BROUGH HEAD

WAVE FARM LIMITED

BROUGH HEAD WAVE FARM

Scoping Report

AUGUST 2011

REPORT REFERENCE NUMBER - BHWF-SD.PR.EU.UK.ORKB-REP-0001

CONTENTS

ACRONYMS

ADCP	Acoustic Doppler Current Profiler
BAP	Biodiversity Action Plan
BHWFL	Brough Head Wave Farm Limited
CAR	Controlled Activities Regulations
CPA	Coastal Protection Act
DECC	Department of Energy and Climate Change
DEFRA	Department of the Environment, Food and Rural Affairs
DTI	Department of Trade and Industry
ECDU	Energy Consents and Deployments Unit
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
EMP	Environmental Monitoring Plan
ENVID	Environmental Issues Identification
EPS	European Protected Species
ES	Environmental Statement
EU	European Union
FEPA	Food and Environment Protection Act
GBSO	Great Britain System Operator
GCR	Geological Conservation Review
GRE	Glass Reinforced Epoxy
GRP	Glass Reinforced Plastic
HDD	Horizontal Directionally Drilled [pipelines]
HIRA	Hazard Identification and Risk Assessment
HP	High Pressure
IMO	International Maritime Organisation
IMS	Integrated Management System
IPC	Infrastructure Planning Commission
IUCN	International Union for Conservation of Nature
LAT	Lowest Astronomical Tide
LP	Low Pressure
LRFD	Load and Resistance Factor Design
MCA	Maritime And Coastguard Agency
MLWS	Mean Low Water Springs
MMO	Marine Mammal Observer
MPA	Marine Protected Areas
MRFG	Marine Renewables Facilitators Group

MSL	Mean Sea Level
MS-LOT	Marine Scotland – Licensing Operations Team
MW	Mega Watt
NGET	National Grid Electricity Transmission
nm	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NSA	National Scenic Area
NRA	Navigational Risk Assessment
NTS	Non-Technical Summary
OLBAP	Orkney Local Biodiversity Action Plan
ORCA	Orkney Research Centre for Archaeology
OREI	Offshore Renewable Energy Installation
OTFA	Orkney Trout Fishing Association
PFOW	Pentland Firth and Orkney Waters
PHA	Preliminary Hazard Analysis
PMF	Priority Marine Feature
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institute
ROV	Remotely Operated Vehicle
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SEPA	Scottish Environment Protection Agency
SHETL	Scottish Hydro Electric Transmission Limited
SLNCI	Sites of Local Nature Conservation Importance
SNH	Scottish Natural Heritage
SOPEP	Shipboard Oil Pollution Emergency Plan
SOPs	Standard Operating Procedures
SPA	Special Protection Area
SSER	SSE Renewables (UK) Limited
SSMEI	Scottish Sustainable Marine Environment Initiative
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
TO	Transmission Owner
UKHO	UK Hydrographic Office
WEC	Wave Energy Converter

1. INTRODUCTION

1.1 Background

1.1.1 Brough Head Wave Farm Limited

Brough Head Wave Farm Limited is a partnership between renewable technology developer Aquamarine Power Limited (Aquamarine Power) and SSE Renewables UK Limited (SSER). Brough Head Wave Farm Limited (BHWFL) was incorporated in March 2009 with the aim of using wave energy to generate clean, renewable electricity from Orkney Waters on a commercial scale.

Aquamarine Power was founded in 2005 to commercialise the Oyster hydro-electric wave energy converter. To date, Aquamarine Power's activities have been focussed on installing Oyster devices at the European Marine Energy Centre (EMEC) wave test site in Orkney.

SSE Renewables UK Limited is a wholly owned subsidiary of the SSE Group, which has an installed generation capacity of over 11 GW, including almost 2.5 GW of renewables, and supplies energy to 10 million customers across the UK and Republic of Ireland. SSE defines its core purpose as being able to provide the energy people need in a reliable and sustainable way. SSE is one of the UK's leading offshore renewable energy developers, with an interest in some 6.8 GW of development projects, including 800 MW of wave and tidal energy projects in the Pentland Firth and Orkney Waters (PFOW).

1.1.2 Agreement for Lease

In March 2010 BHWFL was granted an exclusive Agreement for Lease (AfL) on an area of seabed off the Mainland Orkney coast stretching from Costa Head in the north to Neban Point in the south-west (Figure 1.1). This AfL was granted through The Crown Estate (TCE) Pentland Firth and Orkney Waters (PFOW) leasing round for commercial wave and tidal energy projects. This was the world's first seabed leasing round and was designed to enable marine energy developers to investigate the potential for the installation of wave and tidal energy devices around the UK's coastline.

The agreement is not a licence or consent for BHWFL to install Oyster devices on the site, but provides BHWFL with the time and security required to carry out site investigations and environmental surveys in this area. Subsequently BHWFL will apply for consents for a development somewhere within the lease option area, in the knowledge that no other wave and tidal energy projects will be developed in the same area for the duration of the AfL.

Permitting for any proposed development within the AfL area would include a full Environmental Impact Assessment (EIA) and Navigational Risk Assessment (NRA), both of which include extensive consultation with stakeholders.

Within the 26 km^2 AfL area BHWFL has defined two areas of search:

- North – Southern border of Marwick Head SPA to Costa Head; and
- South – Neban Point to the southern border of Marwick Head SPA.

Adjacent to the AfL area a 1 km width onshore area of search has also been identified within which the onshore components of the Brough Head Wave Farm project are intended to be located.

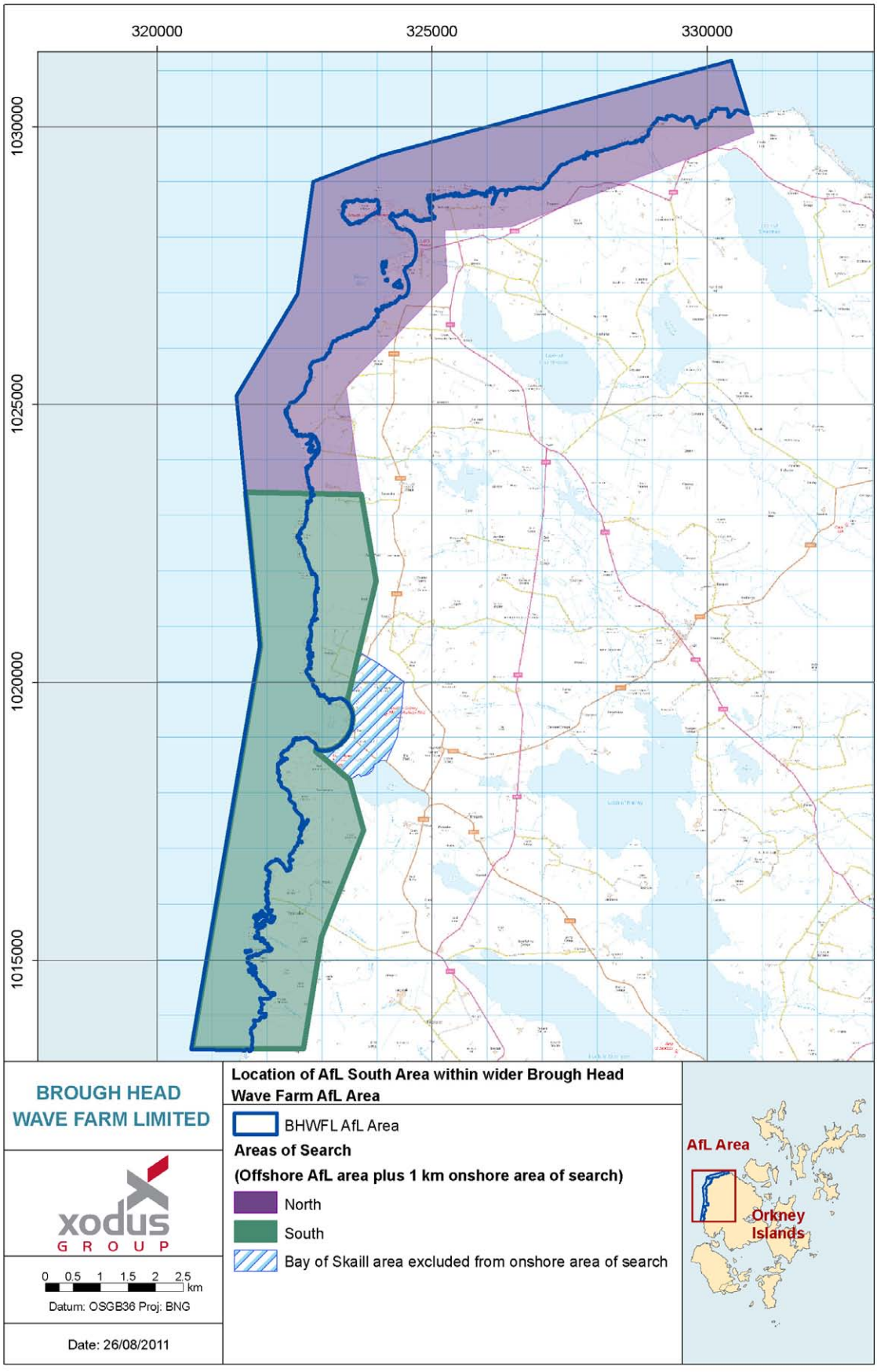

Figure 1.1 **Location of the Brough Head Wave Farm AfL and Areas of Search**

BHWFL has decided to focus initial Scoping efforts on the South area. The reasons for this are described in detail in section 3. The North area has not been excluded from future development but would be the subject of a further Scoping exercise(s). However, the accompanying Preliminary Hazard Analysis (PHA) considers the potential for up to 200 MW of Oyster generation capacity throughout the whole AfL area.

It should be noted that following consultation with Orkney Islands Council (OIC) and the County Archaeologist, and due to the presence of the World Heritage Site of Skara Brae, a decision has been made to exclude the immediate vicinity of the Bay of Skaill from the onshore area of search.

1.1.3 Project Phasing

BHWFL proposes to install Oyster wave energy devices within the area covered by the AfL with a total installed capacity of up to 200MW. However, BHWFL plans a phased approach to the development of the area with the first phases of the project proposed to be located in the AfL South area.

It is proposed that the first phase of the project will be for a development of up to 50MW, dependent on technical, safety, socio-economic and environmental constraints. It is intended that Phase 1 is split into two build-out stages; indicative timelines are outlined below:

- Phase 1a: 10 MW (installed in 2015), up to 10 Oyster devices
- Phase 1b: Up to 40 MW (installed in 2016), up to 40 Oyster devices

This Scoping Report relates to Phase 1 and further potential subsequent phases adding up to a total of 150 MW in the AfL South area. The locations of any phase within the AfL South area have not been chosen yet and this Scoping Report and subsequent Scoping Opinion are seen as an important input into the site selection/refinement process.

1.2 Project Overview

1.2.1 Technology

Oyster is a nearshore wave energy device, typically deployed in 10 to 15 metres (m) water depth. The oscillating action of the waves against the wave energy converter (WEC) (or 'flap') drives hydraulic pistons which pump pressurised freshwater back to shore through a closed loop pipeline system. The onshore hydro-electric plant converts the hydraulic pressure and flow into electrical power via Pelton wheel turbines which in turn drive the electrical generators.

A key design philosophy of the Oyster technology is to ensure the offshore components are as simple and reliable as possible.

1.2.2 Offshore Infrastructure

It is anticipated that each Oyster device to be installed in the BHWFL AfL area will have a rated capacity of up to 1MW. Individual Oyster devices will be installed on monopile foundations and linked by sets of interconnecting pipelines (high pressure, low pressure and a control umbilical) to each other and to the onshore hydro-electric plant, forming a closed-loop hydraulic system. BHWFL is exploring the number of Oyster devices which may be linked to a single onshore hydro-electric plant, and how they may be linked, in order to maximise efficiency. The Oyster devices will protrude above the sea surface (approximately 3 – 5 m above mean sea level) and will be appropriately marked.

1.2.3 Onshore Infrastructure

The onshore hydro-electric plant will include Pelton wheel turbines, electrical generators, a header tank, filtration system, accumulators (to smooth the flow of the pressurised water) and grid transformer and connection terminations. In order to export power generated, connection needs to be made with the wider national grid. In connection with this, Scottish Hydro Electric Transmission Limited (SHETL) is currently progressing a separate study and consultation on the preferred location for a transmission substation in the West of Mainland Orkney, with a subsea cable connection to the mainland of Scotland.

1.3 Document Purpose

The scoping report has been prepared by BHWFL to support the development of a number of wave farm arrays within the Southern Area of the outlined AfL with a total capacity of up to 150 MW and requests a formal Scoping Opinion from Marine Scotland in consultation with the relevant statutory consultees.

The Scoping Report represents the first stage of the EIA process and has been produced to facilitate the identification and assessment of the potential environmental impacts associated with this project. Accordingly, BHWFL wishes to seek feedback and advice on any particular environmentally or socially important areas within the southern portion of the AfL area. The issues identified within the scoping opinion from Marine Scotland will be utilised to inform the final site selection process for the wave arrays.

Specific questions will be flagged within this Scoping Report in order to focus scoping responses, however any additional comments will be welcomed by BHWFL and can be emailed to marten.meynell@aquamarinepower.com; please mark the subject line “Brough Head Scoping Report”.

2. POLICY & LEGISLATIVE CONTEXT

2.1 Planning Policy

In recent years there has been increasing international focus on the concept of marine conservation and marine spatial planning. The key European Union (EU) legislation is the EU Marine Strategy Framework Directive, which was passed in June 2008.

2.1.1 National Regulations

The main UK regulations put in place to deliver the Marine Strategy Framework Directive are the UK Marine and Coastal Access Act 2009 and the Marine (Scotland) Act 2010. Both pieces of legislation put in place frameworks for planning within the marine environment. In addition to the development of a more streamlined consenting process for marine projects, the Act includes measures for marine planning and marine conservation;

- **Marine Planning** – A new statutory marine planning system. Provides a planning regime for the marine environment that links to the terrestrial system. Currently all UK administrations are to agree a UK Marine Policy Statement, which will act as guidance at the highest level for all further marine planning activities. Beneath this there is likely to be a National Marine Plan for Scotland, prepared by Marine Scotland, the Scottish Government body charged with the implementation of the Marine (Scotland) Act 2010. The National Marine Plan for Scotland was published as a pre-consultation draft in March 2011. This document will be the statutory plan for the marine environment and will inform the regional plans and ultimately planning decisions.

- **Marine Conservation** - Improved protection for nature conservation, including new powers to establish and manage Marine Protected Areas (MPA). The MPA network is not solely for conservation, there are provisions for designating Demonstration and Research MPA as well as Nature Conservation and Historic MPAs. The development of the MPA network will take account of existing protected areas, including Special Protection Areas (SPAs) and Special Areas of Conservation (SACs). Under the Act there are is much strengthened protection for seals.

2.1.2 Regional Policy

Currently, neither regional marine spatial planning bodies nor any regional marine spatial plans exist for Scotland. There have been four pilot marine spatial planning activities under the Scottish Sustainable Marine Environment Initiative (SSMEI).

One of these pilot schemes is the Pentland Firth and Orkney Waters (PFOW) Marine Spatial Plan Framework and Regional Location Guidance for Marine Renewable Energy which was published in June 2009. This provides a route map which sets out the process Marine Scotland will follow to build a non-statutory interim Marine Spatial Plan for PFOW.

2.2 Consents & Licensing

The following licenses and consents are required in order to construct and operate an offshore wave energy array in Scotland:

- Consent under Section 36 of the Electricity Act 1989 with deemed permission under Section 57 or separate permission under Section 28 of the Town and Country Planning (Scotland) Act 1997 (for any associated onshore developments);
- Consent under Section 37 of the Electricity Act 1989 to install overhead electric lines;
- Marine Licence under Section 16 of the Marine (Scotland) Act 2010; and
- Permission under Section 20 of the Water Environment and Water Services (Scotland) Act 2003 (if development is within 3 nautical miles (nm) of the coast or inland waters and involves activities controlled under this act).

In certain cases an European Protected Species (EPS) Licence under The Conservation (Natural Habitats, & c.) Regulations 1994 may also be required.

Additionally, applicants seeking permission to construct and operate a wave energy array in Scotland must:

- Submit an ES as required by the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000;
- Provide sufficient information to enable an Appropriate Assessment, if one is required, to be undertaken under regulation 61 of the Conservation of Habitats and Species Regulations 2010 and regulation 48 of The Conservation (Natural Habitats, & c.) Regulations 1994, commonly referred to as Habitats Regulations Appraisal; and
- Submit a Decommissioning Programme as required under the Energy Act 2004.

The applicable legislation to the licenses and consents required for the Brough Head Wave Farm project are discussed in further detail in the following sections.

2.2.1 Section 36 Electricity Act 1989

Section 36 of the Electricity Act 1989 requires consent from Scottish Ministers to construct, extend or operate an onshore electricity generating station exceeding (or, when extended, will exceed) 50 MW. Section 36 consent is also required for development of offshore generating stations over 50 MW in the Scottish Renewable Energy Zone (REZ) and over 1 MW within Scottish territorial waters.

As a wave powered electricity generating station within 12 nautical miles (nm) of land and a potential capacity of up to 150 MW the Brough Head Wave Farm project will require consent from Scottish Ministers under Section 36 of the Electricity Act 1989. Phase 1 of the project, up to 50 MW, will be subject to one application; further potential phases would be subject to additional applications.

2.2.2 Section 37 Electricity Act 1989

Section 37 of the Electricity Act 1989 requires consent from Scottish Ministers for the construction of most overhead electric lines.

As overhead electric lines may need to be installed between the hydro-electric plant and the electricity distribution network, this aspect of the Brough Head Wave Farm project would require consent from Scottish Ministers under Section 37 of the Electricity Act 1989.

2.2.3 Marine Licence

Under the Marine (Scotland) Act the Marine Licence came into force on 6th April 2011. The Marine Licence will replace the licences required under Food and Environment Protection Act 1985 (FEPA) and Coastal Protection Act 1949 (CPA). Part 2 of FEPA now applies only to certain reserved activities in the Scottish marine area, and Part 2 of CPA has been repealed.

Marine Scotland Licensing Operations Team (MS-LOT) is responsible, under the Marine (Scotland) Act and Part 4 of the UK Marine and Coastal Access Act 2009, for issuing a Marine Licence. A Marine Licence is required if an activity involves:

- Deposit of any substance or object in the sea or on or under the seabed;
- Construction or alteration or improvement of works on or over the sea or on or under the seabed;
- Removal of substances or objects from the seabed;
- Carrying out of dredging;
- Deposit of and/or use of explosives; or
- Incineration of substances or objects.

A Marine Licence is therefore necessary for the installation of foundations, devices and associated pipelines and infrastructure necessary for the deployment of the Oyster technology. MS-LOT is also responsible for issuing development consents for renewable energy projects under Section 36 of the Electricity Act 1989.

2.2.4 Town and Country Planning (Scotland) Act 1997, Section 57

A request to the Scottish Government for planning permission under Section 57 of the Town and Country Planning (Scotland) Act (i.e. deemed planning permission) may be made as part of the Section 36 application process, therefore removing the need for a separate planning application. This applies to all onshore works above Mean Low Water Springs (MLWS) and in the case of the Brough Head Wave Farm project will be subject to Scotland and Orkney planning regulations and guidance.

2.2.5 Water Environment and Water Services (Scotland) Act 2003

Section 20 of the Water Environment and Water Services (Scotland) Act 2003 and the associated Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR) apply to a development within 3 nm of the highest tide mark. These regulations apply to any activity that:

- Requires abstraction of coastal waters greater than 10 m^3 per day; or
- Requires point source discharges to coastal waters greater than 10 m^3 per day.

Engineering works in coastal and transitional waters are not normally regulated by the Scottish Environment Protection Agency (SEPA) under CAR. These works will be regulated by Marine Scotland under Marine (Scotland) Act (2010). Whilst the ongoing operation of Brough Head Wave Farm is not expected to require anything under CAR, options relating to onshore construction or pressure testing of pipelines may require registrations or simple licences. The requirement for these will be discussed directly with SEPA.

2.2.6 Environmental Impact Assessment Regulations

European requirements on Environmental Impact Assessment (Council Directive 85/337/EEC as amended by Council Directive 97/11/EEC) are applied for the Electricity Act regime through the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 ('the regulations').

Under the regulations a Section 36 development that is likely to have significant effect on the environment must be subject to EIA and an ES submitted with the Electricity Act consent application. An EIA will be undertaken for Phase 1 of the Brough Head Wave Farm project. Further potential phases in the South area will be subject to future EIAs.

Before making an application, a Scoping Opinion (Regulation 7) may be sought whereby an application for a formal opinion on the information to be supplied in the ES is made to Scottish Ministers. This document represents a request for a Scoping Opinion, in the form of a Scoping Report.

2.2.7 The Conservation (Natural Habitats, & c.) Amendment (Scotland) Regulations 2007

The European Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC) are transposed into Scottish law by the Conservation (Natural Habitats &c) Amendment (Scotland) Regulations 2007. European sites protected under this legislation include SPA, SAC and Ramsar sites. A competent authority shall make an appropriate assessment of the implications for the site in view of that site's conservation objectives, before deciding to undertake or give any consent, permission or other authorisation for, a plan or project which:

- Is likely to have a significant effect on a European site in the UK (either alone or in combination with other plans or projects); or
- Is not directly connected with or necessary to the management of the site.

The need for appropriate assessment extends to plans or projects outwith the boundary of the site in order to determine their implications for the interests protected within the site. Competent authorities need to identify the qualifying interests and the conservation objectives for each European site involved in an appropriate assessment.

For any European Protected Species (EPS), Regulation 39 of the Conservation (Natural Habitats, &c.) Regulations 1994 makes it an offence to deliberately or recklessly capture, kill, injure, harass or disturb any such animal. It is also an offence to deliberately or recklessly obstruct access to a breeding site or resting place of any such animal, or otherwise to deny the animal use of the breeding site or resting place. In addition, it is an offence to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs. For cetaceans only (dolphins, porpoises and whales) there is a more general offence deliberately or recklessly to disturb these creatures. The damage or destruction of a breeding site or resting place of any EPS of animal is an offence of strict liability. An EPS Licence is required for any activity that might result in disturbance to EPS. In the case of Brough Head Wave Farm any requirement for an EPS Licence would be on advice from SNH to Marine Scotland and the Scottish Government.

2.2.8 Energy Act 2004

The decommissioning responsibilities have not been devolved to Scotland and therefore licensing requirements lie with the Department of Energy and Climate Change (DECC) and

Section 105-114 of the Energy Act 2004, Decommissioning Programme. BHWFL will produce a decommissioning programme for the Brough Head project, produced to the standards of DECC Guidance Notes (DECC, 2011).

2.2.9 Survey, Deploy and Monitor Policy for Marine Renewables

The Scottish Government's Strategic Environmental Assessment (SEA) on Marine Renewables in 2007 concluded that the deployment of new technology, particularly marine renewable devices, would carry a degree of uncertainty regarding potential associated environmental impacts. As a result, a risk-based 'Survey, Deploy and Monitor Policy' is being developed to enable efficient, sustainable deployment of wave and tidal energy devices; BHWFL awaits the publication of the policy.

2.2.10 Rochdale Envelope Approach

BHWFL is adopting the Rochdale Envelope approach to EIA. This approach is essential at this early stage of the wave and tidal energy industry to allow for improvements of technology. Once a project installation commences it needs to be making best use of available technology and take into account any new data that will help understanding of environmental impact. To commit to a detailed project design at this stage for a project proposed for construction in 2015 would not allow for this continued improvement or for lessons from testing Oyster 800 or other devices in the interim to be taken into consideration.

According to the Infrastructure Planning Commission (IPC), who has produced an advice note entitled "Using the Rochdale Envelope" (IPC, 2011), the Rochdale Envelope approach recognises that there may be areas of uncertainty when an application is submitted, although project proposals still need to be of sufficient detail to allow EIA and preparation of an ES. The regulating authority (in this case Marine Scotland) must be assured that the environmental effects (including residual effects) of a proposal have been assessed; in the case of applying the Rochdale Envelope approach it must be ensured that the maximum potential adverse impacts of a project have been fully assessed and taken into account in the decision-making process (IPC, 2011).

An assessment of the variations of the proposed project needs to be included in the EIA as well as highlighting areas where certain matters remain unresolved. Potential variations within a project should be assessed in terms of the likely worst case scenario. The developer is required to deal with these possible variations within the project in a manner that aids decision making. The EIA should also outline the reasons why certain parts of the proposal are not yet finalised (IPC, 2011).

In addition, the potential cumulative and synergistic impacts of the proposal when considered alongside other major developments need to be identified and assessed against the baseline position (IPC, 2011).

2.3 Guidance and Strategic Research

A number of external data gathering or research initiatives exist; BHWFL proposes to make efficient use of existing data and ongoing work as far as possible, rather than duplicating effort. Some work has been commissioned directly by the PFOW Developers Forum and therefore may be directly applicable to projects within the PFOW area. Other work has been commissioned by organisations such as SNH, Marine Scotland, SEPA and EMEC in order to further the understanding of the potential impacts of marine renewable developments on the

marine environment. All known commissioned pieces of work are summarised at Appendix B including their scope and timescale for delivery.

Q	***Have all the regulatory requirements that the project should be taking into account been identified?***

3. PROJECT DESCRIPTION

3.1 Site Selection & Location

Following the launch of TCE PFOW leasing round for commercial wave and tidal energy projects BHWFL undertook analysis to select a suitable location within the PFOW leasing area for a commercial project using the Oyster technology taking into account wave resource and environmental sensitivities. The Brough Head Wave Farm site was subsequently selected and an application was submitted to TCE.

In March 2010 BHWFL was granted an exclusive Agreement for Lease (AfL) on the selected area of the Orkney coast stretching from Costa Head in the north to Neban Point in the south-west (see Figure 1.1). It should be noted that the AfL does not give the holder unlimited development access across the whole option area. Instead the AfL allows the developer time and security to undertake research and gain consent for a development somewhere within the specified area. Once development consent is granted, the development area, subject to the conditions of consent, is turned into a seabed lease.

As discussed in Section 1, the AfL area has been split into two areas of search, North and South. The southern part of the site has been chosen for Scoping at this stage for various reasons:

- Consideration of bathymetry ;
- Likely wave resource on west coast;
- Potential for connection to the grid (Indications are that the likely location for the Scottish Hydro-Electric Transmission Limited (SHETL) substation will be on the west of Mainland Orkney);
- Environmental designations;
- Centres of population;
- Proximity to port and harbour facilities;
- Road access; and
- Onshore sensitivities.

The North area has not been excluded from development in the future, and will be the subject of further scoping in due course. Please also note the accompanying Preliminary Hazard Analysis (PHA) considers the potential for up to 200 MW of Oyster generation capacity throughout the whole AfL area (both North and South areas). Figure 3.1 shows the AfL South area.

3.2 Project Timelines

It is proposed, as discussed in section 1.1.3 Project Phasing, that the first phase of the project will be for a development of up to 50MW, dependent on technical, safety, socio-economic and environmental constraints. It is intended that Phase 1 is split into two build-out stages; indicative timelines are outlined below:

- Phase 1a: 10 MW (installed in 2015), up to 10 Oyster devices

- Phase 1b: Up to 40 MW (installed in 2016), up to 40 Oyster devices

The Southern AfL area also has the potential to add further phases totalling up to a total of 150 MW. The locations of any phase within the AfL South area have not been chosen yet and this Scoping Report and subsequent Scoping Opinion are seen as an important input into assessing the capacity of the area to host up to 150MW and will contribute to the site selection/refinement process.

Each Oyster device is likely to have a rated capacity of up to 1 MW, equating to approximately 10 devices installed for Phase 1a and up to 40 devices installed for Phase 1b. Onshore construction for Phase 1a may commence in summer 2014. BHWFL is exploring options for the connection of Oyster devices to the onshore hydro-electric plant in order to maximise efficiency. BHWFL will develop the project in a layout which maximises the power capture in as small a development area as possible whilst maintaining high standards of safety and ensuring economic viability. The overall size of the development will be dictated by practical installation considerations and environmental considerations, including bathymetry which will be a key input to the location as this data will allow assessment of the technical feasibility of installing Oyster devices on Orkney's rugged seabed.

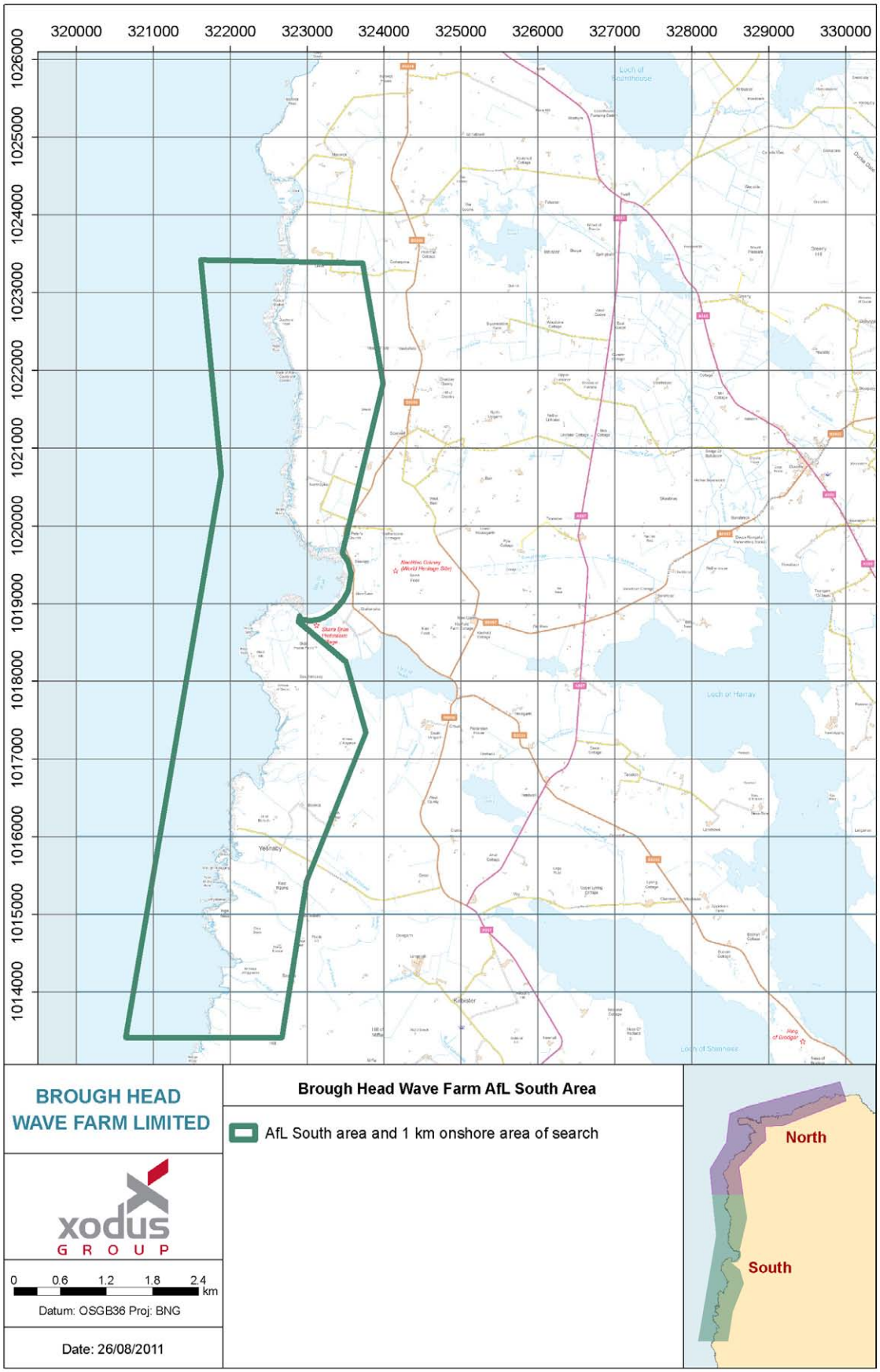

Figure 3.1 Chart showing the location of the AfL South area

3.3 Project Components

3.3.1 Overview and Development of Oyster Technology

Oyster is a nearshore wave energy device, typically deployed in 10 to 15 metres (m) water depth. The oscillating action of the waves against the wave energy converter (WEC) (or 'flap') drives hydraulic pistons which pump pressurised freshwater back to shore through a closed loop pipeline system. The onshore hydro-electric plant converts the hydraulic pressure and flow into electrical power via Pelton wheel turbines which drive electrical generators. Figure 3.2 depicts the main components of the Oyster technology.

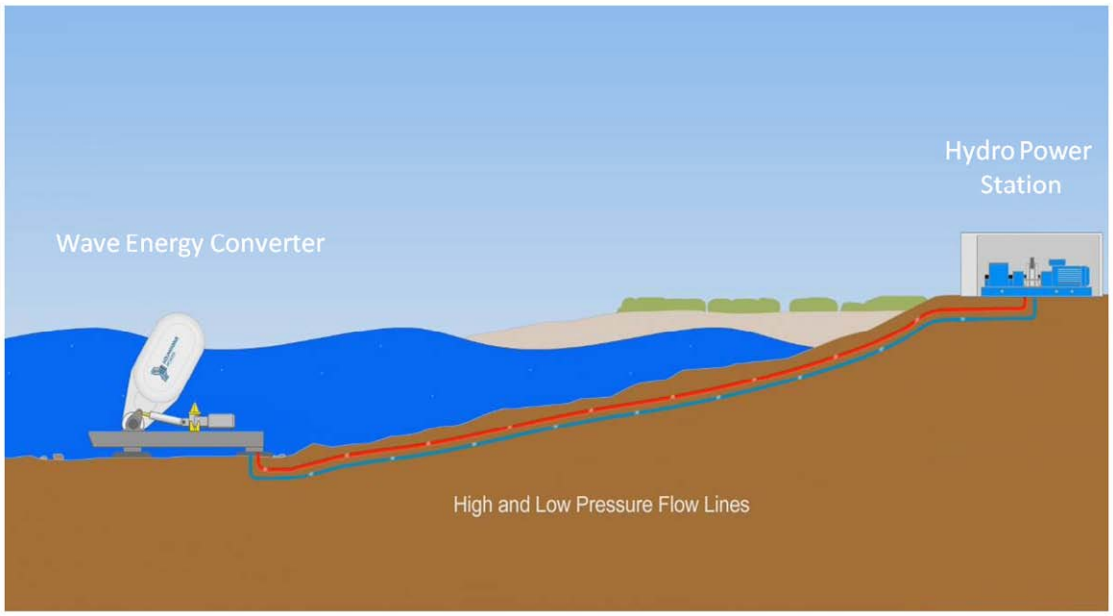

Figure 3.2 Schematic of the Oyster technology

The Oyster technology is continually being developed as lessons are learned during testing of full-scale prototype devices, such as Oyster 1 (315 kW) which was deployed for testing at the EMEC wave test site, Billia Croo, Orkney. The Oyster technology continues to undergo commercial demonstration trials in Orkney and information from these trials will inform the final design of the Oyster devices proposed for installation in the BHWFL AfL area. The next generation of Oyster device, Oyster 800, is currently being deployed at EMEC this summer (2011), and applications have been submitted for two further Oyster devices to be installed at the same location in 2012 and 2013, as the first test array of Oyster devices. As more devices are designed, fabricated and deployed the design will be refined. For example design refinements for Oyster 800 have been aimed at making it 250% more powerful than Oyster 1, simpler to install, easier to maintain and more efficient. In addition, design improvements have meant a reduction in the number of piles required to install each Oyster device with Oyster 1 using four piles, Oyster 800 two piles, and future devices likely to be installed on a monopile.

Figure 3.3 shows illustrative dimensions of an Oyster device on a monopile. It also shows mean sea level, the height of which will change throughout the tidal cycle, as will the angle of the device as it moves with the waves. Devices to be installed as part of the Brough Head Wave Farm project are likely to be similar but may have different dimensions as described in Table 3.1. Figure 3.4 and Figure 3.5 illustrate the front and back views of an Oyster device on a monopile, based on the present device design intended for installation at the EMEC wave test site in 2012.

All figures are illustrative at present as the detail cannot be released currently due to Aquamarine Power's Intellectual Property requirements.

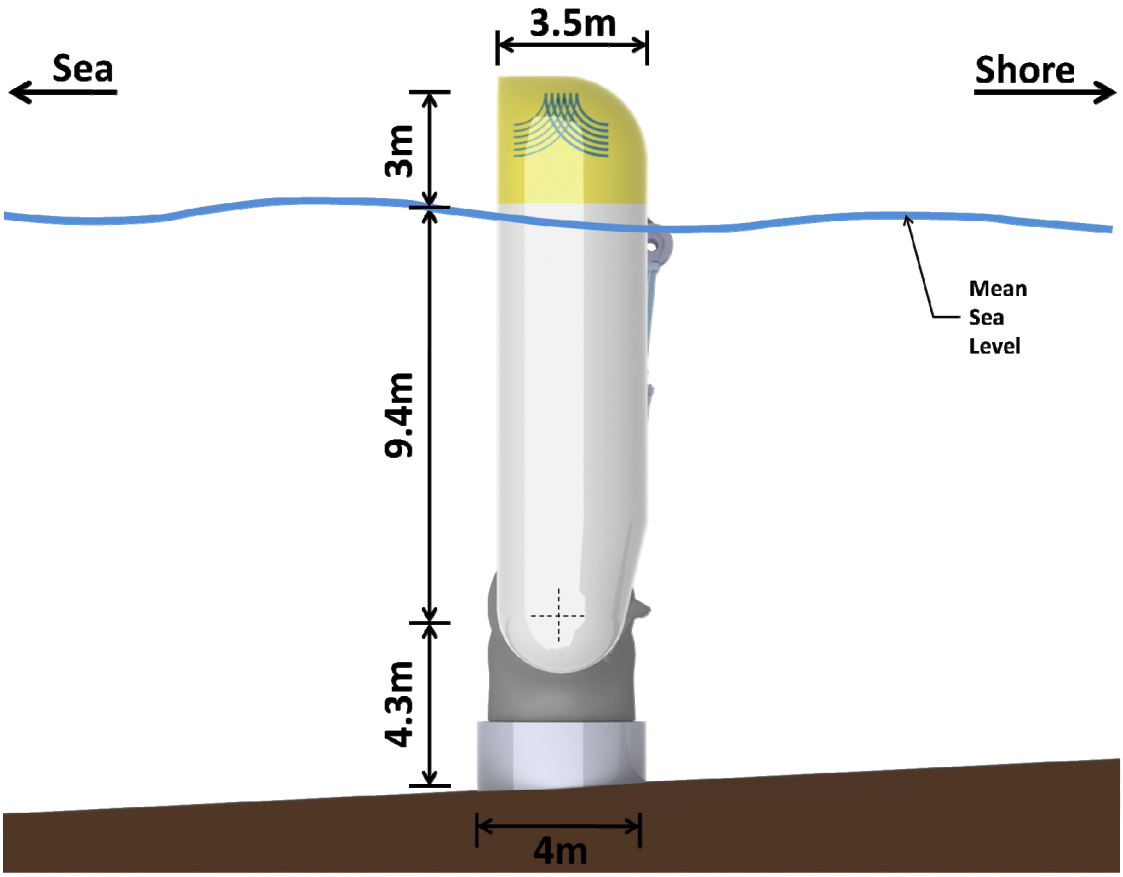

Figure 3.3 **Illustrative relative dimensions of the Oyster device to be deployed at Billia Croo in 2012**

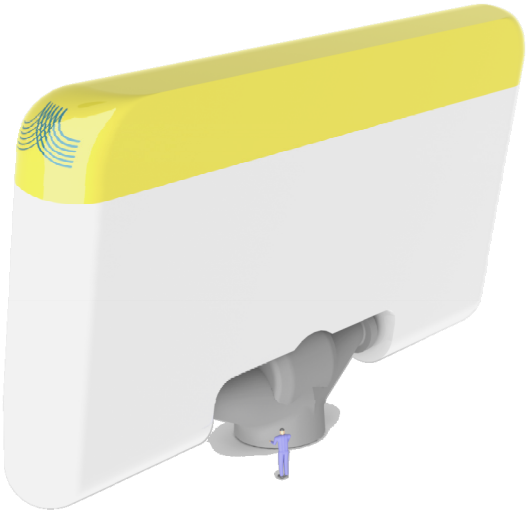

Figure 3.4 **Illustrative front (facing oncoming waves) view of Oyster device**

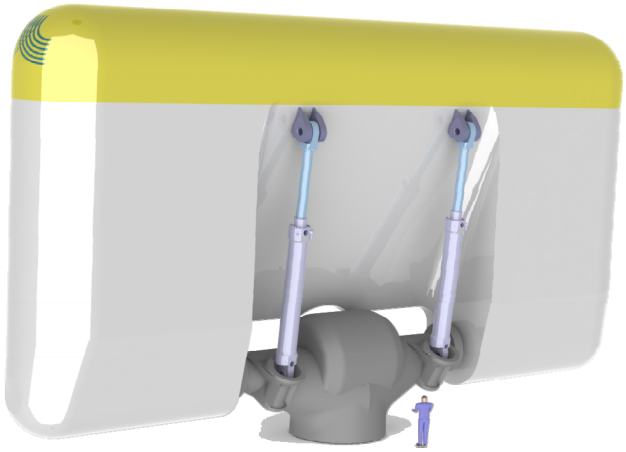

Figure 3.5 Illustrative back (landward side) view of Oyster device

3.3.2 Offshore Components

It is anticipated that each Oyster device installed within the Brough Head AfL would comprise a flap, hydraulic modules, support structure, and a monopile foundation. The approximate dimensions are provided in Table 3.1. In addition, rock anchors may be installed around each device to assist with securely lowering each Oyster flap onto its foundation monopile, and for maintenance operations throughout the life of the project. Interconnecting pipelines between individual Oyster devices may connect multiple devices to a closed loop pipeline system. Rock supports and mattresses may be used to secure and protect the interconnecting pipelines on the seabed.

Each Oyster flap will protrude above the sea surface. In flat calm seas (sea state zero) some part of the Oyster flap will be visible at all states of the tidal range, including spring tides. In less calm seas, dependent on the size of waves and state of the tide, the Oyster flap will be pushed downward by the waves and may disappear from view before returning to the surface due to its built-in buoyancy. Relative to mean sea level (MSL), it is anticipated in calm seas that the uppermost 3 – 5 m of the Oyster flap, 26 – 30 m wide, will be visible. This uppermost section of the flap will be painted according to standard best practice to ensure it is clearly visible to other users of the sea. In addition to the Oyster device itself, buoys may be present on the surface to mark the position of installation and maintenance anchors.

For Phase 1 of the project (up to 50 MW) it is anticipated that a length of coastline of up to 3 km may be required, but the spacing of devices is dependent on local bathymetry and selection of a suitable onshore site.

Devices are likely to be deployed in two staggered lines with minimum separation distances between the devices of 10m (horizontal axis) and 25m (perpendicular axis) as shown in Figure 3.6. This figure shows a very indicative layout scenario which may alter during site investigations and site design; the exact array layout will be informed by a range of factors including technology development, hydraulic modelling, analysis of site bathymetry data from an installation perspective, device maintenance requirements, and other environmental data.

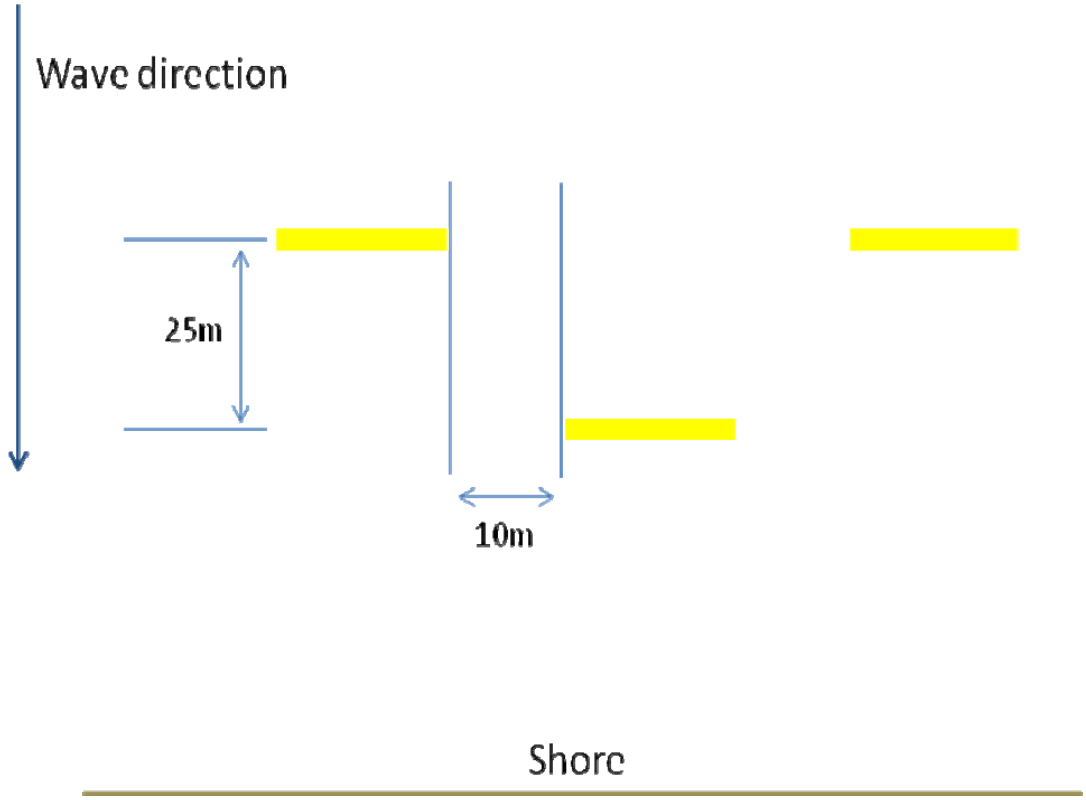

Figure 3.6 Indicative Device Layout Scenario

Considering potential later phases in the South area there may be a number of clusters of devices with each leading to an onshore hydro-electric plant with a total combined output of up to 150 MW but this will be dependent on current studies and the Scoping Opinion. Once detailed bathymetry data is available (surveys due to be carried out late summer 2011), the layout of devices offshore may be considered in more detail.

Table 3.1 below sets out typical Oyster device specifications.

Item	Specification
Oyster Device Components	
Flap	26 - 30 m wide (parallel to shore), up to 6 m thickness (perpendicular to shore), approximately 13 m high (vertically – top of flap to hinge point), hinge axis depth approximately 9 m below MSL
Support structure	Suitably scaled to sit on top of the monopile foundation supporting the Flap
Hydraulic modules	The hydraulic modules will be contained within the envelope of the flap, monopile and support structure
Monopile foundation	Up to 6 m diameter, 18 m deep (into seabed)
Antifoulants and Corrosion Protection	In accordance with North Sea standards, cathodic protection in the form of aluminium-zinc alloy sacrificial anodes will be used Coatings and corrosion protection techniques and are being investigated
Pipelines and Umbilical	

Item	Specification
Closed loop pipeline system	The offshore devices will be connected to each other via one high pressure and one low pressure pipeline. These pipelines will in turn be connected to the shore via high pressure and low pressure pipelines. There is a link between the number of pipelines and their size in order to maintain the efficiency of the closed loop system. At this stage it is anticipated that for a development of up to 50MW the range of pipeline numbers and sizes may be up to 20 pairs of small pipelines (14" diameter) or 3 pairs of large pipelines (40" diameter) or a range of numbers and sizes within these limits.
Umbilical	Umbilicals carrying a combination of electrical cables and fibreoptics. Routed within a steel or plastic trunking system and installed alongside the closed loop pipeline system between the onshore hydro-electric plant and the Oyster devices.
Pipeline support structures	Support and protection on the seabed may be through spool support protection frames, pipe supports, concrete/plastic mattresses and/or stabilising rock anchor supports

Table 3.1 Specification of Main Component Parts of the Oyster Technology

3.3.3 Onshore Components

An onshore hydro-electric plant will contain two to four drive train units for a development of up to 50 MW, generator equipment, header tank and storage/site office area. The drive train unit is based on existing hydro-electric (Pelton wheel) technology which transforms water pumped by the Oyster devices to shore (through the closed loop pipeline system described above) into electricity. It is anticipated that the onshore footprint for a farm of up to 50 MW may be in the order of 4000 m^2 (0.4 ha), accounting for the plant (constructed building(s)), associated infrastructure outside, vehicle turning and parking area.

The hydro-electric plant will connect to the electricity transmission network via one of the proposed SHETL substation options shown in Figure 3.7. The EIA for the first phase of the Brough Head development will consider the electrical infrastructure up to the point of connection to the selected SHETL substation.

BHWFL has considered options relating to overland grid connection routes from phased developments within its Southern Area to connect with the proposed substation options currently being studied by SHETL. The key factors which have influenced selection of the options for which a scoping opinion is sought can be summarised as:

1. Single connection route: preference for one grid connection asset for each phase developed within the Southern Area (e.g. single connection for Phase 1a and 1b (for up to 50MW)).

2. Economics: the cost of the above grid connection should not render the development un-economic, and Phase 1a must be economic in its own right, it will not be built as a loss leader to Phase 1b.

3. Integrated: preference to develop an integrated solution that combines infrastructure with other wave and tidal projects and offers potential to strengthen the wider Orkney grid at a later date.

The required infrastructure and its routing will be informed by factors relating to:

- Installed capacity of the phases;

- Relative location of the on-shore hydro-electric plant and SHETL substation;
- Environmental appraisal;
- Consultation with local and national stakeholders
- Potential linkages with other projects and the wider Orkney grid;
- Economics;
- Proximity to site (influenced by connection voltage from site to substation); and
- Access.

Options for the infrastructure include:

- New overhead lines / underground cables on new routes;
- New overhead lines / underground cables adjacent to existing routes;
- Part new/ part rebuild of existing routes;
- Undergrounding; and
- Combinations of all of the above.

It should be noted that options relating to the rebuilding of existing grid infrastructure are unlikely to be carried out by BHWFL as they are neither the owner nor operator of these assets. BHWFL is also looking into ways in which the grid connection from the hydro-electric plant to the SHETL substation may be developed and constructed. The appropriate mechanism for delivering this requires further discussion with the GB System Operator (GBSO), National Grid Electricity Transmission (NGET), and consequently the Transmission Owner (TO), SHETL.

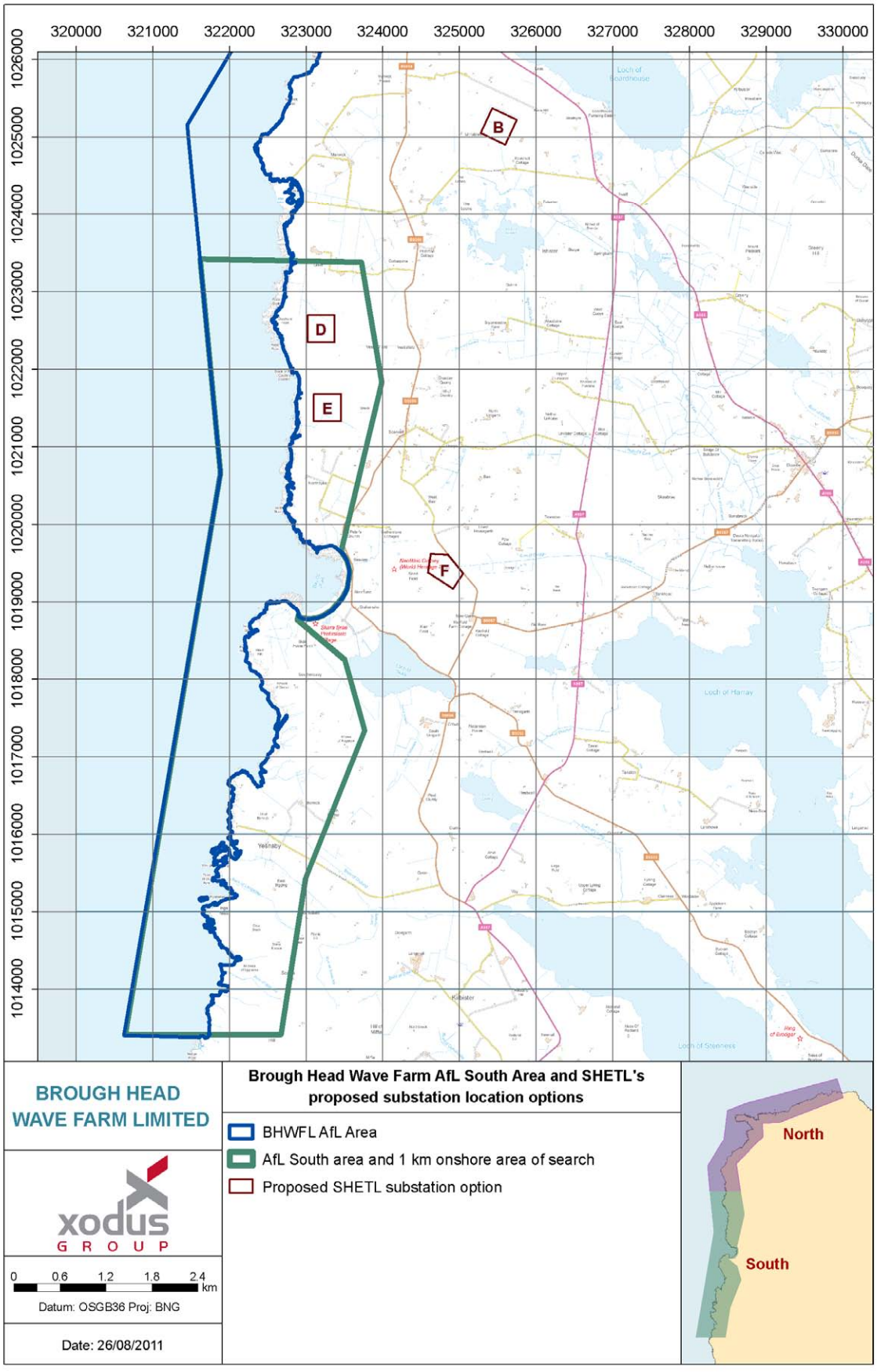

Figure 3.7 **Chart showing the proposed SHETL substation options**

3.4 Installation and Commissioning

3.4.1 Offshore Installation and Commissioning

Based on experience from installation at EMEC, installation of Oyster devices and associated seabed infrastructure is likely to utilise a mixture of jack-up barge, tugs, multi-cat vessels and dive boats. A sequential list of likely operations is provided below:

- Seabed preparation – kelp clearance, installation of anchors and potential for infilling of gullies and gaps with rock or small amounts of rock removal;
- Monopile foundation installation – most likely using a jack-up barge and a drilled and grouted piling method as per Oyster 1 and Oyster 800;
- Oyster device installation – the Oyster devices will be manufactured and transported (on a barge or wet-towed) to Orkney and stored at a suitable port facility, possibly Lyness, before final tow to site. BHWFL are considering the most appropriate port facilities for all phases of the project. Each Oyster device will be positioned over the monopile foundation using a guide system and lowered over the pile to be secured in place using grout;
- Installation of interconnecting pipelines/umbilicals – installed on the seabed between devices and the closed loop pipeline system to connect to the onshore hydro-electric plant. Stabilising rock anchor supports or concrete mattresses may be used for protection; and
- Commissioning – to involve hook-up of the pipelines, pressure testing, electrical component testing, visual examinations and functional testing of the mechanical, electrical and instrumentation components, and de-ballasting to allow the flap to rise to its vertical position.

The methods and number and type of vessels used for installation will be further refined following deployment of all Oyster 800 devices at the EMEC wave test site and as part of the ongoing design and development of the Oyster technology. Installation for Phase 1a is likely to take place in 2 phases throughout the summer months; pile installation requiring a jack-up rig and device installation requiring a spread of vessels comprising a number of tugs and dive support vessels (multi-cats). These phases would run concurrently though the device installation phase would lag behind the piling phase, starting and finishing a little later. For a larger build out phase, such as Phase 1b, two or three vessel teams as described above may be needed.

3.4.2 Pipeline Installation

The offshore devices will be connected to each other via one high pressure and one low pressure freshwater pipeline. These pipelines will in turn be connected to the shore via high pressure and low pressure pipelines. The number, size and installation method for the pipelines to shore is being reviewed to find optimal configurations.

Pipelines are the subject of ongoing design and review. There is a link between the number of pipelines and their size in order to maintain the efficiency of the closed loop system. At this stage it is anticipated that for a development of up to 50MW the range of pipeline numbers and sizes may be up to 20 pairs of small pipelines (14” diameter) or 3 pairs of large pipelines (40” diameter) or a range of numbers and sizes within these limits. The method of pipeline installation will depend on the number and size of pipelines selected. This may be Horizontal Directional Drilling (HDD) or an alternative method such as laying the pipelines on the seabed. The chosen method will route, support and protect the pipelines between the offshore deployment area and the onshore hydro-electric plant.

Once bathymetry and wave resource data of the AfL area has been analysed, suitable locations will be identified, both offshore and onshore. Smaller diameter interconnecting pipelines and umbilicals will connect each Oyster device to the larger closed loop pipeline system. These will either be rigid or flexible and will be installed onto the seabed, protected and supported by concrete or plastic mattresses, rock anchor supports and spool support frames. The means of protection and support will depend on the pipeline/umbilical material selected and the nature of the seabed.

3.4.3 Hydro-electric Plant

The onshore site is likely to consist of a hydro-electric plant/building(s), built to house the drive train equipment (mechanics/hydraulics equipment, power electronic convertors and a site office. In addition, space will be required outside the hydro-electric plant to accommodate a pressurised header tank, accumulator and valve skids, and transformers which will be held in casings to prevent oil spills and protect them from the atmosphere.

The location of the onshore infrastructure will be informed by offshore site selection, further onshore studies and consultation. Furthermore, the layout and design is yet to be finalised and will be informed by topography and other physical/biological/human factors at the chosen location.

3.4.4 Electrical Infrastructure

Construction of an overhead line would most probably involve access along the route by vehicles capable of traversing the terrain and installing the required size of wooden poles, insulators and wires. Post construction there would be minimal disturbance save for that related to operation and maintenance activities.

Underground installation would most probably involve burial at a target depth of 1m. In suitable soil types this can be achieved with minimal disruption to the ground by use of a cable burial plough. Alternatively a trenching and backfilling method can be employed in any soil type. In most circumstances normal use of the land can resume post installation.

3.5 Operation and Maintenance

Planned inspection and light maintenance activities are likely to take place every six months with staggered extended maintenance periods. Devices/hydraulic modules are likely to require more extensive inspection and service on a five year basis. For a development of up to 50 MW (and therefore 50 devices at 1 MW each) it may be that up to 10 devices will be overhauled each year. The first extended maintenance may happen in year two or three following installation of Phase 1a. Maintenance may involve removal of isolated hydraulic modules, leak testing of pipelines, power-washing biofouling, small areas of kelp removal or maintenance of any other component parts. Whilst designed for minimal diver maintenance, there is potential that divers may be required for some of these maintenance activities associated with the Oyster devices, such as power-washing biofouling and kelp removal.

Fibre-optic and electrical umbilicals between offshore devices and a Supervisory Control and Data Acquisition (SCADA) computer will ensure an open communication channel for monitoring device instrumentation and status signals. Alarm indication and shut-down signals will be recorded and data will be stored remotely as well as locally at the onshore site.

Design loads on Oyster devices are evaluated for extreme loading and background (fatigue) loading conditions. The monopile foundations and support structures are being designed to

prevent structural failure and loss of station of the flap. The loads are inherently self-limiting as extreme loading pushes the flap under the waves so that excess energy passes over the top of the flap.

The onshore electrical infrastructure options available are all established technologies in widespread use with a proven track record for reliability. Beyond allowing for exceptional events it is anticipated that the operation and maintenance requirements should be minimal compared with the scale of operations required for installation and decommissioning.

For all infrastructure there will be an ongoing need for access in order to carry out routine and reactive maintenance.

3.6 Decommissioning (or Repowering)

Oyster devices will have a design life of 20 years and would be decommissioned at the end of their life. The potential for repowering of the site and the operations involved at the end of life of an Oyster device will be considered in the EIA. Repowering is the process whereby a device reaching the end of its life is removed and replaced with a new device to continue the life of the project.

At the end of the grid connection route infrastructure's effective life, full consideration will be given to a suitable decommissioning strategy and agreed with the relevant authorities. Above ground cables are likely to be removed if there is no other use/benefit from their presence. For underground cables the final decision would be taken in consultation with the relevant authorities.

A Decommissioning Programme, under the Energy Act (2004)(see section 2), will be submitted and agreed with the Department of Energy and Climate Change (DECC), and decommissioning undertaken in accordance with the details outlined in the programme, and to a standard meeting industry best practice at that time.

3.7 Rochdale Envelope Approach

BHWFL proposes taking a Rochdale Envelope approach (see section 2) during the EIA to address elements of uncertainty associated with the ongoing design and refinement of the Oyster technology. This project description presents a series of maximum extents or magnitudes for key aspects of the proposed project. These should be used when considering the scope of the EIA for the initial phases of the Brough Head Wave Farm project in the AfL South area.

In addition this project description should be used to inform advice on site selection for up to 150 MW in the South area including the identification of environmental and social constraints.

Following site selection the extents and magnitudes defined in this section will be refined (if required) and used to assess the significance of potential environmental effects during the EIA for Phase 1 of the Brough Head Wave Farm project. Further potential phases will be assessed through separate EIAs.

4. BASELINE ENVIRONMENT AND DATA GAPS

4.1 Conservation and Designated Sites

A number of designated sites exist within the PFOW area overlapping both the marine and terrestrial environments. This describes those sites either within the vicinity of the proposed project or which may have an interaction with the proposed project. Table 4.1 provides explanation of the various designation types found in and around Orkney.

With specific regard to nature conservation, site wide and site specific wildlife monitoring will confirm the use of the South area by marine wildlife species. At the present stage a zone of ecological influence for the Brough Head Wave Farm project in the South area has not been identified. The results of marine wildlife monitoring will help to inform this zone of influence and enable judgements to be made as to the most appropriate designated sites to focus on in the EIA. The list of designated sites presented in Table 4.2 is therefore not exhaustive but is based on feedback from previous Scoping Opinions regarding projects at Marwick Head and Billia Croo. Figure 4.1 shows the relationship between the South area and the nearby designations.

Designation Type	Explanation
Special Protection Areas (SPA)	In 1979, the European Community created a directive on the Conservation of Wild Birds. The Birds Directive contains duties on Member States in relation to all species of wild birds which are to be undertaken via domestic legislation. In particular, it requires member states to preserve enough wild places to safeguard migratory and vulnerable bird species. These are to form a network of protected areas called Special Protection Areas (SPAs). Member states must take appropriate steps to avoid pollution or deterioration of SPAs, or any significant disturbances affecting the birds. The directive also requires that Member States shall pay particular attention to the protection of wetlands, especially those of international importance.
Site of Special Scientific Interest (SSSI)	Under the Wildlife and Countryside Act 1981 (Britain's domestic legislation to implement the Birds Directive), the Government has a duty to notify as a SSSI any land which in its opinion is of special interest for its flora, fauna geological or physiographical features. SSSIs are thus Britain's best sites nationally for wildlife and geology. A SSSI is given certain protection against damaging operations, which must be authorised by the statutory nature conservation body. A SSSI also has a certain amount of planning protection, but in practice this is sometimes not sufficient to prevent development.
Special Area of Conservation (SAC)	In 1992, the European Directive on the Conservation of Natural Habitats was created, requiring Member States to identify and designate areas of land as Special Areas for Conservation (SACs) on account of their importance for wildlife other than birds.
Geological Conservation Review (GCR)	Geological Conservation Review sites were designed in order to identify areas of national and international importance needed to show all the key scientific elements of the Earth heritage of Britain. These sites display rocks, fossils, sediments and features of the landscape that make a special contribution to our understanding and appreciation of the geological history of Britain and Earth science.
National Scenic Area (NSA)	National Scenic Areas are Scotland's only national landscape designation. They are those areas of land considered of national significance on the basis of their outstanding scenic interest which must be conserved as part of the country's natural heritage. They have been selected for their characteristic features of scenery comprising a mixture of richly diverse landscapes including prominent landforms, coastline, sea and freshwater lochs, rivers, woodlands and moorlands.

Designation Type	Explanation
World Heritage Site (WHS)	A World Heritage Site is classified by the UNESCO World Heritage Committee under the international World Heritage Programme. Sites are conserved for their outstanding natural or cultural importance to the common heritage of humanity. A World Heritage Site Sensitive Area is one in which development is allowed but in line with policies which take into consideration the effect of development on the World Heritage Site.

Table 4.1 Explanation of designations found in and around Orkney

Designation	Site	Qualifying Interest
SAC SSSI GCR	**Stromness Heaths and Coasts** 14 km of the west of Mainland Orkney coastline stretching inland around Black Craig Development overlaps part of the SSSI, SAC and GCR	The site is internationally and nationally important for examples of vegetated sea cliffs, including maritime grasslands, and dry dwarf-shrub heaths including northern maritime and oceanic upland heath. The alkaline fens are also regarded as of international importance. The site supports six mainly coastal and lowland nationally rare vascular plants including large colonies of the endemic (*Primula scotica*). The cliffs in the region provide examples of the Devonian Old Red Sandstone rocks. Fossilised remains form small masses of banded rock called stromatolites and the site is noted for horse-toothed stromatolites. The coastline continues to change through erosion which has formed caves, arches, geos, stacks and shore platforms.
SPA SAC SSSI	**Hoy** Geographical extent covers the north and east of Hoy and its coastline and extends 2 km offshore Approximately 6 km from AfL boundary	The main upland conservation interest of the site lies in the extensive and relatively undisturbed acidic northern montane and moorland habitats. The site qualifies as an SAC for 9 Annex I habitats under the EC Habitats Directive The SPA is classified as the site regularly supports populations of European importance of red throated diver (*Gavia stellata*), peregrine (*Falco peregrinus*) and great skua (*Stercorarius skua*). It is also classified for its seabird assemblage (over 20,000 breeding birds with around 120,000 individuals comprising 14 different species) including species such as fulmar (*Fulmarus glacialis*), great-backed gull (*Larus marinus*), guillemot (*Uria aalge*), kittiwake (*Rissa tridactyla*) and puffin (*Fratercula arctica*).

Designation	Site	Qualifying Interest
NSA	**North Hoy** Geographical extent covers the north of Hoy, Graemsay, Stromness and to the north, west and east of Stromness over a large area visible from the hills of North Hoy The proposed development overlaps the NSA *Note: text on the qualifying interest is taken directly from the citation for the NSA*	The great ice-rounded eminences of the hills of North Hoy dominate the Orkney scene with a power that is scarcely in tune with their modest height (479 m). Their bold shape, fine grouping, soaring cliffs and headlands, including the famous stack of the Old Man of Hoy, are important to the Caithness and Orkney scenes. North Hoy has a particularly strong visual inter-relationship with the south-west of Mainland Orkney, the pastoral character of which around the shores of the Loch of Stenness makes a good foil for the bold hills of Hoy. The basin of this loch is enclosed by low rolling hills of lush grassland, some arable land, scattered farm steadings and stone dykes with a noticeable lack of trees, giving a very open landscape, the character of which is enlivened by the abundant remains of ancient occupation. This landscape culminates in the west in cliffed headlands like a rampart against the sea, which breaks through at Hoy Sound in a fast tidal race. The stone-built settlement of Stromness rising steeply out of its harbour further enhances the character of the area
SPA SSSI RSPB Reserve	**Marwick Head** Geographical extent covers the cliffs at Marwick Head and extends 1 km offshore Marwick Head SPA is adjacent to the northern border of the South area	Regularly supports populations of European importance of common guillemot *Uria aalge*. Marwick Head also regularly supports in excess of 20,000 individual seabirds including nationally important populations of black-legged kittiwake *Rissa tridactyla* (~ 2 % of the UK population) and common guillemot (~ 4 % of the UK population)
SAC SSSI	**Loch of Harray and Stenness** Geographical extent just covers the lochs inland Approximately 3 km from AfL boundary	These two lochs exhibit a range of salinities from close to seawater in the Loch of Stenness to eutrophic (nutrient-rich) freshwater in the Loch of Harray. The associated flora and fauna is diverse comprising predominantly brackish and marine species in Stenness and freshwater species in Harray, with a transition zone in the vicinity of the Bridge of Brodgar. The Loch of Stenness qualifies as an SAC for its coastal lagoon quality
SSSI RSPB Reserve	**Loch of Isbister and the Loons** Approximately 2 km from AfL boundary	Heavily grazed heather of ornithological interest, fens and breeding bird assemblage including Pintail *Anas acuta*

Designation	Site	Qualifying Interest
SSSI GCR	**Cruaday Quarry** Within development area	Upper Palaeozoic site, Devonian geological system Amphibian and fish fossils
SSSI	**Glims Moss and Durka Dale SSSI** Within development area	Hydromorphological mire, bog and fens
SSSI RSPB Reserve	**Loch of Banks** Approximately 4 km from AfL boundary	Fens, and breeding birds including Hen harrier Circus cyaneus
GCR	**Bay of Skaill** Within development area	Palaeozoic palaeobotany, Devonian geological system, and plant fossils
GCR	**Yesnaby and Gaulton Coast** Within development area	Early-Devonian, sea cliffs sections of the Yesnaby Sandstone Group, including unique Aeolian facies. Sections in the Lower Stromness Flagstone Formation containing the best stromatolites in the Orcadian Basin
WHS	**Heart of Neolithic Orkney World Heritage Site** Within development area	Group of Neolithic monuments consisting of a large chambered cairn (Mae's Howe), two ceremonial stone circles (the Stones of Stenness and the Ring of Brodgar) and a settlement (Skara Brae), along with a number of unexcavated sites. The Skara Brae buffer zone is within the area of the potential development site, while the buffer zone for the other sites is out with the proposed development area. However, both of these sites are within the World Heritage Site sensitive area which can affect council planning decisions

Table 4.2 Designated sites identified in the vicinity of the South area

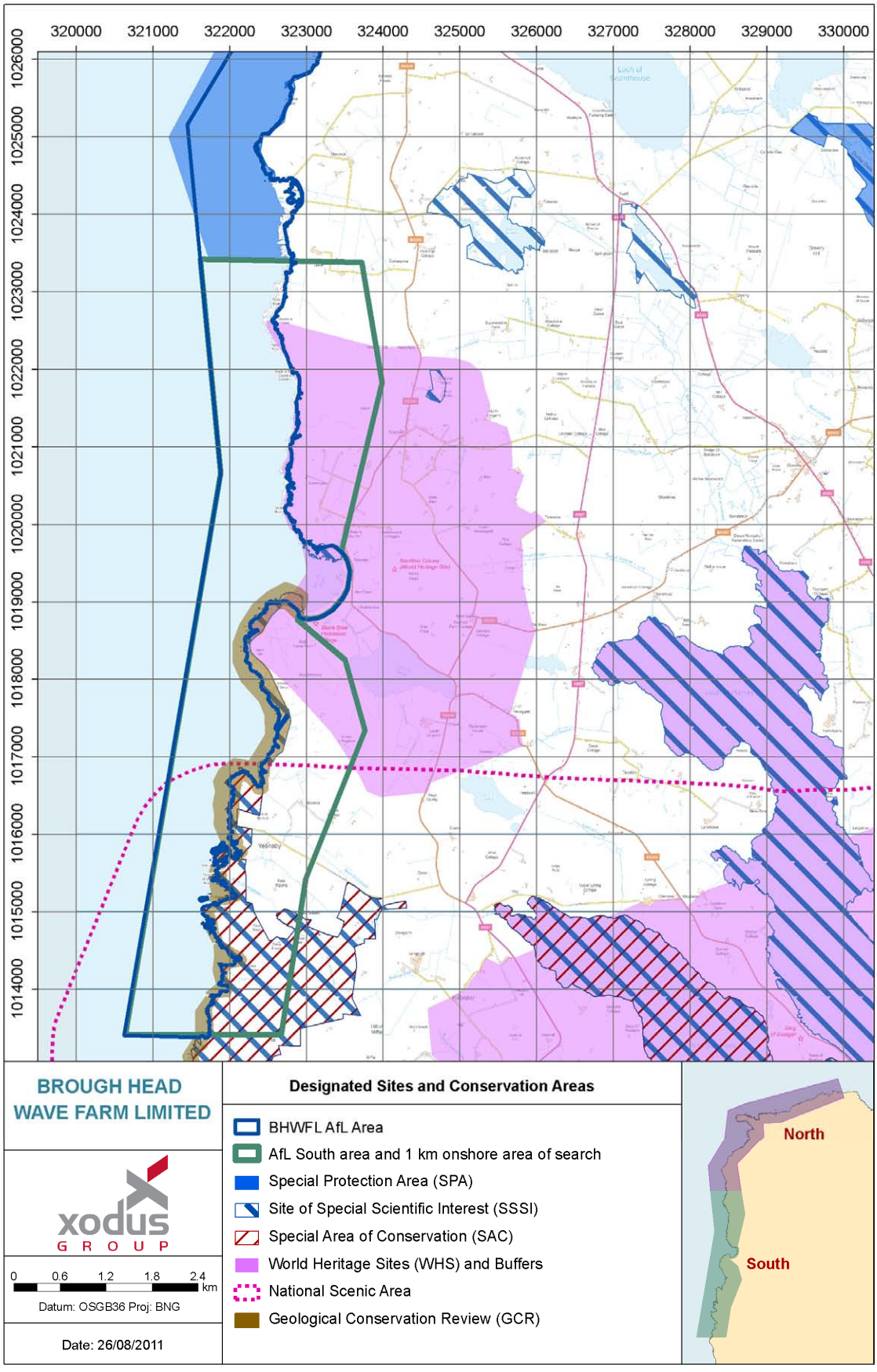

Figure 4.1 **Designated Sites and Conservation Areas around the South area**

4.2 Physical Environment

4.2.1 Air Quality and Climate

The average maximum temperature is 10.5 ºC and the minimum average temperature is 5.3 ºC (Met Office, 30-year data). Strong winds are a major feature in and around Orkney including the Brough Head Wave Farm AfL area; prevailing winds are from between the west and south-east for 60% of the year. For 30% of the year winds are greater than 8 m s^{-1} with gales occurring on an average of 29 days per year (Hansom, 2007).

The 2008 Local Air Quality Management Progress Report determined that Orkney is currently meeting the air quality objectives set out in the National Air Quality Strategy. The west of Mainland Orkney is considered to have much higher quality of air than the main population hubs on Orkney, such as Kirkwall and Stromness, as it is considerably more rural (OIC, 2008).

4.2.2 Water Quality

There are currently no bathing waters listed on the west of Mainland Orkney (SEPA, 2011). Generally the water quality around Orkney is considered to be good (Scottish Government, 2010).

4.2.3 Wind, Waves and Tides

Throughout PFOW, seabed topographic constraints result in high current velocities where tidal harmonics are dominated by semidiurnal tides with large tidal ranges (DECC, 2009). In the offshore areas the flood streams are generally from west to east, through the Pentland Firth and between islands in Orkney and Shetland, with the flood stream deflected southwards along the Shetland coastlines. The maximum tidal current amplitude in nearshore waters, expected in the AfL South area, along the west coast of Orkney is 0.04 m/s, (DECC, 2009).

The combination of exposure to prevailing winds and deep, open offshore waters produces a high energy wave regime along the western coast of Orkney. Significant wave heights can exceed three metres for over 10% of the time and one metre 75% of the time (DECC, 2009).

4.2.4 Bathymetry, Seabed Geology and Type

Much of the proposed offshore development area is less than 25 m in depth. The Oyster devices are most likely to be placed in water depths between 10 and 15 m. Based on a BHWFL survey offshore Marwick Head (Aspect Land and Hydrographic Surveys, 2009) it is anticipated the bathymetry will comprise largely of rock steps with steep slopes and a number of large crevices and seabed rises. Rapid depth changes of up to 15 m may also be expected.

The geology of Orkney is quite uniform. Many of the islands, including the west of Mainland Orkney, are formed of sedimentary rocks of Devonian age, deposited between 400 – 360 million years ago. They belong to the Old red Sandstone (ORS) Supergroup and are fluvial and lacustrine in origin.

The exposed cliffs surrounding the survey area comprise most likely siltstones and fine grained sandstones. These rocks are characterised by well developed layering, gentle folding and strongly accentuated jointing. The same rocks are expected to create the bulk of the bedrock exposed on the seabed within the proposed development area.

Irregularly spaced faults are often significant features of the Old Red Sandstone rocks. The fault lines create preferential erosional zones that aid the formation of deep troughs both in the cliff face and on the seabed.

Using the available BGS data (BGS, 1987), the bedrock comprises mudstone, siltstone and sandstone throughout the site. Extrapolation of the onshore geology suggests normal faulting will extend offshore, in addition to some folding exposing scattered fossil horizons. Mirroring that found onshore, offshore faulting is not expected to be intense.

There are several foul areas (obstructions; fully submerged rocks/boulders/other) in the inshore coastal waters of the west of Mainland Orkney. A foul area is defined as an area of numerous unidentified dangers to navigation which serves as a warning to mariners that all dangers are not identified individually and that navigation through the area may be hazardous.

Interpretation of sub bottom profiler, multibeam bathymetry and multibeam back scatter records in the Marwick area predict exposed bedrock with a lack of any surfical sediments (Aspect Land and Hydrographic Surveys, 2009), although it is known that the area surrounding the Bay of Skaill is likely to be different.

BHWFL and TCE PFOW Developers Forum have procured detailed bathymetry survey work within the AfL area, which is underway at present. This will allow ground truthing of some of the above baseline information, as well as technical analysis of areas suitable for installation of devices and detailed resource modelling.

4.2.5 Terrestrial and Coastal Geology, Hydrology and Hydrogeology

The cliffs and associated forms of west Orkney are good examples of the control exerted by geology on coastal landforms. The variety of features that are found in Orkney, including such well known features as the Old Man of Hoy, reflect the dominant geological control of horizontally bedded, faulted and fractured, flagstone and sandstone (Scott *et al*, 2005).

The southern part of the AfL South area is within a National Scenic Area (NSA), due to the geology, topography, archaeology and coastal scenery (SNH, 2010). Part of the west coast of Orkney has been designated as a Geological Conservation Review (GCR) site due to the national importance of the cliff geology in the area as well as the potential to accurately measure the coastal geological retreat caused by such high-energy environments. The west coast of Orkney is often subjected to the full force of the Atlantic Ocean with deep-water inshore allowing huge waves to arrive at the cliffs unbroken (Hansom, 2007).

The varying coastline on the west coast of Orkney contain sheer high cliffs and distinct arches, geos, stacks and gloups interspersed with occasional sandy beaches and enclosed bays (Scott *et al*, 2005). The cliffs range in height along the west coast from zero at the Bay of Skaill beach to 59 metres at Row Head. At the south of the onshore area of search the land topography rises up to some relatively high and steep hills including the North Hill (151 metres) and Scarra (124 metres).

There are several burns that run through the Brough Head Wave Farm onshore area of search as well as several waterfalls.

4.2.6 EIA Studies – Physical Environment

Table 4.3 sets out the studies required to characterise the physical environment for the EIA.

Ongoing consultation and collation of additional site-specific data will inform the significance of potential project effects and cumulative/in-combination effects.

Receptor	EIA Study	Outline Method / Data Source
Bathymetry	Detailed mapping of seabed bathymetry to inform site selection and project design (including positioning of Oyster devices and installation of seabed infrastructure).	The Crown Estate has procured detailed bathymetry survey work within the AfL area on behalf of all the wave and tidal developments in the north and west of Orkney. Scope includes: single beam, multi-beam, side-scan sonar and magnetometer survey work.
Topography, Geology and Hydrology	Mapping of burns and drainage ditches and the potential for aquifers and underground water flow, mapping of topography and understanding of site geology.	Ordnance Survey and British Geological Survey map data will help inform site selection. Desk and field study to collect site-specific data on topography and hydrology (methodology and scope not yet defined).
Wave and tidal flows	Wave resource modelling and the effect of introducing a wave energy absorbing device on coastal processes.	ADCP data collection. Wave resource modelling, potential for sediment sampling, if required (methodology and scope not yet defined).

Table 4.3 EIA studies for the physical environment

Q ***Do the studies proposed for characterisation and assessment of effects on the physical environment look appropriate and complete?***

4.3 Biological Environment

Marine Habitats and Communities

4.3.1 Sub-tidal Environment

The west facing coast of the Mainland Orkney and its sublittoral habitats and communities are predominantly very exposed bedrock and/or large boulders, backed by sheer cliffs, and bedrock extends into deep water close inshore (Barne et al. 1997). The shores are dominated by barnacles with occasional clumps of the rare brown alga *Fucus distichus* and the red alga *Palmaria palmata* (Barne et al. 1997).

There are no conservation sites designated for benthic ecology in the vicinity of the proposed development area.

The 2009 site survey undertaken off Marwick Head was conducted using a remotely operated vehicle (ROV). Results show the coastal inshore waters down to depths of approximately 15 m

comprise thick kelp (*Laminaria hyperborea*) forests with a number of related species including the sea urchin *Echinus esculentus*, epiphyte *Ptilota gunneri* and the common starfish *Asterias rubens*. Interstitial spaces at the base of the kelp are relatively exposed rock seabed, occasionally overlaid with a thin veneer of sand. Below approximately 15 m, the kelp forests thin out and are largely absent below 20 m. Red algae species (possibly including *Delesseria sanguinea*) are found. At depths of 20 m out to the extremes of the survey area, exposed rock (including crevices and steps) are covered with varying degrees of the soft coral *Alcyonium digitatum* (Dead man's fingers), which are extensive in places. Benthic fauna are largely dominated by *E.esculentus* and the bryozoan *Flustra foliacea*, as well as sponges (possibly including *Cliona celata*).

It is predicted that the environment throughout the AfL South area has similar attributes although it is acknowledged that the environment around the Bay of Skaill, due to the difference in seabed sediment and water flows, may be different.

The characteristic species of the communities found in the deeper and exposed sub-littoral, are found to have faunal crusts with the polychaete *Pomatoceros triqueter*, the barnacle *Balanus crenatus* and bryozoans. Dead man's fingers *Alcyonium digitatum*-dominated communities were found on moderately exposed rock. Bryozoans, mussel beds (both *Mytilus* and *Modiolus*), brittle stars and faunal and algal encrusting species with the presence of the sea urchin *Echinus esculentus* also form the characteristic species of these communities (Eleftheriou, A, 2003).

4.3.2 Intertidal Environment

The coastline along this area comprises mostly of very wave-exposed rock and due to the high energy nature of the coastline the shores are relatively species-poor. However, for those species that do exist along the west coast, the abundance is found to be high (Murray et al, 1999). In exposed conditions, supralittoral rock typically has an extensive lichen zone whilst littoral rock is characterised by encrusting species such as mussels *Mytilus edulis,* the limpet *Patella* spp., the barnacles *Chthamalus* sp. and *Semibalanus balanoides*, brown algae including *Fucus distichus sub sp. anceps* and *F. spiralis f. nana, F. serratus* and a few red seaweeds including *Corallina officinalis, Chondrus crispus, Mastocarpus stellatus* and *Rhodothamniella floridula* (Eleftheriou, 2003).

Substantial erosion has taken place at such sites as Yesnaby, where small inlets have formed which offer some shelter from wave action. In those parts of the rocky coast that are sheltered and on mixed sediments there were dense fucoids such as *Pelvetia canaliculata*, *Fucus spiralis, F. vesiculosus*, barnacles and in the very sheltered areas *Ascophyllum nodosum* was present (Murray et al. 1999). It should be mentioned that the fucoids *Fucus distichus* and *F. spiralis f. nana* found on exposed shores on Orkney generally have a northern distribution confined mostly to the Orkney and Shetland Islands as well as parts of the north of the Scottish mainland (Eleftheriou, 2003). *Fucus distichus* is listed as a UK Biodiversity Action Plan (BAP) species and is also listed on the Orkney Local BAP.

4.3.3 Ornithology

The west coast of Orkney is extremely important for seabirds; many use the cliffs and adjacent heaths as prime breeding and nesting sites, and consequently give rise to some of Europe's major seabird populations. Numbers of at least twelve seabird species breeding here exceed 1% of their European populations including the fulmar (*Fulmarus glacialis*), gannet (*Morus bassanus*), shag (*Phalacrocorax aristotelis*), arctic skua (*Stercorarius parasiticus*), great skua (*Catharacta skua*), common gull (*Larus canus*) and great black-backed gull (*Larus marinus*),

kittiwake (*Rissa trydactyla*), arctic tern (*Sterna paradisaea*), guillemot (*Uria aalge*), razorbill (*Alca torda*) and black guillemot (*Cepphus grylle*).

The cliffs at Marwick Head support internationally important assemblages of seabirds and protected species including the guillemot and kittiwake which are both listed under the Birds Directive (EEC, 1979). As a result of this, Marwick Head has been designated as a Special Protection Area (SPA), primarily for the guillemot. A one kilometre seaward extension was granted to this SPA in 2009 to encompass the immediate marine environment used by seabirds including the surface, water column and seabed (EC Directive 79/409) (SNH, 2008). Furthermore, the Marwick Head site is also a designated RSPB reserve. The AfL South area is adjacent to the Marwick Head SPA which has its southern boundary at the north of the development area.

Row Head is also known to be an important seabird breeding colony (RSPB, *pers comm.,* 2011).

There is currently an issue regarding falling seabird numbers around Orkney due to the pressures they face as a result of climate change. It is thought that rising seawater temperatures have altered the plankton ecology in the area, and that as a result sandeel populations have declined dramatically leading to seabirds struggling to find food (RSPB, 2009).

4.3.4 Marine Mammals

All cetacean species are European Protected Species and the cetacean fauna around Orkney is one of the richest in the UK, with seventeen species having been recorded since 1980 (Evans, 2010). Seven of these species (representing 25% of the UK cetacean fauna) are recorded throughout the year or as regular annual visitors. Evans *et al* (2010) report that the minke whale (*Balaenoptera acutorostrata*), long- finned pilot whale (*Globicephala melas*), killer whale (*Orcinus orca*), Risso's dolphin (*Grampus griseus*), white- beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphins (*Lagenorhynchus acutus*) and the harbour porpoise (*Phocoena phocoena*) are all recorded in this region.

There are two species of seal commonly found in Orkney waters; the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*), both of these species occur around the coasts of Orkney.

Approximately 45% of the world's grey seals breed in the UK and 90% of these breed at colonies in Scotland with the main concentrations in the Outer Hebrides and in Orkney (SCOS, 2009). Of the five main breeding areas of grey seals in the UK, the greatest number of pups (43% of the UK total and approximately 15% of the world total) are born at colonies in Orkney (SMRU, 2011). Thus, the populations of grey sea in Orkney are very important both in national and international terms.

Approximately 30% of European harbour seals are found in the UK although this proportion has declined from approximately 40% in 2002 (SCOS, 2009). In Orkney, harbour seal numbers declined by 63% between 2001 and 2008 (SMRU, 2011). Until 2001, Orkney was the main stronghold for harbour seals in the UK, holding 22% of the population. Following these population declines the contribution to the UK total provided by Orkney fell to 12% in 2008 (SMRU, 2011). Even so, Orkney is still important nationally and internationally for harbour seals. The Orkney harbour seal population is considered to be in a parlous state, having declined greatly in recent years.

No significant seal populations (of either species) are present within the proposed development area. However, there are known haul-out sites for harbour seals both north and south of this area at Marwick Bay and Warebeth (Wilson and Malone, 2011). Therefore, seals may swim through the proposed development site or use it for foraging.

4.3.5 Fish & Shellfish

The west coast of Orkney in general is important for many different fish species and a variety of finfish and shellfish are likely to be present in and around the area. Off the coast of Orkney 108 marine fish have been recorded including 88 bony fishes, 19 sharks and rays (elasmobranchs) and one jawless fish (agnatha) (Potts and Swaby, 1997). The basking shark (*Cetorhinus maximus*) is currently listed by the International Union for Conservation of Nature (IUCN) as "Vulnerable" globally and "Endangered" in the northeast Atlantic and north Pacific, though is only occasionally seen in the waters of Orkney. The basking shark is protected from disturbance and capture in British waters (up to 12 nm offshore) through legislation such as the Wildlife and Countryside Act and European legislation (Evans *et al*, 2010).

The distribution of fish species can vary greatly between juvenile and adult phases and with seasonal migrations. The waters surrounding Orkney have different species that use the area for the different stages of their lifecycles.

Mackerel (*Scomber scombrus*) are widely distributed around Britain and are present in the seas of Orkney. During the northward feeding migration a small proportion of the population enter and spawn in the coastal waters around Orkney, arriving in May and June. Most of the population continues migrating northeast, but mackerel do remain in the region throughout the summer months. However, the highest numbers are found in the late summer and autumn (August to October) when returning migration to the southwest takes place (Robson, 1996).

Herring (*Clupea harengus*) were once locally abundant in the summer and autumn feeding throughout the region, however the stock has undergone periods of severe depletion in the mid 1970s and mid to late 1990s. By 2003 stocks had begun to rise following the introduction of management actions although herring populations continue to be vulnerable (Simmonds, 2007). Sprat (*Sprattus sprattus*) and sand eel (*Ammodytes* spp.*)* have recognised spawning grounds in Orkney waters. Sprats spawn in the early summer, peaking between May and July, whilst sand eels spawn from November to February (Gordon, 2003). Sand eels have been found to have spawning grounds around the whole of the Orkney coastline (Ellis *et al*, 2010). Sand eels are significantly important for bird species in the area, such as puffins, and both sand eels and herring lay their eggs on discreet areas of the seabed, rather than through pelagic dispersal, which makes them more susceptible to disturbance on the seabed (Gordon, 2003).

Other fish species without defined spawning grounds locally, but widely distributed in the waters around Orkney, include haddock (*Melonogrammus aeglefinus*) and saithe (*Pollachius limanda*). Flat fish species such as plaice (*Pleuronectes platessa*) and dab (*Limanda limanda*) occur on sandy areas of the seabed with their juveniles living close inshore in nursery areas (Gordon, 2003).

Ellis *et al* (2010) report that the several species also have nursery grounds in the area of the proposed development, including anglerfish (Lophius litulon), blue whiting (*Micromesistius poutassou),* cod (*Gadus morhua*), hake (*Merluccius merluccius*), ling (*Molva molva*), spotted ray (*Raja montagui*), spurdog (*Squalas acanthias*) and whiting (*Marlangius merlangus*). In all cases these nursery grounds are part of much larger nursery areas which encompass Orkney and a large proportion of Scottish waters.

The common skate (*Dipturus batis*) is featured on the Local BAP for Orkney and Ellis *et al* (2010) have found evidence that they too use the west coast of Orkney as a nursery ground. Skates are arguably one of the most vulnerable of exploited marine fish because of their large size, slow growth rate, late maturity and low fecundity (ICES, 2006).

Brown/sea trout are considered a local priority species (Orkney Biodiversity Action Plan, 2002). However, there are no trout burns or lochs within the proposed development site; the closest sites are to the north of the proposed development area between the Loch of Boardhouse and Birsay Bay, and to the southeast at Mill Burn, Stromness (OTFA, 2011).

Salmon (*salmo salar*) are present in Orkney waters (National Biodiversity Network). However, the true extent of their migratory patterns is not known in Scotland (Malcolm *et al*, 2010). One salmon river flows into the sea at Birsay Bay approximately 2 km to the north (National Biodiversity Network, 2011).

In addition to the commercially important fish species, populations of smaller fish species are likely to be supported by the area around the proposed development site. These species will be an important food source for birds and mammals in the area.

There are no designated shellfish growing waters near to the AfL area (Faber Maunsell and Metoc, 2007). However, the area is used by fishing vessels creeling for lobsters and crabs within the proposed development site (OFA, 2011).

Terrestrial / Freshwater Habitats and Ecology

4.3.6 Terrestrial Habitats & Species

There are several protected terrestrial species and habitats that can be expected to exist in the proposed development area. Many of these species are protected under European legislation such as the Conservation (Natural Habitats, & c.) Regulations 1994 (as amended).

Otters (*Lutra lutra*) are currently on the UKBAP, Scottish BAP and Orkney LBAP and have been categorised by the IUCN Red List as “near threatened” (IUCN, 2011). Otters can be expected in the proposed development site; the National Biodiversity Network (NBN) Gateway has records of them being present near Yesnaby. However, the full extent of where they exist in Orkney is not fully known as no recent surveys have been carried out in the proposed development area.

The great yellow bumblebee (*Bombus distinguendus*) is currently on the UKBAP, Scottish BAP and Orkney LBAP and can be found in the proposed development area (NBN Gateway). The bees are considered “nationally scarce” and disturbance of their natural habitats, machair and grasslands, is recommended as being kept to a minimum (RSPB, 2010).

The Orkney vole (*Microtus arvalis orcadensis),* listed on the Scottish BAP and Orkney LBAP, is likely to occur within the proposed development site. The Orkney vole can be found in rough grassland and moorland environments found in the west of Mainland Orkney.

Within the onshore area of search exists the Special Area of Conservation (SAC) and Special Site of Scientific Interest (SSSI) of Stromness Heaths and Coasts. The SSSI has been designated because of the coastal geomorphology and stratigraphy which includes non-marine Devonian comprising of lower and middle Old Red Sandstone. The biological reasons for the designation include coastlands comprising of maritime cliff and upland habitats which contain subalpine dry heath. The nationally scarce Scottish primrose (*Primula scotica*) can be found on the maritime heathland and grassland with the largest colonies occurring near Yesnaby. This designation encompasses most of the coastline for the proposed development site, running

from just north of the Bay of Skaill along to the Point of Ness in the very south (SNH citation, 2010). The SAC has been put in place because of the alkaline fens, European dry heaths and vegetated sea cliffs of the Atlantic and Baltic coasts that are present (JNCC, online).

4.3.7 Ornithology

There are several terrestrial bird species that can be found in the Orkney Islands that are listed in the UK, Scottish and local BAPs. As they are mobile they are likely to be found in the terrestrial element of the proposed development site.

Species that can be expected to be present within the proposed development area or within the vicinity of this area include the Greater scaup (*Aythya marila*), Corncrake (*Crex crex*), Northern lapwing (*Vanellus vanellus*), Black-tailed godwit (*Limosa limosa*), Eurasian curlew (*Numenius arquata*), Sky lark (*Alauda arvensis*) and Dunnock (*Prunella modularis*). These species are listed on the UKBAP. Species that are listed on the Scottish BAP for this area include the Whooper swan (*Cygnus Cygnus*), Short-eared owl (*Asio flammeus*), Pochard (*Aythya farina*), Dunlin (*Calidris alpine*), Linnet (*Carduelis cannabina*) and Hen harrier (*Circus cyaneus*).

4.3.8 EIA Studies – Biological Environment

Table 4.4 sets out the studies required to characterise the biological environment for the EIA.

Ongoing consultation and collation of additional site-specific data will inform the significance of potential project effects and cumulative/in-combination effects.

Receptor	EIA Study	Outline Method / Data Source
Marine habitats and communities	Understanding of the seabed habitats and communities throughout the site chosen for development. Understanding of the use and distribution of the selected site in the South area by marine mammal and bird species (plus basking sharks), and fish.	Field study using video footage and/or still camera footage (methodology and scope not yet defined). Shore-based marine wildlife monitoring survey currently ongoing across the entire Brough Head Wave Farm site to characterise the whole site and aid site selection. Site-specific field survey monitoring the use of a chosen site by marine mammals, birds and basking sharks (methodology not yet defined). Desk based fish study using available published data, current research and consultation with Marine Scotland Science and local stakeholders including Orkney Trout Fishing Association. Aquamarine Power is collecting underwater noise measurements during installation and operation of Oyster 800. This information will be used to inform the scope and methodologies of any studies relating to underwater noise.
Terrestrial / freshwater habitats and communities	Understanding of the habitats and communities within the chosen development site area and how they might be effected by the proposed project.	Extended Phase 1 habitat survey (including intertidal survey if required) and otter survey to categorise the habitats in the area and establish the presence of otters within the proposed development site area. Dependent on the results of the Phase 1 habitat survey and the chosen location for the onshore hydro-electric plant there may be a need to undertake further work to look at specific terrestrial / freshwater habitats and communities – this will be discussed with relevant stakeholders when further information is available.

Table 4.4 EIA studies for the biological environment

Q ***Do the studies proposed for characterisation and assessment of effects on the biological environment look appropriate and complete?***

4.4 Human Environment

4.4.1 Marine and Terrestrial Cultural Heritage

Overview and methodology

A Cultural Heritage Baseline Assessment has been carried out by Orkney Research Centre for Archaeology (ORCA) on behalf of Xodus and Aquamarine of sections of 1km wide coastal strips on the west and north coasts of Mainland, Orkney.

The assessment was commissioned in order to establish the baseline cultural heritage conditions in areas being considered for development of the Brough Head Wave Farm project.

The baseline assessment will be used to inform site selection and consideration of the potential effects of the proposed development on archaeological and cultural heritage resources.

The walkover survey was executed in accordance with the relevant sections of the Institute for Archaeologists (IfA) Standard and Guidance for Archaeological Field Evaluation (revised 2008) across the onshore area adjacent to the AfL.

Preliminary results in the AfL South area

The area around the World Heritage Site of Skara Brae, the Scheduled area around this and the whole of the south side of Skaill bay are especially sensitive. This not only comprises the setting and buffer zone for the WHS, but also includes the setting for the A-Listed Skaill House and its Designed Landscape. Geophysical surveys have shown that archaeological remains continue southwards beyond the statutorily designated areas.

Other sensitive areas include the immediate environs of the Broch of Borwick and around the promontory fort of the Brough of Bigging, both in the general Yesnaby area, where there are also WW2 buildings. Indeed, there appears to be a particular concentration of significant sites in the Yesnaby, East Bigging and Staney Knowe area. This could indicate the potential for more undiscovered archaeological remains to survive in this area.

Marine archaeology and cultural heritage

There is the potential for submerged landscapes in the vicinity of the Bay of Skaill and a couple of wrecks are known to exist off the coast of Marwick Head, namely HMS Hampshire and an un-named wreck. HMS Hampshire is a designated war grave and is protected under the Protection of Military Remains Act (PMRA) 1986 with a 300 m exclusion zone surrounding it (PMRA, 1986). The un-named wreck is classed as dangerous (reason as yet unknown) and is also in the vicinity of Marwick Head.

The bathymetry surveys currently underway within the AfL will help to identify any other wreck remains within the AfL South area. Evidence from the EMEC wave test site suggests that any wrecks washed up in the depths where Oyster devices will be deployed are likely to be significantly weathered/broken up by the turbulent waters.

4.4.2 Landscape, Seascape and Visual Amenity

The submergence of the land, coupled with the frequent strong winds and the erosive force of the sea in the area, has been responsible for rapid marine erosion along the exposed coasts, particularly along the west coasts of Hoy and Mainland Orkney, which has produced impressive cliffs with their geos, gloups, natural arches and stacks (Land Use Consultants, 1998), which are essential contributors to Orkney's identity and perception.

The sea is important to the physical and cultural landscapes of Orkney and the meeting of land and sea at the coast and the features that are formed are key elements in the landscape. Along the western coast, the land meets the sea in a cliff rampart that has been shaped by the action of Atlantic waves. The lower lying coastal features such as tilted flags, sand dunes and sandy bays lack the drama of the high cliffs, but are appreciated for recreation and their general accessibility (Land Use Consultants,1998).

The hills are generally vegetated by moorland, away from these areas peat is limited. Agriculture is the dominant land use of much of the west of Mainland Orkney as the landscape is noticeably open due to the lack of trees (DECC, 2009).

The Hoy and West Mainland National Scenic Area (NSA) boundary is located approximately 8 km to the south of the proposed development site area. It is designated for the North Hoy hills which have a strong, visual, inter-relationship with the west of Mainland Orkney coastline, Stromness town and harbour, and lochs (in particular Harray Loch) in the west of Mainland Orkney.

There is a sense of naturalness and remoteness experienced within the AfL South area provided by the sparsely settled area with the dominant coastal features, backed by moorlands. The distinct natural and cultural features present a seascape which makes an important contribution to the sense of culture, landscape and history associated with Orkney (Scott *et al*, 2005). The high cliffs give a distant and elevated view.

The landscape and seascape along the west coast of Orkney, including within the South area, has been used by local and international artists.

4.4.3 Navigation and Commercial Fisheries

The shipping and navigational aspects of the proposed development area have been assessed as part of a Preliminary Hazard Analysis (PHA) which can be found at Appendix C of this report.

Fishing vessels throughout the year and recreational yachts throughout the summer are the only vessels likely to be found regularly within 1.5 nm of the proposed development. A significantly high number of vessels use Hoy Mouth and Hoy Sound to the south of the proposed development in the vicinity of Stromness and Lyness.

Occasionally the RNLI have been called to incidents off the west coast of Mainland Orkney but only one incident in the last 15 years has occurred in the Marwick Bay area.

There are no ferry routes that are used in the proposed development area. The area on the west of Mainland of Orkney, including the proposed development site, has been designated as an “Area to be Avoided” by oil tankers in order to minimise any detrimental environmental effects from oil spills (DTI, 2003).

Commercial fisheries are an important industry in the Orkney Islands in terms of employment and economic revenue (DTI, 2003).

Stromness is host to two industrial crab fishing vessels (14 metres in length) which can use up to 100 creel pots at any one time. There are also some crabbers fishing to the west of Mainland Orkney from further afield, such as Ireland. The Orkney Fisheries Association (OFA) confirms that these vessels would be much further out with the proposed development site. There are also two whitefish vessels in Stromness which go as far as the Faroe Islands and Norway and there are other large fishing vessels which are based in Kirkwall.

However, the OFA have confirmed that the whole Orkney coastline is creeled[1] for lobsters in inshore waters, with crabs being fished for slightly further offshore. The west of Mainland of Orkney tends to produce larger lobsters than the east coast due to the rugged coastline. Lobster vessels will try to operate as far inshore as possible when fishing, dependant on the weather, as the inshore catch tends to be of a higher quality than further offshore (OFA Anatec, 2011).

Juvenile lobsters are also released into waters around the coast by the Orkney Lobster Hatchery. This is to try and make the lobster industry more sustainable (Orkney Lobster Hatchery).

Aquaculture is important in the Orkney Islands for species such as salmon. However, there are no aquaculture sites within the vicinity of the proposed development site.

4.4.4 Tourism and Recreation

Marine

Tourism is an extremely important industry in the Orkney Islands. There are a number of recreational and tourist activities taking place on the islands including cruise visits, fishing, diving, surfing, kayaking and sailing.

On average seventy cruise liners visit the islands (but do not generally pass through the AfL area) annually potentially carrying thousands of tourists (OIC Marine Services, 2011).

Trout fishing is popular on the islands and can be done at sea or in some of the lochs and burns on the island. There is likely to be no trout fishing carried out within the proposed development site (OFTA, 2011).

Diving is also a popular activity with many wrecks to see around the coastlines; there are also many species of flora and fauna that can be seen in the waters of Orkney (Good Dive, online).

Surfing, kitesurfing, windsurfing and kayaking have been identified as activities which may occur within the AfL South area and advice is sought on the locations in which these activities take place.

Sailing is also popular on the Orkney Islands but there are no piers or marinas within or close to the proposed development site. However, some recreational cruisers and yachts may transit through the proposed development area during passage from the west coast of Scotland or between Stromness and Kirkwall or the outer islands of Orkney.

Terrestrial

There are many different places to visit on the islands which attract thousands of tourists to the islands every year. Some of the archaeological sites have been given World Heritage Status such as Skara Brae, Maeshowe and the Ring of Brodgar (Visit Orkney, online). Many tourists also visit parts of the proposed development site including viewpoints at Yesnaby, which

[1] *Creeling involves the placing of long lines of creels (pots) on the seabed with a buoyed clump weight at each end. These lines may consist of up to 100 creels on a line of over 1,000 m in length overall. The line is normally laid parallel to the land and relatively close to the shoreline in waters up to 30 m in depth, though creeling in greater depths does occur. The creels are normally recovered, checked and re-laid daily.*

provide views over the cliffs. There is also another view point north of the AfL South area at Marwick Head from which The Old Man of Hoy, the tallest sea stack in Britain, may be seen on a clear day.

4.4.5 Local Communities and Other Users of the Area

Offshore Oil & Gas

There are no offshore oil and gas blocks within the vicinity of the proposed development (DTI, 2003).

Subsea Cables & Pipelines

A BT telecommunications cable (Northern Lights Cable) is installed between Dunnet Bay and the Bay of Skaill.

Marine Aggregate Extraction

The British Marine Aggregate Producers Association (BMAPA) confirms that there are no licensed marine aggregate sites within the study site area (pers. Comm. 2010), a situation that is unlikely to change in the foreseeable future.

Marine Waste Disposal

There are no marine waste disposal sites in the vicinity of the proposed development (DTI, 2003).

Military Activity

There is no military activity within the vicinity of the proposed development. The closest charted practice and exercise areas are off the northwest of mainland Scotland and east of the Orkney Islands (DTI, 2003).

Munitions

There are no munitions disposal sites within the vicinity of the proposed development site, although the full extent of munitions that are present in the marine environment is not known (DTI, 2003).

Population

There are many smallholdings and dispersed housing situated all along the west coast of Mainland Orkney. Throughout the AfL south area there are several small farms, smallholdings and cottages as well as holiday homes dispersed over a large area. However, there is no single centre of population within the site area. The nearest population centres are at Stromness or Dounby.

Noise

There is currently limited information on marine and terrestrial noise in the proposed study area. Potential existing anthropogenic sound sources in the area include recreation, agriculture and shipping, although anthropogenic noise levels are likely to be low.

4.4.6 Transport and Road Infrastructure

The B9056 passes through the onshore development area of search and provides access for thousands of tourists each year to the WHS Skara Brae and Skaill House as well as those travelling to and from the Bay of Skaill or up and down the west coast of Orkney. All other road infrastructure in the proposed development area is minor and comprises single track roads. Existing levels of traffic have not yet been obtained.

4.4.7 EIA Studies – Human Environment

Table 4.5 sets out the studies required to characterise the biological environment for the EIA.

Ongoing consultation and collation of additional site-specific data will inform the significance of potential project effects and cumulative/in-combination effects.

Receptor	EIA Study	Outline Method / Data Source
Marine and terrestrial cultural heritage	Consideration of setting of cultural heritage assets and consideration of sites identified in the walkover survey during site selection	Impact assessment study relating to archaeology and cultural heritage and proposal of appropriate mitigation strategies in agreement with the County Archaeologist Setting of cultural heritage assets to be considered alongside landscape and seascape assessment
Landscape, Seascape and Visual Amenity	As within a rural area, overlapping with WHS buffer and overlapping with NSA it is likely that a full landscape, seascape and visual impact assessment is required	Desk and field study including the identification of viewpoints and sensitive receptors, production of photomontages, in agreement with OIC and local stakeholders
Navigation and Commercial Fisheries	Understanding of the navigational issues associated with installing the proposed project within the AfL South area Understanding of the specific use of the South area by local creel fishermen and other commercial fisheries	Marine wildlife monitoring includes collection of vessel sightings data Consultation with OFA and direct discussion with local creel fishermen Consultation with OIC Marine Services and potential use of their VTS data from Yesnaby (due for installation by June 2012)
Tourism and Recreation	Understanding of all marine and terrestrial stakeholders using the area	Desk based review of tourism and recreation activity. Consultation with tourist organisations including Visit Orkney and the Orkney Tourism Group

Receptor	EIA Study	Outline Method / Data Source
Local Communities and Other Users of the Area	Understanding of all marine and terrestrial stakeholders using the area and existing socio-economic conditions Understanding of existing noise sensitive receptors and sources/levels of noise in the area in relation to the predicted noise levels output from the proposed project	Desk based review and analysis of socio-economic conditions. Consultation with OIC, Highlands and Islands Enterprise and other local stakeholders Desk based study on noise. Consultation with OIC to evaluate requirement for noise modelling under BS4142 (scope and methodology not yet defined)
Transport and Road Infrastructure	Understanding of traffic volumes and movements, main routes and the status of roads	Desk based review of existing conditions. Consultation with OIC and Transport Scotland to see if a traffic survey is required

Table 4.5 EIA studies for the human environment

Q ***Do the studies proposed for characterisation and assessment of effects on the human environment look appropriate and complete?***

Q ***Are there any sources of key environmental information not identified which should be consulted to aid site selection?***

5. ENVIRONMENTAL ISSUES IDENTIFICATION

5.1 Approach to Environmental Issues Identification

The overall purpose of Environmental Issues Identification (ENVID) is to facilitate the identification of key environmental aspects and receptors to allow the potentially significant environmental consequences of the proposed development to be identified. Those issues identified are taken through to EIA. EIA is an iterative process which is aimed at managing environmental risk and improving environmental performance.

The EIA process involves assessing issues in order to determine the level of potential risk they present to the environment and to identify possible measures which could be taken to eliminate or limit such risks. The findings are used to inform the project design stages throughout the ongoing EIA process, and ultimately to provide a holistic, environmentally sensitive design.

It is intended to apply the ENVID process throughout the Brough Head Wave Farm project. This initial ENVID undertaken during EIA scoping will be carried forward and periodically updated during the full EIAs for each development phase, following receipt of the Scoping Opinion.

All stages of the project development have been considered, from installation through operation and maintenance to decommissioning, based on a comprehensive list of aspects associated with the outline project description provided in this Scoping Report.

This initial ENVID process has identified only where there may be interactions between aspects of the project and environmental receptors. The results are presented in the ENVID matrix in Appendix D.

Once a suitable areas for development has been identified, the range of EIA studies and their detailed scopes will be developed and agreed with Marine Scotland and its advisors.

5.2 Key ENVID Outcomes

Consideration of potential project interactions has been split according to project processes, namely:

- Onshore site clearance and construction;
- Offshore installation and maintenance;
- Operation; and,
- Decommissioning.

The following sections describe some of the potential impacts likely to be considered during the EIA for each project process. It should be noted that this is not an exhaustive list and site selection and the Scoping Opinion will help to confirm the key potential impacts for consideration in the EIAs for developments within the South area. Sensitivities may differ across the onshore and offshore areas of search.

5.2.1 Onshore Construction

Onshore construction is likely to comprise construction of the hydro-electric plant and potentially horizontal directional drilling activity. It is recognised that there may be direct

disturbance to terrestrial / freshwater habitats and communities due to the onshore footprint (including laydown area) and noise, light and vibration emissions during construction works. There may also be a number of potential indirect impacts relating to site preparation, and alteration to water courses or drainage systems around the construction site. In addition there may be increased heavy-vehicle traffic on the local road network during site preparation and construction. Un-planned events may include sediment run-off and leaks or spills from construction plant, which would have to be carefully managed.

5.2.2 Offshore Installation and Maintenance

A number of activities associated with offshore installation, such as installation of pipelines and installation of device foundations, will result in modification and disturbance to the seabed. This will have direct impacts on seabed habitats and communities and may have indirect impacts on other species using the area. Additionally, the discharge of drill cuttings and the noise and vibration emissions during the drilling of foundation monopiles may have an effect on marine habitats and communities. Installation activities may also affect local fisheries.

All offshore operations including installation, maintenance and decommissioning, require the use of vessels. The navigational safety aspects of vessels and installation activities are captured in the PHA at Appendix C however vessel activity also has the potential to disturb marine species using the area such as marine mammals, basking sharks and sea birds due to noise emissions and the general level of activity in the area offshore.

5.2.3 Operation

The ENVID has highlighted that the presence of the Oyster devices in the water column may have a disturbance or displacement effect on marine species. Underwater noise emissions from the devices may play a part in this although this issue is presently being investigated for Oyster 800 at the EMEC wave test site. The devices also pose a navigation risk which is also the subject of the PHA. The long term presence of seabed infrastructure may have a benefit to seabed habitats and communities, although this also presents a potential snagging risk to local fisheries. The devices will be visible above the sea surface giving rise to an alteration in the seascape and visual amenity.

The ENVID also highlighted the potential for other unplanned events such as leaks from pipelines, although BHWFL is exploring the fluid composition so that in such an event harm would be minimised to marine habitats or communities.

Operating the onshore hydro-electric plant has fewer long term interactions and the extent of the interactions identified is dependent on the site selected. These include noise emissions, general activity at the plant including transport to the plant and the long term landscape or visual impact of the plant.

5.2.4 Decommissioning

Decommissioning will be subject to a detailed Decommissioning Programme, however impacts are expected to be related to the removal of onshore and offshore infrastructure and the disposal/recycling of component parts as appropriate.

6. ENGAGEMENT STRATEGY

6.1 Approach to Stakeholder Engagement

BHWFL is committed to best environmental practice throughout the entire project lifecycle and the following strategy will be maintained as a 'Stakeholder Engagement Plan' and 'Stakeholder Database' (both of which will be live documents) during the project by the Project Manager to incorporate any shift in strategy, amendments to stakeholder roles or contacts etc.

Effective communication and consultation is an essential component of the EIA and NRA. This section describes how external communication and consultation will be managed and coordinated as part of the EIA and NRA processes.

The purpose of communication and consultation is to ensure appropriate and timely engagement is made with the relevant groups and organisations in order that the necessary processes (e.g. licensing/consenting) are undertaken to a satisfactory outcome; but also to help identify any potential conflicts and/or opportunities, and to establish the preferred options that present the lowest risk and most benefit for all concerned.

6.1.1 Pre-Scoping Consultation

In advance of preparation of this Scoping Report BHWFL and/or its appointed consultants has met with a number of individuals and organisations. These meetings were set up following wider distribution of a Project Briefing Document (PBD) which outlined the proposed project and provided an opportunity for early feedback. In addition, BHWFL attend regular meetings with Marine Scotland and SNH to discuss all ongoing Oyster projects in Scottish waters.

The following organisations have been consulted on the Brough Head Wave Farm project to date, and where appropriate the discussions of these meetings have been incorporated into the body of this Scoping Report:

- Marine Scotland;
- SNH;
- Orkney Islands Council (OIC) Planning;
- County Archaeologist;
- OIC Marine Services;
- Orkney Fisheries Association (OFA); and
- A number of local marine recreational organisations – Orkney Sailing Club, Orkney Dive Boat Operators' Association, Stromness Sailing Club, Orkney Sea Kayaking Association and Kirkwall Kayak Club.

6.2 Stakeholder Identification

It is essential that stakeholders are defined at an early stage of the process in order to facilitate communication and consultation in a way that meets the needs of the project, and the stakeholders. Two groups of stakeholders have been identified:

- **Regulator Group** –includes organisations that have a legal remit in the issuing of consents, licenses and approvals for the project; and
- **Stakeholder Group** –includes organisations that have an interest in the project due to the nature and remit of their objectives and/or activities, and/or geographical location.

A full list of stakeholders identified to date is provided in Appendix D.

6.3 Communication and Engagement Strategy

The following sections outline the current project strategy for ongoing engagement with stakeholders. As the EIA progresses this strategy will be updated as appropriate.

6.3.1 Regulator Group

As the regulating authority Marine Scotland is the first point of contact for the Brough Head Wave Farm development team with the wider Regulator Group organisations. Marine Scotland therefore has a principle role to play in the following areas:

- Agree important issues for the EIA process;
- Ensure awareness of the requirements of others;
- Agree through informed discussion the key areas of concern of each regulator;
- Confirm the competent authorities for various consents required in order to ensure correct communication;
- Consider methodologies for environmental assessment and comment on suitability;
- Provide and/or confirm suitability of specific data/information; and
- Reviewing EIA Scoping, navigational PHA, EIA and NRA documents.

The Regulator Group consists of the regulating authority Marine Scotland, statutory consultees and selected non-statutory consultees including the following:

- Marine Scotland – Licensing Operations Team (MS-LOT);
- Scottish Environment Protection Agency (SEPA);
- Scottish Natural Heritage (SNH);
- Northern Lighthouse Board (NLB);
- Maritime and Coastguard Agency (MCA);
- Marine Scotland Science (MS-Science);
- Marine Scotland Compliance (MS-Compliance);
- Department of Energy and Climate Chance (DECC);
- Orkney Island Council Planning Department (OIC-Planning); and
- The Crown Estate.

The Regulator Group largely consists of those that are within MS-LOT's Marine Renewables Facilitators Group (MRFG) or those identified by MS-LOT as key consultees.

Mechanisms for communication, roles/responsibilities and key contacts will be confirmed with members of the Regulatory Group to enable effective and efficient communication between regulator and project. This information will be recorded within the Stakeholder Engagement Plan and Database.

To this end the project proposes a strategy which is underpinned by open and frequent discussion and the transfer and sharing of information. The proposed strategy for engaging the Regulator Group is to continue meeting with Marine Scotland on a quarterly basis for all BHWFL and Aquamarine Power projects. Where specific issues need to be addressed with the Regulator Group, these meetings will be organised as required. Where several issues may be addressed in one meeting this will be the preference over a number of smaller meetings. BHWFL appreciates the time pressures on organisations and will work to ensure an efficient and acceptable approach to ongoing engagement.

6.3.2 Stakeholder Group

The Stakeholder Group includes organisations with an interest in the project but who are not identified within the Regulator Group. The main objective of engaging the Stakeholder Group, aside from meeting the requirements under the EIA Directive and EIA Regulations regarding consultation, is to ensure that as many organisations as possible are made aware of the project and have an opportunity to provide feedback and relevant data/information. Stakeholder engagement aims to address any concerns and to maximise any potential opportunities that arise throughout the EIA process.

Members of the Stakeholder Group would include:

- Non-Statutory Consultees (as identified in the Consultation on Marine Licensing for Scotland under the Marine (Scotland) Act 2010);
- Organisations that have an interest in the project due to the nature and remit of their group objectives and/or activities and also their location; and,
- Local organisations, groups and businesses in the vicinity of the project.

The involvement of the Stakeholder Group in the EIA and NRA processes is to ensure that as many organisations as possible are made aware of the proposals and have an opportunity to provide feedback and relevant data/information. Different members of the Stakeholder Group will be engaged as specific technical issues dictate.

6.4 Public Consultation

The purpose of public consultation is to ensure that the wider community is aware of the proposals and are confident that the project has followed the correct procedures (e.g. EIA, NRA) and have an opportunity to contribute. Public consultation will be undertaken at key stages within the EIA process and meet the requirements of the legislation. This is likely to be in the form of public notices and information sessions although as the project progresses it may be appropriate to consider alternative means of broader public consultation.

7. SUMMARY & CONCLUSIONS

7.1 Introduction

BHWFL proposes to install Oyster wave energy devices within the area covered by the AfL with a total installed capacity of up to 200MW. However, BHWFL plans a phased approach to the development of the area with the first phases of the project proposed to be located in the AfL South area.

Phase 1 of development of Brough Head Wave Farm is anticipated to generate up to 50 MW of the total Brough Head Wave Farm project capacity (up to 200 MW), depending on technical, safety, socio-economic and environmental constraints. This Scoping Report relates to Phase 1 and further potential phases adding up to a combined total of 150 MW in the AfL South area. Each phase would be subject to separate EIAs.

The locations of any phase within the AfL South area have not been chosen yet and this Scoping Report and subsequent Scoping Opinion are seen as an important input into the site selection/refinement process.

7.2 Consultation

BHWFL recognises the benefit to all parties from wide-ranging consultation at all stages of this project. Early consultations have been initiated with key stakeholders and this Scoping Report acts as an important part of this process.

BHWFL intends to develop this consultation process in order to maintain an effective consultation strategy with all stakeholders, both statutory and non-statutory, for the life of the development. The consultation process is detailed in Section 5 of this report.

7.3 Site Selection and Environmental Impact Assessment

BHWFL will use the Scoping Opinion and ongoing consultation to aid with site selection within the AfL South area.

BHWFL intends to adopt best practices for the project through an ongoing review of approaches to impact assessments of offshore/near shore wave energy arrays.

BHWFL has held preliminary discussions with a number of consultees regarding methods of impact assessment for some of the key issues. This process will be extended further as a result of this scoping report.

These preliminary consultations have identified likely key issues resulting from the installation, operation, maintenance and decommissioning of the proposed wave array. These, and others, will be investigated further in the EIA and described in the ES.

7.4 Mitigation and Monitoring Techniques

BHWFL understands the importance of identifying practical and appropriate mitigation measures during the EIA. It is anticipated that these will also be highlighted during the ongoing consultation process as the previous experience of the developers and consultees is utilised.

The wave energy project will be subject to an appropriate environmental mitigation and monitoring plan (EMMP). This EMMP will be informed through the stakeholder consultation process and by the results of the test installations at the EMEC wave test site.

7.5 Summary of Scoping Questions

The complete list of scoping questions which have been presented in this Scoping Report are detailed below. This will aid stakeholders in providing helpful feedback and comment.

- ***Have all the regulatory requirements that the project should be taking into account been identified?***
- ***Do the studies proposed for characterisation and assessment of effects on the physical environment look appropriate and complete?***
- ***Do the studies proposed for characterisation and assessment of effects on the biological environment look appropriate and complete?***
- ***Do the studies proposed for characterisation and assessment of effects on the human environment look appropriate and complete?***
- ***Are there any sources of key environmental information not identified which should be consulted to aid site selection?***
- ***Does the proposed list of consultees outlined in Appendix E reflect the range of stakeholders that should be considered for this project?***

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APPENDIX A ENVIRONMENTAL STATEMENT CONTENT

Proposed contents for the Environmental Statement for Phase 1 of Brough Head Wave Farm:

PART 1 INTRODUCTION

1. Development Background

An introduction to renewable energy development and wave power in particular. This will include a short overview of the wave resource in Scotland and around Orkney, and will outline the potential benefits of the development.

2. Policy and Legislation

An overview of the relevant statutory planning guidance and Development Plan policies which apply to the proposed project.

3. Site Selection and Alternatives

A description of the site selection process for the first phase of the Brough Head Wave Farm project will be outlined. In addition it will describe the main alternatives studied and the main reasons for choice of this site, taking into account the environmental effects. It will describe the way in which mitigation of environmental effects has been considered during design of the project and the EIA process.

4. Project Description

Details of the site and a description of the proposed project will be discussed. This will include details of the size, layout and design of the site and associated onshore/offshore infrastructure. As per the Rochdale Envelope approach it will identify where there may be variations or where designs remain unresolved. This chapter will also outline the construction, operation, maintenance and decommissioning requirements of the project.

5. Environmental Overview

High level overview, with detail left to impact sections.

PART 2 ENVIRONMENTAL IMPACT ASSESSMENT

6. EIA Methodology

An overview of the impact assessment methodology used for the EIA process including scoping and consultation and the identification of key environmental effects. This section will conclude by providing an overview of the ES structure, leading onto a number of EIA study chapters.

7. EIA Study Chapters

Each of the chapters will be prepared by the relevant expert environmental consultant(s), with supporting technical input provided by the Brough Head Wave Farm project team. Each chapter may be structured in the following manner:

- Introduction
- Legislative framework and regulatory context

- Assessment methodology for the topic including a summary of relevant consultation, data sources used and the means of defining the topic study area. Should there be any data gaps identified these will be noted.
- Description of existing baseline conditions
- Assessment of the nature, magnitude, duration and significance of the likely effects of the construction/installation, operation, maintenance and decommissioning of the proposed project on the specific topic
- Mitigation
- Residual Impact
- Cumulative & in-combination Impacts

PART 3 CONCLUSIONS AND COMMITMENTS

8. Environmental Mitigation and Monitoring Plan

9. Summary and Conclusions

10. References

11. Appendices

APPENDIX B STRATEGIC STUDIES

There are a variety of strategic studies planned or underway (not proposed to be undertaken by BHWFL), which will generate data and information relevant to the assessment of impacts from wave and tidal projects. These studies are outlined below; please note this list has not been curtailed to explicitly match the requirements of the Brough Head Wave Farm project.

ID	Title	Lead Organisation	Description	Status
Marine Mammals				
1	Review and distribution of Harbour and Grey Seals in the Pentland Firth and Orkney	SNH/SMRU	To determine space use by Orkney Harbour and Grey Seals in the PFOW using existing data on seal movements and haul outs and therefore considering the implications for these species of installing marine renewable developments, particularly tidal turbines.	Ongoing
2	Review of abundance and distribution of Basking Sharks and Cetaceans in PFOW	SNH/HEBOG	To collate existing information on cetaceans and basking shark distribution and abundance within the PFOW so as to inform the consenting process and to specify future field survey work required where existing information is scarce or inadequate.	Ongoing
3	Estimating collision risk between Harbour Porpoises and marine renewable energy devices	MS/SAMS	To investigate whether existing marine mammal acoustic deterrent devices (ADDs) could be used to mitigate collision risks in Scottish waters. To do these measurements ambient sound in Scottish seas will be undertaken. These will then be input together with sources level of existing acoustic deterrent devices (pingers, ADDs etc.) to an acoustic warning model developed by SAMS to assess their effectiveness.	Ongoing
4	Acoustic outputs of tidal turbines and marine mammal responses	SNH & SEPA / SAMS	To determine the capacity of marine mammals (seals and cetaceans) to 'hear' tidal turbines in high energy environments where such devices will be deployed and, thereby, take evasive action.	Ongoing
5	Development and establishment of a marine mammal stranding scheme in PFOW	TBC	Build upon existing and UK and Scottish Marine Mammal recording, recovery and inspection of marine mammals stranded upon beaches in the PFOW as a means of gauging the collision risk (if any) presented by turbines to these species. Such a scheme will also provide a means of addressing allegations about the causes of death of mammals that become stranded should they arise.	Under dev

ID	Title	Lead Organisation	Description	Status
6	EMEC Monitoring Programme	TBC	EMEC marine mammal monitoring programme under development to utilise existing monitoring data and gather new data.	Under dev
Birds				
7	Review techniques to detect seabird presence and movement below the sea surface and determine potential application in the vicinity of tidal turbines	SNH / RPS	This will be a preliminary investigation into the feasibility of underwater detection systems. The ability to detect birds depends in part on bird size, their physical properties of the seawater in which they are swimming. Work will focus on the potential use of visual detection systems (underwater cameras), active systems such as sonar, other approaches to monitoring such as strain gauges or any other potentially suitable technique. A short report will be produced identifying the system(s) that offer potential field testing, taking into account technical feasibility, availability 'off the shelf' and circumstances whereby their function will be compromised.	Ongoing
8	Assessment methodology for determining cumulative impacts of marine renewable energy devices on marine birds	SNH / RPS	Review of existing approaches to the assessment of cumulative impacts, particular draft guidance on the onshore environment and draft guidance being prepared for the offshore wind sector to COWRIE. A draft guidance document will be prepared which identifies a suitable approach to the assessment and determination of cumulative impacts on marine birds arising from offshore wave and tidal turbine technology. The draft guidance will be used by SNH for further consultation and discussion with stakeholders in government, other regulatory authorities as well as NGOs and industry.	Ongoing
9	Assessment methodology for determining collision risk of marine renewable energy devices on marine birds	SNH / RPS	Development of an encounter rate model. It is expected that this will be written in an appropriate format that is likely to be both widely available and simple to use. Suitable encounter rate model based on known biology of relevant species. Suggest default avoidance rate for these species Recommend suitable field based methodology for the collation of data that is suitable for use in a bespoke model Identify other parameters	Ongoing

ID	Title	Lead Organisation	Description	Status
10	The determination of foraging range and diving depths in the PFOW wave and tidal resources area	SNH / RPS	Seabird surveys can demonstrate the presence of particular species and relevant measures of abundance in particular development locations, but there is a need to determine the breeding colony origin of these individuals' as well as additional / alternative areas that are used for feeding and other maintenance activities. The importance of this lies, especially, in the need to determine connectivity between designated sites (especially SPAs) and areas that may be proposed for renewable energy developments. The purpose of this work is to design an outline of the work required to undertake this.	Ongoing
11	Methodology for surveys of marine birds in and around the sea areas proposed for wave and tidal energy developments off the west coast of Scotland	SNH / RPS	Seabird surveys can demonstrate the presence of particular species and relevant measures of abundance in particular locations, using various types of survey (shore-based, boas-based and aerial surveys being the principal sources of such information). Understanding the distribution of seabirds in these areas will provide the basis for marine spatial plans as well as assisting with individual development proposals. The purpose of this work is to design an outline of the work required to do this.	Ongoing
12	Seabird surveys in the PFOW	MS / APEM	To conduct field surveys to establish the utilisation of sea space by sea birds in the Orkney / Pentland areas focusing on areas with potential for marine energy generation.	Ongoing
13	Assessing movements of seabirds in relation to marine renewable energy devices	ERI	The project will investigate the movements of, and habitat use, by seabirds from SPAs in the PFOW and assess the potential environmental impacts of the proposed development.	Ongoing
14	EMEC Monitoring Programme	TBC	EMEC bird monitoring programme under development to utilise existing monitoring outputs and gather new data.	Under dev
Fish				
15	Review of migratory routes and behaviours of Atlantic salmon, sea trout and European eel in Scotland's coastal environment: implications for the development of marine renewables	MS / MS	To help establish the potential for interactions between turbine arrays and salmon entering SACs.	Ongoing

ID	Title	Lead Organisation	Description	Status
16	Literature review of the effects of EMF and noise arising from marine renewable developments on Atlantic salmon, sea trout and European eel	SNH / Cranfield	To conduct a literature review on the effects of EMF and noise on migratory routes and behaviour of Atlantic salmon, sea trout and European eel in the marine environment. Gaps in current knowledge and research requirements will also be identified.	Ongoing
17	Monitoring of the fishery in a no-take zone established at EMECs wave test site at Billia Croo, Orkney	MS & EMEC / EMEC	To investigate the effects of a no-take zone established around wave energy devices at te EMEC test site and thereby contribute to our understanding on the potential effects of marine energy deployments on fish and fisheries.	Ongoing
Shipping and Navigation				
18	Shipping and navigation	MS	To determine volume and routes of different types of shipping in order to identify the need for setting priority areas for shipping and renewables.	Ongoing
19	Cumulative Navigational Risk Assessment	TBC	Currently investigating the potential to undertake a Navigational Risk Assessment for the PFOW region.	Under dev
Marine Habitats				
20	Analysis and assessment of marine habitats and species surveyed by Marine Scotland in PFOW	SNH / Colin Moore	To review photographs and video footage of seabird habitats in areas of wave and tidal power resource in the Pentland Firth and Orkney to describe the species and habitats present and identify any which may be sensitive to such developments.	Complete
21	Bathymetric surveys of wave and tidal power resource areas in Orkney and the Pentland Firth	MS	To generate high resolution bathymetric maps of the seabed in areas of wave and tidal resources in the Pentland Firth and Orkney to describe the species and habitats present and identify any which may be sensitive to such developments.	Complete
22	Sensitivity of biogenic reef forming organisms and commercially important benthic invertebrate in the area of marine renewable development	ERI	Objective is to determine the principal behavioural / physiological responses of a number of organisms which are either of commercial interest and / or biogenic reef-forming species, and therefore hotspots of biodiversity, to predicted disturbances of wave / tidal energy devices (through determining responses to sedimentation). By gaining a better understanding of biological responses at species level the emerging RE industry will be better informed with respect to potential commercial and biodiversity impact.	Ongoing

ID	Title	Lead Organisation	Description	Status
23	EMEC Monitoring Programme	TBC	EMEC programme under development to characterise benthic impacts.	Under dev.
24	Benthic and Intertidal surveys on west and north coast of Orkney	ICIT, SuperGen	Benthic and intertidal surveys on west and north coast of Orkney	Ongoing
25	Bathymetry surveys off west coast of Orkney	The Crown Estate	Bathymetry surveys off west coast of Orkney	Ongoing
Generic and Cross-Cutting Research				
24	Review of potential impacts of wave and tidal renewables developments on Scotland's marine environment	MS / Aquatera	To identify what is known about the impacts of wave and tidal energy devices in the marine environment and gather additional knowledge that will i) inform the development of guidance and requirements for monitoring ii) aid in the delivery of a marine renewables research strategy that is complimentary to other national and international research programmes.	Ongoing
25	Guidance on survey and monitoring in relation to marine renewable deployments in Scotland	SNH / Royal Haskoning	To develop baseline survey and monitoring protocols and guidance (for marine mammals, seabirds and benthic habitats) that can be adapted or applied directly by developers deploying wave or tidal turbines in Scottish waters to a) inform the HRA processes b) detect and describe the principal natural heritage impacts that such devices might have.	Ongoing
26	Development of a methodology for acoustic monitoring of renewable devices at EMEC wave test site, Orkney.	MS / EMEC	To provide a repeatable and robust methodology to allow developers at EMECs wave test site to ascertain whether or not there is any detectable acoustic output from wave energy devices operating in a high energy wave climate under varying conditions.	Ongoing
27	Potential ecological impacts of a small scale tidal renewable device at the Isle of May SAC, Firth of Forth	SNH / SMRU / CEH, Aberdeen University	Project to establish the feasibility and implications for the natural heritage of deploying a small tidal energy converter within the Isle of May SAC, designated for seabirds, reefs and grey seals.	Ongoing
28	Identification and discussion of cumulative and in combination impacts of Pentland Firth and Orkney waters wave and tidal projects.	Royal Haskoning / The Crown Estate	Establishing a methodology for the assessment of cumulative impacts of wave and tidal energy projects.	Ongoing

ID	Title	Lead Organisation	Description	Status
Landscape and Seascape				
29	Seascape Research and Modelling	MS	To model impact upon seascape of planned renewable activities. To determine economic value of seascape and any change in this as a result of renewable activities.	Ongoing
Social and Economic				
30	Tourism and recreation	MS	To determine the spatial extent and economic activity of relevant tourism activities.	Ongoing
31	Socio – economic	MS	To determine costs and benefits of renewable activities.	Ongoing
32	Wave and Tidal Energy in the Pentland Firth and Orkney Waters: How the Projects Could be Built	The Crown Estate	Building the 1,600 MW of projects by 2020 will require several billion pounds of investment in the electricity generation equipment, balance of plant and supporting infrastructure (such as electricity networks, ports and harbours). The prospect therefore raises significant commercial opportunities for businesses, as well as economic development potential for Scotland, the regions surrounding the projects and local communities	Complete

APPENDIX C NAVIGATIONAL PRELIMINARY HAZARD ANALYSIS

Preliminary Hazard Analysis
Brough Head Wave Farm
(Technical Note)

Prepared by:	AnatecLimited
Presented to:	Brough Head Wave Farm Limited
Date:	25August 2011
Revision No.:	01
Ref.:	A2723-AP-PHA-1

Anatec	**Aberdeen Office**	**Cambs Office**
Address:	36 Upperkirkgate, Aberdeen, AB10 1BA, Scotland, UK	16 Ward Way, Witchford, Ely, Cambs, CB6 2JR, UK
Tel:	01224 633711	01353 661200
Fax:	0709 2367306	0709 2367306
Email:	aberdeen@anatec.com	cambs@anatec.com

This study has been carried out by Anatec Ltd on behalf of Brough Head Wave Farm Limited (BHWFL). The assessment represents Anatec's best judgment based on the information available at the time of preparation. Any use which a third party makes of this report is the responsibility of such third party. Anatec Ltd accepts no responsibility for damages suffered as a result of decisions made or actions taken in reliance on information contained in this report.

TABLE OF CONTENTS

1. Introduction

1.1 Background

Brough Head Wave Farm Limited (BHWFL) is a partnership between wave energy company Aquamarine Power Limited and utility company SSE Renewables UK Limited.

Anatec were commissioned byBHWFL to carry out a Preliminary Hazard Analysis (PHA) for the proposed Brough Head wave energy project on the west coast of Mainland Orkney.

A chart overview of the Agreement for Lease (AfL)area is presented in Figure 1.1.

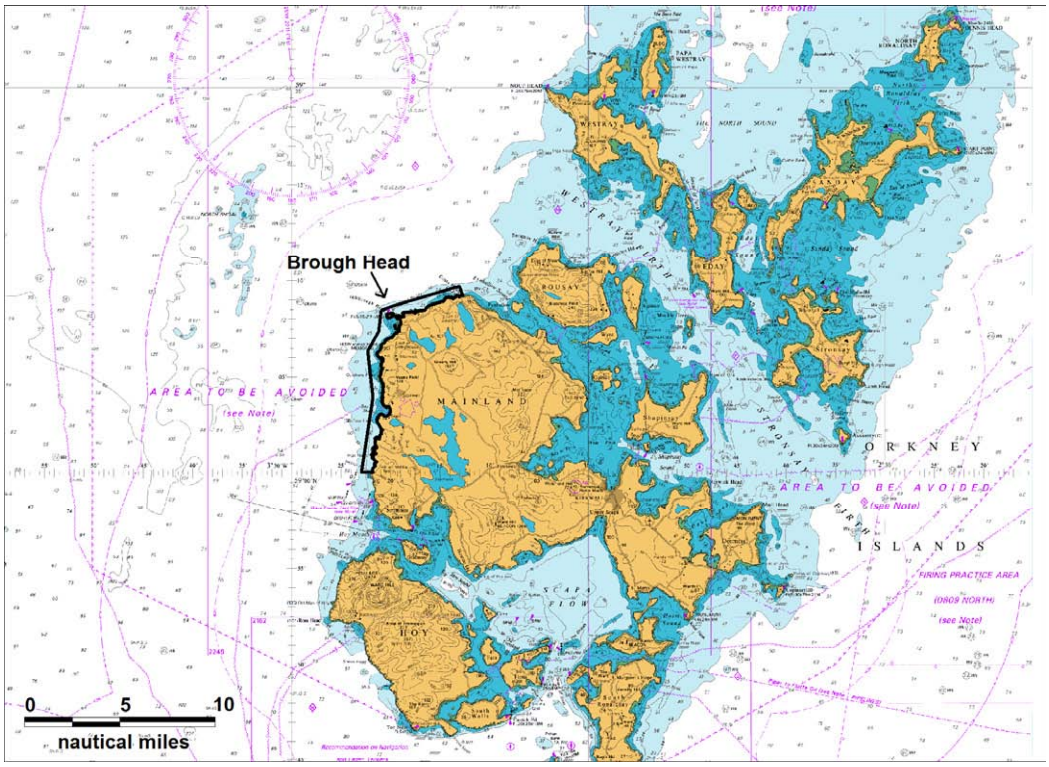

Figure 1.1 General Chart Overview of the Brough Head AfL Area

1.2 Objectives

The objectives of the work were as follows:

- Identify the navigational features of the area
- Perform a baseline vessel activity review (including AIS survey data)
- Review recent maritime incident data
- Consult with navigational stakeholders about the proposed development
- Perform a preliminary hazard analysis
- Propose an appropriate scope and methodology for the Navigation Risk Assessment

1.3 Abbreviations

The following abbreviations are used in this report.

AfL	-	Agreement for Lease
AIS	-	Automatic Identification System
ALARP	-	As Low As Reasonably Practicable
ATBA	-	Area to be Avoided
BHWFL	-	Brough Head Wave Farm Limited
DfT	-	Department for Transport
EMEC	-	European Marine Energy Centre
GRT	-	Gross Registered Tonnes
GT	-	Gross Tonnes
HP	-	High Pressure
IALA	-	International Association of Lighthouse Authorities
ICES	-	International Council for the Exploration of the Seas
IMO	-	International Maritime Organisation
km	-	Kilometre
LP	-	Low Pressure
MAIB	-	Marine Accident Investigation Branch
MCA	-	Maritime and Coastguard Agency
MEHRA	-	Marine Environmental High Risk Area
MMO	-	Marine Management Organisation
MS LOT	-	Marine Scotland Licensing Operations Team
MW	-	Mega Watts
nm	-	Nautical Mile (1,852 metres)
NRA	-	Navigation Risk Assessment
ODBOA	-	Orkney Dive Boat Operator's Association
OFA	-	Orkney Fisheries Association
OFS	-	Orkney Fishermen's Society
OIC	-	Orkney Islands Council
OREI	-	Offshore Renewable Energy Installations
PHA	-	Preliminary Hazard Analysis
PLN	-	Port Letter Number
RNLI	-	Royal National Lifeboat Institution
RYA	-	Royal Yachting Association
SCADA	-	Supervisory Control and Data Acquisition
SSE	-	Scottish and Southern Energy
UKHO	-	United Kingdom Hydrographic Office
VMS	-	Vessel Monitoring Service
VTS	-	Vessel Traffic Services
WEC	-	Wave Energy Converter
WGS 84	-	World Geodetic System (1984)

2. Description of Project

2.1 Introduction

This section presents details on the location of the proposed Brough Head project and the planned wave energy technology to be used. Further information is available in the Environmental Scoping Report.

2.2 Project Boundary

The Brough Head Agreement for Lease (AfL) area is situated off the west and north coastsof MainlandOrkney. Whilst the Scoping Report requests opinions on the southern part of the AfL (Neban Point to just south of Marwick Head, approximately), the PHA considers the entire AfLarea for up to 200 MW capacity. Ultimately, the development is planned to follow a phased approach, with the southern area being the proposed location for the first phases of development.

The boundary coordinates of the AfLarea are presented in Table 2.1.

Table 2.1 Coordinates of Brough Head (WGS 84)

Point	Latitude	Longitude
A	59.1531º N	3.2126º W
B	59.1618º N	3.2182º W
C	59.1453º N	3.3288º W
D	59.1409º N	3.3503º W
E	59.1227º N	3.3545º W
F	59.1060º N	3.3733º W
G	59.0657º N	3.3641º W
H	59.0003º N	3.3834º W
I	59.0003º N	3.3662º W

A chart overview of the area is presented in Figure 2.1. The area is approximately7.5nm^2 (25.72km^2).

The charted water depths within the area boundary vary between 7 and 30 metres (depths are reduced to chart datum which is approximately the level of lowest astronomical tide). A survey of the area is being carried out commencing August 2011 to provide more detailed bathymetry data which will help inform site selection.

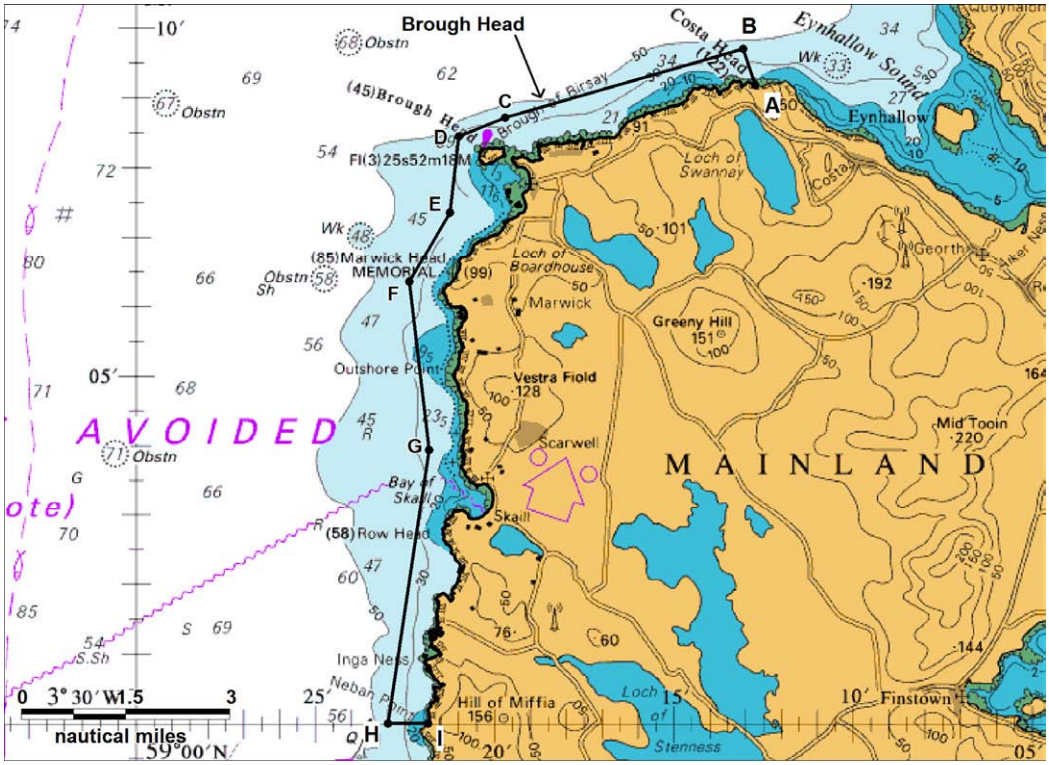

Figure 2.1 Chart Overview of Brough Head Wave Farm AfLArea

2.3 Oyster Technology

Oyster is a near-shore wave energy device, typically deployed in 10 to 15 metres (m) water depth. The oscillating action of the waves against the wave energy converter (WEC) (or 'flap') drives hydraulic pistons which pump pressurised freshwater back to shore through a closed loop pipeline system. The onshore hydro-electric plant converts the hydraulic pressure and flow into electrical power viaPelton wheel turbines which drive electrical generators.

Figure 2.2 depicts the main components of the Oyster technology. A key design philosophy of this technology is to ensure the offshore components are as simple and reliable as possible.

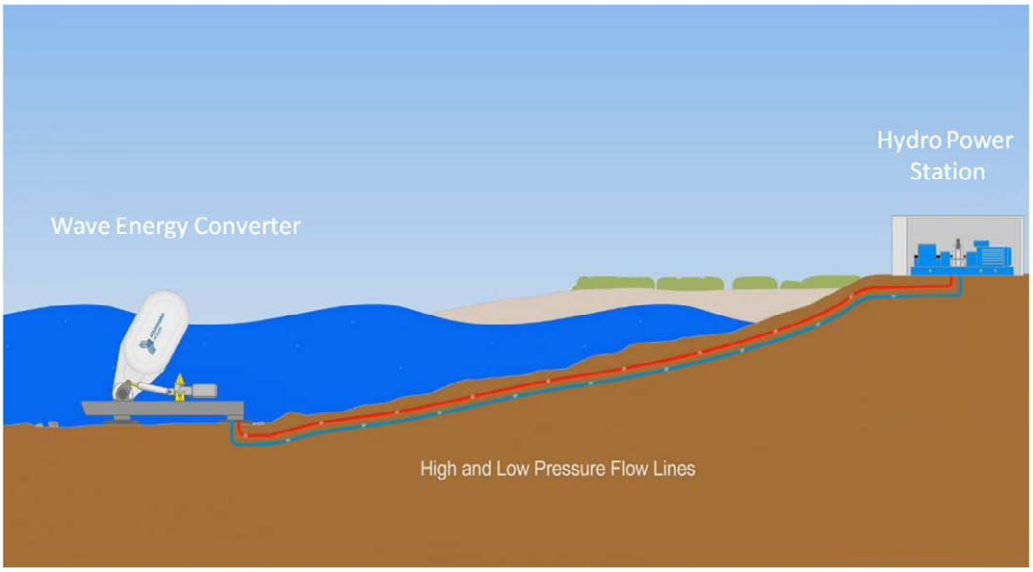

Figure 2.2 Schematic of the Oyster technology

The Oyster technology is continually being developed as lessons are learned during testing of full-scale prototype devices, such as Oyster 1 (315 kW) which was deployed for testing at Billia Croo, the European Marine Energy Centre's (EMEC) wave test sitein Orkney. The next generation of Oyster device, Oyster 800, is currently being deployed at EMEC this summer (2011), and applications have been submitted for two further Oyster devices to be installed at the same location in 2012 and 2013, as the first test array of Oyster devices. As more devices are designed, fabricated and deployed the design will be refined, and it is anticipated that each device installed within the Brough Head AfL area will have a rated capacity of up to 1MW.

In terms of dimensions of the device expected to be deployed within the Brough Head AfL area, the flap will be 26-30 m wide (parallel to shore), up to 6 m thick (perpendicular to shore), approximately 13m high (vertically – top of flap to hinge point), with a hinge axis depth approximately 9m below mean sea level. Therefore, the freeboard is expected to be approximately 3-5m, which means the flap will pierce the surface in all tidal states (although wave action will affect this).

The monopile foundation will be up to a maximum of 6 m in diameter and drilled up to 18 m deep into the seabed.

Fibre-optic and electrical umbilicals between offshore devices and a Supervisory Control and Data Acquisition (SCADA) computer will ensure an open communication channel for monitoring device instrumentation and status signals. Alarm indication and shut-down signals will be recorded and data will be stored remotely as well as locally at the onshore site.

Design loads on Oyster devices are evaluated for extreme loading and background (fatigue) loading conditions. The loads are inherently self-limiting as extreme loading pushes the flap under the waves so that excess energy passes over the top of the flap. Extreme loads on the

Oyster devices will be calculated at an appropriate return period for the specific site conditions based on the results of scale model testing under storm conditions. Fatigue loads are evaluated from the results of scale model testing in a range of different sea states.Additionally, model data design loads will be verified by full scale offshore testing at EMEC. The monopile foundations and support structures are being designed to prevent structural failure and loss of station of the flap.

2.4 Layout

BHWFL will develop the project in a layout which maximises the power capture in as small a development area as possible whilst maintaining high standards of safety and ensuring economic viability. The overall size of the development is dictated by practical installation considerations and environmental considerations, including bathymetry.
For Phase 1 of the project, up to 50 MW, it is anticipated that a length of coastline of up to 3 km (1.6nm) may be required, but the spacing of devices is dependent on local bathymetry and selection of a suitable onshore site.

Devices are likely to be deployed in two staggered lines with minimum separation distances between the devices of 10m (horizontal axis) and 25m (perpendicular axis) as shown inFigure 2.3. This figure shows a very indicative layout scenario which may alter during site investigations and site design; the exact array layout will be informed by a range of factors including technology development, hydraulic modelling, analysis of site bathymetry data from an installation perspective, device maintenance requirements,and other environmental data.

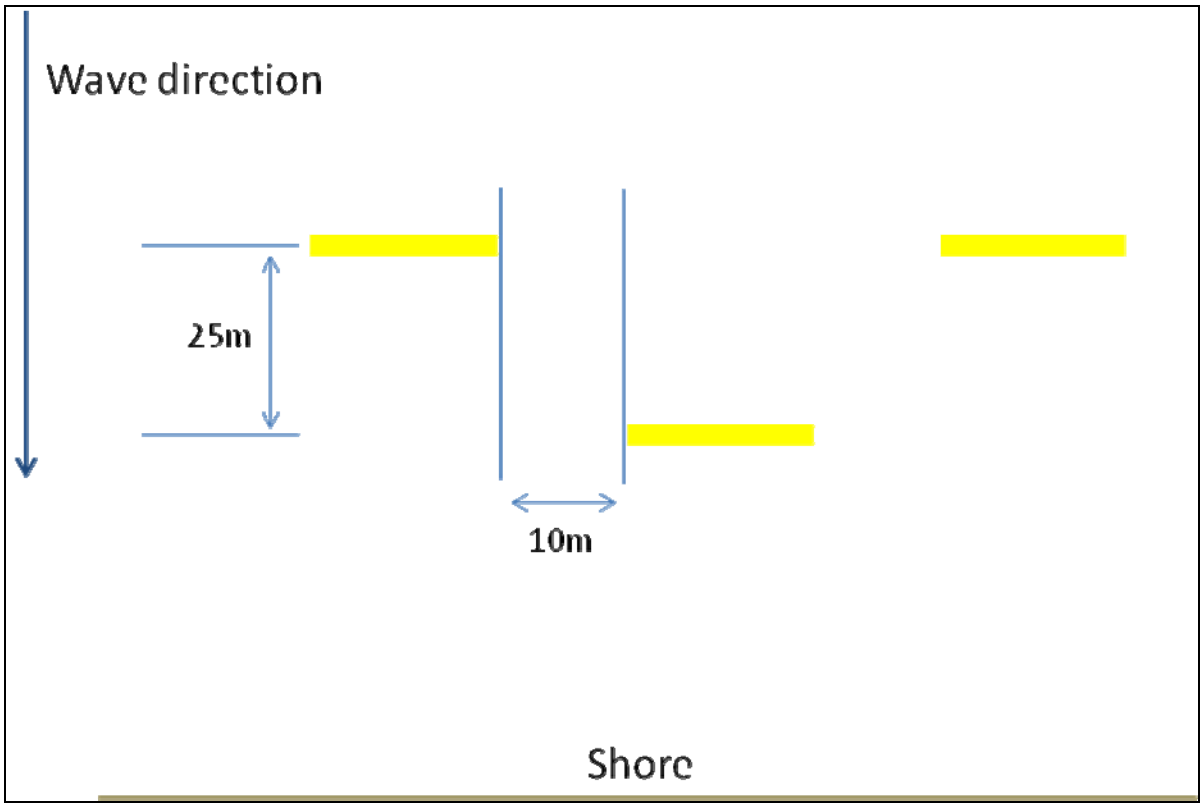

Figure 2.3 Indicative Device Layout Scenario

2.5 Pipelines

The offshore devices will be connected to each other via one High Pressure (HP) and one Low Pressure (LP) pipeline. These pipelines will in turn be connected to the shore via HP/LP pipelines.

Pipelines are the subject of ongoing design and review. There is a link between the number of pipelines and their size in order to maintain the efficiency of the closed loop system. At this stage it is anticipated that the range of pipeline numbers and sizes for a development of up to 50 MW may be up to 20 pairs of small pipelines (14" diameter) or 3 pairs of large pipelines (40" diameter) or a range of numbers and sizes within these limits. The method of pipeline installation will depend on the number and size of pipelines selected. This may be Horizontal Directional Drilling (HDD) or an alternative method such as laying the pipelines on the seabed. The chosen method will route, support and protect the pipelines between the offshore deployment area and the onshore hydro-electric plant.

2.6 Installation, Maintenance and Decommissioning

Based on experience from installation at EMEC, installation of Oyster devices and associated seabed infrastructure is likely to utilise a mixture of jack-up barge, tugs, multi-cat vessels and dive boats.

Planned inspection and light maintenance activities are likely to take place every six months with extended maintenance periods taking place on a five-year basis per device.

Whilst designed for minimal diver maintenance, there is potential that divers may be required for some of these maintenance activities associated with the Oyster devices, such as removal of bio-fouling.

More details are provided in the Environmental Scoping Report.

3. Navigational Features

The waters around Orkney (excluding the Pentland Firth and Scapa Flow) are within an IMO-adopted Area to be Avoided (ATBA), which was established to protect this sensitive coastline following the *Braer* incident. To avoid the risk of pollution and damage to the environment, all vessels over 5,000 GT carrying oil or other hazardous cargoes in bulk, should avoid this area.

Orkney Islands Council (OIC) Marine Services administers 29 Orkney Harbour Areas for which it is the Competent Harbour Authority. The nearest main port is Stromness approximately 3nm south east of the southern boundary of the AfL. Vessels calling at Stromness report to the Marine Services Vessel Traffic Service (VTS) based at the Harbour Authority Building at Scapa when crossing the Harbour Limit west of Hoy Sound (Reporting Point 'Delta').

The VTS presently have three radar sites for observing traffic:

- Sandy Hill covering Scapa Flow and the Pentland Firth
- Scapa covering the body of Scapa Flow
- Kirkwall covering Kirkwall Harbour and approaches

The VTS is planned to be upgraded and a further three radar sites added by the summer of 2012 aimed at monitoring marine renewable energy sites, including a site at Yesnabywhich will cover the west of Orkney.

Pilotage is compulsory within the Competent Harbour Authority areas for passenger vessels over 65m in length, all other vessels over 80m overall length, all vessels under tow where the combined overall length of the towing vessel and the vessel being towed is over 65m, all vessels over 300 GRT carrying persistent oils in bulk. The nearest pilot boarding position is approximately 3.5nm from the south of the AfL area.

A BT telecommunications cable (Northern Lights Cable) is installed between Dunnet Bay and the Bay of Skaill. Mariners are advised not to anchor or trawl in the vicinity.

South east of the Brough Head AfLis the EMEC Billia Croo Wave Test Site. This site is used to develop and test a variety of marine wave energy devices. The area leased by EMEC from The Crown Estate is shown in Figure 3.1. It should be noted that only the deeper-water test area is currently delineated on Admiralty Charts. Mariners are advised to avoid passing within this test area, which is marked by cardinal buoys. Charts also note that devices marked by buoys could be located between the deep-water test area (depicted on charts) and the shore.

To the south of the area is Hoy Mouth, the entrance to Hoy Sound, which affords entry to Stromness and Scapa Flow from the west. Tidal streams in the vicinity of Hoy Mouth and the western entrance to Hoy Sound are strong in-going east from a line joining Braebuster Point

and Breck Ness, and very strong out-going from the narrows of Hoy Sound and Burra Sound through Hoy Mouth.

Tor Ness in Hoy has been identified as a Marine Environmental High Risk Area (MEHRA) by the UK Government, i.e., an area of environmental sensitivity and at high risk of pollution from ships. The Government expects mariners to take note of MEHRAs and either keep well clear or, where this is not practicable, exercise an even higher degree of care than usual when passing nearby.

West of the AfL area, south west of Brough Head, lies a military wreck surrounded by a restricted area of 300m radius.

Figure 3.1presents the site area relative to the main navigational features.

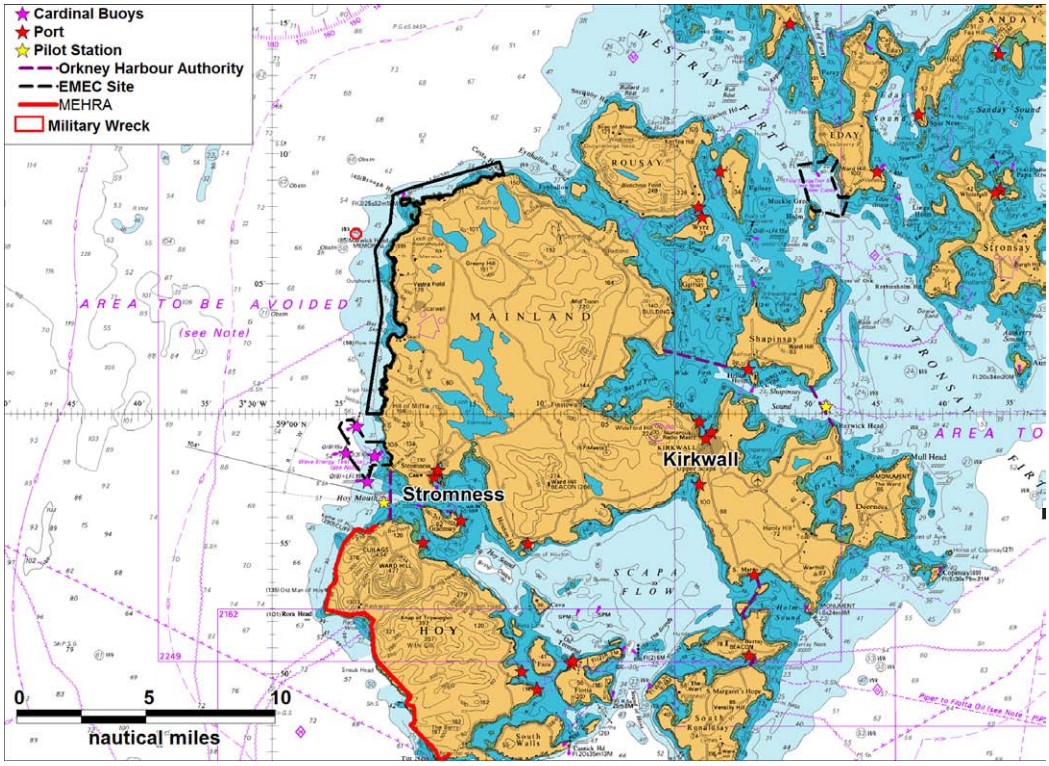

Figure 3.1 Navigational Features in the Area

4. Baseline Vessel Activity Analysis

4.1 Shipping

This section presents AIS data within 5nm of the Brough Head area for twoseparate 28 day periods in 2010; a summer period and a winter period.

AIS generally covers ships above 300 gross tonnes and fishing vessels of 45m length and over. A growing proportion of smaller fishing vessels and recreational craft also carry it voluntarily.

Plots of all the tracks recorded within 5nm of the Brough Head AfLarea during the summer and winter periods, colour-coded by vessel type, are presented in Figure 4.1 and Figure 4.2, respectively.

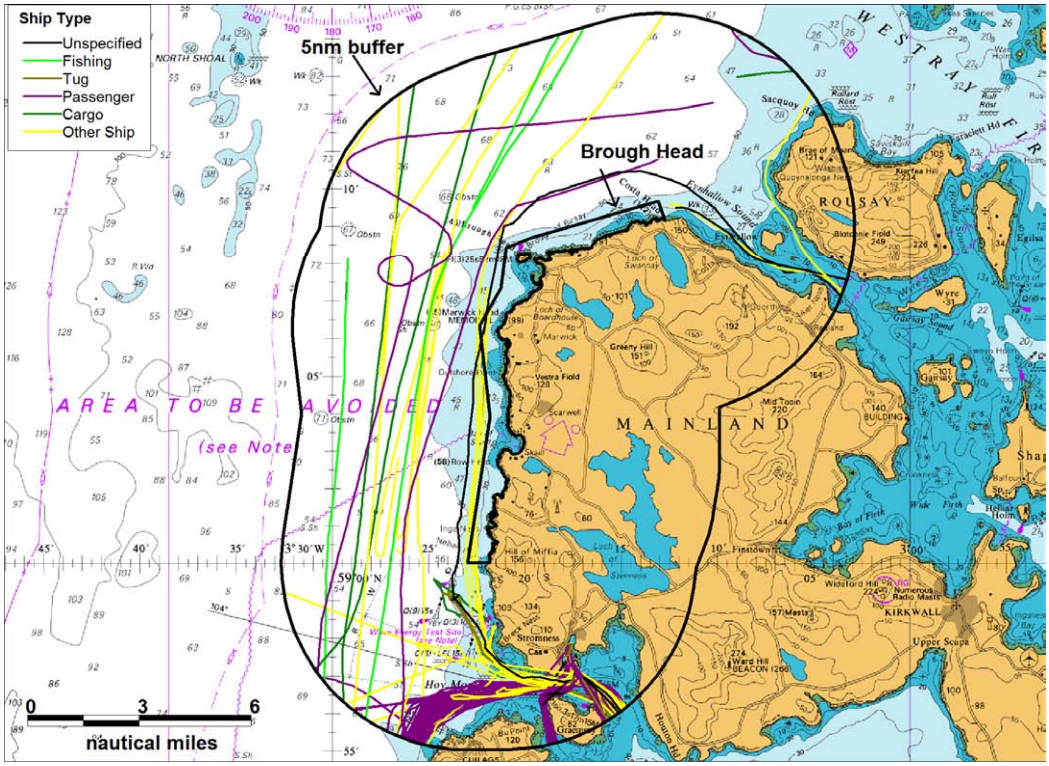

Figure 4.1 AIS Tracks by Type –28 Days in Summer 2010

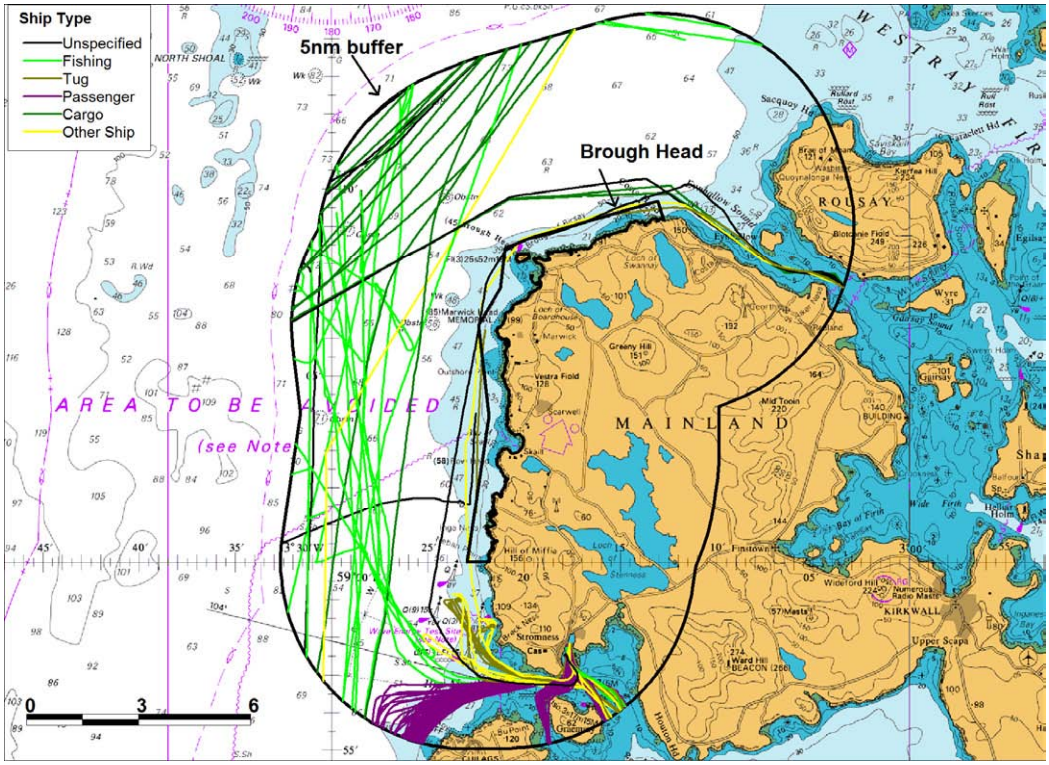

Figure 4.2 AIS Tracks by Type – 28 Days in Winter 2010

During both periods there was an average of 4-5 unique vessels per day passing within 5nm of the site, with a maximum of 9 on the busiest day.

Around half the vessels tracked were passenger ships with the majority being Orkney Ferries' South Isles service between Stromness, Hoy and Graemsay, and NorthLink Ferries' Scrabster-Stromness service. There was also a significant amount of activity associated with the EMEC Billia Croo test site (predominantly tugs and 'other ships'). All this activity was to the south of the Brough Head AfLarea.

A number of vessels were tracked to the west of the site, the majority of which were fishing vessels recorded during the winter period.

Plots of the tracks within 5nm of theBrough Head area during summer and winter, colour coded by vessel length, are presented in Figure 4.3 and Figure 4.4.

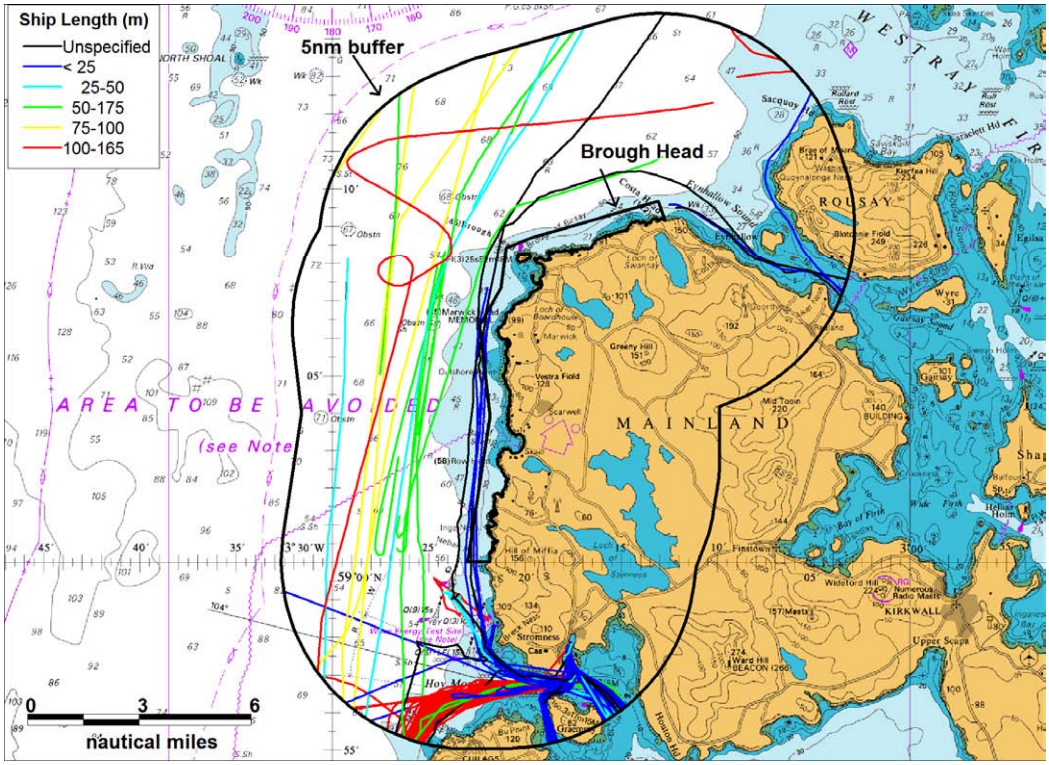

Figure 4.3 Plot of Summer 2010 AIS Tracks by Length

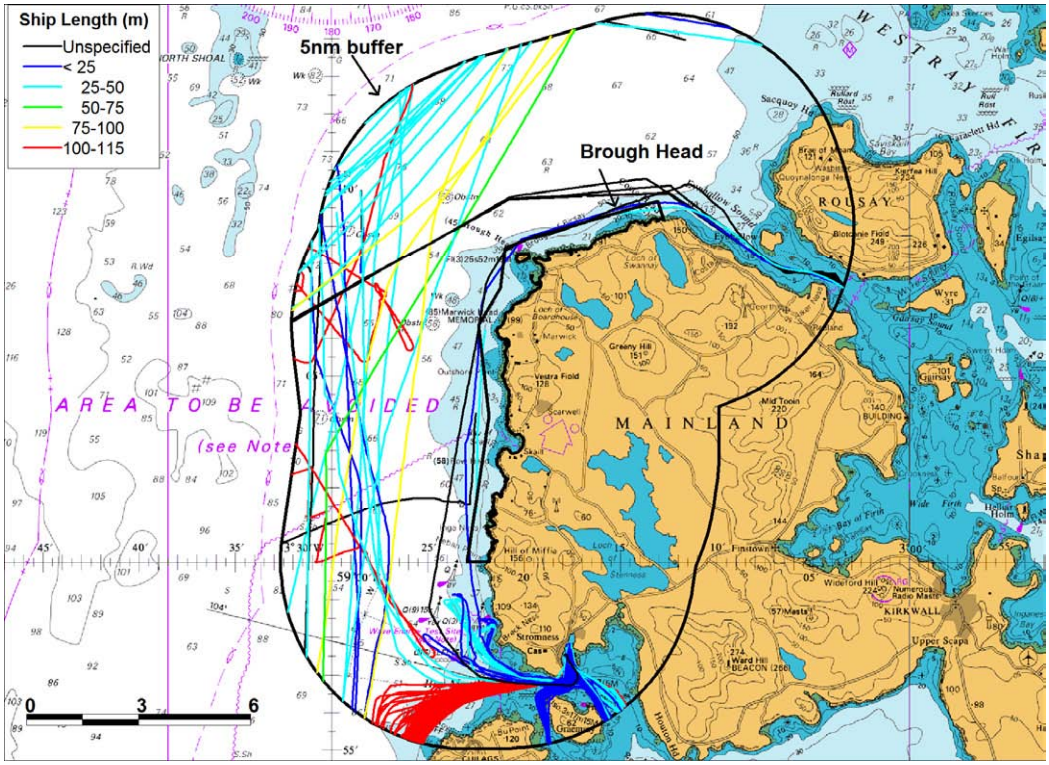

Figure 4.4 Plot of Winter 2010 AIS Tracks by Length

In the summer period, the longest vessel was the cruise ship *Saga Pearl* at 165m, bound for Kirkwall and transiting 1.4 nm to the west of the site area. During the winter period, the longest vessel was the UK flagged fishing vessel *CornelisVrolijk FZN*, at 115m, tracked 1.8nm to the west of the site area.

Five vessels passed through the site area during the summer period and three during winter, therefore, the average was one transit per week. Details on these vessels are presented inTable 4.1. (Where information was not broadcast on AIS, these have been researched using other data sets.)

Table 4.1 Vessels Tracked crossing Site Area

Name	Type	Length (m)	Destination
Jammy Dodger	Pleasure Craft	13	Stromness
Lodesman	Work Boat	22	Unspecified
Norholm	Fish Carrier	32.2	Kirkwall
Scapa Pioneer	Pilot Vessel	16	Unspecified
SerenWib	Sailing	12	Unspecified
Uskmoor	Commercial Diving Work Boat	16	Unspecified
Uskmoor	Commercial Diving Work Boat	16	Unspecified
Voe Viking	Tug	26	Unspecified

Half of the intersecting tracks (*Lodesman*, *Uskmoor*x 2 and *Voe Viking*) were observed to be associated with EMEC's Billia Croo site to the south of the area.

4.2 Fishing Vessel Activity

The AIS data presented above included a number of fishing vessel tracks. This section reviews other sources of fishing vessel activity data in the form of sightings and satellite data.

4.2.1 Surveillance Data - Geographical Division

Fisheries statistics in the UK are reported by ICES statistical Rectangles and Subsquares. The Brough Head AfLarea is located within ICES Rectangle 47E6 Subsquare 4 (47E6/4), as shown in Figure4.5. The area of Subsquare 47E6/4 is approximately 231nm^2 (795km^2). The four closest Subsquares have been analysed as part of the baseline fishing assessment.

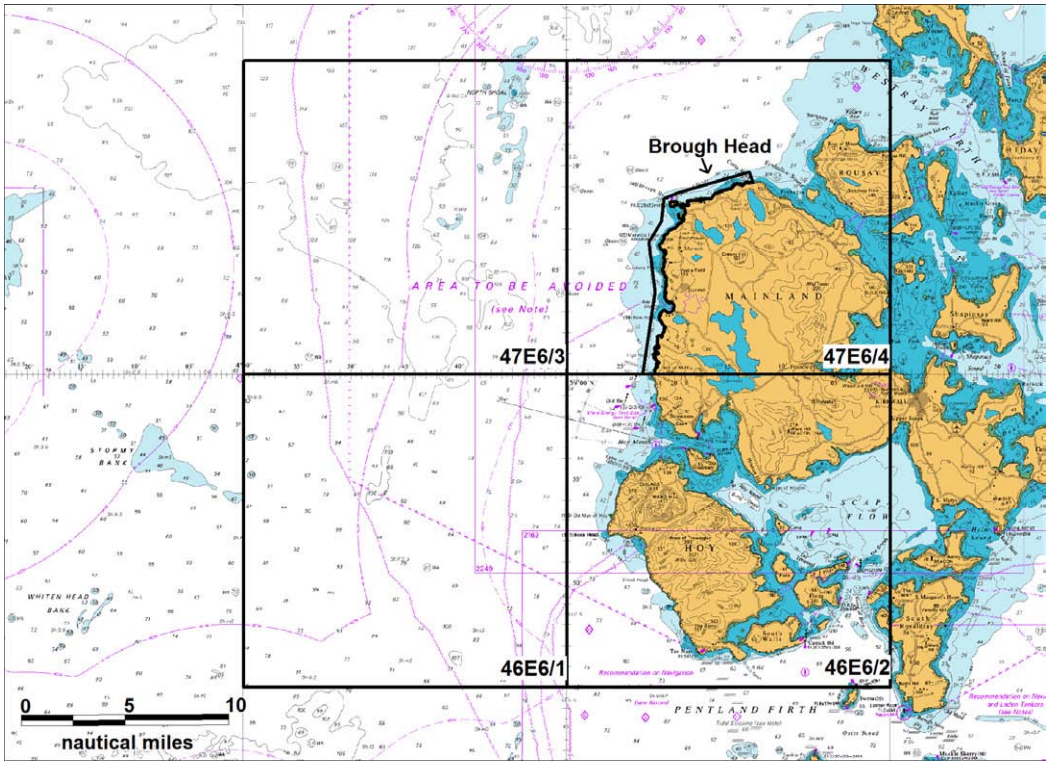

Figure4.5 ICES Subsquares encompassing Brough HeadAfL Area

4.2.2 Sightings Data

Data on fishing vessel sightings were obtained from Marine Scotland Compliance who monitor the fishing industry in Scottish waters through the deployment of patrol vessels and surveillance aircraft.

Each patrol logs the positions and details of fishing vessels within the Rectangle being patrolled. All vessels are logged, irrespective of size, provided they can be identified by their Port Letter Number (PLN).

The numbers of fishing vessel sightings, surveillance patrols and hence average sightings per patrol within each ICES Subsquare encompassing the proposed site in the five-year period 2006-10 are presented in the table and bar chart below.

Table 4.2 Average Sightings per Patrol (2006-10)

ICES Subsquare	Sightings	Patrols	Sightings per Patrol
46E6/1	62	453	0.137
46E6/2	52	453	0.115
47E6/3	178	1120	0.159
47E6/4	59	1120	0.053

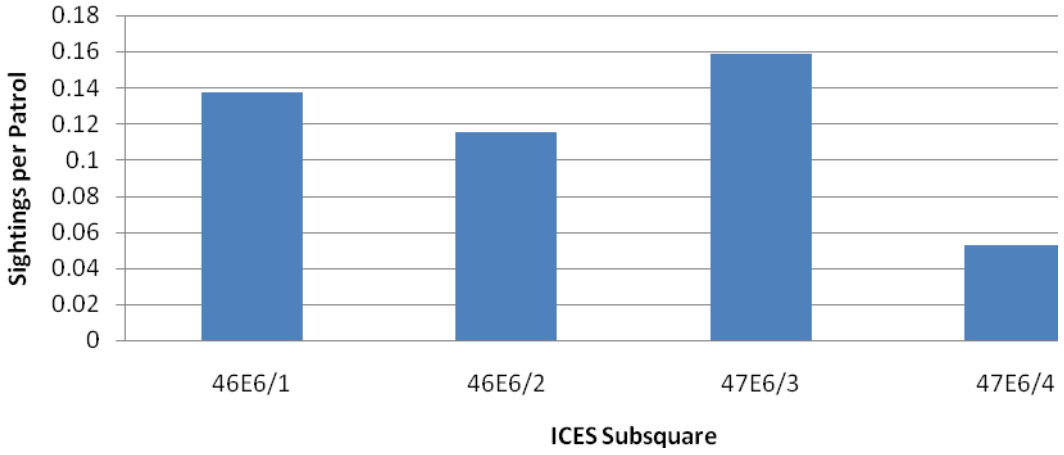

Figure 4.6 Average Fishing Vessel Sightings per Surveillance Patrol (2006 – 2010)

Subsquare 47E6/3, the Subsquare to the west of Brough Head,had the highest average sightings per patrol at 0.16vessels (an average of one sighting per 6 patrols).

The sightings data were imported into a GIS for mapping and analysis. A plot of the vessel sighting locations, colour-coded by gear type, is presented in Figure 4.7.

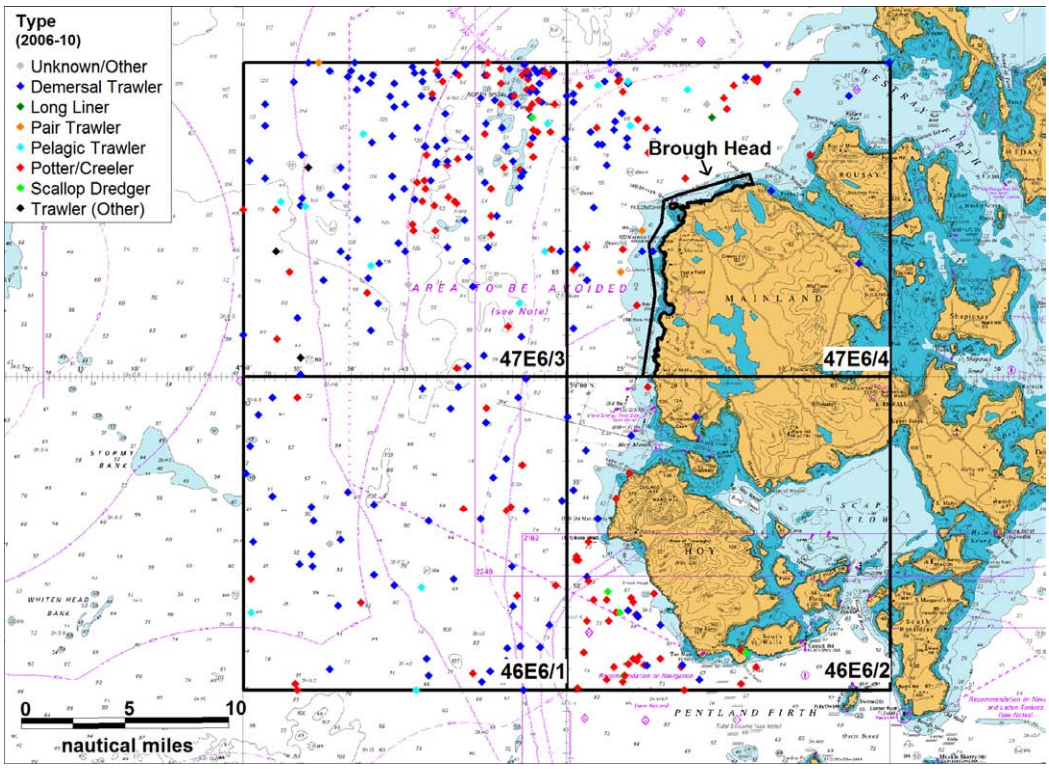

Figure 4.7 Fishing Vessel Sighting Locations (2006-10)

The main fishing type overall was demersal trawler (56%), including the one vessel sighted in the AfL area. The next most common type of fishing vessel was potter/creeler (36%) although none were sighted within the AfL area.

Fishing vessels colour-coded by nationality are presented in Figure 4.8.

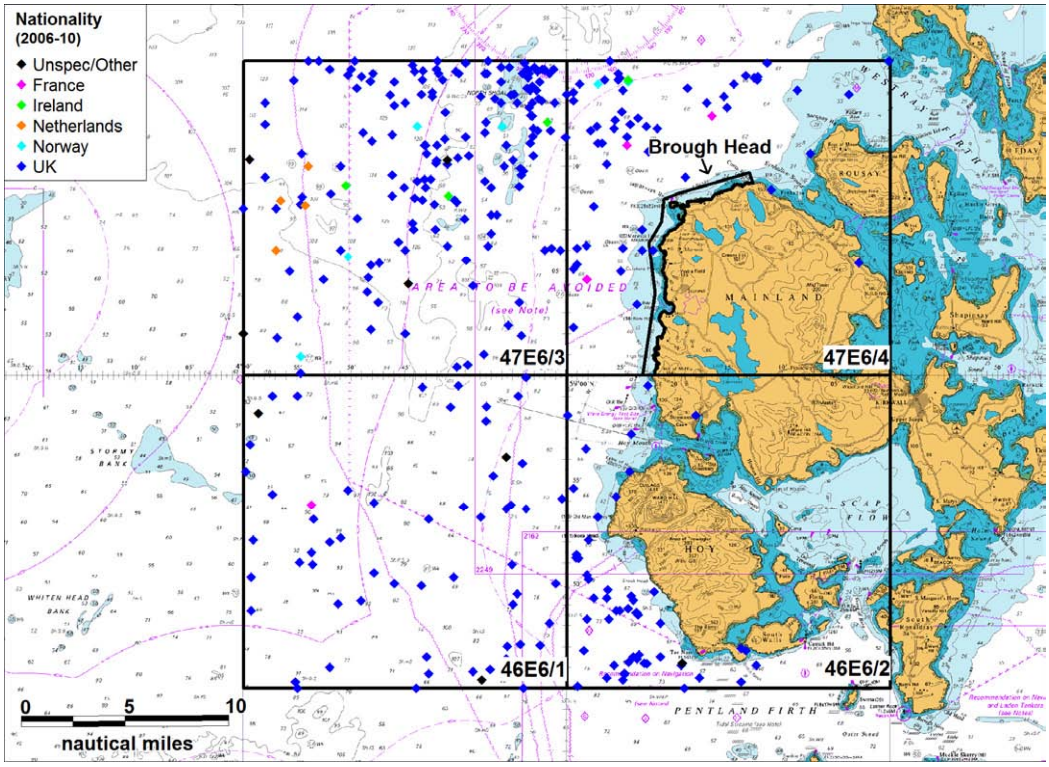

Figure 4.8 Fishing Vessel Sightings by Nationality (2006 – 10)

The vast majority of fishing vessels were registered in the UK (93%), including the single sighting within the AfL area.

The fishing vessels colour-coded by activity when sighted are presented in Figure 4.9.

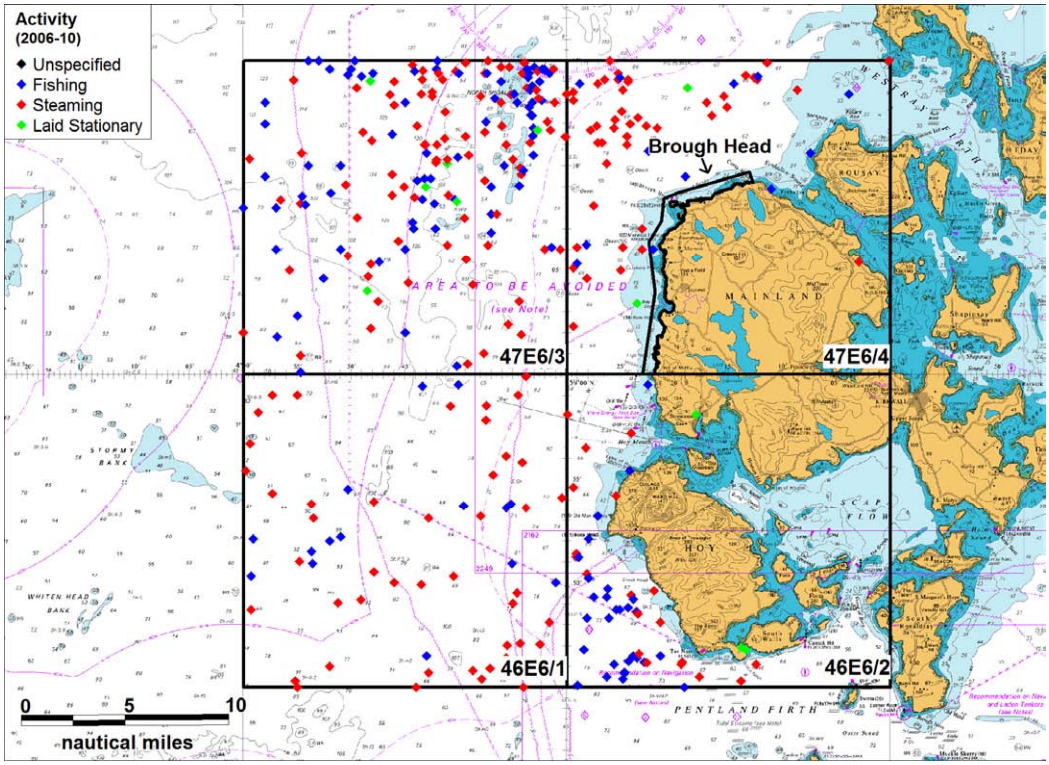

Figure 4.9 Fishing Vessel Sightings by Activity (2006 – 2010)

58% of vessels sighted were steaming (transiting to/from fishing grounds), 39% were engaged in fishing, i.e., gear deployed, and 3% were laid stationary (vessels at anchor or pair vessels whose partner vessel is taking the catch whilst the other stands by). The vessel sighted within the Brough Head AfLboundary was engaged in fishing.

Statutory Instrument 'The Inshore Fishing (Prohibition of Fishing and Fishing Methods) (Scotland) Order 2004' prohibits fishing from 1st May to 30th September each year, in an area of waters within 2 miles of the mean high water mark of ordinary spring tides, on the coasts of Mainland Orkney and Hoy bounded in the north by Costa Head and the south by The Berry.

The length groups of vessels are presented in Figure 4.10. Overall, 59% were ≥ 15m in length.

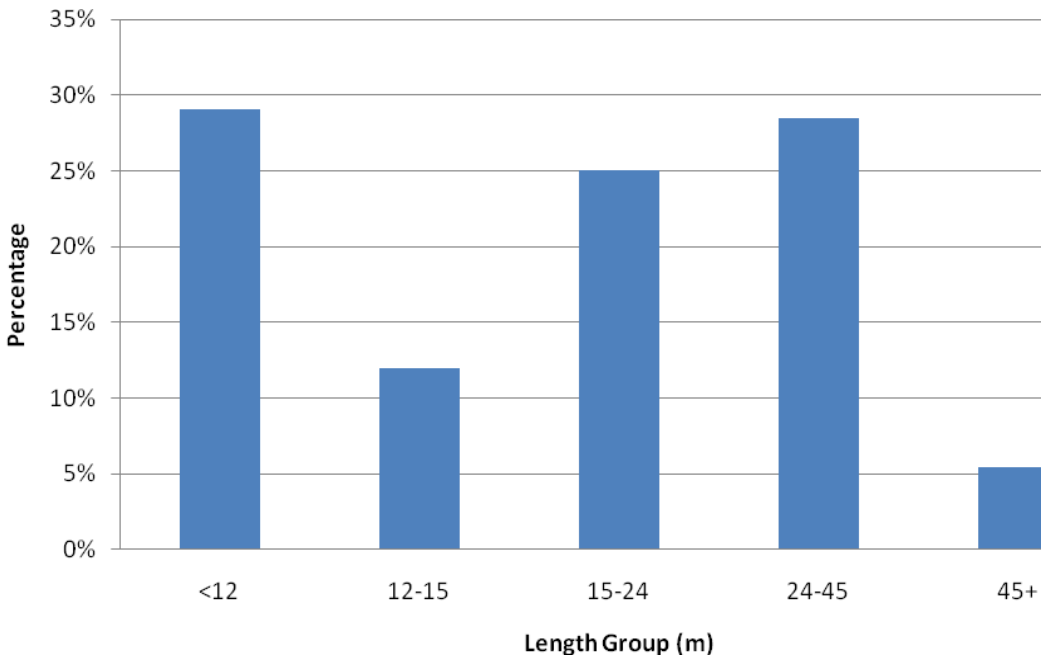

Figure 4.10 Fishing Vessel Sightings by Length Group (2006 – 2010)

4.3 Satellite Data Analysis

The Marine Management Organisation (MMO) operates a satellite-based vessel monitoring system. The vessel monitoring system is used, as part of the sea fisheries enforcement programme, to track the positions of fishing vessels of 15m length and over in UK waters. It is also used to track all UK registered fishing vessels globally.

Vessel position reports are typically received every 2 hours. The data covers all EC countries within British Fisheries Limits and certain Third Countries, e.g., Norway and Faeroes. Vessels used exclusively for aquaculture and operating exclusively within baselines are exempt.

The satellite data used for the analysis was provided by Marine Scotland Compliance, who has responsibility for fishing vessel activity in Scottish Waters. Only UK vessel activity was available. Based on the sightings analysis, UK vessels of 15m length and over represent approximately 55% of the vessel activity recorded during patrols.

A plot of vessel positions, colour-coded by speed, is presented for the years 2008-10 in Figure 4.11 to Figure 4.13.

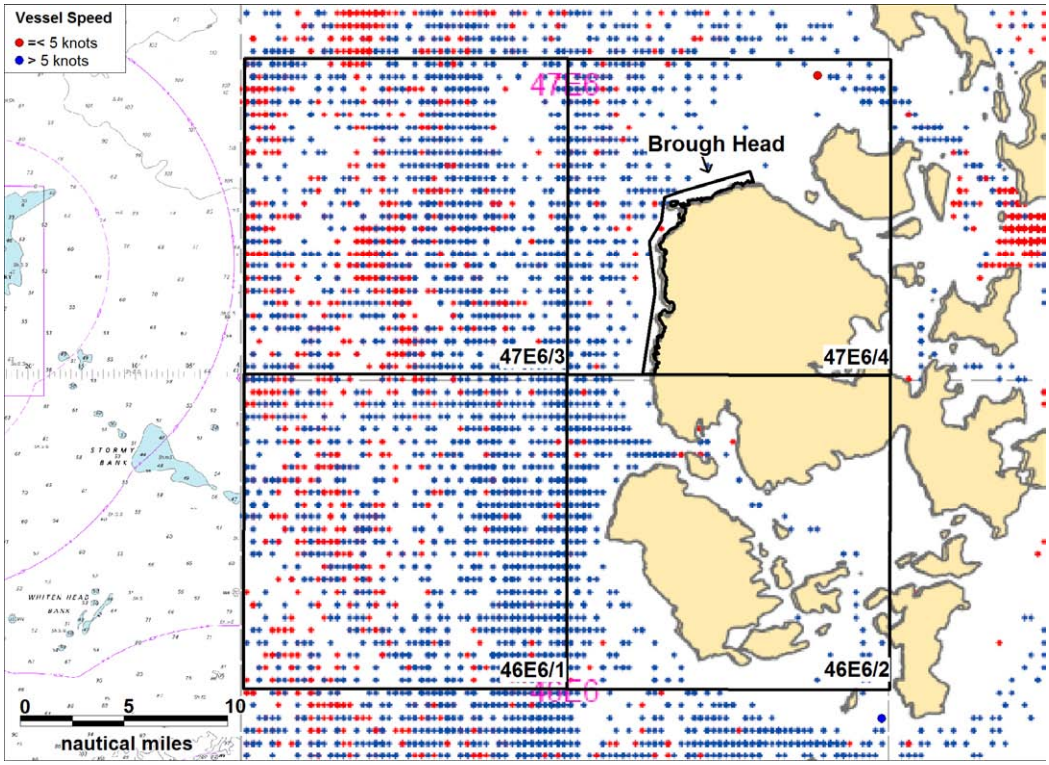

Figure 4.11 Chart of Satellite Fishing Vessel Positions by Speed (2008)

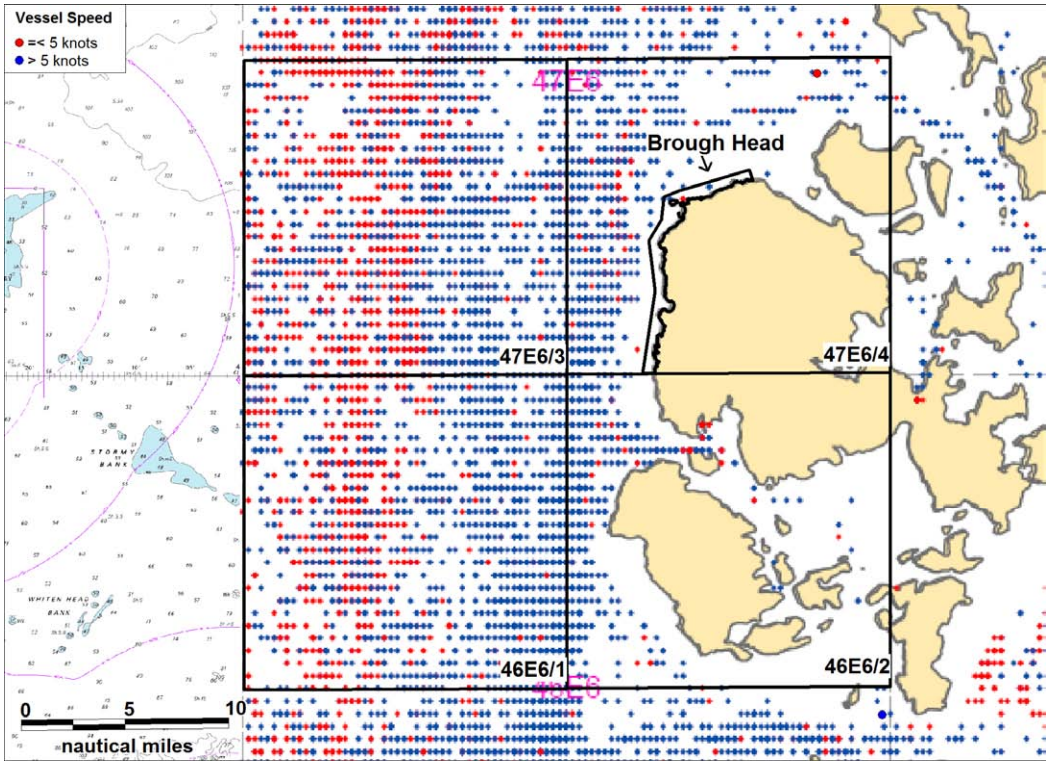

Figure 4.12 Chart of Satellite Fishing Vessel Positions by Speed (2009)

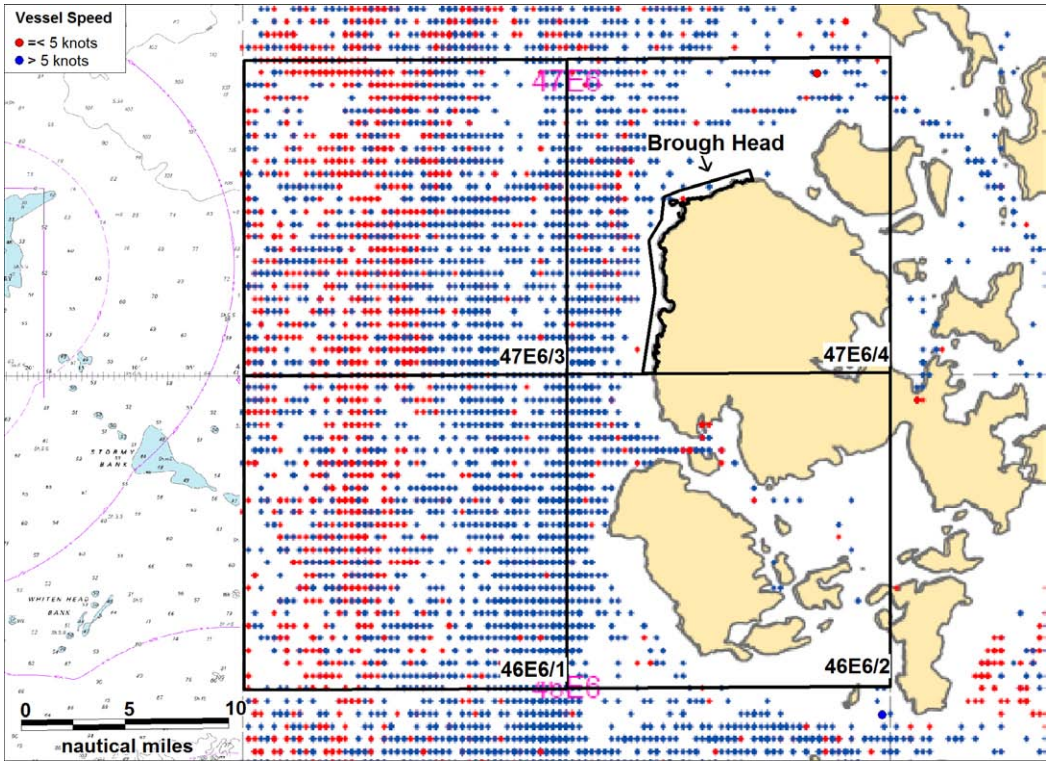

Figure 4.13 Chart of Satellite Fishing Vessel Positions by Speed (2010)

The vast majority of fishing vessel positions were to the west of the site area with only 2-3 positions logged within the Brough Head AfLarea per year. In the vicinity of the area, most vessels were tracked travelling at speeds over 5 knots which indicates they are likely to be steaming on passage. A small minority were logged below 5 knots which indicates they may have been fishing.

4.4 Recreational Vessel Activity

This section reviews recreational vessel activity withinthe Brough HeadAfLarea based on the available desktop information.

4.4.1 RYA Data

The RYA, supported by the Cruising Association,hasidentified recreational cruising routes, general sailing and racing areas in the UK. This work was based on extensive consultation and qualitative data collection from RYA and Cruising Association members, through the organisations' specialist and regional committees and through the RYA affiliated clubs. The consultation was also sent to berth holder associations and marinas.

The results of this work were published in Sharing The Wind (Ref. i) and updated GIS layers published in the Coastal Atlas (Ref. ii).

A summary plot of the recreational sailing activity and facilities identified in the North East Scotland Sailing Area is presented in Figure 4.14.

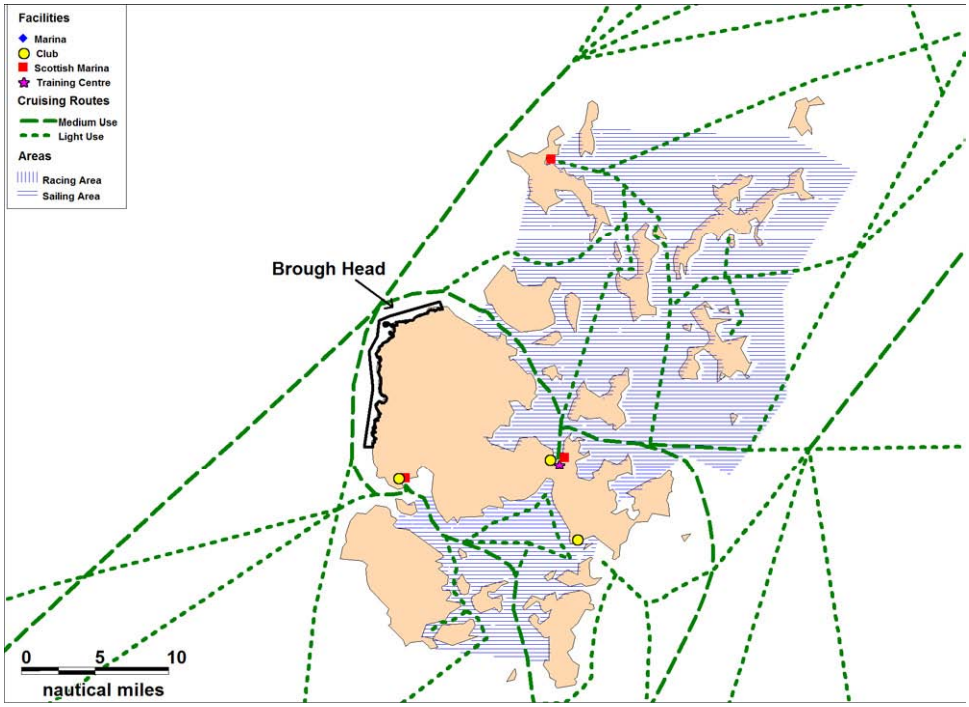

Figure 4.14 Recreational Information for North East Scotland Strategic Area

A more detailed chart of the recreational vessel activity and facilities in the vicinity of the AfLarea is presented in Figure 4.15.

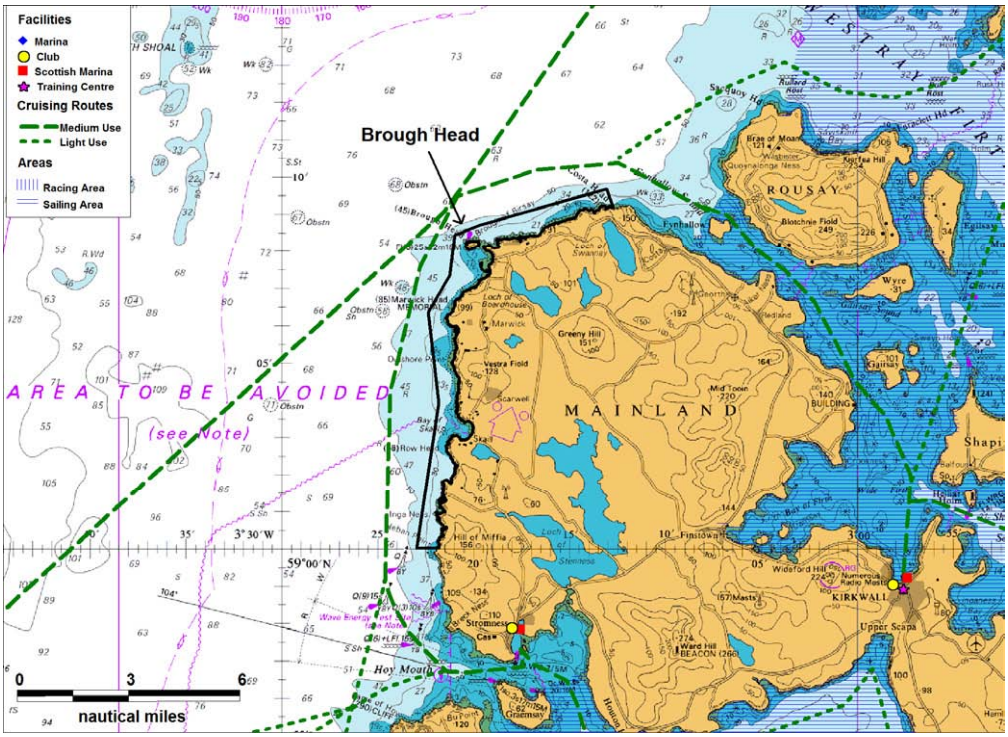

Figure 4.15 Recreational Data in the vicinity of Brough HeadAfL Area

Based on the published data, the AfLarea lies outside general sailing and racing areas identified by the RYA. Also no cruising routes pass through the AfL area. There is a medium-use[1] cruising route running north/south off the west coast of Mainland Orkney, including yachts to/from Stromness, approximately 0.5-1nm east of the site boundary. This joins with a second medium-use route which passes about 1.3nm to the north west of the island of Brough Head. These routes are likely to be heading to/from Kirkwall or Westray / Shetland.

In terms of facilities, the nearest club is the StromnessSailing Club, approximately 3nm south of the area boundary, and the closest marina is also at Stromness.

4.4.2 Clyde Cruising Club Sailing Directions

The Clyde Cruising Clubproduces Sailing Directions for various areas of Scotland. The publication covering Orkney Waters (Ref.iii) which was compiled with local knowledge, includes information for recreational sailors in the vicinity of the AfL area.

Reference is made to EMEC's Billia Croo wave test site. Yachts are advised to avoid passing through the deep-water test site marked by buoys. Passage through the gap between it and the coast is considered possible although it is noted that shallow water wave energy devices are sometimes deployed on the coastal side of this channel.

Both medium use cruising routes to the west of Brough Head indicated in Figure 4.15 are used by Clyde Cruising Club. Stromness is used as the most convenient first anchorage for yachts coming to Orkney from the west coast as it avoids tackling the Pentland Firth or the longer passage round the north. Tidal streams in Hoy Sound are very strong (8 knots) and entry should not be attempted in bad weather or with wind against tide or on the ebb tide.

4.4.3 Orkney Marinas Sailing Guides – Kirkwall to/from Westray

The Orkney Marinas website has sailing guides for Orkney waters. The publication "Going West from Westray"includes information for the sailing community within the vicinity. The routes are described below with Figure 4.16 highlighting some of the key reference points.

[1] Recreational boating, both under sail and power is highly seasonal and highly diurnal. A light use recreational route is classified by the RYA as a route known to be in common use but which does not qualify for medium or heavy classification. A medium use recreational route is classified as a popular route on which some recreational craft will be seen at most times during daylight hours.

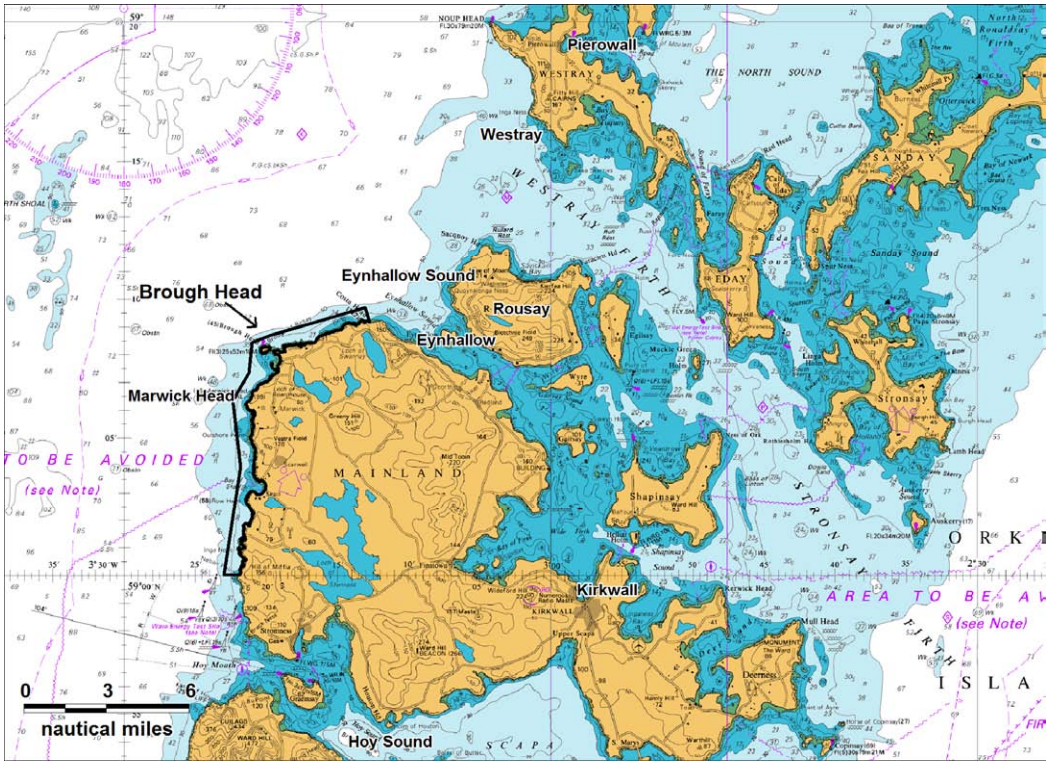

Figure 4.16 West from Westray – Key Features mentioned in Sailing Guide

UUWestray to Stromness or Cape Wrath / Stromness to Westray

Passage time to Stromness is 4.5 hours at 8 knots. If Pierowall is departed with the first ebb in Papa Sound then the flood tide in Hoy Sound will aid passage into Stromness. Tide is low between Marwick Head and Hoy Sound and turns in Hoy Sound about 40 minutes before Kirkwall. If Passage is made from Stromness to Westray two hours before low water it is possible to pick up the flood tide at Marwick Head and carry it to Pierowall.

Kirkwall to Stromness / Stromness to Kirkwall

Kirkwall to Stromness takes about 3.5 hours at 8 knots. Sailing from Stromness to Kirkwall, there is a quite a roost out of Hoy Sound on the ebb during any westerly weather. Eynhallow Sound is best approached on the flood. The deepest water is between Rousay and Eynhallow but the most straightforward channel is between Eynhallow and MainlandOrkney. The tide in Eynhallow Sound turns approximately the same time as Kirkwall so Hoy Sound is reached at the first flood.

4.5 Monitoring Surveys

Data on vessel activity, in particular small vessel activity such as fishing vessels and recreational craft, is presently being logged during wildlife monitoring surveys of the Brough Head AfL area.

This data collection is ongoing and the compiled data will be analysed as part of the NRA.

5. Review of Historical Maritime Incidents

5.1 Introduction

This section reviews maritime incidents that have occurred in the vicinity of the Brough Head area in recent years.

The analysis is intended to provide a general indication as to whether the area of the proposed development is currently a low or high risk area in terms of maritime incidents. If it was found to be a particular high risk area for incidents, this may indicate that the development could exacerbate the existing maritime safety risks in the area.

Data from the following sources has been analysed:

- Marine Accident Investigation Branch (MAIB)
- Royal National Lifeboat Institution (RNLI)

(It is noted that the same incident may be recorded by both sources.)

5.2 MAIB

All UK-flagged commercial fishing vessels are required to report accidents to MAIB. Non-UK flagged vessels do not have to report unless they are within a UK port/harbour or within UK 12 mile territorial waters and carrying passengers to or from a UK port (including those in inland waterways). However, the MAIB will record details of significant accidents of which they are notified by bodies such as the Coastguard, or by monitoring news and other information sources for relevant accidents. The Maritime and Coastguard Agency, harbour authorities and inland waterway authorities also have a duty to report accidents to MAIB.

The locations[1] of accidents, injuries and hazardous incidents reported to MAIB within 5nm of the Brough Head area boundary between January 2001 and December 2010 are presented inFigure 5.1, colour-coded by type.

[1]MAIB aim for 97% accuracy in reporting the locations of incidents.

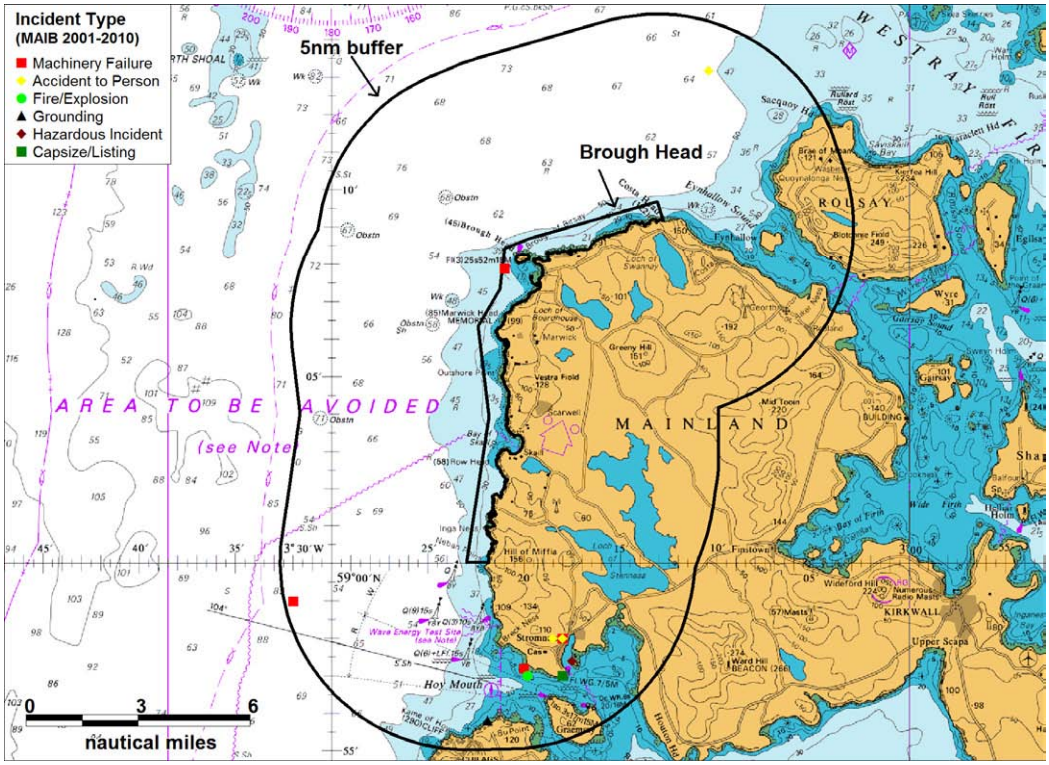

Figure 5.1 MAIB Incident Locations by Type within 5nm of SiteBoundary

A total of 12 incidents were reported in the area within 5nm of the boundary, corresponding to an average of just over one per year. Only one incident occurred within the AfLarea over the 10 years. This was on 5th May 2004, when a UK fishing vessel (9.4m length) suffered a machinery failure.

Brief details of the other 11 incidents which occurred within 5nm are listed below. All involved UK vessels:

- On 15th October 2001 an unspecified vessel grounded.
- On 5th November 2003, an accident to a person occurred on an unspecified vessel.
- On 12th November 2003 an accident to person happened onboard a ro-ro freight/vehicle ferry.
- On 12th July 2003 machinery failed onboard an unspecified vessel.
- On 24th April 2004 a person went overboard from a ro-ro freight/vehicle ferry.
- On 5th May 2004 machinery failed onboard an unspecified vessel.
- On 16th May 2006, a ro-ro freight/vehicle ferry suffered machinery failure.
- On 24th August 2006 a potter grounded.
- On 23rd September 2006 a dive support, small commercial motor vessel suffered a fire/explosion.
- On 16th June 2007 a dory type open boat capsized / listed.
- On 26th October 2007 a pair trawler suffered machinery failure.
- On 23rd November 2009 there was a hazardous incident involving a dredger.

5.3 RNLI

Data on RNLI lifeboat responses within 5nm of the Brough Head site boundary in the ten-year period between 2001 and 2010 have been analysed.A total of 40 uniqueincidents were recorded by the RNLI (excluding hoaxes and false alarms), i.e., an average of four per year. 32 lifeboat launches were made to the incidents.

Figure 5.2 presents the geographical location of incidents colour-coded by casualty type.

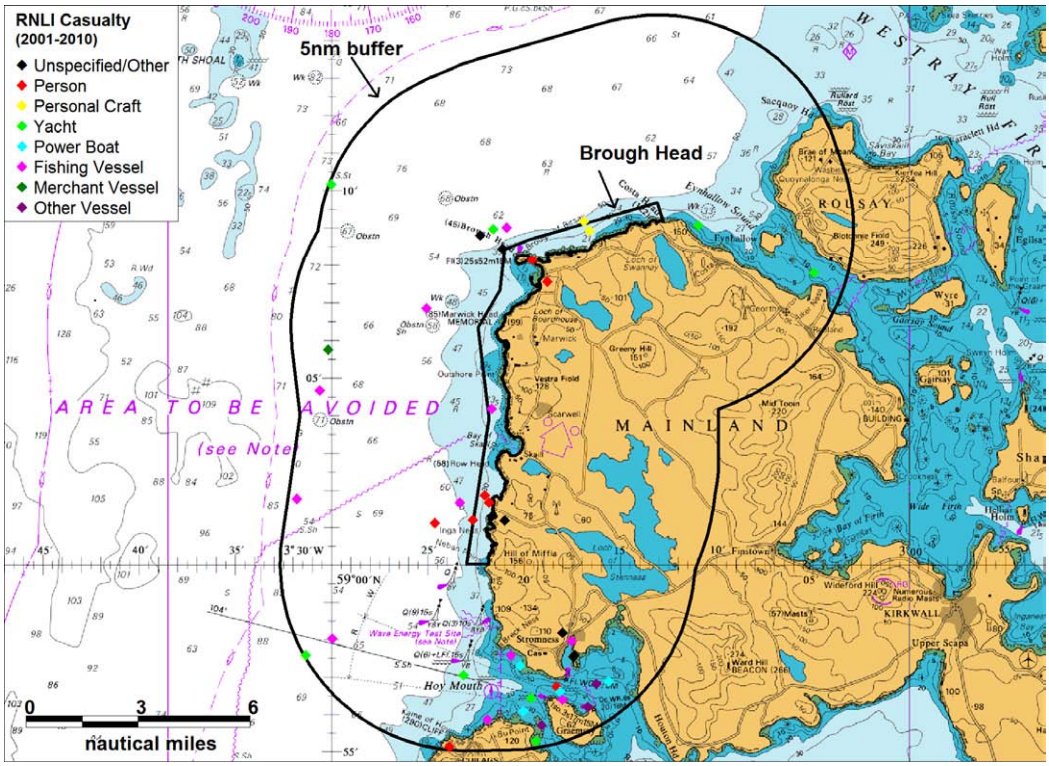

Figure 5.2 RNLI Incidents by Casualty Type within 5nm of Site

Five incidents were recorded within the site area over the 10 years analysed. Details of these incidents are as follows:

- On 26th August 2001 a large fishing vessel suffered machinery failure and Stromness all-weather lifeboat (ALB) was launched.
- On 05th October 2005 a person went missing and Stromness ALB was launched.
- On 11th July 2007 a person got into danger when they were cut off from land and Stromness ALB was launched.
- On 12th January 2010 a person went missing. Stromness responded but did not launch a lifeboat.
- On 17th January 2010 a man went overboard a canoe. Stromness responded but did not launch a lifeboat.

All the incidents within the AfLarea were responded to by the Stromness RNLI stationwhich is approximately 3nm from the southern boundary of the AfL. The Stromness all-weather lifeboat (ALB)is currently the Severn class lifeboat *Violet, Dorothy and Kathleen*.

6. Stakeholder Consultation

6.1 Introduction

This section outlines the main stakeholders identified within the Brough Head AfLarea and details some of the consultation carried out to date.

6.2 Key Consultees

The key navigational consultees identified for the project are listed below:

- Marine Scotland Licensing Operations Team (MS-LOT)
- Marine Scotland Compliance (Fishery Officer - Kirkwall)
- Maritime and Coastguard Agency (MCA)
- Department for Transport (DfT)
- Northern Lighthouse Board (NLB)
- RYA (Scotland)
- Cruising Association
- Orkney Islands Council (OIC) Marine Services
- Orkney Dive Boat Operator's Association (ODBOA)
- Orkney Fisheries Association (OFA)
- Orkney Fishermen's Society (OFS)
- Orkney Sailing Club (OSC)
- Stromness Sailing Club (SSC)
- Orkney Islands Sea Angling Association
- Kirkwall Kayak Club (KKC)
- Orkney Sea Kayaking Association (OSKA)

6.3 Summary of Consultation Meetings

A summary of the information and feedback received during consultation on the PHA is presented in Table 6.1.

Table 6.1 Stakeholder Comments

Stakeholder	Comments
MCA	• 3rd party verificationwill be important. • As it is a buoyant device, there needs to be measures in place for monitoring, alerting and responding / recovering if necessary, including a robust Safety Management System and Emergency Response Cooperation Plan. • Marking and lighting, both physical and on charts, will be key mitigation. NLB to advise on physical marking and lighting. UKHO can advise on chart marking. Charts are unlikely to show every device but could mark the site perimeter and include some specific information on Oyster devices. • It was suggested the developer could provide the local Coastguard, RNLI

Stakeholder	Comments
	and local users identified to regularly use the area with detailed coordinates of all the devices. This wouldallow local fishermen, for example, to add the device locations to their chart plotters. • Baseline data and approach to the NRA were discussed. Cumulative impacts will be a key issue, in particular the separation distance between the Brough Head development and the potential deep-water wave sites to the west, and whether this provides an adequate channel for navigation between the sites.
RYA (Scotland)	• It is important, for safe navigation, that an inshore passage is kept open between the BHWF and the proposed SPR/EON sites off west Mainland Orkney (see Figure 7.1) suitable for both sail and power craft. • The site should be suitably marked taking into account EMEC Billia Croo (if the development is in close proximity). • Although it is unlikely that recreational craft will make this passage in adverse conditions the weather in this area is changeable and can deteriorate quickly. • Entrance to the Bay of Skaill must be kept clear for recreational craft, inshore fishermen and maintenance vessels for the BT cable. • Visual marking is critical
ODBOA	• Currently 10 dive boats in ODBOA. Peaked at 15 a few years ago. Vessels mainly hired by tourists for diving trips, and less frequently for recreational angling. • All vessels are similar carrying 12 passengers and 2-3 crew. They have chart plotters and can set guard zones. Two vessels have AIS. • A couple of diving sites of interest in the southern zone. Convenient as close to Stromness where vessels are based. Three of the vessels visit these sites, approximately 6-7 times each per year on average. Based on indicative water depth and device spacing, vessels may still be able to access these sites. • Inshore passage is important to save time and fuel. Currently pass inshore of Billia Croo. In the case of Brough Head, based on indicative development within the 10-15m depth contour, the effect of having to pass offshore, when conditions dictate, does not appear to be as significant. • Area west of Mainland Orkney is avoided in any winds with a westerly component. • In terms of cumulative impact, 0.5nm separation from deep-water wave sites further west was considered adequate. • Fishing vessels (creelers) and leisure anglers observed in the area.
OFA	• The whole Orkney coastline is creeled for lobsters in inshore areas. Crabs tend to be fished for slightly further out. Fishing activity off the west coast is predominantly in summer when lobsters migrate closer to the shore.Best quality catch in inshore areas. • Four full-timevesselsand three part-time work in the AfLarea out of Stromness, approximately 10-12m in length. Another five full-time vessels are based at Tingwall. The full-time vessels work most days in

Stakeholder	Comments
	summer during daylight hours, although the duration and location of this activity is weather-dependent. • An estimated six hobby fishermen (<10m length boats) set creels in the area, launching from Birsay and Bay of Skaill. • In bad weather, such as strong westerlies, west of Mainland Orkney is not used. • Larger industrial crabbers and white fish vessels tend to fish further offshore, west of the Brough Head AfLsite. • Vessels currently fish in and around the EMEC Billia Croo site. No incidents have been reported to date. • Trawling is illegalwithin 2 miles of the coast during summer (Costa Head to Berry excluding Rackwick Bay, May-Sept). • OFA does not see a major problem in fishing near the Oyster devices. Skippers have skill and knowledge in their operation and would not risk their gear. Fixed device has less potential for snagging due to improved design (mainly monopile and a flap). • Pipelines could be a hazard for creel fishermen if a rope were to snag when hauling.This hazard and potential risk controls, e.g., circulation of as-laid coordinates, will be reviewed during the NRA. • Agreed to consult local fishermen once bathymetry survey has been carried out and a firmer idea of layout is available.
OIC Marine Services	• VTS due to be upgraded by 2012, including 3 new radar locations. One will be at Yesnaby and cover the west coast of Mainland Orkney. Could be a source of radar data for the Navigation Risk Assessment of Brough Head. Upgrade part-funded by a European Development grant to monitor renewable energy sites. • Vessels call port VTS when leaving the harbour and state their destination. Reporting points are located at various locations within Harbour Limits. If calling at Stromness, vessel would call when crossing reporting point Delta, west of Hoy Sound. • Very little commercial traffic off west Mainland Orkney. Traffic between Kirkwall and Stromness, such as cruise ships, tends to go south via Scapa Flow. P&O pulled out of the Stromness-Lerwick ferry service in early 2000's. There are no known plans to reinstate this service. • Marine Services have regular meetingswith EMEC to keep each other updated with developments. Also publish Notice to Mariners on their website. Appropriate arrangements would be agreed with the BHWFL developer. • Ongoing port developments were discussed at Lynessand Stromness, and the possibility of these being used during the development.
Stromness Sailing Club	• Did not anticipate a problem based on indicative water depths of 10-15m for device deployment. • Recreational sailors would not want to be too close to shore as get

Stakeholder	Comments
	reflections from waves hitting the coast, so would pass outside of the area. • Most Stromness club members stay closer in to Stromness Harbour.
Orkney Sailing Club	• Statistics provided on marinas, visitor numbers and yacht sizes. • Key requirement is that the development be marked and lighted. Especially important for foreign visitors who may not be familiar with the area. • Inshore route option would be useful. In easterly wind, approximately 300m separation from the coast, should be sufficient, although some may choose to keep further offshore. In westerlies, sailors would tend to stay well off the coast anyway so should not be an issue. • Based on indicative development in 10-15m water with relatively narrow clusters, the impact should not be too significant. • Typical route past this site would be Kirkwall (via Eynhallow Sound) to Stromness. Sail this in one tide (5-6 hours) to take advantage of tidal streams. In westerlies may take longer route via The String and Scapa Flow. Stromness to/from Westray and Shetland would also pass the area. • In terms of cumulative impact, 0.5 nautical miles separation from sites further west was considered adequate.
KKC	• Typical paddles in the area include Birsay to Bayof Skaill to Yesnaby and back. A longer paddle would be Stromness to Skaill but this is infrequent. • Tend to stay close to the shore to explore caves, but would keep further from the shore if waves rebounding off the coast. • If significant swell would go elsewhere or call off.
OSKA	• Typical paddles in this area are Stromness-Bay of Skaill or Birsay. Used about 10-12 times per year. May also do shorter route such as Bay of Skaill to Yesnaby. • About 6-8 kayakers in one trip with at least one of the group carrying VHF. Signal in the area can vary due to cliffs. • Kayakers stay as close to the shore as possible as this is where sites of interest are located. • They would paddle off west Mainland Orkney only if there have been easterlies for a few days and in a maximum of 1m swell.

7. Preliminary Hazard Analysis

7.1 Introduction

This section provides a preliminary review of the vessel exposure and potential navigational hazards associated with the Brough Head Wave Farm based on the existing vessel activity in the area identified from the baseline data collection and the consultation feedback.

Potential mitigation measures to control the hazards are also discussed.

7.2 Vessel Exposure

From the baseline AIS data collection, a low level of traffic was observed passing through the AfL area, averaging approximately one vessel per week. These were mainly small vessels involved in miscellaneous activities, with half being vessels associated with the marine renewables industry, working at EMEC Billia Croo to the south.

No tankers were observed within five nautical miles of the site, which is mainly due to the area being within the IMO-adopted Area To Be Avoided (ATBA) around Orkney which applies to all vessels over 5,000 gross tonnes carrying oil or other hazardous cargoes in bulk.

The MCA have published guidance to mariners operating in the vicinity of offshore renewable energy installations (OREI) (Ref. iv). The guidance notes that, unlike wind farms, wave energy systems may not be clearly visible to the mariner, and could be semi-submerged.

The MCA guidance suggests three options, in simple terms, for mariners operating in OREI areas:

a. Avoid the area completely
b. Navigate around the edge
c. In the case of a wind farm, navigate, with caution, through the array

The choice will be influenced by a number of factors including the vessel's characteristics (type, tonnage, manoeuvrability, etc.), the weather and sea conditions. The guidance suggests that where there is sufficient sea room it is prudent to avoid the area completely.

The choice will also depend on the navigational features of the area, for example, the sea room and water depth available surrounding the development.

In the case of the proposed Brough Head wave energy development, based on the indicative, narrow layout within the 10-15m water depth region, and likelihood of being at least 300m from shore, it should be possible for vessels to navigate both inshore and offshore of the devices, with minimal or no deviation from their normal passage. Whether vessels pass inshore or offshore will depend upon the vessel size, type, manoeuvrability as well as the wind and sea conditions at the time. In westerlies, the local stakeholder consultation indicated that vessels would keep further offshore.

Further local consultation will be required during the Navigation Risk Assessment (NRA) regarding the creeling activity which is not well represented on AIS or the fishing vessel surveillance data sets. Consultation with individual skippers is planned.

Similarly, more in-depth consultation will be carried out with diving, sailing, angling and kayaking users to discuss the development in more detail, especially once layout options are being worked on.

A discussion of specific hazards and how they will be addressed within the NRA is presented below for the main operational phases of the Brough Head Wave Farm development.

7.3 Hazard Review

7.3.1 Normal Operations

During normal operations, the devices will present a potential collision hazard to vessels navigating in the area. The collision risk will be assessed in the NRA using the following inputs:

- Device locations and dimensions
- Vessel activity
- Metocean data

Further data will be collected on all these inputs during the NRA process.

Any changes in vessel routeing due to the development, e.g., displacement of vessels around the site, will influence the probability of vessels encountering (and colliding) with one another in the area. A comparison will be made between the current and predicted routeing and associated collision risk levels will be modelled.

There is also a potential hazard to vessels in the area should any part of the development fail and become detached / lose station. The object could pose a collision hazard to passing vessels both within and beyond the site boundary. This hazard will be assessed within the NRA taking into account measures for monitoring, alerting and recovery.

Finally, the subsea pipelines could present a snagging hazard to fishing gear and vessel anchors. Once the options are finalised these hazards will be assessed based on the vessel activity in the area and the planned risk control measures.

7.3.2 Installation, Maintenance and Removal

For all vessels operating in the area there will be risks during installation, removal and maintenance, when there will be additional vessels in and around the site associated with the development, some of which may have restricted manoeuvrability. This will extend beyond the site in the case of pipe-laying operations.

This introduces a collision hazard (vessel-to-vessel) as well as potential obstruction to normal routes beyond the site area.

This will be assessed within the NRA based on the best available information on the likely areas of operation, number and types of vessels involved, base ports, duration of operations and weather limits.

7.3.3 Cumulative Impact

For each phase of the proposed Brough Head development, the other planned phases will need to be assessed as part of the cumulative navigation risk assessment. The assessment will also take into account existing developments such as EMEC Billia Croo, and potential cumulative issues associated with nearby sites assessed. An illustration of currently known developments is presented in Figure 7.1.

The most relevant are the E.ON West Orkney Middle South and West Orkney South sites to the west, the Scottish Power Renewables Marwick Head site to the west, and the SSE Renewables Costa Head site to the north.

The best available information at the time of performing the NRA will be used. Where there is uncertainty, a maximum development case will be assumed to be conservative.

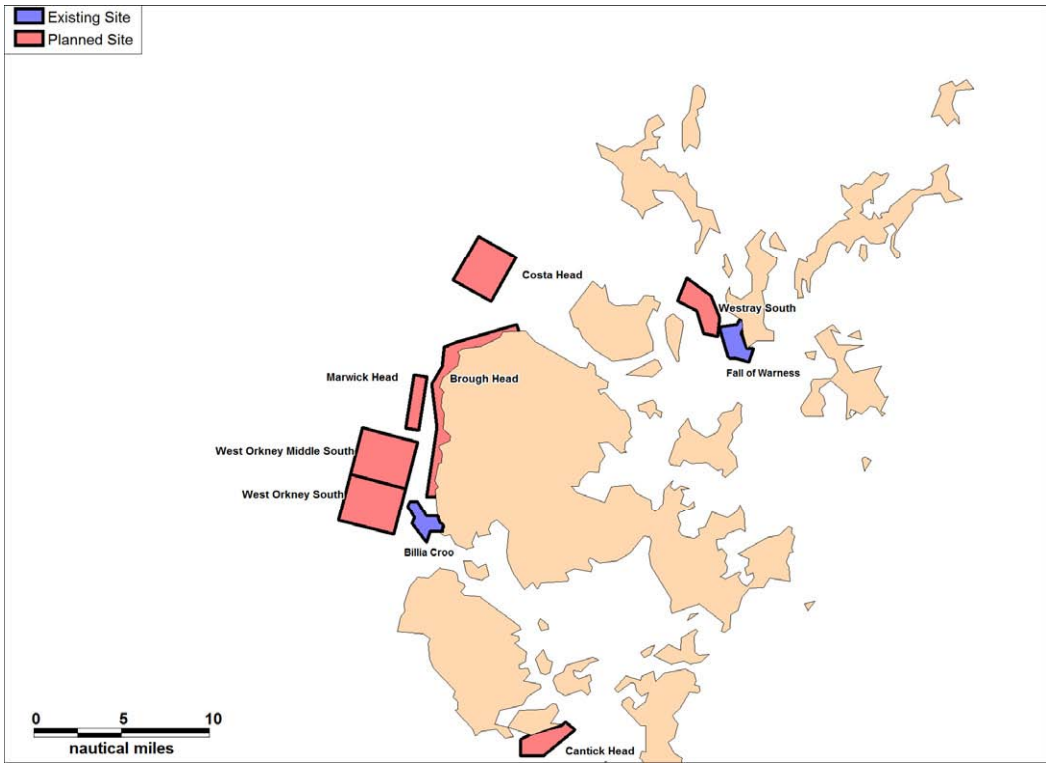

Figure 7.1 Planned Sites to be considered in the Cumulative Assessment

7.4 Mitigation Measures

Appropriate risk control measures will be developed during the NRA to address the risks during all phases of operationto ensure they are reduced to a level as low as reasonably practicable (ALARP).

An important measure is to ensure the final array layout is selected to minimise navigational hazards as far as practicable, i.e., taking into account wave resources, water depth and other constraints. The analysis carried out during this PHA is part of this process, which will continue based on the scoping responses received and throughout the NRA.

In addition to preventive mitigation in the form of site selection, there are a large number of measures that can be applied to help control navigation risks, many of which are now standard industry practice such as:

- Depiction on Charts
- Marking and Lighting
- Circulation of Notices to Mariners
- Fisheries Liaison

Discussions will be held with national and local stakeholders, such as NLB, UKHO and OIC Marine Services, to ensure these and other measures are implemented as effectively as possible for the Brough Head development, taking into account vessel activity.

Other mitigation measures will be identified during the Hazard Review Workshop, which is discussed further in Section 8.

8. Proposed Methodology – Navigation Risk Assessment

For each phase of the project, a Navigation Risk Assessment will be undertaken and consent will subsequently be sought from Marine Scotland.

The assessment methodology will principally be based on the following:

- Department for Energy and Climate Change (DECC) Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms (2005); and

- Maritime and Coastguard Agency (MCA) Marine Guidance Notice 371 (MGN 371) Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues.

The DECC (formerly DTI) methodology, prepared in association with the MCA and DfT, provides a template for preparing the navigation risk assessment. The methodology is centred on risk controls and the feedback from risk controls into risk assessment. It requires a submission that shows that sufficient risk controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with further controls or actions. The methodology includes:

- defining a scope and depth of the submission proportionate to the scale of the development and the magnitude of the risk;
- estimating the 'base case' level of risk;
- estimating the 'future case' level of risk;
- creating a hazard log;
- defining risk control and creating a risk control log;
- predicting 'base case with project' level of risk; and
- predicting 'future case with project' level of risk.

The key features of the Marine Safety Navigational Risk Assessment Methodology are risk assessment (supported by appropriate techniques and tools), creating a hazard log, defining the risk controls (in a Risk Control Log) required to achieve a level of risk that is broadly acceptable (or tolerable with controls or actions), and preparing a submission that includes a Claim, based on a reasoned argument, for a positive consent decision.

The MCA guidance MGN 371 highlights issues that need to be taken into consideration when assessing the impact on navigational safety from offshore renewable energy developments in the UK. Specific annexes that address particular issues include:

- Annex 1: Site position, structures and safety zones;

- Annex 2: Developments, navigation, collision avoidance and communications;

- Annex 3: MCA's windfarm shipping template for assessing windfarm boundary distances from shipping routes;

- Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning; and

- Annex 5: Search and Rescue (SAR) matters.

One of the key requirements of MGN 371 is the collection of maritime traffic survey data of appropriate duration, including seasonal and tidal variations. This is to record all vessel movements in and around the project site and its vicinity. The method and timetable for data collection will be agreed with the MCA in advance to ensure it meets their requirements.

Once technical analysis of detailed bathymetry data has been carried out and suitable areas for deployment of devices identified, further consultation will be carried out with the organisations listed in Section6, as well as any other interested parties identified during the Scoping and NRA processto discuss device layouts.

Local stakeholders representing all the different maritime interests, including ports, fishing, shipping, recreation and emergency services, will be invited to the Hazard Review Workshop, which is a key part of the NRA and a practical method of identifying additional risk controls.

Other key guidance and reference materials that will be used in the Navigation Risk Assessment are listed below:

- MCA Marine Guidance Notice 372 (2008). Guidance to Mariners Operating in the Vicinity of UK OREIs.

- IALA Recommendation O-139 On The Marking of Man-Made Offshore Structures, 1st Edition December 2008;

- DECC Guidance Notes on Applying for Safety Zones around Offshore Renewable Energy Installations;

- IMO Guidelines for Formal Safety Assessment (FSA);

9. References

i RYA, Sharing the Wind, 2004.

ii UK Coastal Atlas of Recreational Boating; Recreational Cruising Routes, Sailing and Racing Areas around the UK Coast; Second Edition by RYA; Supported by Trinity House.

iii Clyde Cruising Club Sailing Directions and Anchorages – Part 5; N & NE Scotland and Orkney Islands; Clyde Cruising Club Publications Ltd, 2010.

iv MCA Marine Guidance Notice 372, Guidance to Mariners Operating in the Vicinity of UK OREIs, August 2008

APPENDIX D ENVID MATRIX

ID	Process	Activity	Aspect	Planned or Un-planned	Air Quality (local)	Greenhouse Gas Emissions	Water Quality and Hydrology	Hydrogeology / Peat	Sediment quality and bathymetry	Coastal Processes	Marine habitats and communities	Terrestrial/freshwater habitats and communities	Designated sites	Marine Cultural Heritage	Terrestrial Cultural Heritage	Landscape/Seascape	Navigation	Commercial Fisheries	Traffic and Transport	Tourism and Recreation	Local Communities	Waste	Legal compliance	Liability
1	Onshore construction	Construction of hydro-electric plant	Light disturbance due to work being carried out during the hours d darkness	P																				
2	Onshore construction	Construction of hydro-electric plant	Atmospheric and dust emissions	P																				
3	Onshore construction	Construction of hydro-electric plant and potential Horizontal Directional Drilling (HDD) works	Onshore site preparation and clearance	P																				
4	Onshore construction	Construction of hydro-electric plant	Onshore footprint and laydown area	P																				
5	Onshore construction	Construction of hydro-electric plant and potential HDD works	Pollution from construction plant leaks and spills	U-P																				
6	Onshore construction	Construction of hydro-electric plant	Noise emissions and vibration from construction plant	P																				
7	Onshore construction	Construction of hydro-electric plant and potential HDD works	Construction and commissioning activities	P																				
8	Onshore construction	Construction of hydro-electric plant and potential HDD works	Sediment run-off from construction site	U-P																				
9	Onshore construction	Construction of hydro-electric plant and potential HDD works	Modification to site drainage	P																				
10	Onshore construction	Pressure testing of pipelines	Water abstraction from burn	P																				
11	Onshore construction	Pressure testing of pipelines	Discharge of pressure testing water	P																				
12	Onshore construction	Horizontal Directional Drilling (If required)	Disposal of drill cuttings	P																				
13	Onshore construction	Horizontal Directional Drilling (If required)	Changes to groundwater flow	U-P																				
14	Onshore construction	Grid connection	Potential trenched installation of cables from hydro-electric plant t substation	P																				
15	Installation, Maintenance & Decommissioning	Vessel activities	Atmospheric emissions	P																				
16	Installation, Maintenance & Decommissioning	Vessel activities	Noise emissions and vibration from vessels	P																				
17	Installation, Maintenance & Decommissioning	Vessel activities	Waste disposal from vessel operations	U-P																				
18	Installation, Maintenance & Decommissioning	Vessel activities	Interactions with other vessels	P																				
19	Installation, Maintenance & Decommissioning	Vessel activities	Presence of moorings around offshore development	P																				
20	Installation, Maintenance & Decommissioning	Vessel activities	Exclusion / restricted access to an area offshore	P																				
21	Installation, Maintenance & Decommissioning	Vessel activities	Oil spill to sea from vessels	U-P																				
22	Installation, Maintenance & Decommissioning	Vessel activities	Direct and indirect displacement of wildlife due to vessel activity	P																				
23	Installation	Installation of anchors and foundation preparation including piling	Modification and disturbance of seabed	P																				
24	Installation	Installation of anchors and foundation preparation including piling	Discharge of drilling mud and cuttings	P																				
25	Installation	Installation of anchors and foundation preparation including piling	Underwater noise emissions and vibration during drilling	P																				
26	Installation	Installation of interconnecting pipelines/umbilicals	Modification and disturbance of seabed	P																				
27	Installation	Pressure testing pipelines for leaks	Discharge of dye into the water column	U-P																				
28	Installation	Horizontal Directional Drilling (if required) seabed exit point	Modification and disturbance of seabed	P																				
29	Installation	Horizontal Directional Drilling (if required) seabed exit point	Discharge of drilling mud and cuttings	P																				
30	Installation	Installation of pipelines on seabed	Modification and disturbance of seabed	P																				
31	Installation	Installation of pipelines on seabed	Discharge of drilling mud and cuttings from installation of rock anchors and/or support structures (if required)	P																				
32	Construction, Operation & Decommissioning	Onshore vehicle presence at hydro-electric plant during construction, operation and decommissioning	Pollution from vehicle leaks and spills	U-P																				
33	Construction, Operation & Maintenance	Construction, operation and maintenance of Brough Head Wave Farm project	Economic impact	P																				
34	Operation	Presence of hydro-electric plant	Physical presence and activity at hydro-electric plant	P																				
35	Operation	Presence of hydro-electric plant	Noise emissions due to operation of drive train units	P																				
36	Operation	Presence of hydro-electric plant	Pollution from hydro-electric plant (including electrical generators) leaks and spills	U-P																				
37	Operation	Operation of Oyster devices	Presence of Oyster devices in the water column and protruding above the sea surface	P																				
38	Operation	Operation of Oyster devices	Underwater noise emissions from operation of Oyster devices	P																				
39	Operation	Operation of Oyster devices	Long term presence of seabed infrastructure including monopile foundations	P																				
40	Operation & Maintenance	Maintenance of Oyster devices and seabed infrastructure	Presence and activity of vessels around the Oyster devices and seabed infrastructure	U-P																				
41	Operation & Maintenance	Presence of pipelines to onshore hydro-electric plant (Pipeline Option 2, not directionally drilled) on the seabed	Presence of exposed pipelines laid on seabed, use of supports, anchors and concrete matresses	P																				
42	Operation & Maintenance	Maintenance of Oyster devices and seabed infrastructure	Use of local harbour facilities by maintenance vessels	P																				

ID	Process	Activity	Aspect	Planned or Un-planned	Air Quality (local)	Greenhouse Gas Emissions	Water Quality and Hydrology	Hydrogeology / Peat	Sediment quality and bathymetry	Coastal Processes	Marine habitats and communities	Terrestrial/freshwater habitats and communities	Designated sites	Marine Cultural Heritage	Terrestrial Cultural Heritage	Landscape/Seascape	Navigation	Commercial Fisheries	Traffic and Transport	Tourism and Recreation	Local Communities	Waste	Legal compliance	Liability
43	Operation & Maintenance	Operation of Oyster devices	Leaching of antifoulants into water column and accidental discharge from the devices' hydraulic systems (including pipelines)	U-P																				
44	Operation & Maintenance	Operation of Oyster devices	Loss of components or loss of station	U-P																				
45	Decommissioning	Decommissioning of onshore hydro-electric plant	Removal of hyrdo-electric plant or change of use of site	P																				
46	Decommissioning	Removal of offshore components	Removal of seabed infrastructure	P																				
47	Decommissioning	Waste disposal of components	Disposal of component parts on culmination of project	P																				

APPENDIX E STAKEHOLDER LIST

Stakeholder	Stakeholder
Association of Salmon Fishery Boards	Orkney Ferries
Association of Scottish Shellfish Growers	Orkney Field Club
Birsay Community Council	Orkney Fisheries Association
BMAPA	Orkney Fisherman's Society
British Trout Association	Orkney Islands Council
BT Network Radio Protection	Orkney Marinas
Chamber of Shipping	Orkney Renewable Energy Forum
Civil Aviation Authority	Orkney Sailing Club
County Archaeologist	Orkney Sea Angling Association
Crown Estate	Orkney Sea Kayak Association
Cruising Association	Orkney Seal Rescue
DECC - Decommissioning	Orkney Sub Aqua Club
Defence Estates	Orkney Surf Club
Department for Transport	Orkney Trout Fishing Association
EMEC	RNLI
Environmental Concern Orkney (ECO)	Rousay, Egilsay and Wyre Community Council
Fishermen's Association Limited	RSPB
Greenpeace	RYA
Harray and Sandwick Community Council	Sail Orkney
Hebridean Whale and Dolphin Trust	Scottish Boating Alliance
HIE	Scottish Canoe Association
Historic Scotland	Scottish Coastal Forum
Historic Scotland	Scottish Environment Link
Inshore Fisheries Group - Marine Directorate, Scottish Government	Scottish Federation of Sea Anglers
JNCC	Scottish Fisheries Protection Agency (MS-Compliance)
Kirkwall Kayak Club	Scottish Fishermen's Federation
Kirkwall SGRPID (SEERAD)	Scottish Government - Energy Consents
Local Tour Operators	Scottish Government - Environment and Rural Affairs
Mallaig & Northwest Fishermen's Association	Scottish Government - Marine Directorate
Marine Conservation Society	Scottish Pelagic Fishermen's Association

Stakeholder	Stakeholder
Marine Safety Forum	Scottish Renewables Forum
Marine Scotland Licensing	Scottish Salmon Producers Association
Marine Scotland Science	Scottish Sea Angling Conservation Network
MCA	Scottish Surfing Federation
MSP for Orkney	Scottish Water - Kirkwall
National Air Traffic Services	Scottish Wildlife Trust
National Trust for Scotland	Sea Mammal Research Unit (SMRU)
Nautical Archaeology Society	SEPA
Northern Lighthouse Board (NLB)	SNH
Northlink Ferries	Stromness Community Council
OIC Marine Services	Surfers Against Sewage (SAS)
Orkney Biodiversity Records Centre	UK Hydrographic Office
Orkney Community Council Liaison	Visit Orkney
Orkney Creel Fisherman's Association	Whale and Dolphin Conservation Society
Orkney Dive Boat Operators Association	World Wildlife Fund for Nature, Scotland