REPORT

Schedule of Works

Kinsale Foreshore Licence Application

Client: Kinsale Offshore Wind Limited

Reference: PC1509-RHD-ZZ-XX-RP-Z-0007

Status: S3/P01

Date: 17 December 2021

Royal HaskoningDHV

Enhancing Society Together

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1 Scope of Works

Kinsale Offshore Wind Limited wish to undertake surveys to assess the suitability of the area of interest for development of an offshore wind farm (the Kinsale Project). The Kinsale Project foreshore licence survey area lies off the south coast of Ireland in the Celtic Sea as shown in **Figure 1**.

1.1 Surveys Proposed and programme

Surveys proposed are set out below including proposed start and duration:

- **Geophysical Survey** – Q2 2023 (approx. 3 months duration)
- **Archaeological Survey** – Q2 2023 (as part of Geophysical survey)
- **Marine Benthic Ecology** – commence Q3 2023 (approx. 3 months duration)
- **Seabird and Marine Mammal Aerial Survey** – commence Q1 2022 (24 months duration)
- **MetOcean (current and wave) Survey** – commence Q3 2023 (approx. 12-36 months duration)
- **Geotechnical Survey** – Q2/3 2024 (approx. 3 months duration).

These timeframes are indicative and are subject to change depending on receipt of the foreshore licence, final survey design, weather delay and outcome of any consultation and responses from statutory bodies.

1.1.1 Duration of Activity

The exact timings and duration of surveys are yet to be determined but this foreshore licence application covers all seasons, regardless of the year. Estimated duration of surveys in total is expected to take approximately 48 months with each survey varying in timeframe from approximately 3 months to a 36 months campaign.

Given the potential for delays due to poor weather conditions and potential timing restrictions, this foreshore licence application relates to the possibility of site investigations taking place over a five-year period.

1.1.2 Site Investigation (SI) Objectives

The objectives of the works proposed under this Foreshore Licence application are as follows:

- To gather further information on seabed and sub-seabed conditions.
- To gather sufficient geotechnical data on the stability of soils, sediments, clays and gravels to allow the characterisation of the sub-seabed strata to inform design.
- To collect accurate wind and metocean (wave, current, tide and water levels) information.
- To provide the project team with baseline information on the environmental conditions at the site, including marine ecology, bird, mammals and benthos.
- To provide the project team with information on the archaeological conditions at the site.

In order to meet the above objectives various SI works and monitoring device deployments are required, for which a Foreshore Licence is required.

1.2 Survey Vessels

A variety of survey vessels will be required to complete the full scope of surveys. The exact vessel types will be defined after the procurement process has been completed. **Appendix 1** provides further details on example survey vessels and equipment. **Figure 1** illustrates the navigation and shipping in the vicinity of the foreshore licence survey area which has been used to help determine vessel requirements.

The vessels will conform to the following minimum requirements as appropriate:

- All health and safety requirements including safe systems of works prepared prior to starting the survey works;
- Endurance (e.g. fuel, water, stores, etc.) to undertake the required survey works;
- Appropriate accommodation and mess facilities on board;
- Station-keeping and sea keeping capabilities required by the specified work at the proposed time of year; the appointed contractor may provide supplemental tug assistance if such assistance benefits the operation;
- Sufficiently qualified staffing to allow all planned work to be carried out as a continuous operation (on a 24 hour per day basis for the offshore activities and on a 12 hour per day basis for the nearshore activities);
- Equipment and spares with necessary tools for all specified works; and
- Compliance with Safety of Life at Sea (SOLAS), International Maritime Organization (IMO) and national requirements for operating within Irish territorial waters.

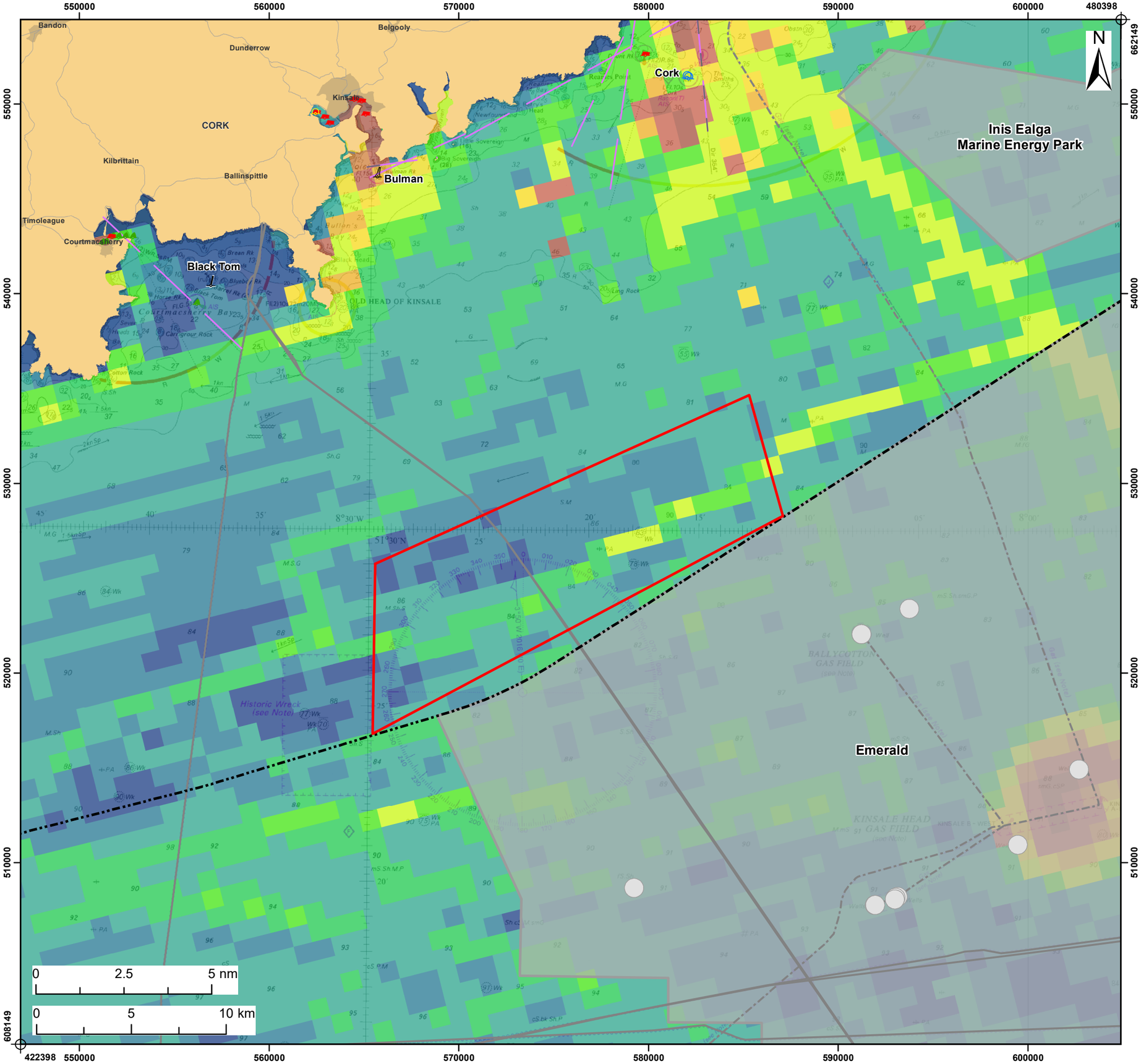
The foreshore licence survey area ranges in depth of approximately 80m to 90m. Example vessels for geophysical surveys are generally between 10-90 m in length (depending on scale of work) and are also suitable for environmental surveys. For deeper water and geotechnical surveys larger 55-90m vessels may be required. For borehole operations, jack-up barges may be used in order to maintain position. The acoustic broadband source levels for different vessel size are typically with smaller vessels (<50m) having source levels 160- 175 dB (re 1µPa), medium sized vessel (50-100) 165-180 dB (re 1µPa) and large vessels (>100m) having source levels of 180-190 dB (re 1µPa) (Richardson, *et al*., 1995). These vessels used for geotechnical surveys typically consist of a self–elevating work platform and legs (normally 4 to 8) that are deployed to the seabed (see **Appendix 1** for further details on example survey vessels).

Kinsale Offshore Wind Limited is committed to the use of good practice techniques and due diligence regarding the potential for pollution throughout all survey activities. A Project Environmental Management Plan (PEMP) will be developed prior to any survey being undertaken. This includes, but is not limited to, the following good practice measures being adhered to (as further described in **Section 2**):

- Oils and lubricants used in the survey equipment would be biodegradable where possible, and all chemicals would be certified to the relevant standard.
- Best practice procedures would be put in place when transferring oil or fuel between service vessels.
- Vessels must be free of invasive alien species on their hulls and in their ballast water.
- Vessels must comply with the IMO ballast water management guidelines.
- Appropriate vessel maintenance following guidance from the International Convention for the Prevention of Pollution from Ships (MARPOL).
- Appropriate spill plan procedures would also be implemented in order to appropriately manage any unexpected discharge into the marine environment.
- Inclusion of control measures such as the requirement to carry spill kits, and bunding to contain any spill, and the requirement for vessel personnel to undergo training to ensure requirements of the PEMP are

understood and communicated.

- All work practices and vessels will adhere to the requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78; specifically Annex 1 Regulations for the prevention of pollution by oil concerning machine waters, bilge waters and deck drainage and Annex IV Regulations for the prevention of pollution by sewage from ships concerning black and grey waters.
- All vessels will be certified by the Marine Survey Office.



Legend:

- Kinsale Survey Area
- Ireland 12nm Limit
- Offshore Wind Farm Sites
- Foreshore Lease Application Submitted
- Beacon - Cardinal
- Buoy - Cardinal
- Buoy - Lateral, Port
- Buoy - Lateral, Starboard
- Buoy - Safe Water
- Buoy - Special Purpose/General
- Navigation Line/ Clearing Line
- Recommended Route
- Well 500m Buffer
- Cable
- Pipeline

Time Spent by All Vessels in 1km² - Monthly Average 2019 (hours/km²/month)

- 0 - 0.25
- 0.26 - 0.5
- 0.51 - 1
- 1.01 - 1.5
- 1.51 - 2
- 2.01 - 4
- 4.01 - 6
- 6.01 - 8
- 8.01 - 10
- 10.01 - 30
- 30.01 - 80

Client:	Project:
Kinsale Offshore Wind Limited	Kinsale Offshore Wind Farm

Title: Kinsale Offshore Wind Farm Navigation and Shipping

Figure:	Drawing No:
1	PC1509-RHD-ZZ-XX-DR-Z-0140

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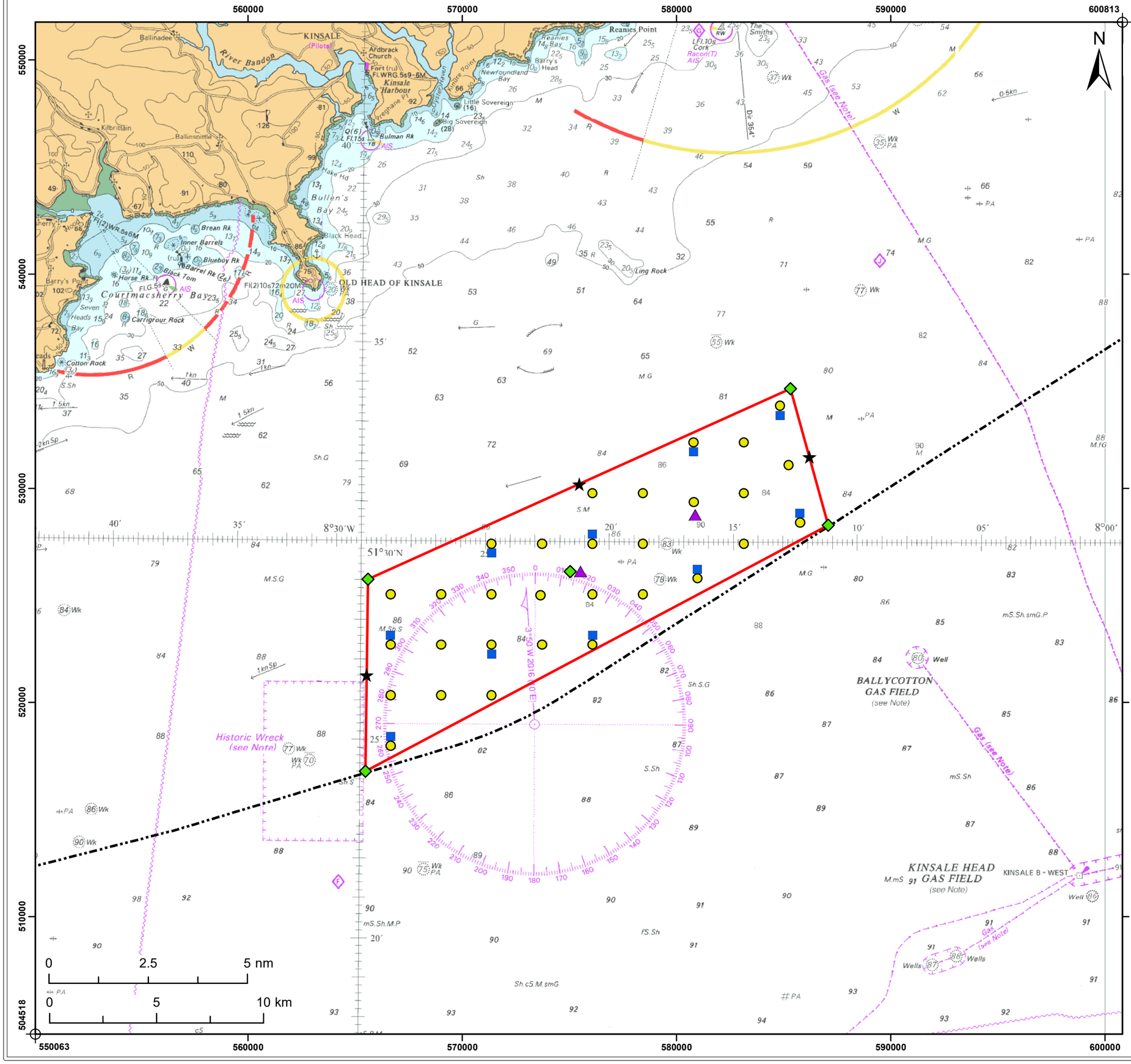
1.3 Description of the Proposed Survey Works

The detail of each type of survey proposed is provided in the subsections below and further details of examples of likely vessels and equipment are provided in **Appendix 1**. The indicative locations of the proposed geotechnical surveys and metocean equipment is illustrated in **Figure 2.** The indicative locations of benthic sampling sites are illustrated in **Figure 3**.



Legend:

- Kinsale Foreshore Licence Survey Area
- Ireland 12nm Limit
- Borehole
- Vibrocore / Cone Penetration Test
- Lidar
- Wave Buoy
- ADCP

Client:	Project:
Kinsale Offshore Wind Limited	Kinsale Offshore Wind Farm

Title:

Indicative Locations of Geotechnical and Metocean Surveys

Figure: 2 | Drawing No: PC1509-RHD-ZZ-XX-DR-Z-0123

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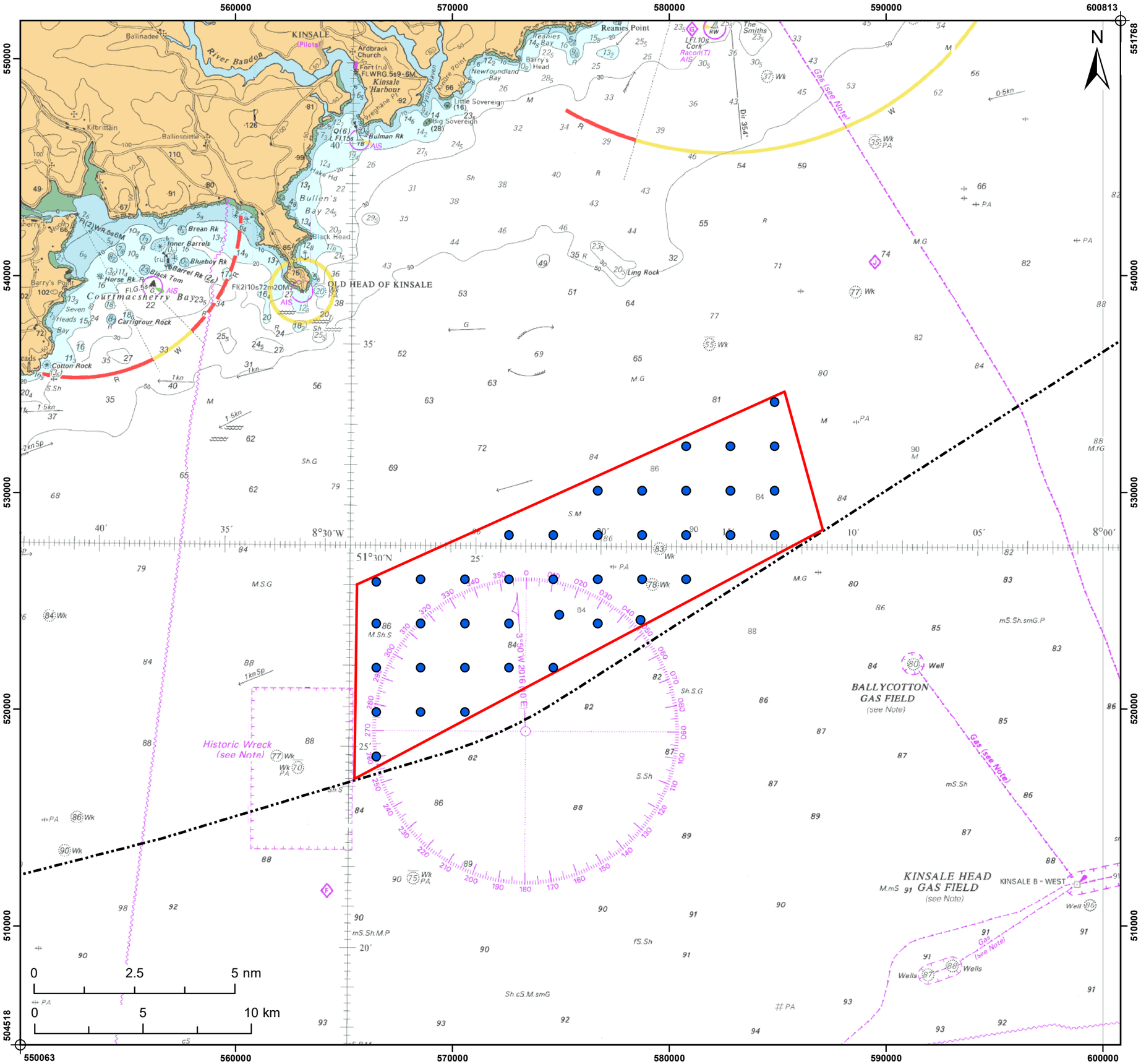

Legend:

- Kinsale Foreshore Licence Survey Area
- Ireland 12nm Limit
- Grab / Drop Down Video Sampling Site

Client:	Project:
Kinsale Offshore Wind Limited	Kinsale Offshore Wind Farm

Title: Indicative Benthic Sampling Stations

Figure: 3 | Drawing No: PC1509-RHD-ZZ-XX-DR-Z-0124

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1.3.1 Geophysical Surveys

For the assessment of potential effects of geophysical surveys, the Review of Consents (RoC) Habitats Regulations Assessment (HRA) for the Southern North Sea (SNS) Special Area of Conservation (SAC) (BEIS, 2020) was used as the basis for the desk-based assessment. BEIS (2020) undertook underwater noise modelling to determine the potential impact ranges of geophysical surveys for harbour porpoise, with their worst case based upon Sub-Bottom Profiling with sound source levels of between 196 and 225 dB re 1 µPa -1 m (rms SPL) and at frequencies ranging from between 0.5 and 300 kHz. All the equipment listed below would fit within this worst case.

Note that no seismic survey is required or proposed.

Multibeam echosounder (MBES) is a recommended technique used to assess the bathymetry of the seabed prior to deploying the Cone Penetration Test (CPT) tool and other tests (see **Section 1.3.6**). The MBES will obtain high resolution bathymetry data to map the seafloor and the seafloor features across the full site area. The system will emit a sound source of 200 and 400 kHz, with a source SPL of 210dB re 1 µPa peak.

A **Magnetometer** will be used to detect geomorphological anomalies and ferrous obstructions. The magnetometer will be a caesium marine magnetometer such as the Geometrics G-882 and capable of recording variations in magnetic field strength during survey to an accuracy of ±0.5nT.

Sub-Bottom Profiling is a method for obtaining high-resolution characterisation of sediments and rock under bodies of water. Sub bottom profilers will be deployed to collect data on all geophysical survey lines. The primary objectives of this survey are:

- To identify the geological structures in the upper 50-100m of the seabed substratum;
- To identify geo-hazards, especially buried boulders, peat layers close to the seabed and shallow gas etc.
- The SBPs may include:
  1. Pinger/parametric system with a sound source of between 0.2 and 22 kHz and Sound Pressure Level (SPL) of 247dB @ 1µPa ref. 1m
  2. Sparker system with a sound source of between 300Hz and 1.2kHz and SPL of 225 dB @ 1µPa ref. 1m
  3. Boomer system with a sound source of up to 5 kHz with an amplitude of 222dB @ 1µPa ref. 1m

The sparker system resolution can be improved by deploying multi-channel streamers to receive the reflected acoustic signals from the seabed. Whether a multi-channel or a single channel streamer is deployed the sound source details remain the same. A key characteristic of this system is that it is high frequency which minimises the impact of the noise source on the surrounding environment. This is distinct from low frequency systems such as air guns (0-10kHz) commonly used in oil and gas seismic surveys.

Ultra Short Baseline (USBL) system is a method for monitoring and recording the subsea positioning of all towed equipment. This is a common system for location monitoring and is not a geophysical sensor itself. A typical USBL system sound source would be c. 20-30kHz, 200dB @ 1µPa ref. 1m.

Side Scan Sonar (SSS) is a method used to detect potential seabed obstructions and identify additional seabed features prior to deploy the CPT. A simultaneous dual frequency SSS will be used.

- The SSS system can operate at greater than 600 kHz using the Edgetech 4125 900 kHz or

equivalent, with a source level of 215 – 226dB re 1 µPa @ 1m.

1.3.2 Archaeological Surveys

No additional dedicated archaeological surveys are likely to be required. The survey scopes detailed in **Section 1.3.1** will also provide data suitable for the interpretation and assessment of features of potential archaeological significance. Under the relevant National Monuments Acts 1930-2014 and the National Cultural Institutions Act 1997 a detection device consent application will be made in advance of the magnetometer survey being undertaken. Geophysical surveys and subsequent archaeological analysis by a licensed marine archaeologist will be undertaken before any intrusive survey works and sample locations will be positioned to avoid archaeological sensitive areas. Requirements are outlined in full in **Section 2**.

1.3.3 Benthic Ecology Surveys

To inform a potential Environmental Impact Assessment (EIA) and Appropriate Assessment (AA), and as per standard protocols for the characterisation and monitoring of marine habitats, the sediment composition and macrofaunal component of the area will be sampled. The quantity and location of the grabs will be determined by review of the geophysical surveys which will provide an understanding of the seabed conditions and features. However, an indicative maximum of approximately 40 locations will be sampled within the foreshore licence survey area.

The programme will use 0.1m² Day Grab and/or a Hamon grab for areas of coarser sediment. Grab samples will be analysed for particle size, Total Organic Carbon and macrofauna.
In addition to collecting infaunal grab samples, data on the epifaunal environment may be required. This will be dependent on the results of the geophysical surveys. If required a targeted Drop-down video (DDV) campaign will be undertaken. This may also include the capture of still photographs.

1.3.4 Marine Mammal and Seabird Survey

To inform a potential EIA and AA, seabird and marine mammal surveys will be undertaken, most likely in conjunction with one another. All surveys would also note the presence of elasmobranchs, turtles and jellyfish if identified. It is proposed that a methodology based on the European Seabirds at Sea Partnership (ESAS) survey method be employed. The aerial surveys would use high- resolution digital photography and/or video to capture high resolution images which will be subsequently analysed, and all sightings of species recorded. The exact methodology will be discussed with the consultant engaged to undertake the work and consultations with National Parks and Wildlife Service (NPWS) will be undertaken.

As aerial survey methods are exclusively observational and deployment of equipment is not required, potential impacts are not anticipated due to flight height altitude (Žydelis *et al*., 2019).

The boat-based survey if required, would be carried out using standard transect survey methods and sightings of marine mammals and seabirds would be recorded. The boat-based survey methods are exclusively observational, and no equipment will be deployed.

1.3.5 MetOcean (current and wave) Survey

Up to two LiDAR units, wavebuoys, marker buoys and Acoustic Doppler Current Profilers (ADCP) will be deployed on site (surface or seabed mounted). The exact details of the LiDAR buoy (and other metocean equipment) and mooring/seabed frame arrangement and locations will be confirmed following a competitive tender process and, where appropriate, results of the geophysical data and consultation. The ZXlidar

300m, Fraunhofer IWES, Fugro SEAWATCH and FLiDAR WindSentinel are illustrative of the type of equipment.

1.3.6 Geotechnical Surveys

The purpose of the geotechnical site investigations are for investigating the stability of the soil to provide good quality geotechnical data to facilitate the detailed design and certification of the:

- Potential offshore wind turbine foundations (Monopiles, Jacket/Tripods); and
- Development and calibration of existing ground models.

Cone penetration testing (CPT) is a method used to determine the geotechnical engineering properties of soils/sediments and delineating soil/sediment stratigraphy. CPT does not involve the removal of any material and the hole created by the penetration of the core (approx. 5cm diameter), will infill almost instantly upon extraction of the rods. The CPT unit has a footprint of approx. 8m² which will sit on the sea floor for the duration of the test, commonly 2-3 hours. No significant underwater acoustic signal results from the operation of CPT, available information suggests a frequency range of up to 600Hz and maximum SPL of between 90 and 145 dB @ 1µPa ref. 1m. Data indicates that SPL levels are not at a level that is thought to cause a disturbance or injury to marine mammals (e.g. Erbe & McPherson, 2017).

Vibrocores may also be undertaken to investigate the nature of the upper layers of the seabed. This process would be an extremely localised activity and would not result in any significant disturbance to the seabed or to mobile species from underwater noise. Vibrocores may penetrate up to 6m into the seabed and have a diameter of approx. 80 - 150mm. A maximum of approximately 30 samples will be taken from within the foreshore licence survey area, this number is indicative. Available information suggests a frequency of 50Hz and maximum SPL of 188 dB @ 1µPa ref. 1m (ESB, 2021, Mainstream Renewable Power, 2021). Data indicates that SPL levels are not at a level that is thought to cause a disturbance or injury to marine mammals (e.g. Erbe & McPherson, 2017).

The OSIL High Power Vibrocorer and the Fugro HPC (high performance corer) are examples of a vibrocore that may be used for the proposed survey works.

Borehole sampling will be undertaken to investigate the stability of soils, sediments, clays and gravels, which will in turn inform design requirements. Sampling involves the penetration of a drill pipe to a scheduled depth, up to 80m below the seafloor. This will cause disturbance to the area of the drill pipe penetration itself and the area directly surrounding this by the mound created by drill risings. An estimated 2m² area (per drill) of the seafloor will be affected by the footprint of the mound created by drill cuttings. Immediately following the removal of the cores, the void in the seabed will fill naturally leaving only a minor impression on the seafloor. The quantity, location and scheduled penetration depth of boreholes will be largely dependent on the interpretation of geophysical data, however it is expected up to 10 boreholes (with a core diameter of between 300-400mm) will be required. This is an extremely localised activity and would not result in any significant disturbance to the seabed or to mobile species from underwater noise. All drilling equipment used will follow the ISO and API technical specifications for drilling equipment.

All relevant survey work is considered in the Supporting Information for Screening for Appropriate Assessment (SISAA) (Royal HaskoningDHV, 2021a - document reference: PC1509-RHD-ZZ-XX-RP-Z-0005), Non-Statutory Environmental Report (Royal HaskoningDHV, 2021b – document reference: PC1509-RHD-ZZ-XX-RP-Z-0008) and Annex IV Risk Assessment (Royal HaskoningDHV, 2021c – document reference PC1509-RHD-ZZ-XX-RP-Z-0009).

2 Good Practice Measures

The following section outlines the measures required to be implemented by law and the relevant guidance, as well as further measures adopted by way of good or standard practice for the carrying out of site investigations and marine surveys.

As outlined below, the surveys and investigations will be conducted in accordance with the Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (Departments of Arts, Heritage and the Gaeltacht (DAHG), 2014).

While the DAHG (2014) guidance refers to the Southall *et al.,* (2007) thresholds for noise impacts, it is considered the assessment in this report (using the NMFS (2018) and Southall *et al*., (2019) thresholds) indicates that the proposed measures, in line with the guidance, is appropriate, however the most recent guidance at the time of the surveys will be used. Comparable UK guidance (JNCC, 2010) states that if impacts are greater than the distance in the guidance then it should be increased, however, the results of the assessments do not show an exceedance of the standard 500m as referred to in the DAHG (2014) guidance. Therefore, there is no indication that anything other than the measures given would be required.

2.1 Geophysical Surveys

The measures outlined below are applicable to all multibeam, single beam, side-scan sonar and sub-bottom profiler (e.g. pinger or chirp system) surveys within bays, inlets or estuaries and within 1,500m of the entrance of enclosed bays / inlets / estuaries, or as requested by the Minister or NPWS (DAHG, 2014). While the proposed Kinsale foreshore licence survey area is not within enclosed bays, inlets or estuaries (or within 1.5km of any such area), the measures as described for geophysical surveys would be applied as good practice.

2.1.1 Multibeam, single beam, side-scan sonar & sub-bottom profiler surveys

Kinsale Offshore Wind Limited will consider opportunities to coordinate with other developers undertaking geophysical surveys during similar timeframes to minimise any potential for in combination effects.

A qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals and to log all relevant events using standardised data forms.

Unless information specific to the location and/or plan/project is otherwise available to inform the mitigation process (e.g. specific sound propagation and/or attenuation data) and a distance modification has been agreed with the NPWS and the Minister, acoustic surveying using the above equipment shall not commence if marine mammals are detected within a 500m radial distance of the sound source intended for use, i.e., within the Monitored Zone.

2.1.1.1 Pre-Start Monitoring

Sound-producing activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible the sound-producing activities shall be postponed until effective visual monitoring is possible.

An agreed and clear on-site communication signal must be used between the MMO and the Works Superintendent as to whether the relevant activity may or may not proceed, or resume following a break (see below). It shall only proceed on positive confirmation with the MMO.

The MMO will conduct pre-start-up constant effort monitoring at least 30 minutes before the sound-producing activity is due to commence. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.

This prescribed Pre-Start Monitoring shall subsequently be followed by a Ramp-Up Procedure which should include continued monitoring by the MMO.

2.1.1.2 Ramp-Up Procedure

In commencing an acoustic survey operation using the above equipment, the following Ramp-up Procedure (i.e. “soft-start”) must be used, including during any testing of acoustic sources, where the output peak sound pressure level from any source exceeds 170 dB re: 1µPa @1m:

a) Where it is possible according to the operational parameters of the equipment concerned, the device’s acoustic energy output shall commence from a lower energy start-up (i.e. a peak sound pressure level not exceeding 170 dB re: 1µPa @1m) and thereafter be allowed to gradually build up to the necessary maximum output over a period of 20 minutes.
b) This controlled build-up of acoustic energy output shall occur in consistent stages to provide a steady and gradual increase over the ramp-up period.

Where the acoustic output measures outlined in steps (a) and (b) are not possible according to the operational parameters of any such equipment, the device shall be switched “on” and “off” in a consistent sequential manner over a period of 20 minutes prior to commencement of the full necessary output.

In all cases where a Ramp-Up Procedure is employed the delay between the end of ramp-up and the necessary full output must be minimised to prevent unnecessary high-level sound introduction into the environment.

Once the Ramp-Up Procedure commences, there is no requirement to halt or discontinue the procedure at night-time, nor if weather or visibility conditions deteriorate nor if marine mammals occur within a 500m radial distance of the sound source, i.e., within the Monitored Zone.

2.1.1.3 Break in sound output

If there is a break in sound output for a period greater than 30 minutes (e.g., due to equipment failure, shut-down, survey line or station change) then all Pre-Start Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) must be undertaken.

For higher output survey operations which have the potential to produce injurious levels of underwater sound as informed by the associated risk assessment, there is likely to be a regulatory requirement to adopt a shorter 5-10 minute break limit after which period all Pre-Start Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) shall recommence as for start-up.

2.1.1.4 Reporting

Full reporting on MMO operations and mitigation undertaken must be provided to the Minister as licensor, and to the NPWS where required.

2.2 Water quality

In terms of potential for changes in water quality (including from accidental spills and leaks) and invasive alien species, Kinsale Offshore Wind Limited is committed to the use of good practice techniques and due diligence throughout all survey activities. Risk of accidental spills / leaks and risks of invasive alien species would be fully managed through implementation of a Project Environmental Management Plan (PEMP),

developed prior to any survey being undertaken, and therefore there is no potential for an adverse effect. The PEMP will include (including vessel requirements set out in **Section 1.2**), but is not limited to:

- Oils and lubricants used in the survey equipment would be biodegradable where possible, and all chemicals would be certified to the relevant standard.
- Good practice procedures would be put in place when transferring oil or fuel between service vessels.
- Vessels must be free of invasive alien species on their hulls and in their ballast water.
- Vessels must comply with the IMO ballast water management guidelines.
- Appropriate vessel maintenance following guidance from the International Convention for the Prevention of Pollution from Ships (MARPOL).
- Appropriate spill plan procedures would also be implemented in order to appropriately manage any unexpected discharge into the marine environment.
- Inclusion of control measures such as the requirement to carry spill kits, and bunding to contain any spill, and the requirement for vessel personnel to undergo training to ensure requirements of the PEMP are understood and communicated.
- All work practices and vessels will adhere to the requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78; specifically Annex 1 Regulations for the prevention of pollution by oil concerning machine waters, bilge waters and deck drainage and Annex IV Regulations for the prevention of pollution by sewage from ships concerning black and grey waters.
- All vessels will be certified by the Marine Survey Office.

2.3 Archaeology

The proposed surveys will be licenced under the National Monuments Acts 1930 – 2014 and National Cultural Institutions Act 1991. With regards to the magnetometer survey in-particular a detection device consent application will be made to the Department of Housing, Local Government and Heritage in advance of the magnetometer survey being undertaken.

A Retained Archaeologist, and Archaeological Contractor(s) will be engaged as required to provide consistency throughout the project. As the main objective is to characterise the area for the purposes of assessment and all data will be provided to a specialist, licensed contractor for archaeological assessment, it is not proposed to have an archaeologist on board the vessel, although the option for having someone on board during future, targeted surveys would be retained should these be required. This would be progressed in consultation with the National Monuments Service (NMS).

A written scheme of investigation (WSI) and protocol for archaeological discoveries (PAD) will be prepared and implemented during the proposed surveys. Additionally, a Retained Archaeologist, and Archaeological Contractor(s) will be engaged as required, ensuring the WSI and PAD are implemented and to provide consistency throughout the project.

The proposed geophysical surveys will be carried out prior to the geotechnical surveys. The data from the geophysical surveys will be analysed by a licensed marine archaeologist in order to determine the scope of the intrusive works (geotechnical and benthic ecology surveys), to ensure the sample locations avoid wrecks and aircraft crash sites and identified seabed features of potential archaeological interest. The scope of the geotechnical and benthic surveys will be agreed in advance with the Department of Housing, Local Government and Heritage and will be planned to take account of geoarchaeological objectives as advised by a licenced marine geoarchaeology specialist. The WSI and PAD will be prepared and

implemented during the site investigation works.

3 References

BEIS (2020). Record of The Habitats Regulations Assessment Undertaken Under Regulation 65 of the Conservation of Habitats and Species (2017), and Regulation 33 of The Conservation of Offshore Marine Habitats and Species Regulations (2017). Review of Consented Offshore Wind Farms in the Southern North Sea Harbour Porpoise SAC.

Department of Arts, Heritage and the Gaeltacht (2014) Guidance to Manage the Risk to Marine Mammals from Man-made Sound sources in Irish Waters.

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Appendix 1 Survey Vessels and Site Investigation Survey Equipment Examples

A1 Survey Vessels

The contracts for the site investigation surveys have not yet been awarded. Examples of potential survey vessels and their associated survey equipment are provided below.

Survey vessels vary in size, from 10m to 90m in length. The size of the vessel is dependent on availability and bathymetry of the survey area.

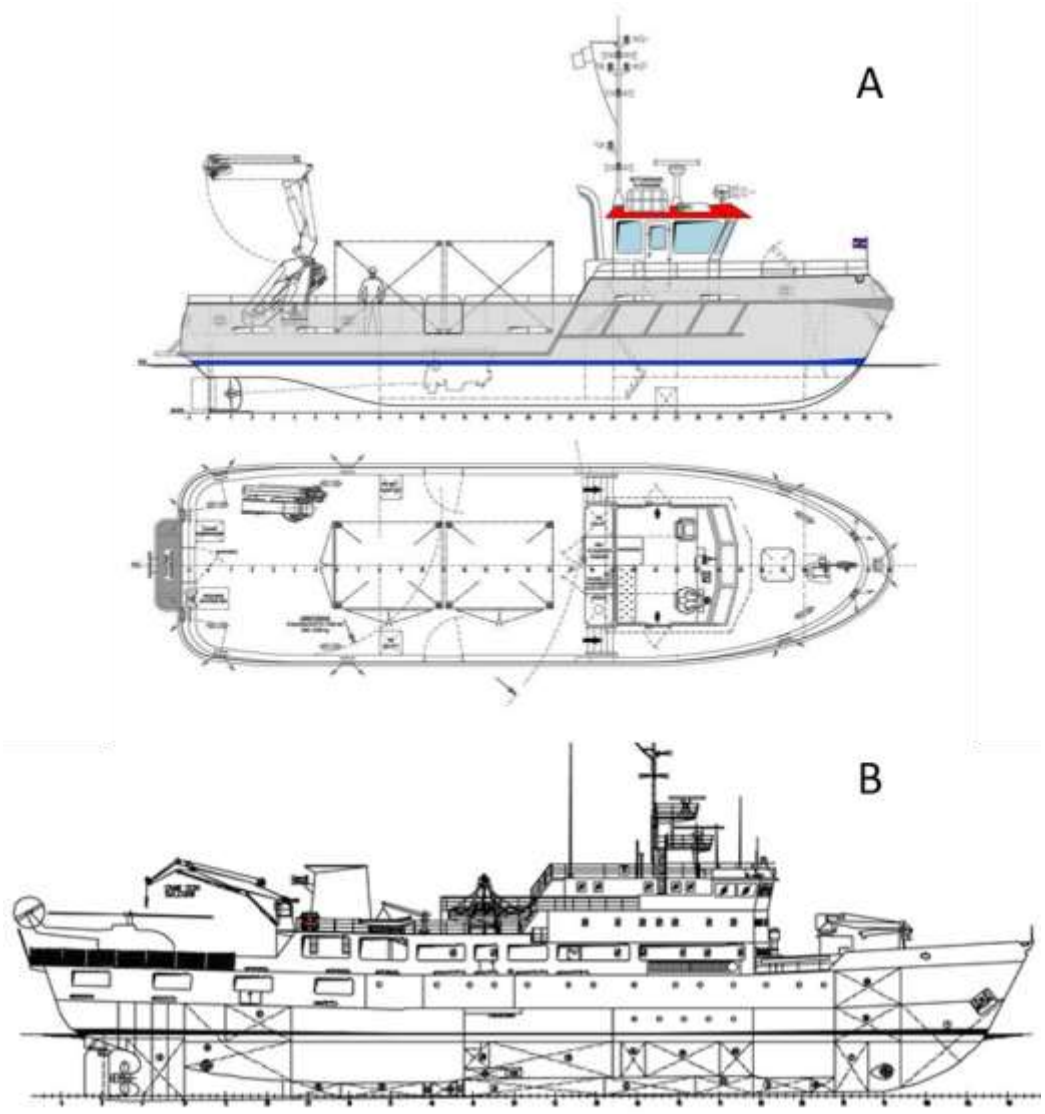

Figure A 1 Examples of small (A) and larger (B) survey vessels used in geotechnical investigations (Dignity Source – Survey Vessel, unknown)

A1.1 Site Investigation Equipment

Typical survey equipment is outlined below.

A1.1.1 DGPS Positioning

Differential Global Positioning System (DGPS) is an enhancement to the Global Positioning System (GPS) which provides improved location accuracy, in the range of operations of each system, from the 15-metre (49 ft) nominal GPS accuracy to about 1–3 centimetres (0.39–1.18 in) in case of the best implementations.

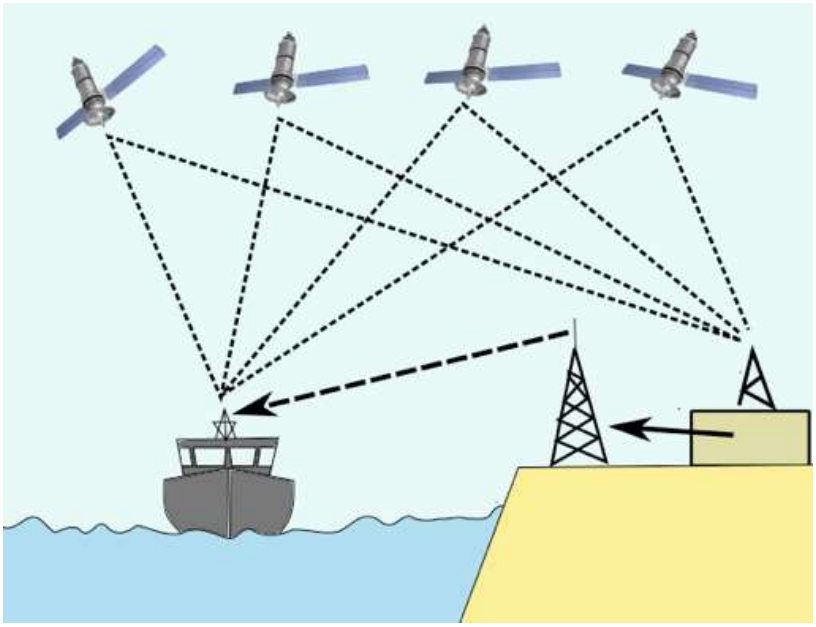

Figure A 2 DGPS schematic (Freedom sailing Scotland, unknown)

A1.1.2 Acoustic positioning

An acoustic positioning system calculates range from a submersible-mounted transducer to other transducers at known locations with known spacing. This permits an accurate range calculation, with adjustment for water temperature/salinity/density, by computing the one-way or round-trip timing.

A1.1.3 Motion Reference Unit

The Motion Reference Unit (MRU) is a solid-state motion reference device capable of measuring Pitch and Roll to a high degree of accuracy. The MRU can be mounted in either a horizontal or vertical position.

A1.1.4 Echosounder

The echo sounder transmits the sound pulses downward into the water by a transducer. The echo reflected from the bed is also received by the echo sounder. The time interval between the emission of the sound pulse and its return as an echo is used to estimate the depth of the water. There are three types:

A. Single Beam Echosounder - releases a single sound pulse in a single, narrow beam
B. Sidescan sonar - emits conical or fan-shaped pulses down toward the seafloor across a wide angle perpendicular to the path of the sensor through the water, which may be towed from a surface vessel or submarine, or mounted on the ship's hull

C. Multi Beam Echosounder: releases a fan of narrow acoustic beams, thus providing 100% coverage of the bottom.

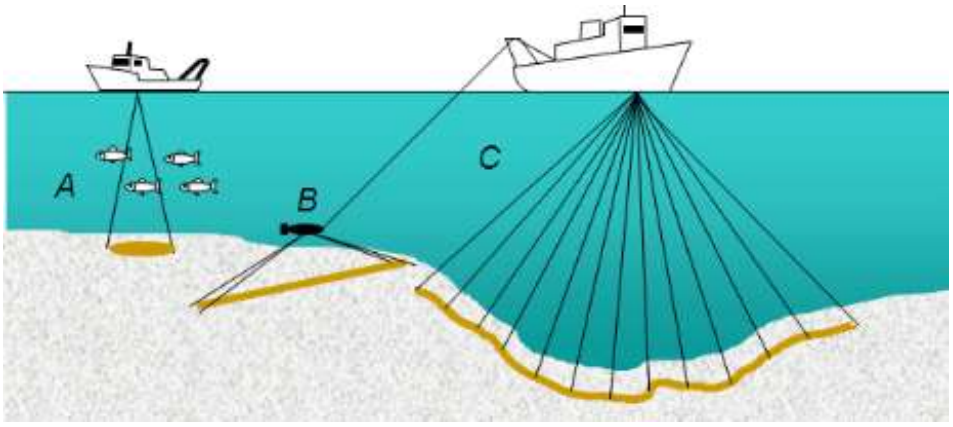

Figure A 3 Types of echosounder (Lurton et al., 2015)

A1.1.5 Sub Bottom Profiler

Sub-bottom profilers are usually comprised of single channel source that sends sound pulses into the shallow sub-sea floor sediments. The sound pulses bounce off the sea floor and subsequent buried sediment layers according to differences in their acoustic impedance (hardness). Acoustic impedance is related to the density of the material and the rate at which sound travels through this material. The different times taken for this signal to be returned and recorded by the sub-bottom profiler indicate how deep the layers are below the sea floor. The surface of the different rock strata beneath the sea floor are mapped over the study area.

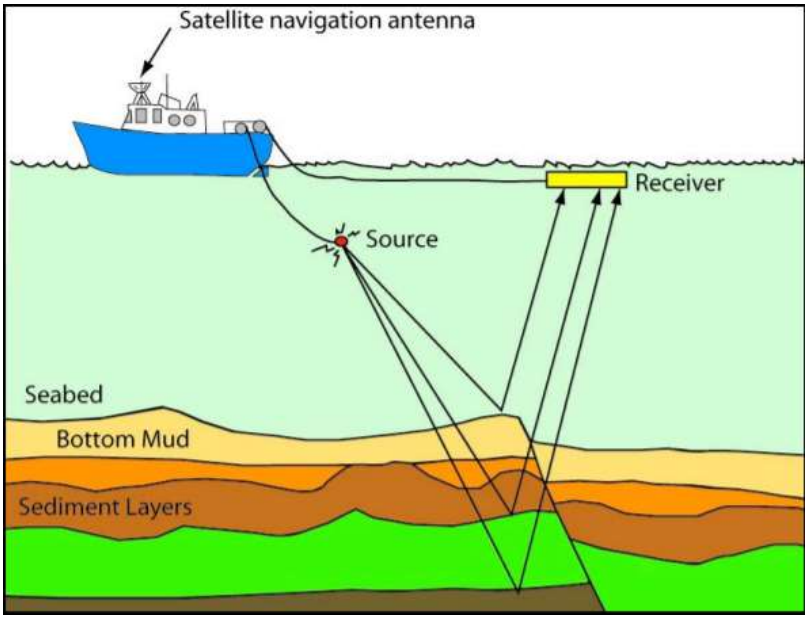

Figure A 4 Sub bottom profiler schematic (Nitsche, unknown)

A1.1.6 Magnetometer

A magnetometer is towed behind a survey vessel and detects the magnetic field anomalies that result when induced magnetic fields are superimposed on the earth's magnetic field, such as the magnetic anomalies created by ferrous material in the earth's magnetic field.

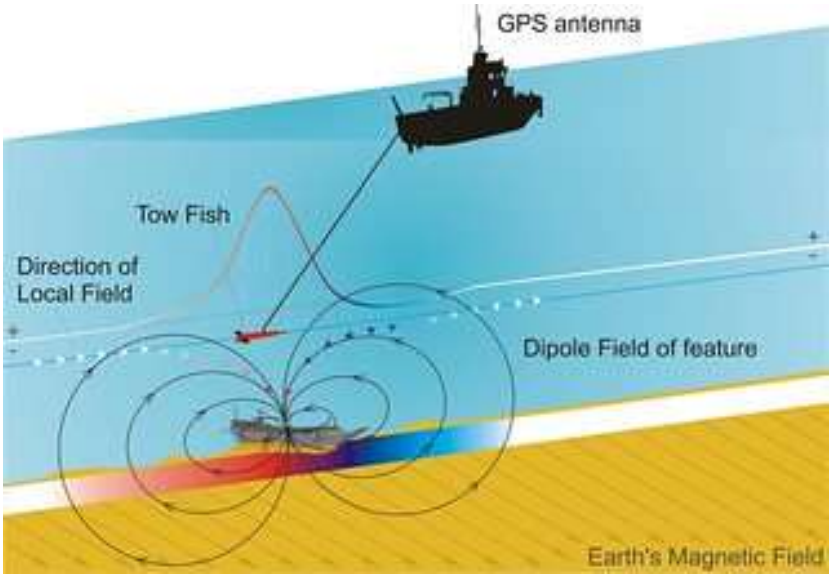

Figure A 5 Magnetometer survey vessel (Wessex Archaeology,2011)

A1.1.7 Day Grab

Day grabs comprise of two stainless bucket sections which are mounted within a stainless-steel frame. On contact with the seabed, a trigger bar is pushed upwards via pressure plates allowing the buckets to close under the gravity of the unit through a pulley system. This controlled contact and closure once on the seabed helps ensure sample disturbance is minimised. The top of the grab is covered by two catch-closed inspection doors also made of stainless steel.

Figure A 6 Day grab (KC Denmark Research Equipment, unknown)

A1.1.8 Drop Down Video

Video and stills cameras are extremely valuable and wide-ranging tools for providing evidence for benthic monitoring and mapping. There are a range of drop-down/towed camera systems suitable for deployment in a range of environmental conditions.

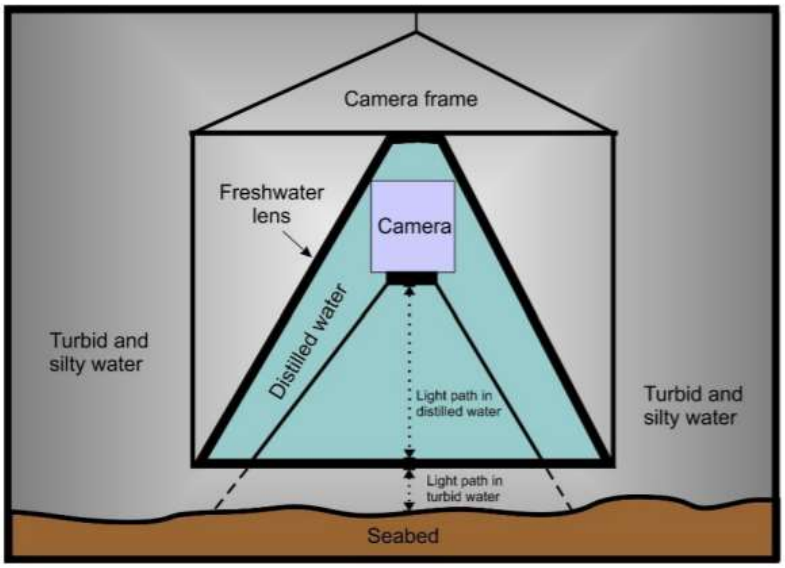

Figure A 7 Drop down video schematic (Hitchin et al., 2015)

A1.1.9 Vibrocorer

The vibrocorer can obtain sediment cores. It works by vibrating the entire core tube at such a high frequency that the sediment becomes thixotropic causing the core tube to sink into the sediment.

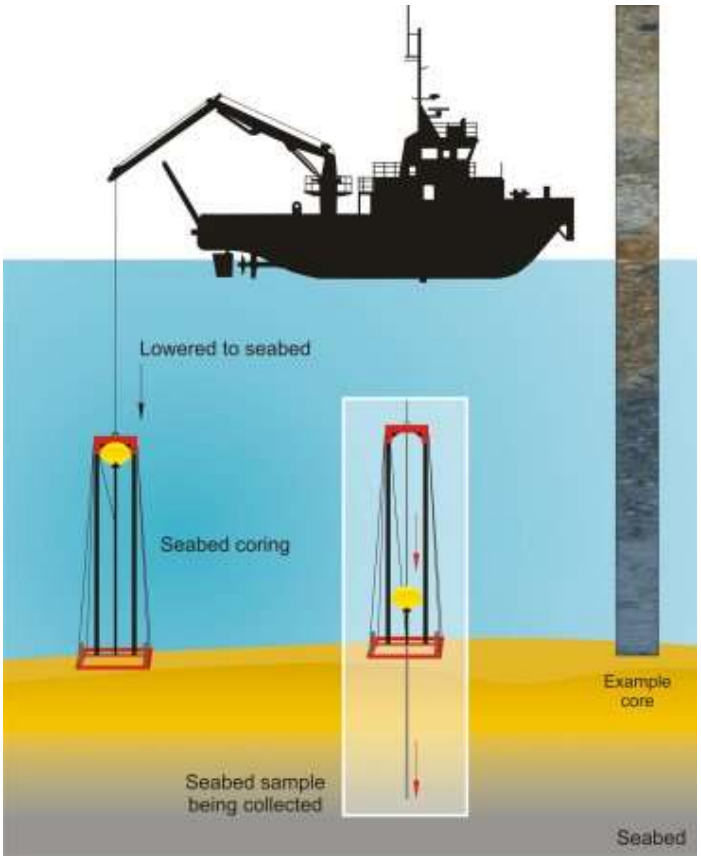

Figure A 8 Vibrocorer schematic (Wessex Archaeology, unknown)

A1.1.10 CPT

The cone penetration or cone penetrometer test (CPT) is a method used to determine the geotechnical engineering properties of soils and delineating soil stratigraphy.

A1.1.11 Boreholes

A borehole is deep vertical hole with small diameter drilled into the ground to obtain soil samples for soil investigation required for the construction of suitable foundation for the planned structure.

A1.1.12 Floating LiDAR buoy

Floating lidar units take offshore wind measurements from a vertical profiling lidar, integrated onto a standalone floating structure, such as a buoy. The lidar unit collects a range of measurements.

Figure A 9 Floating LiDAR buoy (Wind Power Engineering & Development, 2016)

A1.1.13 ADCP seabed mounted

An acoustic Doppler current profiler (ADCP) is a hydroacoustic current meter similar to a sonar, used to measure water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column.

Figure A 10 ADCP seabed mounted (Wikiwand, unknown)