Iolar Exploration Well – Underwater Archaeological Assessment

Document No: **IE-EXP-52/04-IOLAR-HS-00022-RP-01**

Rev: **U1**

Rev	Date	Reason for Revision
U1	05/11/2018	Issued for Use
R1	01/11/2018	Issued for Review

Authorisation Record		Lead Environmental Consultant	Environmental Specialist	Environmental Specialist
		Xodus Signed	Xodus Signed	Xodus Signed
U1	05/11/2018	Annette Woodham	Marten Meynell	Annette Woodham
Rev	Date	Prepared by	Checked by	Approved by

Iolar Exploration Well

Underwater Archaeological Assessment.

Nexen Petroleum UK Ltd

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

Xodus Group
The Auction House, 63A George St
Edinburgh, UK, EH2 2JG

T +44 (0)131 510 1010
E info@xodusgroup.com
www.xodusgroup.com

Underwater Archaeological Assessment.

A100460-S00

Client: Nexen Petroleum UK Ltd
Document Type: Technical Note
Document Number: A-100460-S00-TECH-002

			Annette Woodham Digitally signed by Annette Woodham Date: 2018.11.06 14:12:01 Z	Marten Meynell Digitally signed by Marten Meynell Date: 2018.11.06 14:23:29 Z	Annette Woodham Digitally signed by Annette Woodham Date: 2018.11.06 14:12:17 Z	
A01	05/11/2018	Issued for Use	AW	MM	AW	
R01	01/11/2018	Issued for Review	PTa	AW	AW	-
Rev	**Date**	**Description**	**Issued By**	**Checked By**	**Approved By**	**Client Approval**

CONTENTS

1 INTRODUCTION

1.1 Background

Nexen Petroleum U.K Ltd (Nexen) plans to drill a single exploration well in the Iolar prospect in Frontier Exploration Licence (FEL) 3/18. The proposed Iolar well is located in Block 52/04 on the western side of the Porcupine Seabight, approximately 232 km off the south-west coast of Ireland in 2,162 m water depth (Figure 1.1).

This document presents an Underwater Archaeological Assessment and has been prepared to fulfil drilling approval requirements as set out by the Petroleum Affairs Division (PAD) of the Department of Communications, Climate Action and Environment (DCCAE).

The proposed Iolar well lies within the Irish Offshore Strategic Environmental Assessment area 2 (IOSEA2) conducted in 2007 for the Porcupine Basin area, and the later IOSEA5 carried out in 2015 covering the whole of Ireland's offshore area. An Environmental Risk Assessment (EIA Screening) Report (Nexen, 2018) has been prepared and submitted to PAD and is referenced where relevant in this document, rather than repeating information already provided. Nexen has considered the potential for any impacts on underwater archaeological features as an integral part of the overall environmental risk assessment process, including during the Iolar ENVID (environmental issues identification) workshop attended by key project personnel. The potential presence of features of archaeological significance in the Project area is informed by a detailed site survey commissioned by Nexen in 2017, as described below in Section 2.2.

1.2 Project overview

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

The exploration well will be drilled by the IceMAX floating drill ship with drilling operations expected to start in April 2019. The total duration of the drilling and abandonment operations (on location) is expected to be around 100 to 150 days. The drill ship will maintain position over the drilling location using a dynamic positioning (DP) system, which means that no anchors are required to hold the drill ship in position. A description of the drilling activities is provided in Nexen (2018).

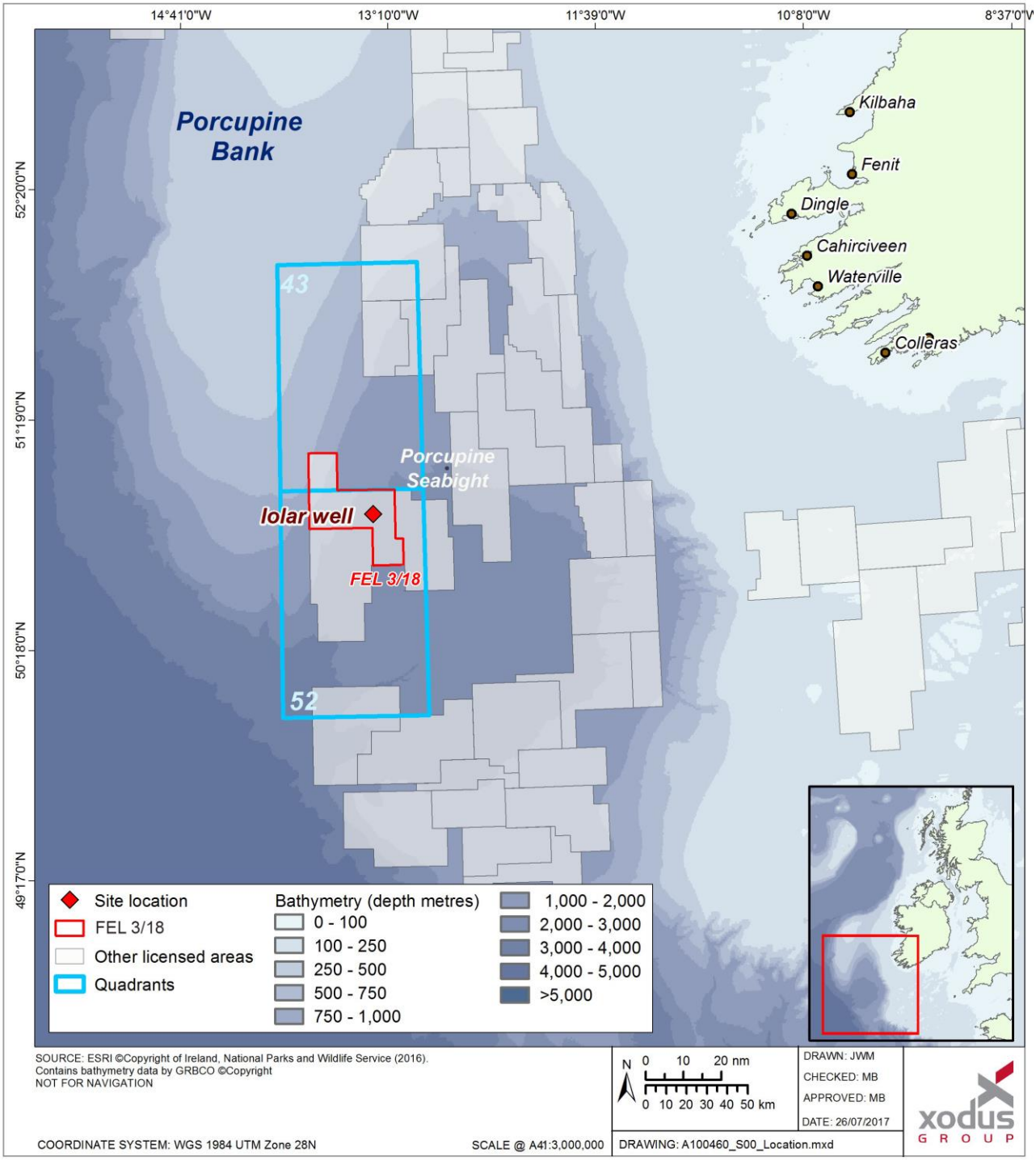


Figure 1.1 Project Location

2 ARCHAEOLOGICAL BASELINE ENVIRONMENT

2.1 Published information

The current Irish coastline may potentially contain a rich variety of archaeological remains; the understanding of this marine archaeological heritage is being continually expanded by the work of a number of national research institutes. The locations of now submerged human activity have not been fully quantified but are likely to be restricted to sheltered areas relatively close to the Irish coast. Surveys of intertidal areas of the Shannon estuary have recovered artefacts and remains indicating the presence of Mesolithic and Neolithic human occupation in these areas. Discoveries on this scale may, however, be isolated cases, as the vigorous wave climate and current regime experienced by much of the Irish continental shelf is not conducive to the preservation of submerged remains (Hartley Anderson, 2005).

The Iolar well is located offshore in deep water (water depth of 2,162 m). The sea states experienced in and around the Porcupine Seabight are amongst the highest and/or roughest of all the coastal waters bordering Ireland and the British Isles. The underlying general pattern of oceanic water mass circulation around Ireland's Atlantic margin include the near surface current from north to south from the northern edge of the Porcupine Seabight to the Porcupine Abyssal Plain. Deep-water currents bring Arctic water southwards beyond the continental slope (DCENR, 2015).

Such areas are unlikely to support significant archaeological resources as historically they have not been subject to any major human use (DCENR, 2007), and shipwrecks are likely to represent the chief archaeological resources in the deeper areas west of Ireland (Hartley Anderson, 2005).

There are known to be thousands of shipwrecks in Irish waters that represent an important legacy of historical maritime activity. The majority of wrecks around the Irish coast lie in inshore areas in depths of less than 50 m, as a result of the greater number of navigational hazards and risks to ships in close proximity to the coast (DCENR, 2015). The Irish National Seabed Survey (INSS) identified a large number of wrecks in inshore areas (INFOMAR, 2018), but none offshore or in deep waters including the Porcupine Seabight. However, DCENR (2015) illustrates the locations of wrecks within the Porcupine Seabight and other offshore areas, although none within the proximity of the Iolar well location. Wrecks in these deeper areas are generally assumed to be associated with fishing, trade routes and war casualties (DCENR, 2015).

The National Monuments Service Wreck Inventory of Ireland Database (WIID) provides the locations of wrecks within the Porcupine Seabight (National Monuments Service, 2018); these are displayed on Figure 2.1. Of these, the nearest wrecks to the Iolar well are the *Mentor* and the *Annet Lyle*; these are located 8.4 km to the south and 10.8 km to the south east, and are from 1886 and 1891, respectively.

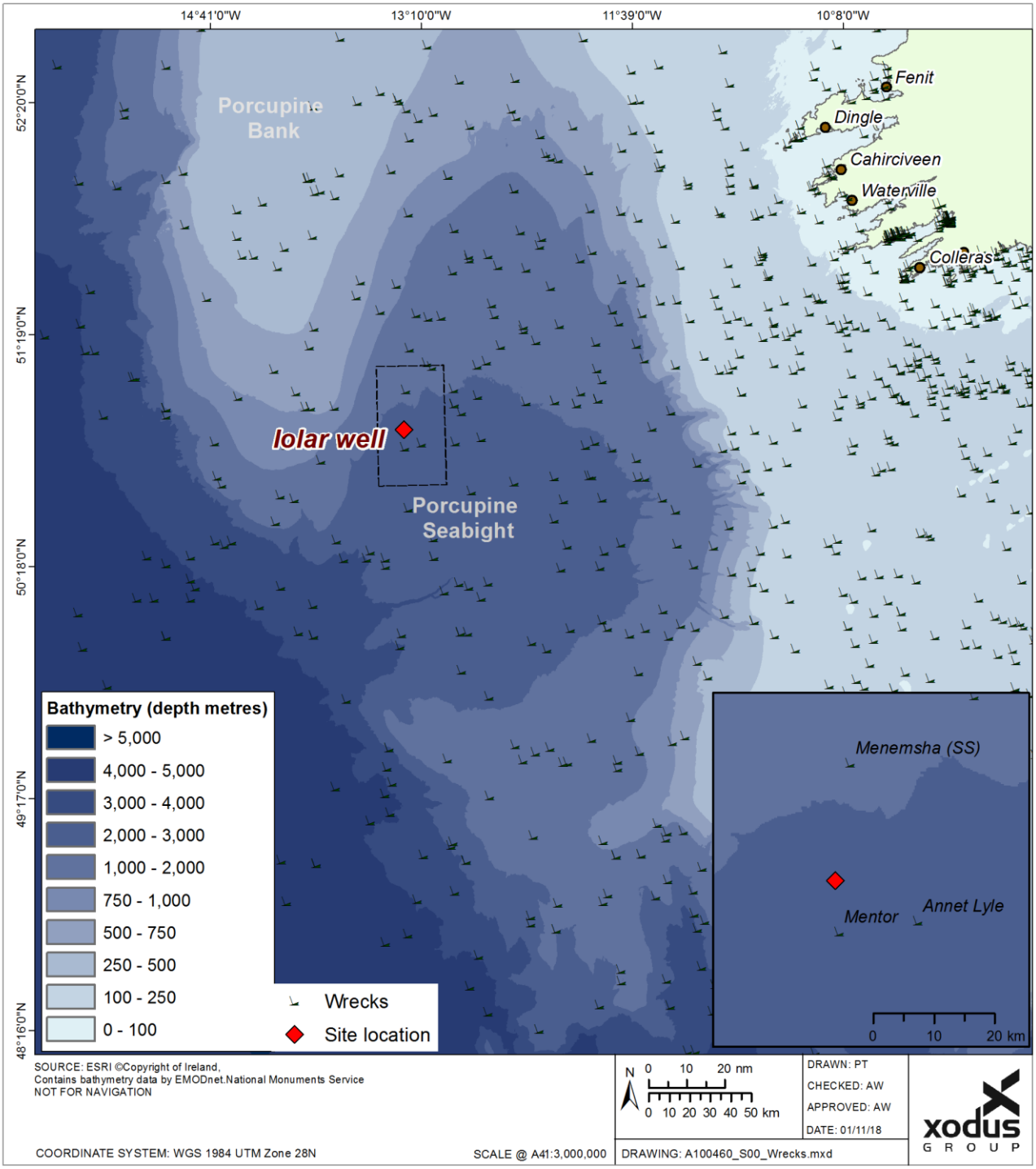


Figure 2.1 Locations of wrecks (National Monuments Service, 2018)

2.2 Iolar well site survey

2.2.1 Summary of survey methods

Nexen commissioned Fugro to undertake a site survey around the proposed Iolar well location in July 2017. The site survey consisted of a shallow geophysical survey over a 5 x 1.8 km area centred on the proposal Iolar well location, together with ground-truthing provided by seabed video and stills photography and environmental seabed sampling.

The shallow geophysical survey programme comprised 21 main lines 5.05 km in length with 50 m and 100 m line spacing and 11 crosslines 1.85 km in length with 500 m line spacing (Figure 2.2). Shallow geophysical data were acquired using autonomous underwater vehicle (AUV)-mounted multibeam echo sounder (MBES), high and low frequency sidescan sonar at ~200 m range and chirp sub-bottom profiler (SBP). The identification of seabed obstructions and existing infrastructure, which will include shipwrecks, was one of the objectives of the site survey.

The PAD Rules and Procedures Manual (PAD, 2014) provides guidelines for high-resolution route surveys to archaeological standards in water depths of less than 50 m. Although the site survey was undertaken in seawater much deeper than 50 m, a comparison of these requirements, with what was undertaken in the Iolar site survey (as reported in Fugro, 2017) is provided in Table 2.1 to provide an indication of the suitability of the methods used. Quinn (2004) provides a discussion of the acquisition and interpretation of geophysical data for archaeological assessment during oil industry geophysical route and site surveys in water depths exceeding 50 m.

Table 2.1 Comparison of the PAD (2014) guidelines for high-resolution route surveys to archaeological standards in water depths of less than 50 m and equipment used for the Iolar site survey (Fugro, 2017)

PAD guidance	Iolar site survey
Methodologies • Single beam echo sounder • High frequency (=500 kHz) sidescan sonar • High-resolution proton or caesium magnetometer • High-resolution sub-bottom profiler.	• AUV-mounted multibeam echo sounder (multi- rather than single-beam echo sounder which will produce a more detailed image) • High frequency side scan sonar used ranged from 120 – 400 kHz • No magnetometer used • Chirp sub bottom profiler used with high resolution (10-30 cm).
Line Spacing Line spacing will be set to ensure full sidescan sonar coverage of the full width of the proposed corridor (defined by the route deviation limits) within which it is proposed the pipe or cable will be laid and any adjacent anchoring swathe.	Survey area of 5 x 1.8 km covered the whole of the proposed Project area, including the proposed well location, the potential location of a relief will in the unlikely event of this being required, and the area of deposition of drill cuttings. Survey included main lines 5.05 km in length, at 50 m and 100 m line spacing and 11 crosslines 1.85 km in length at 500 m line spacing centred around the proposed well location
Positioning DGPS will be used as the primary navigation system.	Starfix DGPS used

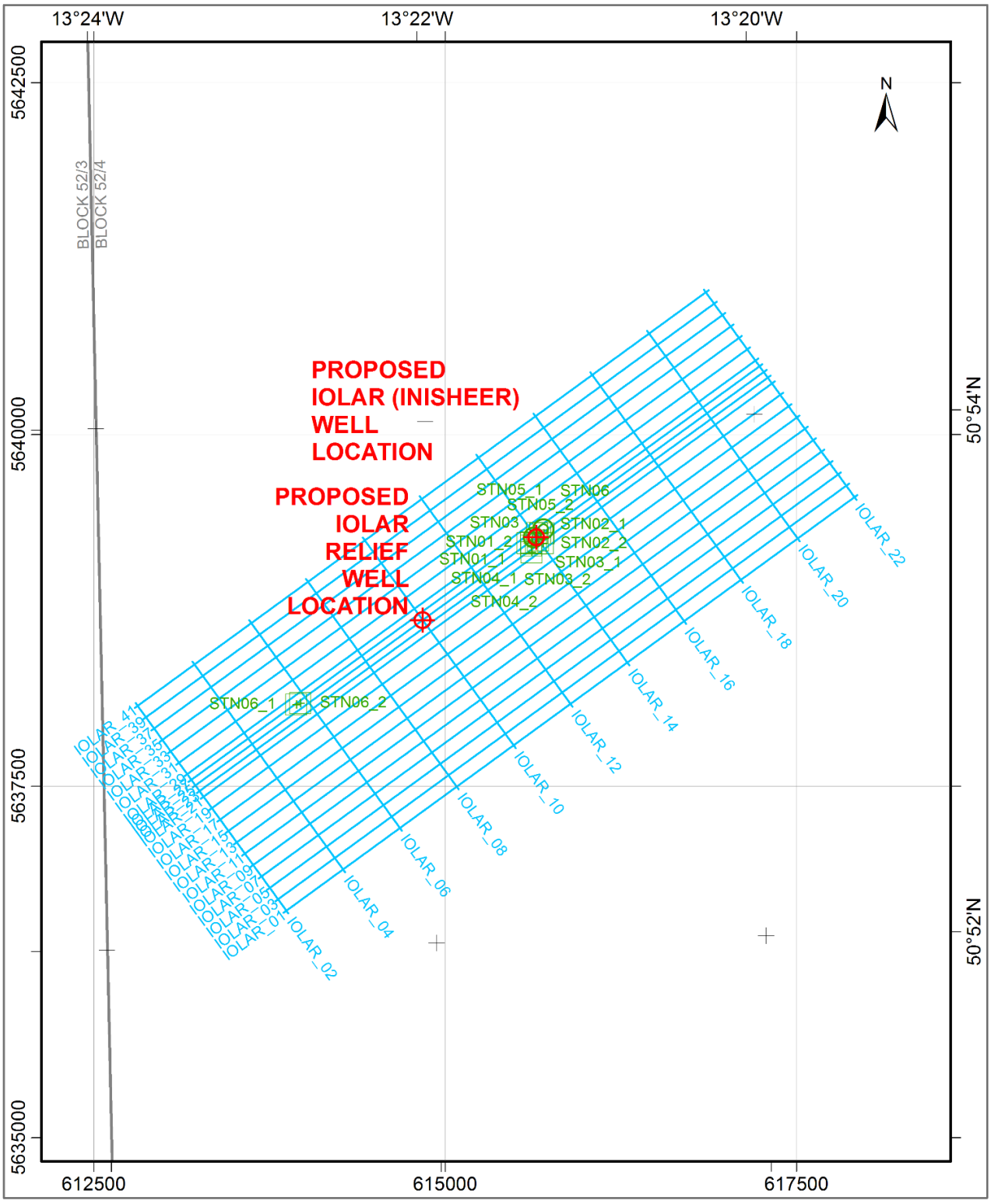


Figure 2.2 Geophysical Survey Programme

2.2.2 Survey results relevant to archaeological assessment

The seabed within the survey area exhibited uniformly low acoustic reflectivity in the sidescan sonar data and is interpreted to comprise extremely low strength slightly sandy clayey silt. The sediment description is based on a combination of sidescan sonar reflectivity, geotechnical sampling and environmental camera footage. An example of the sidescan sonar data is shown in Figure 2.3.

The interpretation of the marine geophysical data obtained within the survey areas by Fugro (2017) identified the following seabed features and obstructions: 18 boulders and one mound; however, no shipwrecks were identified. Tables showing all anomalies detected, together with their dimensions, co-ordinates and location relative to the Iolar well and potential relief well locations are shown in Table 2.2. The mapped locations are shown on the seabed features chart in Appendix A.

The sub-seabed conditions were interpreted from AUV-mounted chirp SBP and existing 3D seismic data. The only anomalies detected in the shallow subsea were interpreted as diffuse gas.

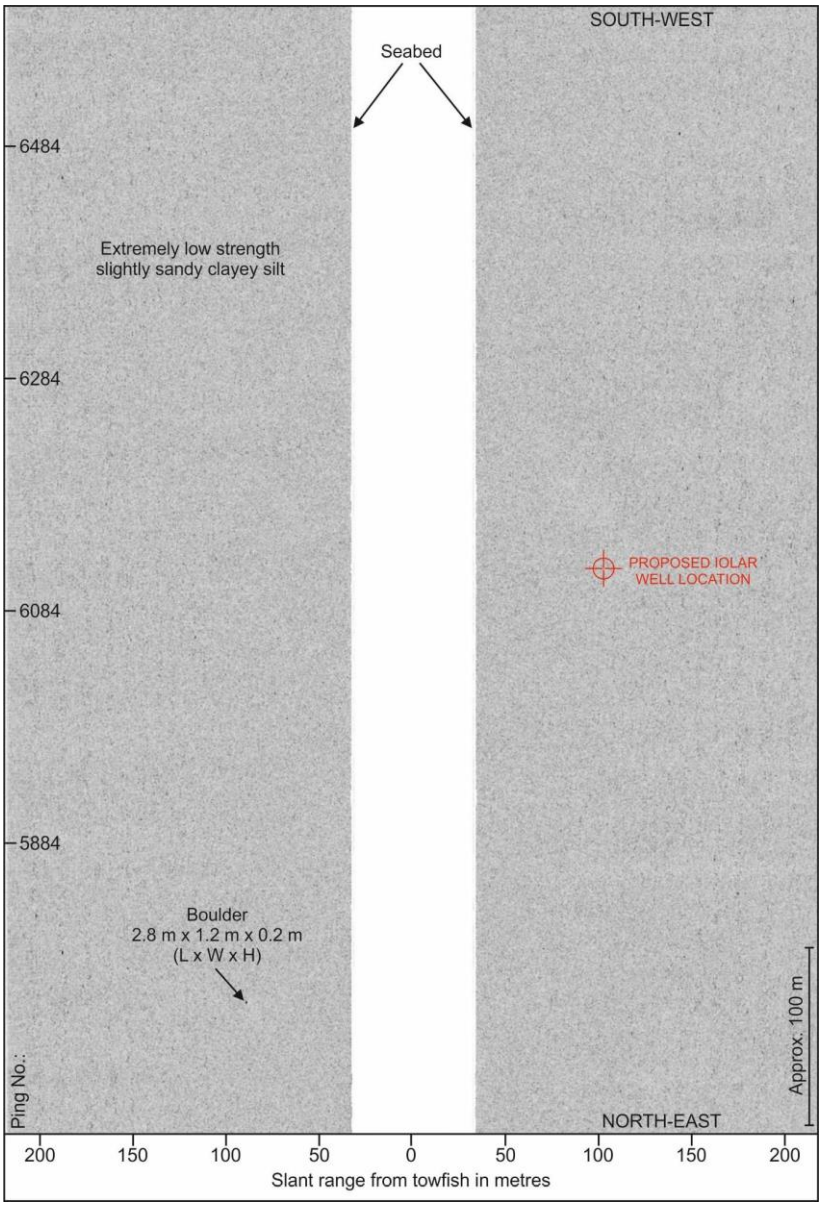


Figure 2.3 AUV mounted sidescan sonar data example at the proposed Iolar Well location (Fugro, 2017)

Table 2.2 Seabed obstructions within the survey area and position relative to the Iolar well location (top) and the relief well location (bottom) (Fugro, 2017)

Geodetic Datum ED50, UTM Zone 28N, 15°W						
Description	Easting [m]	Northing [m]	Dimensions			Distance [m] and direction from proposed Iolar Well location
			Length [m]	Width [m]	Height [m]	
Boulder	613 729	5 636 969	2.1	1.1	NMH	2995 SW
Boulder	613 726	5 636 967	2.8	1.3	0.3	2998 SW
Mound	614 430	5 638 460	23.0	21.0	0.6	1462 SW
Boulder	615 942	5 639 257	2.8	1.2	0.2	294 E
Boulder	613 073	5 637 935	2.1	0.8	0.2	2900 SW
Boulder	613 136	5 637 668	1.8	1.5	NMH	2979 SW
Boulder	613 870	5 638 249	1.8	1.0	NMH	2049 SW
Boulder	613 859	5 637 489	2.0	1.5	0.2	2523 SW
Boulder	614 129	5 637 213	2.4	1.3	NMH	2555 SW
Boulder	614 227	5 638 385	1.6	1.3	NMH	1673 SW
Boulder	614 247	5 638 385	1.6	1.0	NMH	1656 SW
Boulder	615 107	5 638 873	1.6	0.9	NMH	669 SW
Boulder	615 702	5 639 785	2.0	1.3	0.2	520 N
Boulder	615 702	5 639 788	2.2	1.0	0.2	523 N
Boulder	616 511	5 640 731	2.2	1.3	0.0	1698 NE
Boulder	617 367	5 640 166	2.0	1.0	0.6	1940 NE
Boulder	616 636	5 640 095	2.1	0.8	NMH	1289 NE
Boulder	616 546	5 640 030	2.1	0.9	0.3	1177 NE
Boulder	616 645	5 640 005	1.6	1.0	0.4	1239 NE

Geodetic Datum ED50, UTM Zone 28N, 15°W						
Description	Easting [m]	Northing [m]	Dimensions			Distance [m] and direction from proposed Iolar Well location
			Length [m]	Width [m]	Height [m]	
Boulder	613729	5636969	2.1	1.1	NMH	2040 SW
Boulder	613726	5636967	2.8	1.3	0.3	2043 SW
Mound	614430	5638460	23.0	21.0	0.6	465 SW
Boulder	615942	5639257	2.8	1.2	0.2	1245 NE
Boulder	613073	5637935	2.1	0.8	0.2	1917 SW
Boulder	613136	5637668	1.8	1.5	NMH	1982 SW
Boulder	613870	5638249	1.8	1.0	NMH	1060 SW
Boulder	613859	5637489	2.0	1.5	0.2	1542 SW
Boulder	614129	5637213	2.4	1.3	NMH	1630 SW
Boulder	614227	5638385	1.6	1.3	NMH	680 SW
Boulder	614247	5638385	1.6	1.0	NMH	661 SW
Boulder	615107	5638873	1.6	0.9	NMH	331 NE
Boulder	615702	5639785	2.0	1.3	0.2	1402 NE
Boulder	615702	5639788	2.2	1.0	0.2	1404 NE
Boulder	616511	5640731	2.2	1.3	0.0	2646 NE
Boulder	617367	5640166	2.0	1.0	0.6	2933 NE
Boulder	616636	5640095	2.1	0.8	NMH	2287 NE
Boulder	616546	5640030	2.1	0.9	0.3	2176 NE
Boulder	616645	5640005	1.6	1.0	0.4	2240 NE

3 ASSESSMENT OF POTENTIAL IMPACTS ON MARINE ARCHAEOLOGY FEATURES

3.1 Description of the potential impacts

Marine archaeological features have the potential to be impacted when the elements of the Project interact with the seabed, as this is where the archaeological features, if present would be located. As outlined in Nexen (2018), the key activities of the Project which could result in interactions with the seabed are:

1. Spudding the well, cementing the 36" conductor pipe and installing the wellhead and blow out preventer;
2. The deposition and settlement of drill cuttings and drilling muds onto the seabed; and
3. Severing the wellhead prior to well abandonment.

The potential impact on the seabed of the deposition of drill cuttings and drilling muds, including the results from drill cuttings dispersion modelling, is presented in Nexen (2018). The potential for impact to features of archaeological interest from deposition of cuttings is not considered to be of significance since the deposition of cuttings in itself is unlikely to damage any archaeological features. The majority of the seabed area affected will experience only a thin layer of deposition. A more substantial 'cuttings pile' may occur in the immediate vicinity of the well and will include the coarsest rock fragments. This is borne out by the results of the drill cuttings dispersion modelling, which indicates that a pile of up to 2,350 mm thick may develop in the vicinity of the well approximately 20 m from the well head, followed by another accumulation peak approximately 45 m from the well head with a thickness of 280 mm. Overall there is a decrease in deposited material thickness with distance from the discharge location, such that within approximately 80 m the thickness has decreased to less than 15 mm (Nexen, 2018).

This assessment and associated mitigation and management measures are therefore focussed on the potential for damage, disturbance or loss of features of archaeological significance from the jetting of the 36" diameter top hole section into the seabed, the cementing of the 36" conductor pipe and the installation of the wellhead and blow-out preventer (BOP), and later the severing of the wellhead a minimum of 3 m below the seabed prior to abandonment (items 1 and 3 above). The seabed area directly affected by these activities will be very small, and localised around the tophole location.

As outlined in Section 2 above, shipwrecks are likely to represent the chief archaeological resources in the deeper areas west of Ireland, including around the Iolar well location. The recent Iolar site survey did not identify any wrecks within the 5 x 1.8 km wide survey area around the Iolar well location (Fugro, 2017). The nearest recorded wrecks are located over 8 km from the well location.

3.2 Mitigation and management measures

Nexen has identified the following process controls to mitigate the possibility of any damage or disturbance to features of archaeological significance:

- A pre-spud ROV survey will be conducted at the well site to identify any marine artefacts that could potentially be disturbed, or any other obstructions;
- If any potential marine artefacts are observed, a qualified marine archaeologist will be consulted prior to spud, and spudding will not commence until the marine archaeologist has confirmed that the spud location is free of marine artefacts;
- If any item that may be of potential archaeological interest is identified, that item will be avoided and the well location will be moved to an alternate location, which will also be subject to a pre-spud ROV survey and the same precautions identified above. A short report will be prepared by the marine archaeologist detailing the observations made and the actions taken.
- If a discovery of a shipwreck or object of historical interest is made during the above process, Nexen will immediately report the discovery and its location to the relevant Government Departments and Agencies

identified by PAD (2014), i.e. to PAD of the DCCAE; the relevant divisions of the Department of Transport, Tourism and Sport (Irish Coastguard, National Maritime Operations Centre (NMOC) of the Irish Coast Guard, Maritime Safety Policy Division, Marine Services Division and Maritime Transport Division); the Development Applications Unit of the Department of Arts, Heritage and the Gaeltacht; and the Irish Antiquities Division of the National Museum of Ireland.

> Under these circumstances Nexen would also facilitate the statutory authorities in any investigations that they may need to carry out in accordance with the terms of the National Monuments Acts (1930-1994).

3.3 Residual impact assessment

Considering the very small area of potential seabed impact from the drilling activities, the findings of the site survey and the absence of known wrecks within the Iolar well area, is it extremely unlikely that any features of archaeological importance will be present in this area. Given the measures to be implemented, the risk to features of archaeological importance is negligible.

4 CONCLUSIONS

- The area of seabed potentially affected by drilling or well abandonment equipment is limited to a within a few metres of the tophole location and thus the potential for direct damage or disturbance to features of archaeological significance is also limited to this small area.
- The deposition of sufficient quantities of drill cuttings that could potentially disturb or bury such features is also expected to be limited to within approximately 20 m of the tophole location.
- A comprehensive site survey has been conducted and there are no known wrecks within the deepwater Iolar well area. Archaeological features such as wrecks could present a safety hazard to the drill ship itself and therefore Nexen would aim to avoid them.
- It is extremely unlikely that any features of archaeological importance will be present within the small area of seabed that could be impacted.
- Nexen will conduct a pre-spud ROV survey to reduce further the possibility of any damage or disturbance to features of archaeological significance at the well site.
- The risk to features of archaeological importance is negligible.

5 REFERENCES

DCENR (2007). Environmental Report and Technical Annexes for IOSEA2.

DCENR (2015). Environmental Report and Technical Annexes for IOSEA5.

Hartley Anderson Ltd (2005). Deep Water Environment to the West of Ireland. Report to the Irish Shelf Petroleum Studies Group. Project ISO3/21. Draft report, December 2005.

INFOMAR (2018). INFOMAR INSS Shipwreck Locations. Geological Survey of Ireland. Available online at https://data.gov.ie/dataset/infomar-inss-shipwreck-locationsn

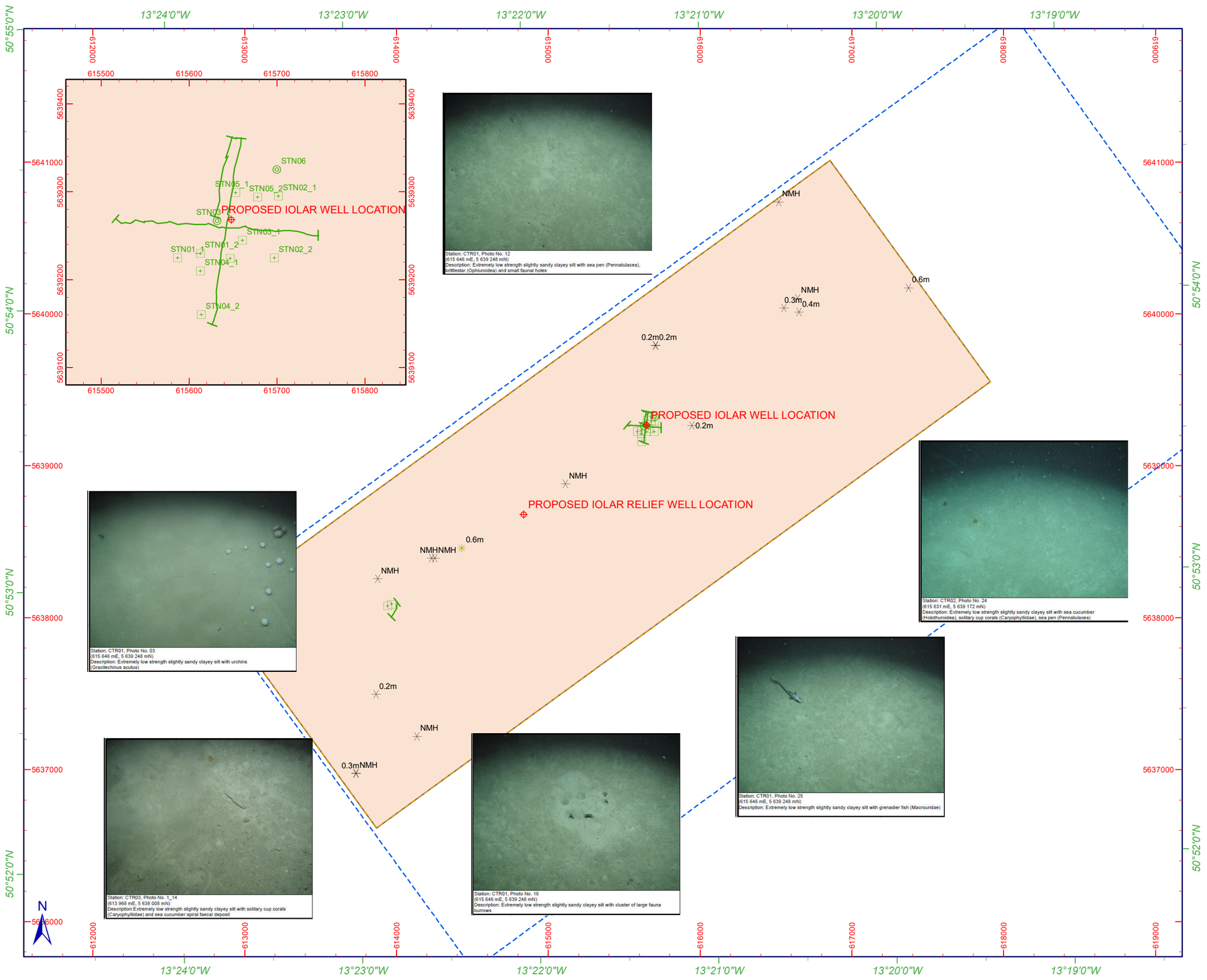
Fugro (2017). Site Survey Lolar (Insisheer) Porcupine Seabight LO 16/7, Ireland. Survey Period: 15 July to 30 July 2017 Fugro Report No: 175261V1.0 Volume 1 of 2: Geophysical Survey and Habitat Assessment Results.

National Monuments Service (2018). Wreck Inventory of Ireland Database. Available online at https://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=89e50518e5f4437abfa6284ff39fd640 Accessed 01/11/2018

Nexen (2018). Iolar Drilling Campaign Environmental Risk Assessment (EIA Screening) Report. Document Number IE-EXP-52/04-IOLAR-HS-00010-RP-01.

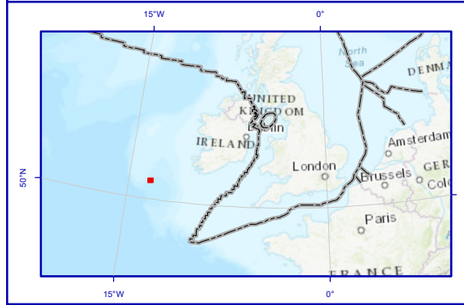
PAD (2014). Rules and Procedures Manual for Offshore Petroleum Exploration and Appraisal Operations. Conducted under an Exploration Licence or other Authorisation. Petroleum Affairs Division. Department of Communications, Energy and Natural Resources. May 2014.

APPENDIX A SEABED FEATURES CHART (FUGRO, 2017)



PROPOSED IOLAR RELIEF WELL LOCATION
PROPOSED IOLAR WELL LOCATION
Boulder
Mound
BOX - Box Core
GC - Piston Core
Environmental Transect
Permit Area
Survey Area
Sandy Clay

GENERAL AREA



0 0.5 NAUTICAL MILES

0 200 400 600 800 1,000 Meters

SCALE 1:25,000 | PAPER SIZE A3

GEODETIC INFORMATION
PROJECTION : UTM 28N
SPHEROID : INTERNATIONAL 1924
DATUM : ED50
EPSG CODE : 23028

IOLAR (INISHEER)

SEABED FEATURES

REV	DATE	REMARKS	DRAWN	CHECK
0	06/11/18	DRAFT	BM	GEO

PROJECT REF : EOS5143
DRAWING : IOLAR_SBF_BM_181116_R0

Produced by RPSE - Woking