and mid frequency cetaceans but not to high frequency cetaceans such as harbour porpoise. However, high-frequency cetaceans can still be affected by airgun noise due to the broad spectrum of impulsive sound emissions; while the primary frequencies produced by airguns are outside their optimal hearing range, some components of the sound can overlap with the higher frequencies they detect.

Conversely, sound emitted from SBP (Parametric Pinger) and SSS will not be audible to low frequency cetaceans.

Owing to different frequency ranges and sound output levels, received sound levels associated with the listed survey technologies will not induce PTS or TTS across all technologies for all species.

Simultaneous deployment of all listed survey technologies will therefore not result in a linear increase in PTS or TTS to these species, and the proposed mitigation measures are considered sufficient to reduce the risk of injury from simultaneous deployment of all listed survey technologies.

Table 1 Annex IV species auditory band width and relevant surveys (reproduced from RAAIVS).

Hearing Frequency Group	Estimated Auditory Band Width (kHz)	Audible Survey	Surveys inducing PTS and/or TTS
Low Frequency Cetaceans Baleen whales (fin, minke, humpback whale)	0.007 – 35	SBP (Sparker) SBP (Boomer) USBL Vessel Noise Airgun Array	SBP (Sparker) Airgun Array
Mid Frequency Cetaceans Most toothed whales and dolphins (bottlenose, common & Risso's dolphin, killer & pilot whale)	0.15 - 160	SBP (Parametric Pinger) SBP (Sparker) SBP (Boomer) USBL Vessel Noise SSS Airgun Array	SSS SBP (Parametric Pinger) SBP (Sparker) Airgun Array
High Frequency Cetaceans Certain toothed whales and porpoises (harbour porpoise)	0.2 - 180	SBP (Parametric Pinger) SBP (Sparker) SBP (Boomer)	SSS SBP (Parametric Pinger) SBP (Sparker)

Hearing Frequency Group	Estimated Auditory Band Width (kHz)	Audible Survey	Surveys inducing PTS and/or TTS
		USBL Vessel Noise SSS	SBP (Boomer) USBL Airgun Array ^δ

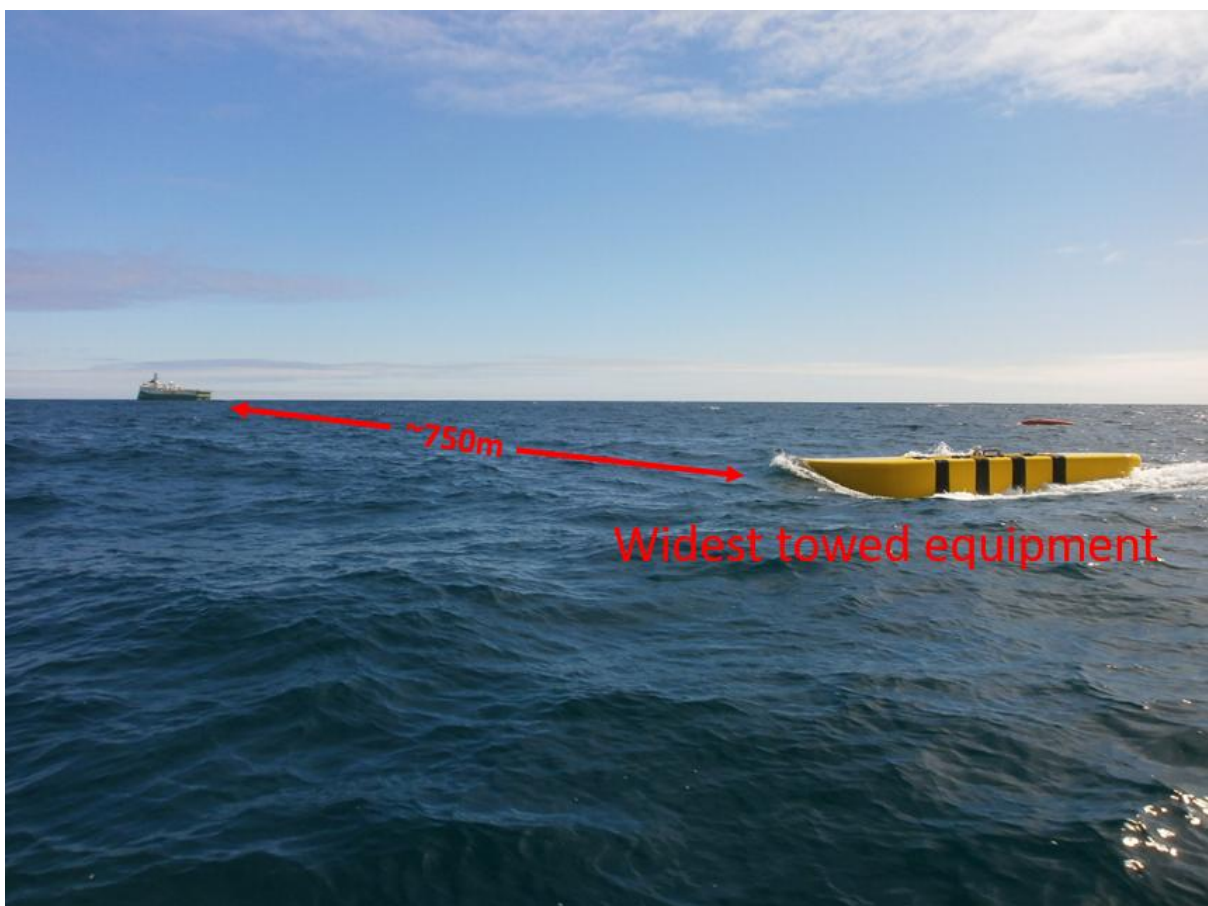


Figure 7 Seismic survey operations being conducted offshore Ireland in 2009. The towed equipment was 1,500m wide and 8,000m long.



Figure 8 Modern seismic survey vessel

4 ECOLOGICAL INFORMATION

As part of the MUL application a Risk Assessment for Annex IV Species was undertaken and is included in **Appendix B** of the Supporting Information document. Supplementary information is included here.

The Risk Assessment for Annex IV Species was completed in 2024 and did not include the Observe II survey results. Abundance estimates from Observe II surveys and other relevant regional datasets are summarised in Table 2 below and have been used to derive information on the population of the species that is subject to this application that may be impacted by the proposed activity (Table 3).

Note, for ObSERVE II densities, no corrected model-based abundance estimates were generated due to the low number of sightings for white-sided and white-beaked dolphin (*Lagenorhynchus* spp.), Risso's dolphin (*Grampus griseus*), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*) and sperm whale (*Physeter macrocephalus*). Long-finned pilot whales (*Globicephala melas*) and all beaked whales including Cuvier's beaked whale (*Ziphius cavirostris*) were exclusively seen in Strata 1, 2 and 3.

Table 2 Densities and reference populations for cetacean species in the Licence Area

Species	Management Unit (MU)	Population in MU (Confidence Interval (CI))	Density (animals/km ²) – Corrected model-based estimates	
			ObSERVE Phase II (Stratum 4)	ObSERVE Phase II (Stratum 6C)
Harbour Porpoise	Celtic and Irish Sea (CIS)	62,517 (48,324 – 80,877)	0.0628 (summer 2021) 0.033 (summer 2022) 0.023 (winter 2022)	0.1084 (summer 2021) 0.053 (summer 2022) 0.058 (winter 2022)
Bottlenose Dolphin	Offshore Channel, Celtic Sea & SW England (OCSW)	10,653 (6,533 – 17,372)	0.118 (summer 2021) 0.126 (summer 2022) 0.129 (winter 2022)	N/A
Common Dolphin	Celtic and Greater North Sea (CGNS)	102,656 (58,932 – 178,822)	2.447 (summer 2020) 2.213 (summer 2022) 0.758 (winter 2022)	2.402 (summer 2021) 1.534 (summer 2022) 0.921 (winter 2022)
Minke Whale	Celtic and Greater North Sea (CGNS)	20,118 (14,061 – 28,786)	0.021 (summer 2021) 0.012 (summer 2022) - N/A (winter 2022) – no abundance estimates generated due to low no. of sightings.	Not recorded in Stratum 6C

JNCC (2025)¹ describes estimated distances to the behavioural thresholds for two sound measurement studies (Hermannsen et al. 2015 and Confidential, 2020b) ranging from 1.6 km for a single airgun (40 in³) to 14.7 km for arrays with volumes 3,500 – 7,000 in³. Reported distances to behavioural thresholds from modelling studies reviewed in Majewska et al. (2025) were up to 12.4 km, for arrays larger than 3,390 in³ (OPRED 2019, 2020, 2021a, 2021b).

Considering that a c. 4500 in³ array is proposed, a 14.7 km buffer (i.e. the maximum distance to behavioural threshold stated above) has been applied to the Licence Area to provide a conservative area where the population of the species that are subject to this application may be impacted by the proposed activity of 4,225.2 km².

Please note the Licence Area includes the vessel turning area; the underwater noise producing equipment will target the seismic survey area, which is a 12 km * 12 km area within the Licence Area, not the entire Licence Area. This approach is therefore considered well aligned with the precautionary principle.

Table 3 Population of the species that are subject to this application that may be impacted by the proposed activity (ObSERVE II densities – Strata 4 and 6C from summer '21 and '22)

Species	Strata 4 and 6c		Density (ind./km ²)	Area of impact (km ²)	Potential No. of individuals impacted	MU population and Confidence Interval (CI)	Potential % MU population impacted
Harbour porpoise	Stratum 4	Summer '21	0.0628	4225.2	266	62,517 (48,324 – 80,877)	0.43
		Summer '22	0.033		140		0.22
	Stratum 6C	Summer '21	0.1084		459		0.73
		Summer '22	0.053		224		0.36
Bottlenose dolphin	Stratum 4	Summer '21	0.118	4225.2	499	10,653 (6,533 – 17,372)	4.68
		Summer '22	0.126		533		5
	Stratum 6C	Summer '21	N/A		-		-
		Summer '22	N/A		-		-
Common dolphin	Stratum 4	Summer '21	2.447	4225.2	10,340	102,656 (58,932 – 178,822)	10.07
		Summer '22	2.213		9,351		9.11

¹ [JNCC Report 803. Updated Effective Deterrent Ranges \(EDRs\) for assessing the significance of noise disturbance in harbour porpoise Special Areas of Conservation \(SACs\) \(England, Wales & Northern Ireland\)](#)

GEOSOLUTIONS

Species	Strata 4 and 6c		Density (ind./km ²)	Area of impact (km ²)	Potential No. of individuals impacted	MU population and Confidence Interval (CI)	Potential % MU population impacted
	Stratum 6C	Summer '21	2.402		10,149		9.89
		Summer '22	1.534		6,482		6.31
Minke Whale	Stratum 4	Summer '21	0.021	4225.2	89	20,118 (14,061 – 28,786)	0.44
		Summer '22	0.012		51		0.25
	Stratum	Summer '21	N/A		-		-
		Summer '22	N/A		-		-

Harbour Porpoise MU pop. = Celtic and Irish Seas (CIS)
Bottlenose Dolphin MU pop. = Offshore Channel and South West England (OCSW)
Common Dolphin MU pop. = Celtic & Greater North Seas (CGNS)
Minke Whale MU pop. = CGNS

The population estimates included within the RAAIVS are for the Celtic Sea and based on Observe I data, whereas the species density data provided in this Supplementary Information Document are derived from the more recent Observe II survey data and provide species density at a more localised scale. Species abundance has been provided at the management unit level for context, on the assumption that the density in the management unit area is in line with the density observed throughout the survey area. We note that the Observe II densities for common dolphin are higher than the Observe I density.

As described in the Supporting Information document and the RAAIVS which accompanies this application, mitigation will be implemented in accordance with Guidance to Manage the Risk to Marine Mammals from Man made Sound Sources in Irish Waters (DAHG, 2014).

The proposed mitigation measures, which are widely applied to minimise harm to marine mammals from seismic and geophysical surveys in Irish and EU waters, substantially reduce the risk of injury and limit effects to short term behavioural responses, with animals returning to baseline behaviour following cessation of activity.

As the mitigation measures will substantially reduce the risk of injury and limit effects to short term behavioural responses, there will be no adverse effects at the population level for any of the species potentially impacted by the proposed activities.

No evidence of breeding, calving, resting or other sensitive life cycle areas for Annex IV species within the survey area has been identified.

With mitigation implemented as outlined in the RAAIVS, the activity will not result in a reduction in population size, range, or reproductive success of these species. The derogation will not be detrimental to the maintenance of these species at favourable conservation status within their natural range.

Marine mammal monitoring and associated reporting will be implemented as outlined in the RAAIVS and will verify whether the derogations have been implemented correctly. These measures will provide scientifically based evidence that the derogation has been implemented correctly and will facilitate implementation of corrective measures, if necessary and where required.

