ENVIRONMENTAL STATEMENT

Oyster 2 Wave Energy Project

European Marine Energy Centre
Billia Croo, Orkney

June 2011

REPORT REFERENCE NUMBER: OY02-DES-RH-XOD-MS-0001

EIA Quality Mark

This Environmental Statement, and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development, was undertaken in line with the EIA Quality Mark Commitments.

The EIA Quality Mark is a voluntary scheme, operated by the Institute of Environmental Management and Assessment (IEMA), through which EIA activity is independently reviewed, on an annual basis, to ensure it delivers excellence in the following areas:

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ACRONYMS

ARC	Abbott Risk Consulting Ltd
BAP	Biodiversity Action Plan
CAR	Controlled Activities Regulations
CPA	Coastal Protection Act
DECC	Department of Energy and Climate Change
DEFRA	Department of the Environment, Food and Rural Affairs
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
GCR	Geological Conservation Review
GRE	Glass Reinforced Epoxy
GRP	Glass Reinforced Plastic
HDD	Horizontal Directionally Drilled [pipelines]
HIRA	Hazard Identification and Risk Assessment
IMO	International Maritime Organisation
IMS	Integrated Management System
IUCN	International Union for Conservation of Nature
LAT	Lowest Astronomical Tide
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
NOAA	National Oceanic and Atmospheric Administration
NSA	National Scenic Area
NSRA	Navigational Safety Risk Assessment

NTS	Non-Technical Summary
OLBAP	Orkney Local Biodiversity Action Plan
ORCA	Orkney Research Centre for Archaeology
OREI	Offshore Renewable Energy Installation
PFOW	Pentland Firth and Orkney Waters
PHA	Preliminary Hazard Analysis
PMF	Priority Marine Feature
PMSS	Project Management Support Services Ltd
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
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
SSMEI	Scottish Sustainable Marine Environment Initiative
SSSI	Site of Special Scientific Interest
UK	United Kingdom
UKHO	UK Hydrographic Office
USA	United States of America
WEC	Wave Energy Converter

A NON-TECHNICAL SUMMARY

A.01 Introduction

Project Overview

This is the Non-Technical Summary (NTS) for the Environmental Statement (ES) (and accompanying Navigational Safety Risk Assessment – NSRA) which has been prepared in support of applications made by Aquamarine Power Limited (Aquamarine Power) under the Marine (Scotland) Act 2010 and Section 36 of the Electricity Act (1989) for the 2.4MW Oyster 2 Array wave energy project.

The complete Oyster 2 Array is a project at the European Marine Energy Centre (EMEC) Billia Croo, Orkney, which comprises 3 Oyster wave energy converters (Oyster 2a, Oyster 2b and Oyster 2c) each rated at 800 kW with a combined project rating of 2.4MW.

The ES and NSRA report the findings of the Environmental Impact Assessment (EIA) and NSRA of the *second phase* of the Oyster 2 Array wave energy project. *Phase 2* comprises:

- Seabed preparation;
- Oyster 2b and Oyster 2c wave energy converter flaps;
- Rock anchors used to position the wave energy converters during installation;
- Wave energy converter latching anchors; and
- Interconnecting pipelines and associated stabilisation anchors.

Application Strategy

Due to the staggered nature of the development of the Oyster 2 Array and following discussions with Marine Scotland and Orkney Islands Council, it was agreed that the project could be phased with three separate applications:

- Onshore (permanent and temporary) planning applications;
- Application under Part 2 of the Food and Environment Protection Act 1985 (FEPA) and Section 34 Coastal Protection Act 1949 (CPA) for Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c (Phase 1); and,
- Application for Marine Licence for Oyster 2b and Oyster 2c (Phase 2), and Section 36 Application for a combined project rating of 2.4MW[1].

The Applicant

Aquamarine Power is an industry leading marine energy company with head offices in Edinburgh, Scotland.

[1] This Section 36 Application also includes the 800kW rated Oyster 2a device which has been consented under CPA & FEPA & will be installed in summer 2011.

Documentation

The ES and NSRA are supported by a number of licenses, supporting documents and impact assessment reports which have been granted and/or prepared for the Oyster 2 project. All relevant documents are detailed in Figure A.0.1, page 12, and provided on a CD accompanying the ES.

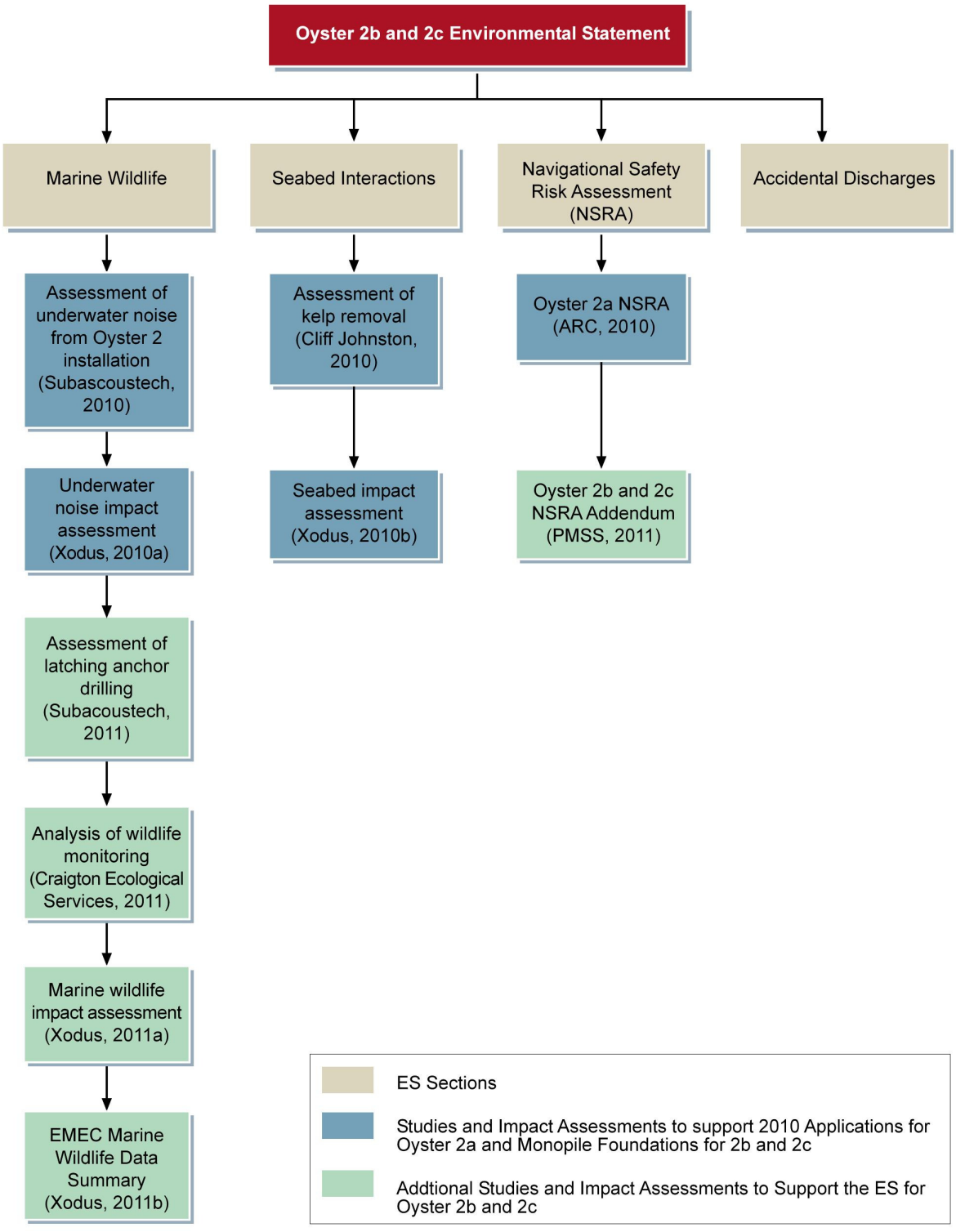

Figure A.0.1 ES and NSRA Documentation

A.02 Legislative Framework

There are a number of policies, guidance documents, leasing requirements and legislation which have a bearing on or a relationship with aspects of the 2.4 MW Oyster 2 Array project:

- Terrestrial Planning – Aquamarine Power was granted planning permission for the permanent and temporary onshore components of the Oyster 2 project under Section 57 of the Town and Country Planning (Scotland) Act in September 2010.
- Marine Planning – Measures for marine planning and marine conservation are included within the two main UK regulations put in place to deliver the Marine Strategy Framework Directive; the UK Marine and Coastal Access Act 2009; and the Marine (Scotland) Act 2010.
- Seabed Lease – EMEC is responsible for the management of its test sites and is therefore the holder of a seabed lease with The Crown Estate for the Billia Croo wave test site.
- Consents and Licensing – The Oyster 2b and Oyster 2c project, combined with Oyster 2a as the 2.4 MW Oyster 2 Array project, requires consent under Section 36 of the Electricity Act 1989 and a Marine Licence under Section 16 of the Marine (Scotland) Act 2010. Since the proposed project will generate over 1 MW of electricity, the application for these must be accompanied by an ES as required by the Electricity Works (EIA) (Scotland) Regulations 2000.
- Conservation – Information is provided in the ES to inform an Appropriate Assessment, if one is required, under The Conservation (Natural Habitats, & c.) Regulations 1994. A European Protected Species (EPS) Licence under the same regulations may also be required.
- Decommissioning – As required by the Energy Act 2004, Aquamarine Power will submit a Decommissioning Programme to the Department of Energy and Climate Change.

A.03 Project Alternatives

Aquamarine Power is focussing on the development and commercialisation of the Oyster technology and securing sites for the commercial development of Oyster.

Testing of the second generation Oyster technology, Oyster 2, is a key part of this development. Having tested its first full-scale prototype, Oyster 1, at the EMEC wave test site, the Oyster 2 Array Project represents the first testing of a wave energy array; and because of a number of other benefits associated with testing at the EMEC wave test site, including the opportunity to be involved with research projects, Aquamarine Power has decided to continue testing at the EMEC site. Detailed siting studies have enabled Aquamarine Power to choose a location within the wave test site that is suitable for the Oyster 2 Array project.

Figure A.0.2, page 14, shows the location of the Oyster 2b and Oyster 2c project.

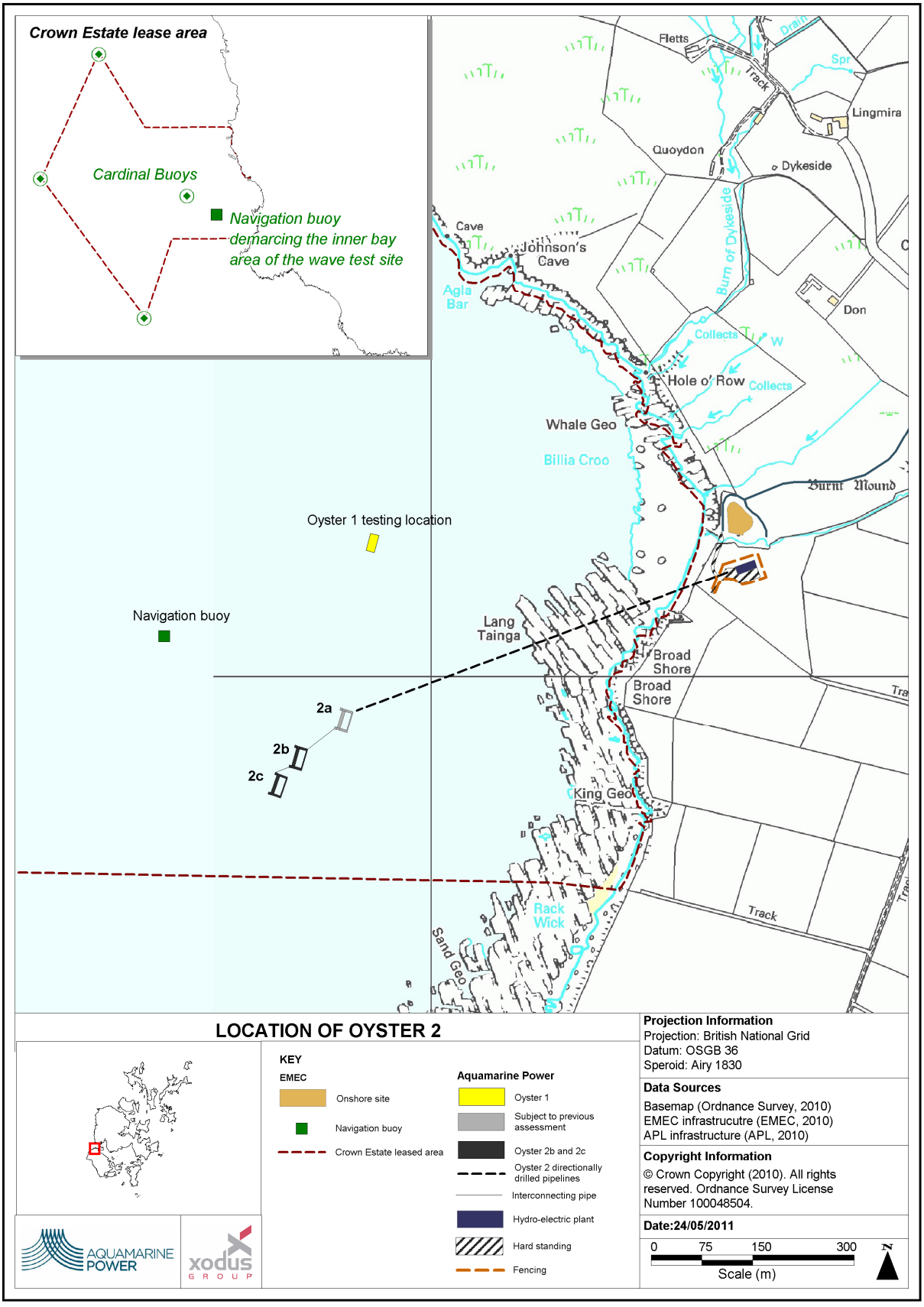

Figure A.0.2 **Location of Oyster 2 project**

A.04 Project Description

Technology

Oyster is a near-shore wave energy device, typically deployed in 10 to 15 metre (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 (for which planning permission has already been granted) converts the hydraulic pressure and flow into electrical power via a Pelton wheel turbine which drive electrical generators.

The Oyster technology is continually being developed as lessons are learned from Oyster 1 (pictured right, during testing at the EMEC wave test site) and the design of each generation of the Oyster device is refined. Oyster 2a is 250% more powerful than Oyster 1, simpler to install, easier to maintain and more efficient. The Oyster 2b and Oyster 2c devices will further refine the design of Oyster 2a.

Figure A.0.3, page 17, is a schematic figure to show the layout of Oyster 2a, Oyster 2b and Oyster 2c in relation to the seabed and the onshore hydroelectric plant.

Components

Oyster 2b and Oyster 2c will have a number of components including a flap, baseframe, hydraulic modules and a foundation monopile. The foundation monopile will be pre-installed in 2011 under CPA licence 2SPC\1\9\19 and 2SPC\1\9\20 and FEPA licence 03987/11/4849. In addition, rock anchors will be installed around the device to assist with securely lowering each Oyster flap onto its foundation monopile, and for maintenance operations throughout the life of the project. Latching anchors will also be installed next to each Oyster device on the seaward side to secure the flap in a maintenance position. Interconnecting pipelines will be installed between the Oyster 2c and Oyster 2b devices and between the Oyster 2b and existing Oyster 2a devices. Stabilising rock anchor supports and mattresses will be used to secure and protect the interconnecting pipelines between the Oyster 2b and Oyster 2c devices.

Installation

Installation of Oyster 2b (and associated seabed infrastructure) is planned to commence in summer 2012, with Oyster 2c (and associated seabed infrastructure) installation commencing in summer 2013. If it is possible then Oyster 2b and Oyster 2c and associated seabed infrastructure for both will be installed in 2012. Each installation process will commence in May. All installation activities utilise a mixture of tugs, multi-cat vessels and dive boats. A sequential list of operations is provided below:

- Seabed preparation – kelp clearance, infilling of gullies and gaps with rock, and installation of rock anchors and latching anchors.

- Oyster 2b/Oyster 2c installation – the Oyster devices will be towed out to the site from a suitable port facility in Orkney, positioned over the monopile foundations using a guide system and lowered over the pile and secured to the pile using grout.
- Installation of interconnecting pipeline/umbilical – installed on the seabed between the device and the directionally drilled pipeline to the onshore hydro-electric plant, using stabilising rock anchor supports and mattresses for protection.
- Commissioning – 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.

Operation and Maintenance

Oyster 2b and Oyster 2c are expected to be operational within five months of commencing installation. Designed to be compatible with diver-less maintenance, planned inspection and light maintenance activities are likely to take place every six months with an extended maintenance period at every five year mark. Maintenance might 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.

Decommissioning

A Decommissioning Programme, under the Energy Act 2004, will be submitted and agreed with the Department of Energy and Climate Change (DECC) and decommissioning undertaken in line with the details outlined in the programme.

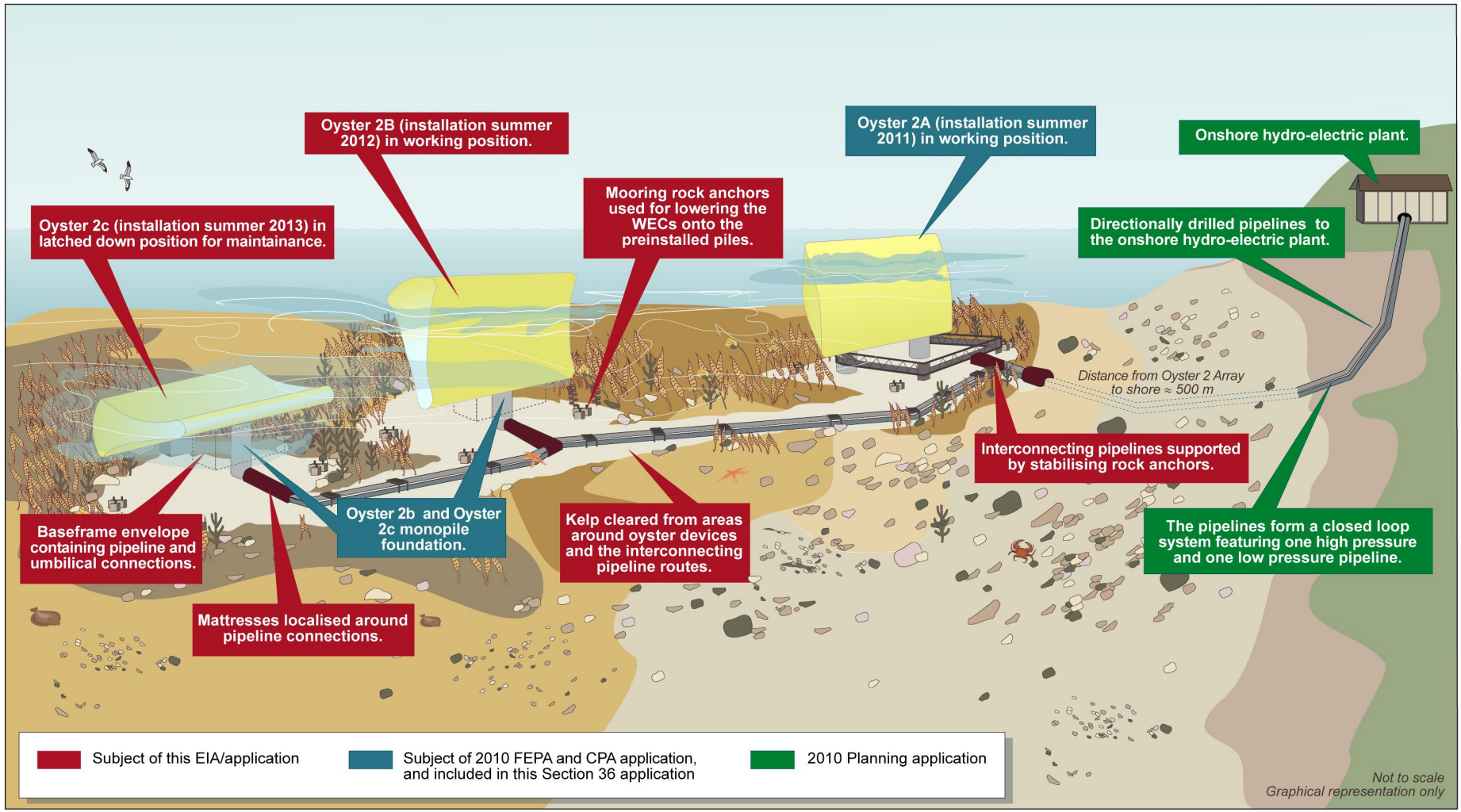

Figure A.0.3 **Graphical impression of Oyster 2a, Oyster 2b and Oyster 2c in position on the seabed at the EMEC wave test site**

(Please note that this is not to scale and is a graphical representation only of the Oyster 2 array)

A.05 Stakeholder Engagement

Aquamarine Power has undertaken to engage regularly and thoroughly with stakeholders, where necessary against a backdrop of a number of established relationships between EMEC and consultees. This has included the following stages:

- Issue of pre-scoping letters to local and national stakeholders inviting initial comments on the project and to identify important data sources;
- Submission of EIA Scoping Report and Navigational Preliminary Hazard Analysis (PHA) to Scottish Ministers in January 2010;
- Community Public Event held in February 2010 in Stromness to present the project and allow the general public to comment and advise on any potential issues;
- Receipt of the Scoping Opinion from Scottish Ministers in April 2010;
- Post-scoping meetings with local and national stakeholders to identify key baseline information, provide opportunity for further comment and advice, ensure all potential issues have been identified, and agree methods for impact assessment;
- Ongoing discussions regarding the application strategy with Marine Scotland and Orkney Islands Council.

Since receiving consent for the deployment of Oyster 2a and the monopile foundations for Oyster 2b and Oyster 2c, Aquamarine Power has engaged with Marine Scotland and Scottish Natural Heritage (SNH) during the development of an Environmental Monitoring Programme (EMP) for Phase 1 of the Oyster 2 project.

A.06 Environmental Overview

The environmental characteristics of the Billia Croo wave test site have been investigated as part of the EMEC wave test site development EIA and subsequent projects undertaken at the site. EMEC and SNH have compiled an environmental sensitivities chart for the Billia Croo wave test site which provides an overview of the key environmental characteristics of the wave test site (EMEC 2009) see Table A.0.1.

Species Group	Months											
Key:	**High**	**Moderate**	**Low**	**Minor Interaction**	**Unclear due to lack of data**							
Birds (*see note*)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Birds are present throughout the year at Billia Croo with the spring and summer breeding months considered to be the most sensitive as this is the time when greatest concentrations of birds will be present and may be particularly vulnerable to any pollution. Of the birds present, none are internationally or nationally important aggregations. The key issue to consider is collision risk. ***Wildlife monitoring additional to the established EMEC wildlife monitoring has been undertaken by Aquamarine Power to observe the use of the area between the proposed development site and the coast (this area also includes the deployment location of Oyster 1). The use of this area by bird species is discussed in more detail in Section 8.***												
Fish / Shellfish	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
The Billia Croo site (and Orkney as a whole) is located within spawning and nursery areas of a number of fish species, although none of a protective status. There is also commercial fisheries both inshore (shellfish) and further offshore (trawling) from the wave test site. ***EMEC has commenced a project using funding from the Scottish Government to turn the inner area of the wave test site into a Scientific Monitoring Zone. Juvenile lobsters were released into the area in autumn 2010 as part of this project which is supported by local fishermen.***												
Plankton	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
A spring phytoplankton bloom of diatoms and dinoflagellates occurs between March and May. The main components of the zooplankton are copepods, which form an important link in the food chain.												
Coastal/Seabed Habitats	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
From baseline EIA studies there is no evidence to indicate any particular sensitivity. ***A site-specific survey of seabed habitats has been carried out by Aquamarine Power to identify the species and habitats present at the proposed development site. The details of this are summarised in Section 9.***												

Species Group	Months											
Key:	**High**	**Moderate**	**Low**	**Minor Interaction**	**Unclear due to lack of data**							
Basking Sharks	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Basking sharks are regularly spotted in Orkney waters during the summer and are a UK Biodiversity Action Plan (BAP) priority species; although there are no recorded sightings at the wave test site [EMEC collected data]. The key issues to consider are the potential for collision risk and installation/operation/decommissioning disturbance. ***Since this table was compiled, additional wildlife monitoring carried out by Aquamarine Power has included sightings of 10 basking sharks in the inner bay area.***												
Marine Mammals	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Limited records exist for marine mammal sightings in the area. A few sporadic sightings include harbour porpoise, seals, minke whale, Risso and Orca, which are commonly observed species in Orkney waters. The nearest harbour seal haul out site is at Warebeth. The key issues to consider are potential for collision risk and installation/operation/decommissioning disturbance. ***Wildlife monitoring additional to the established EMEC wildlife monitoring is being undertaken by Aquamarine Power to observe the use of the area between the proposed development site and the coast (this area also includes the deployment location of Oyster 1). The use of this area by marine mammal species is discussed in more detail in Section 8.***												
Otters	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Where suitable habitat is present along south west Orkney mainland coastline, otter resting sites, feeding areas and potential holts have been identified. Otters normally cub in the winter months in Orkney, although they can breed at any time of year. Due to the lack of evidence it is not possible to identify a seasonal sensitivity for the otter. The key issue to consider is disruption from shore based works. ***Included for completeness – not directly relevant to offshore activities/developments.*** *There is a known low-level presence of otter in the vicinity of Billia Croo. Booth (2010) suggests that there is no evidence to indicate that otters are regularly using the area around the onshore EMEC facility and that in the sea, otters prefer sheltered, shallow water in which to feed. Booth suggests that the beach at Billia Croo is steep and exposed and therefore less likely to be suitable.*												

Table A.0.1 EMEC Environmental Sensitivities Table

Additional to the data presented in the wave test site environmental description, EMEC undertakes marine wildlife monitoring (by visual observation) of the wave test site to collect data on marine wildlife (basking sharks, cetaceans, pinnipeds and birds) presence and activity in the wave test site. This monitoring began in April 2009 and the results to date are used to provide context to the marine wildlife impact assessment.

Aquamarine Power has undertaken its own marine wildlife monitoring since April 2010 which has focussed on the inner bay area of the wave test site (within which the Oyster project is

located). A seabed survey has also been undertaken to characterise the seabed at the deployment site. The specific details and results of this monitoring are presented in the relevant impact assessment chapters of the ES.

A number of designated sites are in the vicinity of the EMEC wave test site, including Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSI), Geological Conservation Review (GCR), National Scenic Area (NSA) and Sites of Local Nature Conservation Importance (SLNCI) including:

- Stromness Heaths and Coasts (SAC, SSSI, GCR) – Oyster 2 Array development area adjacent to (overlaps GCR designation)
- Hoy (SPA, SAC, SSSI) – development 2.7 km from designation
- North Hoy (NSA) – development within designation
- Marwick Head (SPA) – development 13.3 km from designation
- Loch of Harray and Stenness (SAC, SSSI) – development 5.4 km from designation
- Brunt Hill (SLNCI) – development 1.75 km from designation
- The Loons (SLNCI) – development 2.76 km from designation

The qualifying features (species and habitats) have been taken into consideration throughout the EIA.

A.07 Assessment Methodology and Identification of Environmental Impacts

The EIA and associated NSRA process requires an understanding of the proposed installation, operation and decommissioning of the Oyster 2 project and the environment upon which there may be an impact. Central to the process is the systematic identification of issues that could impact the environment, including other users of the environment. Once identified, these issues have to be assessed to define the level of potential impact they present to the environment, so that measures can be taken to remove or reduce such effects through design or operational measures (mitigation). Additionally this process identifies those aspects of the proposed project that may require monitoring.

Cumulative effect and interrelation between each factor is considered in addition to the factors in isolation.

Definitions of sensitivity and magnitude criteria are specific to each potential issue and are provided, where appropriate, in the impact assessment chapters.

The ENVID (Environmental Impact Identification) process has been applied throughout the Oyster 2 project. An initial ENVID was undertaken during the scoping stage of EIA and the results incorporated into the EIA Scoping Report. This was carried forward and updated during the full EIA following receipt of the Scoping Opinion.

The issues that the ENVID identified as potentially significant are listed below and discussed in the following sections.

- Potential interactions with marine wildlife
- Potential interactions with the seabed;

- Potential navigational safety issues; and
- Potential accidental discharges.

A.08 Marine Wildlife Impact Assessment

An assessment of the potential for impact on marine wildlife due to the installation, operation and decommissioning of the Oyster 2b and Oyster 2c devices has been undertaken. This has included identification of the possible magnitude of any impact and appropriate mitigation measures. The assessment draws upon marine wildlife data collected for the EMEC wave test site by both EMEC (wider test site, April 2009 – March 2011) and Aquamarine Power (inner bay area, April 2010 – March 2011). A marine wildlife impact assessment report (Xodus, 2011a) has been prepared and is available on the CD accompanying the ES.

The survey data collected indicates that dolphins and porpoises, seals, fish and birds are present in the inner bay area throughout the year. The harbour porpoise and Risso's dolphin are the only species of whale and dolphin recorded in the inner bay area during the Aquamarine Power monitoring; these species are common throughout Orkney. EMEC collected data indicates the presence of other species in the deeper, further offshore waters of the wave test site. Seals are present throughout the year with grey seals more frequently observed than harbour (common) seals. Basking sharks have also been observed during marine wildlife surveys. Various species of bird are present throughout the year, including the presence of birds during the breeding season as well as over wintering populations. Some bird species present are likely to originate from international important protected areas located nearby, including the Hoy SPA and Marwick Head SPA.

The principal known impact to marine wildlife from the proposed Oyster 2 Array will be the potential for disturbance and displacement from the inner bay at Billia Croo during the installation (and decommissioning) phase of the proposed development, with potentially disturbing activities to marine mammals, fish and seabird species occurring in close proximity to the proposed development site during device installation and maintenance. The significance of impacts will vary between different species, depending on the season they are present, numbers with which they are present and their sensitivity to the different activities being undertaken. This disturbance impact is expected to be temporary in nature, with short intermittent periods of disturbance from vessel traffic and vessel presence during maintenance activities.

During operation there is an uncertainty factor applied to the impact assessment whereby the likelihood of any impact occurring is deemed to be 'possible'. This is due to the novel nature of the Oyster technology and the lack of existing evidence for or against impacts on marine wildlife from the long term presence of the technology.

Considering the above alongside mitigation measures proposed for the slowing down of vessels travelling to site, anchor drilling design, and measurement of the underwater acoustic signature of the Oyster 2 Array, disturbance and displacement impacts to marine wildlife are, overall, considered to be minor and therefore not significant. Aquamarine Power will continue its marine wildlife monitoring at Billia Croo in order to further the understanding of any potential impacts on marine wildlife from the operation of the Oyster technology. The results of this monitoring will be regularly reviewed in order to ascertain the significance of any potential impacts.

The marine wildlife impact assessment has specifically considered potential impacts on protected sites (habitats) and species, as required by the EU Habitats and Species Directives. With regards to Special Protection Areas (SPAs), i.e. those areas protected for birds, it is

concluded that the project will not result in any negative impacts on the conservation objectives of these sites. The proposed development will not result in any negative impacts on Special Areas of Conservation (SACs), designated for their populations of seals. Further consultation with Marine Scotland will establish the need for a European Protected Species (EPS) licence with regards the potential to impact whales and dolphins.

A.09 Seabed Interactions Impact Assessment

An assessment of the potential for impact on the seabed environment has included identification of the possible magnitude of any impact and appropriate mitigation measures. The assessment draws upon field work conducted at the installation site, desk-based research and Aquamarine Power's experience of deployment of Oyster 1. Reference is also made to the background information and assessment presented for the Oyster 2a device (Xodus, 2010b).

The seabed in the vicinity of and surrounding the proposed Oyster 2 Array comprises wave-exposed bedrock dominated by kelp, intersected by occasional steep-sided gullies. The site specific survey work identified two biotopes across the survey area; kelp park and kelp forest. The forest biotope was present at the proposed locations for the Oyster 2b and Oyster 2c devices, with park being restricted to slightly deeper water. The kelp habitat is generally in good condition. Kelp stipes (stalks) are encrusted with algae and beneath the kelp *Pomatoceros* sp. and a bryozoan turf was recorded away from the exposed, rocky surfaces. Grazing on this turf were occasional occurrences of *E. esculentus*, with *Asterias rubens* present also. On exposed rock faces and in gullies where kelp was not such a dominating feature, *A. digitatum* was occasionally abundant, although more often in lower densities, with *E. esculentus* and *Pachymatisma johnstonia*.

The key seabed impacts resulting from installation of Oyster 2b and Oyster 2c, similar to that from Oyster 2a (Xodus, 2010b), are related to the seabed habitat removed from use (corresponding to the area of kelp forest cleared) and the discharge of cuttings. Although the habitat is considered to be 'Reef' as defined under Annex 1 of the Habitats Regulations, the area impacted is very small and represents a very low proportion of that habitat type available locally, regionally and nationally, even when considered cumulatively with Oyster 2a. In addition, it is anticipated that kelp recovery will be rapid, based on evidence from testing Oyster 1, also at the EMEC wave test site.

The integrity of protected sites including the South Stromness Coast and West Coast of Orkney GCR sites and Stromness Heaths and Coasts SSSI will not be affected by the proposed development.

The area which is required to be cleared of kelp will be kept to as little as possible and the installation layout clearly defined and communicated to all personnel involved in kelp clearance. In addition, the anchors that will be drilled into the seabed will be designed to minimise drill cuttings generation, without compromising their technical performance. These measures will ensure impacts on the seabed will be minimised.

Following installation the seabed will be monitored to establish kelp recovery and impacts from drill cuttings discharge.

It is concluded that installation of the Oyster 2b and Oyster 2c devices and associated seabed infrastructure will not have a significant negative impact on the benthic environment.

A.10 Navigational Safety Risk Assessment

An NSRA conducted by Abbott Risk Consulting (ARC) Ltd for Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c (ARC, 2010a) was carried out in 2010. An addendum to the NSRA has subsequently been conducted in 2011 by Project Management Support Services (PMSS) Ltd accounting for the installation and operation of Oyster 2b and Oyster 2c (PMSS, 2011).

The NSRA and addendum have been undertaken in accordance with Marine General Guidance Notice MGN 371 (M + F) – Offshore Renewable Energy Installations (OREI): Guidance on UK Navigational Safety and Emergency Response Issues.

The NSRA has identified that vessel traffic in and around the EMEC wave test site comprises a mix of:

- Vessel activity associated with the wave test site and other renewables developments off the west coast of the Orkney mainland, including; vessels engaged in maintenance of the Billia Croo wave test site buoys; vessels engaged in installation / maintenance / survey activities within or adjacent to the EMEC wave test site; and vessels engaged in site investigation survey work of adjoining areas for potential offshore renewable energy installations.
- Vessels identified as using Hoy Mouth as an entry / exit point to Scapa Flow / including; ferries plying the route between Stromness and Scrabster; vessels engaged in fishing off the west coast of mainland Orkney; RNLI Lifeboats engaged in Search and Rescue (SAR) activities, dive boats on passage to dive sites; and yachts on passage to or from Scapa Flow / Stromness, including up the west coast of mainland Orkney.

In addition to the Oyster 2b and Oyster 2c project components, that are the subject of the Oyster 2 Array EIA, the addendum to the NSRA assesses the potential for risks to navigation which may be posed as a result of minor changes to the pile/foundation design (from twin pile to monopile foundation) which have arisen in the intervening period between the submission of the NSRA in 2010 and this ES.

Whilst the addition of the Oyster 2b and Oyster 2c project components (see Section A.01) introduces slight changes to the hazards identified in 2010, the same potential risks remain:

- Failure of the device or infrastructure leading to buoyant components becoming a hazard to shipping; and,
- Creel fishing boats colliding with (or gear snagging on) the devices, monopile foundations or seabed infrastructure.

An important aspect of the proposed mitigation to ensure navigational safety is the appropriate charting and marking (buoys) of the shallow water wave test site. The charting and marking of the test site is the responsibility of EMEC and the UKHO and the charting and marking of the Oyster devices in the water is the responsibility of Aquamarine Power. Further to this, Aquamarine Power will comply with EMEC requirements and broadcast proposed works by appropriate Notices to Mariners and Navigational Warnings in advance of the works commencing.

Should the recommendations presented in the 2010 Oyster 2a NSRA (ARC, 2010a) and subsequent addendum (for Oysters 2b and Oyster 2c) (PMSS, 2011) be followed; the residual impact is assessed to be tolerable and therefore not significant.

The 2010 NSRA report (ARC, 2010a) identifies cumulative impacts as part of the assessment process. This includes other renewable developments as well as other commercial and

recreational activities associated with the routes around the wave test site. At present both the Lyness redevelopment project and potential wave energy developments off the west coast of the Orkney mainland are at very early planning stages and little detail is available on the vessel traffic patterns that might be associated with them. Therefore, at this stage, it is not possible to undertake a detailed assessment of potential cumulative navigational risks except to note that future developments will potentially influence overall navigational risks in the area as a whole in the future.

A.11 Accidental Discharges

The key sources of potential accidental discharges have been identified as potential release of:

- Vessel fuel during installation, maintenance and decommissioning activities;
- Hydraulic fluid from the Oyster closed loop system; and
- Oil/chemical releases from underwater drilling equipment, during anchor installation.

Although the receiving environment may be considered sensitive to oil or fluid leaks and spills; the likelihood of specific events occurring, the quantity and type of oils and fluids, the dispersion effect of the high energy environment and the implementation of a series of management and mitigation measures will limit the potential effect on the environment.

Established procedures and practices in place that dove tail with existing EMEC procedures will ensure than an efficient and effective response will be implemented to safeguard personnel and minimise potential environmental effects. The residual significance of the Oyster 2b and Oyster 2c project in relation to accidental / non-routine events is considered to be negligible.

The EMEC wave test site has been designed for multiple technologies to be tested at the site at one time. EMEC's Integrated Management System (IMS) manual, Standard Operating Procedures (SOPs) and Permit to Work system, will control multiple activities on site at any one time. This will ensure the reduction of the cumulative risk of pollution related events.

A.12 Environmental Management and Monitoring

The Oyster 2 project will use wave energy to produce sustainable electricity. However, the installation of any project in the marine environment has the potential to impact on the environment and other users of the area. Whilst the potential effects have been assessed through the EIA and NSRA and presented in the ES (and accompanying NSRA report) it is necessary to manage the project and implement mitigation to ensure that the project is sustainable and to minimise or mitigate any ongoing effects on the marine environment.

The commitments stated in the ES will be implemented as part of the management of the project through communication with the project team and any contractors with whom Aquamarine Power engages. Some commitments will also form part of a broader environmental monitoring strategy.

The environmental monitoring strategy is an important aspect of Aquamarine Power's wider development strategy. Monitoring undertaken for Oyster 2b and Oyster 2c (and for the Oyster 2 Array as a whole) will be designed to be fit for purpose and appropriate to the scale of development and the projects' location within the EMEC wave test site. However, monitoring will also be undertaken to help define the likely extent of any potential impacts or identify performance improvements in the context of the intended commercial development of the Oyster technology.

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1. INTRODUCTION

The Oyster 2 Array is an Aquamarine Power Limited (Aquamarine Power) project at the European Marine Energy Centre (EMEC) wave test site, Billia Croo, Orkney, which comprises 3 Oyster wave energy converters (Oyster 2a, Oyster 2b and Oyster 2c) each rated at 800 kW with a combined project rating of 2.4MW.

This Environmental Statement (ES) and accompanying Navigational Safety Risk Assessment (NSRA) reports the findings of the Environmental Impact Assessment (EIA) and NSRA processes for the *second phase* of the Oyster 2 wave energy project. (Figure 1.1, page 28,) *Phase 2* comprises:

- Seabed preparation;
- Oyster 2b and Oyster 2c wave energy converter flaps[2];
- Rock anchors used to position the wave energy converters during installation;
- Wave energy converter latching anchors; and
- Interconnecting pipelines and associated stabilisation anchors.

1.1 Background to the Project

1.1.1 Aquamarine Power Limited

Aquamarine Power is an industry leading marine energy company with head offices in Edinburgh, Scotland.

1.1.2 Oyster Development and Commercialisation

Aquamarine Power's technology is its Oyster wave energy converter. Aquamarine Power has undertaken sea trials of Oyster 1, which was successfully installed over the summer of 2009 at the EMEC wave test site and connected to the grid. Oyster 1 was a single test device with a rated capacity of 315 kilowatt (kW). The next phase, on the route to commercialisation of large-scale sites around the globe, is to test an array of Oyster devices (Oyster 2).

Commercialisation of Oyster has a global focus with Aquamarine Power pursuing projects throughout Scotland, Ireland and the USA. In Orkney, activities to date have been focused at the EMEC wave test site. Aquamarine Power and its joint venture partner SSE Renewables UK Limited (jointly Brough Head Wave Farm Limited) have also been granted an option to lease an area off the west coast of Orkney through the Crown Estate's Pentland Firth and Orkney Waters leasing round for commercial wave and tidal energy projects. Aquamarine Power has also secured an option to lease an area off the west coast of the Isle of Lewis as part of the Crown Estate's Saltire Leasing Round.

[2] This Section 36 Application also includes the 800kW rated Oyster 2a device which has been consented under CPA & FEPA & will be installed in summer 2011.

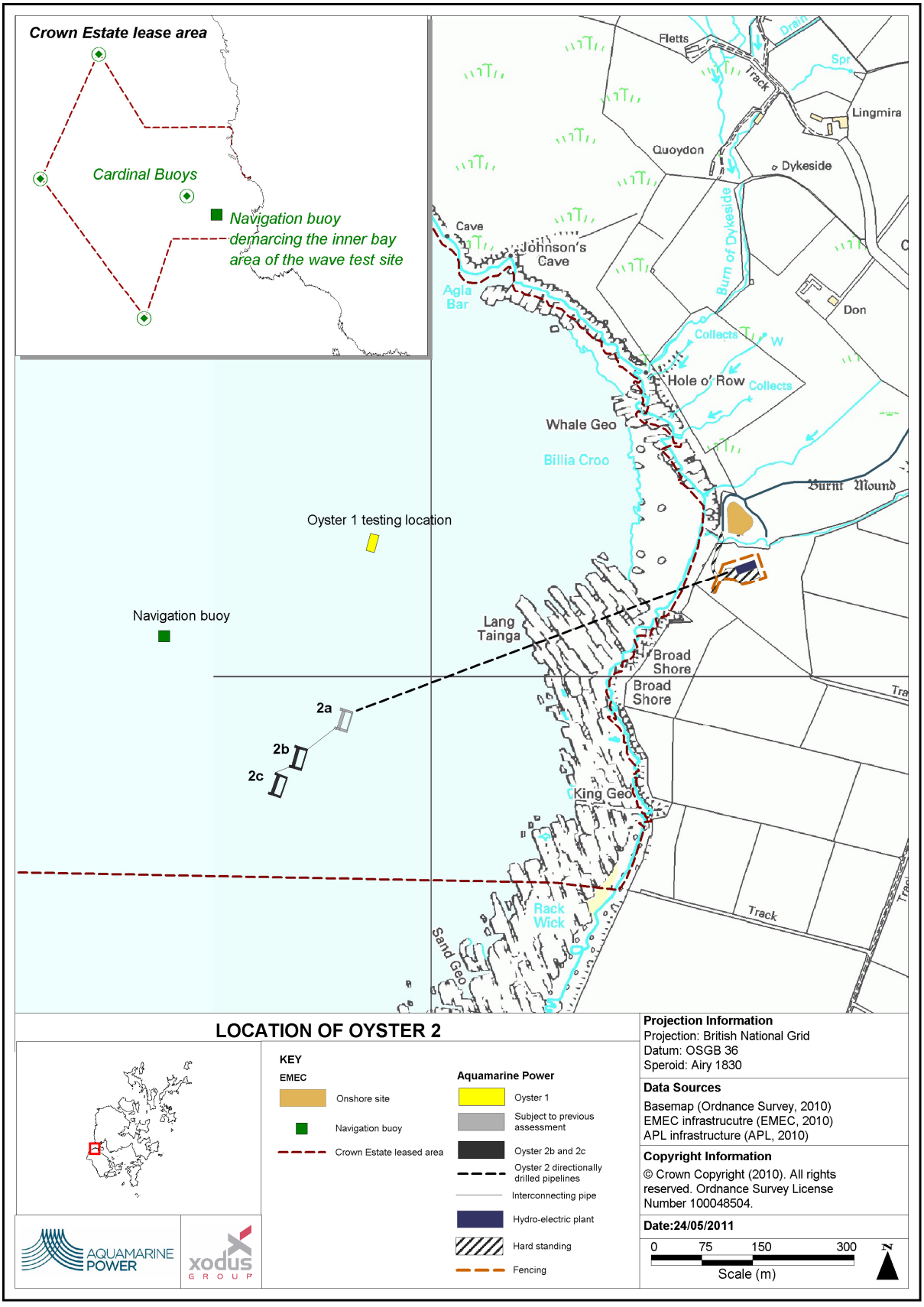

Figure 1.1 **Location of Oyster 2 Wave Energy Project**

1.1.3 The Oyster 2 Array (Oyster 2a, Oyster 2b and Oyster 2c)

Oyster 2 is the second generation of the Oyster technology and is a 2.4MW array consisting of three Oyster devices (Oyster 2a, Oyster 2b and Oyster 2c). Whilst looking to test an array, Aquamarine Power continues to improve the design of its Oyster technology and will therefore be deploying the Oyster 2 project in either two or three phases; Oyster 2a in 2011, Oyster 2b (and associated seabed infrastructure) is planned to commence in 2012, with Oyster 2c (and associated seabed infrastructure) installed in 2013. If it is possible then Oyster 2b and Oyster 2c and associated seabed infrastructure for both will be installed in 2012. Detailed design work is being undertaken on Oyster 2b and Oyster 2c however the level of detail presented within this ES is sufficient to support the required consent / licence applications.

Construction and installation of the onshore infrastructure/activities required to support the offshore devices commenced in November 2010.

Due to the staggered nature of the proposed activities and following discussions with Marine Scotland and Orkney Islands Council, it was agreed the project could be phased with three separate applications, Table 1.1 below provides details of the consents received to date for the Oyster 2 project. Schematic Figure 1.2, page 31, illustrates the phased nature of the Oyster 2 Array project. In addition to those listed in the table a number of Controlled Activities Regulations (CAR) registrations and simple licences were granted for activities associated with the onshore works. An European Protected Species (EPS) licence for disturbance of cetaceans during Oyster 2a installation has also been granted.

Project Component / Phase	Licence / Application Status	Reference	Supporting Studies
Already Received Consent			
Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c	FEPA Licence obtained December 2010 and amendment to FEPA Licence obtained March 2011	03987/10/0-4849 03987/11/0-4849 (amendment)	Environmental Supporting Document (not a statutory ES) and Navigational Safety Risk Assessment (see supporting CD)
	CPA Licences obtained October 2010	2SPC\1\9\19 (marine works) 2SPC\1\9\20 (moorings)	Environmental Supporting Document (not a statutory ES) and Navigational Safety Risk Assessment (see supporting CD)
	EPS Licence obtained May 2011	MS EPS 01/2011	None
	Environmental Monitoring Plan (EMP)	OY02-DES-RH-XOD-PLN-0001	None
Onshore works	Temporary planning permission granted September 2010	10/339/PP	Various environmental related studies (see supporting CD)
	Permanent planning permission granted September 2010	10/340/PP	Various environmental related studies (see supporting CD)

Project Component / Phase	Licence / Application Status	Reference	Supporting Studies
	CAR Simple Licence – Discharge to seabed at HDD breakthrough	CAR/S/1086504	None
	CAR Simple Licence – Pressure testing pipelines and discharging to sea	CAR/S/1086505	None
	CAR Registration – Culvert across the Burn of Streather	CAR/R/1086256	None
	CAR Registration – Abstraction of seawater for directional drilling	CAR/R/1086258	None
	CAR Registration – Discharge to septic tank and soakaway	CAR/R/1086257	None
To be Consented & subject to this ES			
Oyster 2a and Oyster 2b (and associated seabed infrastructure)	Marine Licence Application (subject to this application)	None	Environmental Statement and Navigational Safety Risk Assessment
Oyster 2a, Oyster 2b and Oyster 2c (and associated seabed infrastructure)	Section 36 Application (subject of this application)	None	

Table 1.1 Consents for the Oyster 2 Array Project

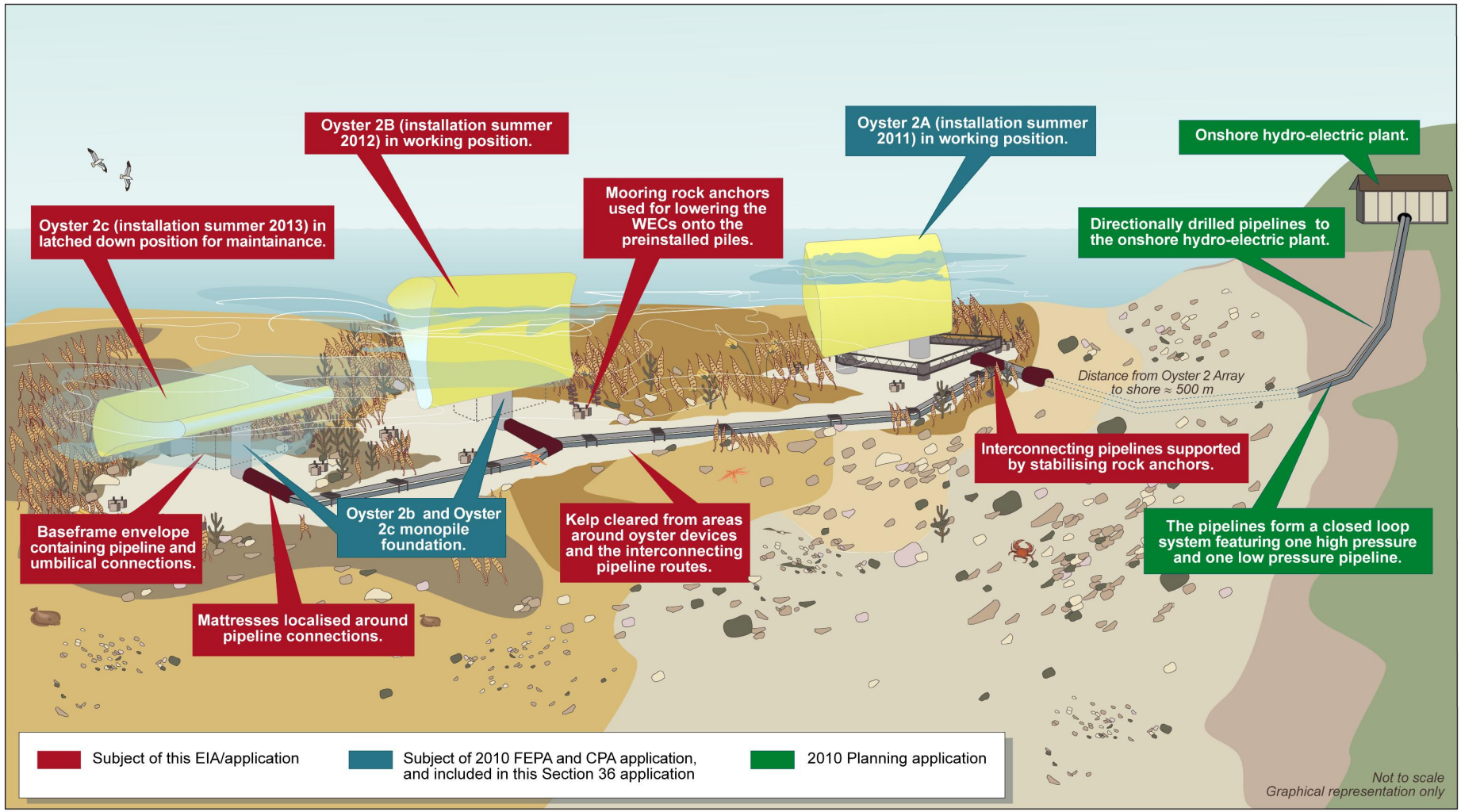

Figure 1.2 **Schematic Showing Oyster 2a, Oyster 2b and Oyster 2c in Position at the EMEC Wave Test Site**

(Please note that this is not to scale and is a graphical representation only of the Oyster 2 array)

1.2 Purpose and Scope of the Environmental Impact Assessment

The EIA is a process that identifies the areas where significant environmental effects may potentially occur as a result of a development, and outlines any mitigation measures or management controls aimed at reducing or offsetting these effects. The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 enforce this requirement in relation to the proposed marine energy development.

The ES reports the findings of the EIA process and explains how conclusions have been reached. This informs stakeholders and statutory consultees and provides recommendations for the establishment of environmental management and monitoring plans.

Due to the phasing of applications for the Oyster 2 project a number of environmental studies and impact assessments have already been undertaken. Where appropriate, studies were completed in 2010 to support the onshore planning applications and the applications for FEPA and CPA licences for Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c. Figure 1.3, page 33, below shows the relationship between the impact assessment chapters of this ES and work undertaken to support the previous Oyster 2a offshore application. It also shows where addendums to previous reports have been prepared in relation to the installation of Oyster 2b and Oyster 2c.

1.2.1 Document Structure

This ES is structured as follows:

- **Section 1** – Introduction and background to the proposed project
- **Section 2** – Legislative framework
- **Section 3** – Description of the main alternatives considered
- **Section 4** – Description of the Oyster 2b and Oyster 2c project
- **Section 5** – Overview of stakeholder engagement and community consultation
- **Section 6** – Overview of the environment at the EMEC wave test site
- **Section 7** – EIA methodology and Environmental Issues Identification (ENVID)
- **Sections 8 to 11** – Impact assessment chapters on marine wildlife, seabed interactions, navigation and accidental events
- **Section 12** – Environmental Management / Mitigation Plan

Environmental consultants Xodus Aurora, specialists in EIA for marine energy projects, were commissioned to undertake the EIA and prepare the ES.

In addition to the sections described above, and Appendix A which includes expanded information on the EIA methodology and the full ENVID matrix, the ES is accompanied by a CD which includes the relevant licences, supporting documents and impact assessment reports relevant to the Oyster 2 Array project. This is particularly important for the impact assessment chapters on marine wildlife, seabed interactions, and navigation which should not be read without reference to the reports provided on the CD and referenced at the beginning of each relevant ES Section.

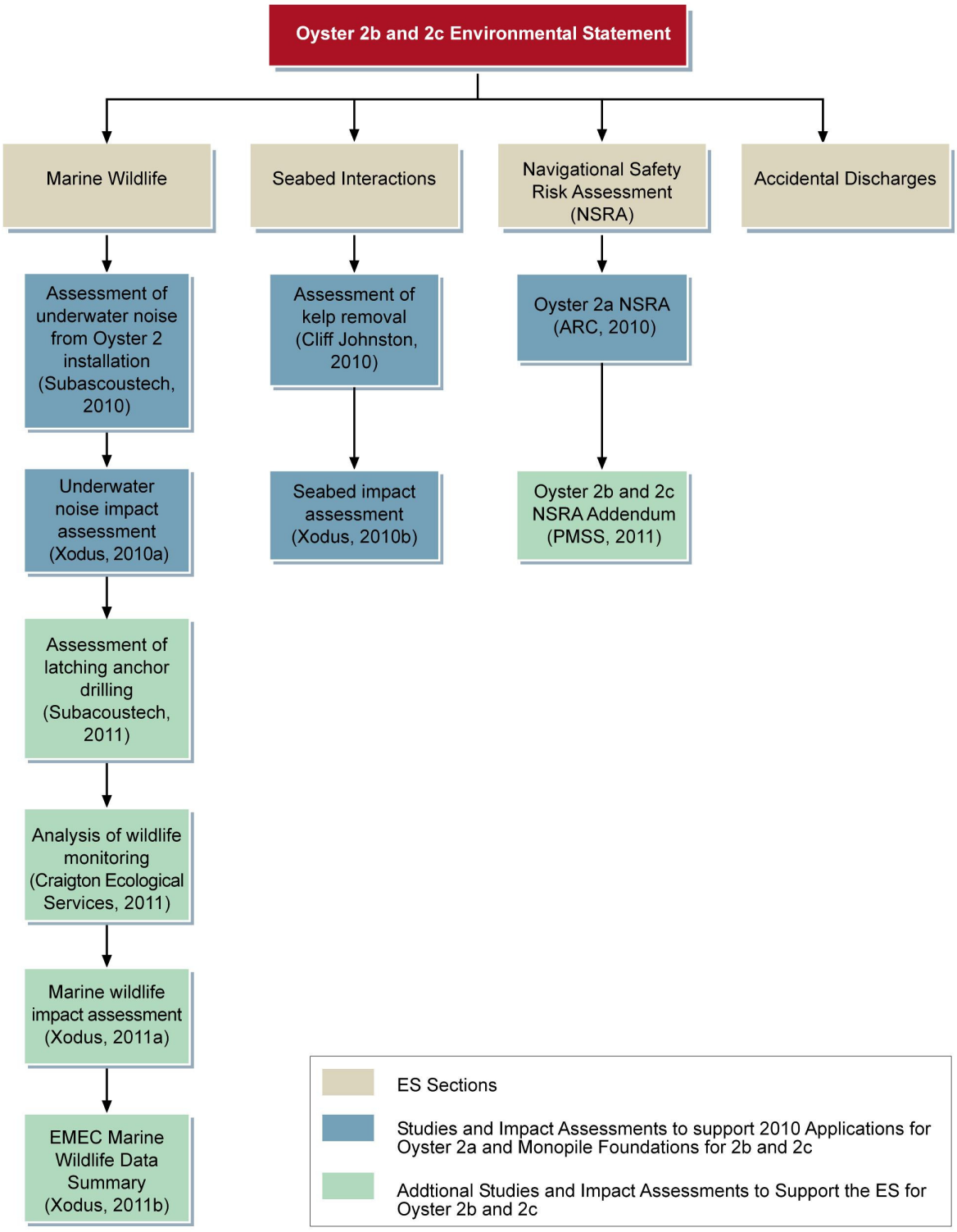

Figure 1.3 Relationship between this ES and Supporting Documents

1.3 Data Gaps and Uncertainties

The environmental characteristics of the EMEC wave test site have been investigated as part of the original wave test site development EIA. Whilst data on marine wildlife and the underwater acoustic signature of the site is still being collected, the wave test site is relatively well understood.

As part of the EIA and as required by the EIA regulations, information gaps and uncertainties in scientific understanding were identified and specific initiatives to address these issues commissioned. These included undertaking marine wildlife monitoring of the inner bay area of the wave test site and commissioning studies into kelp clearance and modelling the underwater noise of vessel and installation activities associated with the Oyster technology.

As a new technology still in the test phase of development, operational environmental monitoring data for Oyster is limited. However, Aquamarine Power has developed an Environmental Monitoring Plan (EMP) for the Oyster technology at EMEC and is committed to increasing the understanding of potential environmental impacts that result from the installation, operational and maintenance and decommissioning of the Oyster technology. This is an important part of the company's technology development process and also an important contribution to the advancement of this emerging renewable energy industry.

The specific areas of focus of the EMP are to understand:

- Marine wildlife interactions with the Oyster technology;
- The underwater acoustic signature of the Oyster device; and
- Potential seabed impacts from the installation and presence of the device.

2. LEGISLATIVE FRAMEWORK

2.1 Introduction

This section provides an overview of the planning policy, guidance, leasing requirements and legislation which have a bearing on or relationship with aspects of this project.

2.2 Planning Policy and Guidance

2.2.1 Terrestrial Planning

All onshore works above the Mean Low Water Springs (MLWS) are subject to Scotland and Orkney planning regulations and guidance. Aquamarine Power was granted planning permission for the permanent and temporary onshore components of the Oyster 2 project, under Section 57 of the Town and Country Planning (Scotland) Act in September 2010 (see Section 1).

2.2.2 Marine Planning

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.

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 (see Section 2.4), 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 improved protection for seals.

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 Locational 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 the Pentland Firth and Orkney Waters.

2.3 Seabed Lease

A seabed lease must be obtained from The Crown Estate before any development is installed on the seabed. EMEC is responsible for the management of its test sites and is therefore the holder of a seabed lease with the Crown Estate for the Billia Croo wave test site and has granted permission to Aquamarine Power for the use of this site for development of the Oyster 2 Array.

2.4 Consents and 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).
- Marine Licence under Section 16 of the Marine (Scotland) Act 2010.
- Permission under Section 20 of the Water Environment and Water Services (Scotland) Act 2003 (if development is within 3 nm of the coast or inland waters and involves activities controlled under this act) (see Section 2.4.3).

In certain cases an 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 The Conservation (Natural Habitats, & c.) Regulations 1994; and
- Submit a Decommissioning Programme as required under the Energy Act 2004.

The applicable legislation to the licenses and consents required for the Oyster 2 project, specifically for Oyster 2b and Oyster 2c which are the subject of this ES, are discussed in further detail in the following sections.

2.4.1 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 capacity of over 1 MW the Oyster 2 Array (2.4MW) will require consent from Scottish Ministers under Section 36 of the Electricity Act 1989.

2.4.2 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 is therefore not applicable to the Oyster 2b and Oyster 2c project), 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.
- 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 Oyster 2b and Oyster 2c. MS-LOT is also responsible for issuing development consents for renewable energy projects under Section 36 of the Electricity Act 1989 (see Section 2.4.1).

2.4.3 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 Regulations) 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.
- 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). There are certain aspects related to the

breakthrough of the directional drilling of pipelines, abstraction of seawater for pressure testing pipelines and the onshore burn crossing which required registrations or simple licences under CAR. These were applied for and granted for Phase 1 of the Oyster 2 Project. The operation of the Oyster 2 array does not require anything further under CAR.

2.4.4 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.

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. A request for a Scoping Opinion, in the form of a Scoping Report, was submitted to Scottish Ministers in January 2010.

2.4.5 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);
- 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. There are a number of Natura 2000 sites in proximity to the EMEC wave test site which have been considered during the EIA.

For any 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 (dolphins, porpoises and whales) only, 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 European Protected Species.

2.4.6 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. Aquamarine Power will produce a decommissioning programme for the Oyster 2a project, produced to the standards of DECC Guidance Notes: Decommissioning of offshore renewable energy installations under the Energy Act 2004. A Decommissioning Programme has already been prepared for Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c (Oyster 2 Phase 1) and will be updated as required and when appropriate for the second phase of the Oyster 2 Array project.

2.4.7 Survey, Deploy and Monitor Policy for Marine Renewables (April 2011)

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 with them a degree of uncertainty regarding the environmental impacts resulting from these types of developments. This issue of uncertain impacts provides 'regulators' and statutory advisors with difficulties when it comes to determining applications.

As a result a 'Survey, Deploy and Monitor Policy' has been developed to enable efficient, sustainable deployment of wave and tidal renewable devices. Although not yet published, it is understood the policy is a risk based strategy which will:

- Allow regulators to advise on licensing decisions using risk analysis based on device technology, site sensitivity and size of development.
- Ensure environmental sensitivities are properly taken account of, especially in the case of Natura Sites and European Protected Species.
- Provide developers and regulators with a framework approach to guide monitoring, assessment and licence procedures.

This Policy is not aimed at preventing development more so ensuring that development can be permitted in a sustainable way, delivering climate change objectives in a manner that is compatible with the environmental characteristics/sensitivities of the site.

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3. PROJECT ALTERNATIVES

3.1 Introduction

It is a requirement of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 that alternatives for achieving the objectives of the proposed development should be described and the basis for the selection of the preferred proposal should be outlined.

3.2 Technology Development Strategy

Aquamarine Power is focussing on the following:

- The development and commercialisation of the Oyster technology; and
- The securing of sites for the commercial deployment of Oyster.

Recent development and commercialisation of Oyster has been on sea trials of Oyster 1 which was installed and generating electricity at the EMEC wave test site in Orkney, Scotland during 2009 and 2010. This test deployment, the first full-scale prototype of the Oyster wave power technology, has provided valuable design, performance and environmental information.

Commercialisation of Oyster has a global focus with Aquamarine Power pursuing projects throughout Scotland, Ireland and the USA. Prior to large-scale commercialisation Aquamarine Power is utilising the lessons learned from Oyster 1 and continuing to work towards demonstrating the viability of its technology for large-scale commercialisation. Its present focus is on demonstrating the second generation Oyster technology which, in addition to capturing improvements to design and performance, will demonstrate its performance as an array of three devices working together and linked to a single onshore hydro-electric plant, as well as how that array will interact with the environment.

Aquamarine Power has successfully applied for consent for the installation of Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c (installation summer 2011) and this ES addresses the second phase of Oyster 2; the extension of testing to an array of three Oyster devices; comprising Oyster 2a (already consented and to be installed in 2011) and Oyster 2b (2012) and Oyster 2c (2013) or both Oyster 2b and Oyster 2c in 2012.

At this stage of development of the Oyster technology Aquamarine Power is continuously reviewing the design and installation and operations and maintenance engineering. The detailed design of Oyster 2b and Oyster 2c is therefore not finalised and a small number of options remain which have been described in this ES and assessed in the EIA.

3.3 Site Selection

3.3.1 Overview of Options

In order to select an appropriate site for the testing of an array of Oyster devices Aquamarine Power explored a number of options. An initial decision was made to focus on further testing in Orkney based on experience gained at Oyster 1 including local knowledge and existing relationships with stakeholders and the local supply chain, as well as having experienced employees already based in Orkney.

Consideration was then given to the identification of locations suitable for testing the first wave energy array. The following two options were considered most appropriate:

- Use the EMEC wave test site to develop a test array adjacent to Oyster 1: or
- Subject to a successful application for a lease option agreement to The Crown Estate, develop a test array within the Brough Head Wave Farm site.

European Marine Energy Centre

EMEC is a leading organisation in testing commercial scale wave and tidal energy technologies. As the first centre of its kind in the world, EMEC has established high standards for environmental performance and has already prepared an ES for the construction of the wave test site at Billia Croo, Orkney, as well as a site NSRA.

One of the advantages of the established EMEC wave test site is that environmental monitoring and research has been ongoing at the site since its establishment in 2005. The site is well understood and also has a number of research projects underway. The research directly relevant to Oyster projects is briefly described below:

- Wildlife Observations Programme – Monitoring of the wildlife activity at Billia Croo provides information about the number of species frequenting the area and the ways in which they use the site.
- Acoustic Characterisation – Investigating the detectability of any acoustic output from wave energy devices operating in a high energy environment. This will facilitate assessment of wave energy device operational noise in the context of the ambient background noise at the site, and also provide a robust and repeatable methodology to enable EMEC developers to compare the output from their devices with the baseline ambient characterisation.
- Inshore Crustacea Fisheries Project – Aiming to demonstrate that the wave energy industry and the local inshore fishing community can not only co-exist in sustainable harmony, but that there can be mutual benefits too.

In addition to this research EMEC has been involved in broader research and is part of, or facilitates, a number of groups/forums in order to work with developers and other organisations to ensure the most appropriate monitoring and research is being undertaken and help developers make the most of testing the technologies with EMEC. Aquamarine Power has representation on the appropriate developer groups/forums.

EMEC also has a set of procedures and practices in place for gaining consent, installation, operation and decommissioning of wave energy devices at the test centre. In cognisance of these, Aquamarine Power is developing in-house procedures which will be implemented in parallel to ensure a high standard of practice across the organisations and compliance with contractual obligations, health, safety and the environment.

Brough Head Wave Farm

The challenges of gaining consent for a new site, outwith the EMEC test site were considered to give too high a risk for the project which is intended as a test project and not a large-scale commercial build out.

It was therefore considered a lower risk option, to continue testing the Oyster technology at the EMEC wave test site rather than at Brough Head, as well as having the opportunity to be involved with research projects that would be less feasible at a different location.

3.3.2 Micro-siting

Having made the decision to deploy the Oyster 2 (Oyster 2a, Oyster 2b and Oyster 2c) array at the EMEC wave test site, Aquamarine Power then undertook a siting analysis to establish the most suitable location for deployment of the devices within the test site area. The search was split into two phases. First, an initial search to identify suitable deployment areas within the wave test site based on:

- Wave energy resource (device orientation is broadly perpendicular to the predominant wave direction);
- Water depth;
- Seabed gradient; and
- Seabed protrusion.

Following an evaluation of potential areas the final location within the wave test site has been selected, taking into account design of the Oyster foundations and piles which are strongly influenced by the topography of the seabed. A further influencing factor is the location and orientation of the horizontally directionally drilled pipelines from the onshore hydro electric plant.

Within the selected location, further micro-siting has been undertaken by Aquamarine Power engineers and analysts to find the optimum location for the testing of Oyster 2. The Oyster 2a location and the locations of the monopile foundations for Oyster 2b and Oyster 2c have been identified.

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4. PROJECT DESCRIPTION

4.1 Oyster 2 Array

The Oyster 2 Array is a project at the EMEC wave test site, Billia Croo, Orkney, which comprises 3 Oyster wave energy converters (Oyster 2a, Oyster 2b and Oyster 2c) each rated at 800 kW with a combined project rating of 2.4MW. This ES reports the findings of the EIA for the 2nd Phase of the Oyster 2 wave energy project. Phase 2 of the project comprises:

- Seabed preparation;
- Oyster 2b and Oyster 2c wave energy converter flaps[3];
- Rock anchors used to position the wave energy converters during installation;
- Wave energy converter latching anchors; and
- Interconnecting pipelines and associated stabilisation anchors.

4.2 Technology

Oyster is a near-shore wave energy device, typically deployed in 10 to15 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 a Pelton wheel turbine 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. As such its operation is not reliant on any electrical components or active control functions operating in the offshore environment.

4.3 Location of devices

The proposed location of the Oyster 2 devices is to the south of the Oyster 1 location in the near-shore area of the EMEC wave test site at Billia Croo. These devices have been sited according to available wave resource, water depth, seabed gradient and seabed protrusion. The locations of the WECs are presented as the coordinates of the centre points of each in Table 4.1, alongside coordinates of the pipeline exit point. The coordinates stated for Oyster 2b and Oyster 2c are approximate and could change +/- 30 m. Please also refer to Figure 1.1 for geographical context.

[3] This Section 36 Application also includes the 800kW rated Oyster 2a device which has been consented under CPA & FEPA & will be installed in summer 2011.

Component	Eastings (m)	Northings (m)	Latitude (N), WGS84 (DD MM.MM)	Longitude (E), WGS84 (DD MM.MM)
Oyster 2a	321868	1009937	58 58.166	-3 21.629
Oyster 2b	321803	1009882	58 58.136	-3 21.697
Oyster 2c	321773	1009843	58 58.115	-3 21.727
High Pressure Pipeline Exit point	321899.0	1009921.2	58 58.158	-3 21.597
Low Pressure Exit Point	321896.3	1009937.9	58 58.167	-3 21.601

Table 4.1 Oyster 2 Device Location Coordinates

4.4 Onshore infrastructure

Although Aquamarine Power is making use of the EMEC near-shore wave test site there is not adequate space for the equipment necessary to operate Oyster 2 at the existing EMEC onshore facility. Following offshore micro-siting, Aquamarine Power identified the optimum location for the onshore infrastructure as adjacent to the EMEC onshore facility, allowing the electricity produced to be exported to the grid via EMEC's substation.

The details of the onshore infrastructure are provided here for completeness only; the onshore infrastructure has not been assessed in the impact assessments for the EIA presented within this ES.

The onshore infrastructure includes:

- 2 x drive trains[4], each one consisting of 2 Pelton wheel turbines within a common enclosure, driving a shaft with 1 flywheel per drive train and 1 generator per drive train;
- 2 banks of power electronic inverters to convert generator output to grid frequency and voltage;
- Header water tank vented to the environment at ambient pressure;
- Filtration system;
- 2 x step-up transformers (1 per drive train) between the generator output and grid connection point;
- Electrical system protection to protect itself and the grid;
- Additional transformer to convert grid voltage to 'step down' to provide mains voltage to the site;

[4] Each drive train is rated appropriately for the output of 1.2 MW to the grid.

- Onshore accumulators connected to the directionally drilled pipelines which are used for smoothing the flow of pressurised water;
- Dump resistors which are used in any sort of emergency to shed power quickly (it is not confirmed whether these will be included but it is likely);
- Operator's rest/office area, workshop and switch room; and,
- Directionally drilled pipelines from the onshore facility to an exit point on the seabed near to the location of the Oyster devices.

4.5 Offshore infrastructure

4.5.1 Device structure and operation

The Oyster technology is continually being developed as lessons are learned from Oyster 1 and the design of each generation of the Oyster device is refined. Oyster 2a is 250% more powerful than Oyster 1, simpler to install with 2 piles rather than 4, easier to maintain due to its modular design and more efficient due to improvements in its hydrodynamic shape.

The Oyster 2b and Oyster 2c devices will further refine the design of Oyster 2a resulting in a lighter and cheaper monopile design which has an easy to maintain modular design and an improved hydrodynamic shape with reduced losses.

Figure 4.1, page 49, provides an indicative drawing of what the Oyster 2b and Oyster 2c devices may look like. Two key material types and combinations are being considered for the Oyster 2b and Oyster 2c devices and the shape of the device may change depending on the material used.

- Material Option 1 will be similar to the materials used for Oyster 1 and Oyster 2a and use steel as the main material of construction.
- Material Option 2 will use a combination steel and of composites, elastomers, marine grade rubber and steel.

Whether material Option 1 or 2 is used will make little change to the environmental impact.

The Oyster 2b and Oyster 2c devices are made up of a baseframe and a flap. Included within this are hydraulic modules (cylinders and accumulators). The devices will sit on pre-installed monopiles with additional latching anchors which are drilled and grouted into the rock seabed. The monopile foundations have been the subject of a previous FEPA Licence application and associated amendment (Ref 03987/10/0-4849). The piles provide a secure and level base on the seabed at around - 13 m MSL (Mean Sea Level) or - 11 m LAT (Lowest Astronomical Tide) water depth.

The offshore structures have a design life of 20 years and designed in accordance with the Load and Resistance Factor Design method (LRFD) defined within Det Norske Veritas Offshore Standard DNV-OS-C101. This ensures they can meet the conditions of the environment within which it is intended to operate. The Oyster 2 devices will be oriented perpendicular to the predominant wave direction.

Design loads on the Oyster 2 devices are evaluated for extreme loading and background (fatigue) loading conditions. Extreme loads on the Oyster 2 devices are 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. The representative wave climate was derived from wind and wave hind-cast data from the US National Oceanic and Atmospheric Administration (NOAA) and used in standard modelling programme (MIKE 21) to generate a representative wave climate for the Oyster site. The modelled wave climate was found to compare well with actual data collected at the EMEC wave test site.

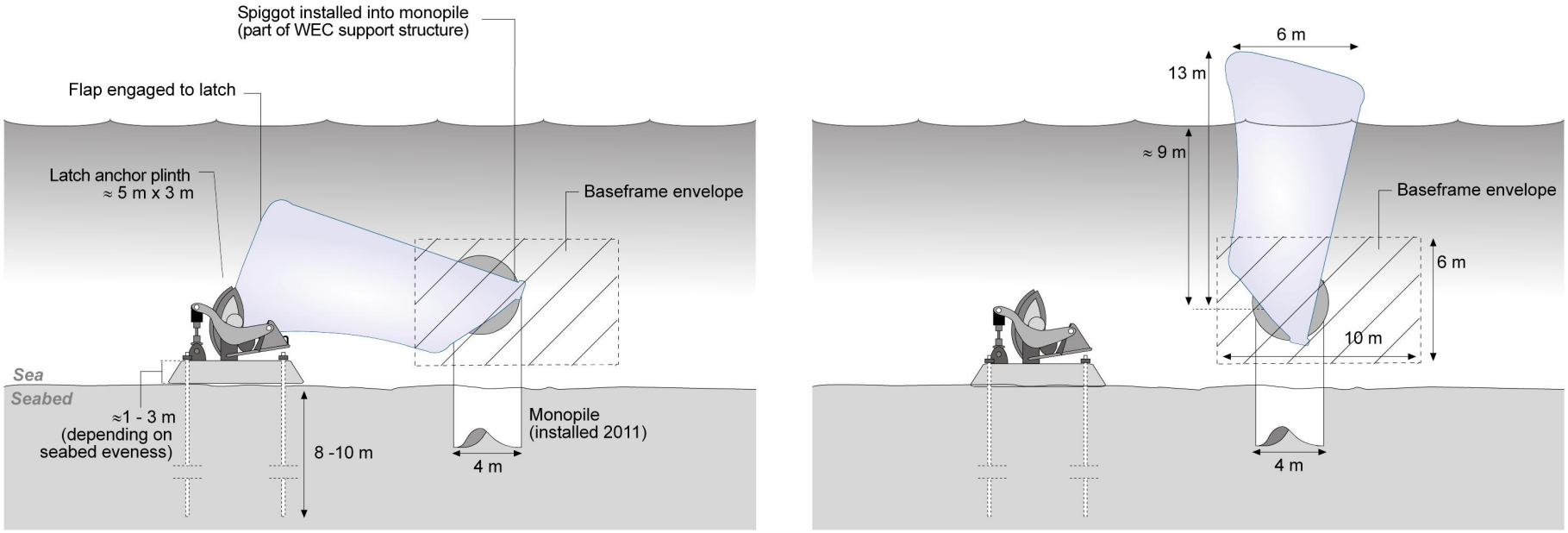

Figure 4.1 Schematic Showing the Components of Oyster 2b and Oyster 2c

The extreme loads are analysed at the Ultimate Limit State and are multiplied by an appropriate load factor to derive design loads. In DNV-OS-C101 the return period considered is 100 years. The extreme design loads are combined with standard material factors in accordance with the DNV LRFD (Load Resistance Factor Design) methodology. The fatigue loads are analysed for the Fatigue Limit State with appropriate design fatigue factors to account for the criticality of different components. The design fatigue factors are evaluated in accordance with DNV-RP-C203, which is a design code for the fatigue design of offshore steel structures. The final design is based on the most onerous of the extreme and fatigue cases, therefore ensuring that the structural reliability achieved is consistent with best practice in offshore design.

Table 4.2 summarises the key specifications of the Oyster 2b and Oyster 2c devices.

Item *(per WEC)*	Specification
Flap	30 m wide (parallel to shore), 6 m thickness (perpendicular to shore), 13 m high (vertically – top of flap to hinge point), hinge axis depth ~ 9 m below MSL
Baseframe	1 unit – 30 m wide, 10 m thick, 6 m high (this is the envelope within which the baseframe would be located) The top of the baseframe is up to 8 m high above seabed depending on seabed slope
Hydraulic modules	The hydraulic modules will be contained within the envelope of the baseframe and flap
Monopile foundation	Pre installed and subject of a previous FEPA Licence application (Ref 03987/10/0-4849 and 03987/11/4849)

Table 4.2 Specification of Main Component Parts of Oyster 2b and Oyster 2c Devices

4.5.2 Seabed infrastructure

In addition to the WECs themselves, the Oyster 2 Array will require additional seabed infrastructure. The different components of this infrastructure are illustrated in schematic Figure 1.2. The design of the supporting seabed infrastructure is not yet finalised, but will be one of the two following options.

- Option 1:
    - Hydraulic pipelines (1 Glass Reinforced Epoxy (GRE) plastic low pressure pipeline and 1 steel high pressure pipeline);
    - Carbon steel spool support/protection frames including glass flake epoxy protection paint;
    - Aluminium alloy sacrificial anodes;
    - A number of mattresses will be used as localised protection around pipeline exit points and tie-ins.

- Option 2:
    - Hydraulic pipelines (1 flexi hose high pressure pipeline and 1 flexi hose low pressure pipeline);
    - A number of mattresses will be used as protection along the pipelines.

The following infrastructure would be located on the seabed in addition to either Option 1 or Option 2:

- Four sets of rock anchors will be installed on both/either sides of each Oyster device (4 per WEC). Each set of rock anchors has 3 anchors 52 millimetres (mm) in diameter and 1.5 metres (m) length. These will be used to assist in securely lowering each Oyster WEC onto its foundation monopile, and for maintenance operations throughout the life of the project. The rock anchors will be fixed to the seabed through a triangular template 1m in length using drilled holes, anchors and a standard injection mortar system.
- Approximately 15 sets of stabilising rock anchor supports will be used to secure the interconnecting pipelines in place. These rock anchors will be similar to those used for installation purposes (see bullet point above) but smaller in size and will be fixed to the seabed using manually drilled holes, anchors and a standard injection mortar system.
- The monopile foundations (as consented in a previous FEPA Application – see CD accompanying this ES) will be located on the seabed. Surrounding the piles there will be the baseframe which is a 'box' unit which sits on the piles underneath the Oyster flap. The baseframe supports the flap and contains components such as the control box.
- Two sets of latching anchors per WEC will be installed next to each Oyster device at the seaward side of the flap. Each set of latching anchors has 4 anchors each measuring 200mm in diameter and 10m in length. The latching anchors will be used to secure the Oyster flap into the closed position (horizontal to the seabed) for maintenance operations throughout the lifetime of the project. The latching anchors will be fixed to the seabed using drilled holes, anchors, a concrete plinth and grout system.

4.5.3 Latching anchor drilling technique

The two sets of latching anchors per WEC will be installed using the following sequence:

- Kelp clearance in the area where the latching anchors will be installed using a diver and knife or a seawater jet powered from a hydraulic power pack aboard a vessel;
- Build shuttering for grout plinth (this will prevent grout from entering the marine environment);
- Pump in grout;
- Allow plinth grout to cure;
- Drill holes for anchors through the grout plinth and into the seabed;
- Flush the drill bore with water;
- Insert anchor grout into drilled hole;
- Insert anchor;

- If necessary add further grout to fill the drilled hole to seabed level;
- Allow anchor grout to cure; and
- Install latch and tension up.

The type of machinery which will be used during installation of the latching anchors would be a Eurodrill HD1250, Krupp HP50 Hammer Drill or a similar type of drill with a 300 mm carbide rock bit, and an estimated power output of 38 kW. The drill would be used underwater and would be mounted on a frame. The type of drilling will be rotary percussive.

The time taken to drill each anchor (within a set) would be approximately 10 hours. The total time taken to drill a set would be approximately 40 hours, so the total drilling time per WEC would be approximately 80 hours. This assumes a speed of 1m/hour using a drill which can operate at a speed of between 1.04 and 4.6 m/hour

The vessels which would be used during installation activities would be a multicat and a diving support vessel.

Installation of 2 sets of latching anchors per WEC is expected to take 1 day for seabed preparation, 7 days for drilling of anchors, 2 days for installation.

4.5.4 Hydraulic modules

Oyster 2 is based around a closed-loop hydraulic system which is the key component of the technology which enables it to transmit wave energy to the shore.

It is anticipated that there will be four hydraulic modules on each device; all removable. It is planned to remove and replace the modules during maintenance and repair procedures. The modules have been designed for removal by small vessels. Each hydraulic cylinder module(s) consists of the hydraulic cylinder, check valves, a pressure relief valve and isolation valves. Each hydraulic accumulator module will contain a bank of accumulators. Each module will also incorporate communications harnesses and junction boxes. The hydraulic modules will be hydraulically isolated from the device prior to being removed.

It is intended that each module can be removed and replaced as a single unit in the event of failure of the system; however it will also be possible to replace constituent components without removing the complete module. It is anticipated that modules would be removed for refurbishment and maintenance at intervals in the order of five years. Although it is intended that the architecture of the hydraulic module should be suitable for conversion to a fully diverless intervention, it is expected that for Oyster 2 divers will initially be required for module removal and replacement.

The removable modules perform independently of each other in that they contain the necessary valves and accumulators such that one module can pump high pressure fluid whilst the other is non-operational, or even removed. This feature provides partial redundancy.

4.5.5 Oils and fluids

Hydraulic fluid allows the movement of the flaps to be transmitted to shore. The baseline design for Oyster 2 was to use fresh water as a hydraulic fluid. Component suppliers (particularly the manufacturers of hydraulic cylinders) have indicated that it will be necessary to use an additive to the water to increase the lubricity of the working fluid. This lubricity is necessary to achieve the required sealing life and ensure maintenance is required only once every five years. At present it is likely that the hydraulic fluid in the high and low pressure

pipelines will consist of fresh water with the hydraulic additive Eco-Stack Magic and defoamer Agent 70. Subject to ongoing performance testing the hydraulic additive added to the pipelines may change. Aquamarine Power is committed to using the most environmentally friendly hydraulic additives possible whilst maintaining performance standards of the Oyster hydraulics. Small quantities of other oils fluids and gels are also required in other systems within the Oyster device (for example hydraulic fluid in the latch damper) and in the horizontal directionally drilled (HDD) pipeline boreholes (for example the umbilical gel).

Table 4.3 summaries the fluid inventories in the different systems for the entire Oyster 2 Array. Please note that the quantities for Oyster 2a have been separately consented but are included here due to the shared nature of the pipelines by the Oyster 2 Array.

Location of fluid	Type of fluid	Quantity	Maintenance activities	Risk of leak / discharge
In High and Low Pressure Horizontally Directionally Drilled Pipelines Connect the onshore header tank to the offshore device	**Fresh water, Eco-Stack Magic and Agent 70**	Total system volume - 250,000 litres Stack Magic at 5% and Agent 70 at 0.1%	During commissioning activities the system would experience some losses, for example during the 'hook up' of pipelines. This would be minimised as much as possible by circulating only water during this process and would not add the hydraulic fluids to the system until the commissioning activities have been completed. Aquamarine Power are working towards no discharge during installation and commissioning activities. Maintenance activities are likely to be undertaken every 5 years. Maintenance activities would involve changing out of the removable hydraulic modules. This could result in the discharge of some fluid (max 700 l) but every effort would be taken to reduce this.	Low risk – some fluid could be discharged during maintenance activities
Latch Damper Part of the offshore Oyster device. The fluid would be contained within a cylinder within the device.	**Qunitolubric 888-46** *Fire resistant hydraulic fluid* *Non toxic / non toxic to aquatic life* *Non-irritating* *Biodegradable*	Estimated at 300 l per WEC (900 l in total system)	It is unlikely that any in-situ maintenance activities would be undertaken on the latch damper. There is a possibility that the damper would be changed after 10 years of operation. In this instance the complete unit would be removed & maintenance carried out onshore so no loss of fluid is envisaged. The damper would be visually inspected on a regular basis.	Low risk – the latch damper is designed to take impact loads for the duration of its life with no losses through sealing surfaces
Ballast Control System (including subsea hydraulic control module) which is part of the offshore Oyster device.	**Castrol Carelube** *Biodegradable* *Low aquatic toxicity*	Estimated at 70 l per WEC (210 l in total system)	Maintenance activities are likely to be undertaken every 5 years. The unit containing the ballast control system would be removed from the Oyster device by disconnecting hoses (which are fitted with self seal quick couplers (non return valves) and any maintenance activities undertaken out of the sea.	Low risk – the ballast control system is contained within the Oyster device, which as above has been designed to take impact loads for the duration of its life

Location of fluid	Type of fluid	Quantity	Maintenance activities	Risk of leak / discharge
Umbilical – Fibre optic cable gel (located within the horizontally directionally drilled pipelines which connect the offshore device to the shore)	**Sepigel** – Thixotropic hydrogen scavenging gel	Estimated at 1.5 l for entire system	No maintenance activities expected.	Low risk - this would not be discharged to the sea unless the umbilical is accidently cut/severed

Table 4.3 Fluid Inventory for Entire Oyster 2 Array (Oyster 2a, Oyster 2b, Oyster 2c and Pipelines)

4.5.6 Colour, lighting and marking

Oyster 1 and Oyster 2a are painted yellow and white and it is likely that the Oyster 2b and Oyster 2c devices will be painted to a similar specification. Aquamarine Power will work in consultation with the Northern Lighthouse Board (NLB) to ensure that the Oyster 2b and Oyster 2c devices are appropriately marked.

4.5.7 Control system

Offshore instrumentation for control as well as research and development purposes will be mounted on the Oyster 2 devices. The instrumentation will include pressure sensors, strain gauges on the flap hinge, a camera, integral status monitors, wave distribution pressure sensors, a vibration sensor, structural strain gauges and linear transducers.

The design testing of Oyster 2a will include a remote ballasting system. Deballasting will be a manual operation (as with Oyster 1). Manual ballasting will be possible and will ensure that the Oyster 2a is not reliant on remote operations. For Oyster 2b and Oyster 2c, Aquamarine Power is considering alternative maintenance configuration strategies which may not involve ballasting of the devices.

Communications to enable the control signals from onshore to the offshore devices, a power supply, offshore instrumentation data and status signals will be via a fibre-optic and electrical umbilical. A central SCADA computer will display all information and control operations using a graphical interface and provide historic trends. Alarm indication and shutdown signals will be recorded. Data will be stored remotely as well as locally at the onshore site.

4.5.8 Corrosion protection and antifouling

Oyster 1 was in location for approximately 1 year and 5 months. Monitoring of Oyster 1 during spring 2010 saw that with the increase in daylight there was a noticeable increase in algal growths and harder growths such as barnacles. Cleaning and pressure washing was required for some offshore maintenance operations (e.g. tightening bolts or connecting hoses). Marine growth (biofouling) has not been substantial enough to have an impact on the performance of Oyster 1, however it is noted that whilst the growth experienced to date is a nuisance it does not have any significant impact on the ability to maintain and operate the device.

If the Oyster 2b and Oyster 2c devices are constructed from mainly steel (see Flap Design 1 in Table 1.6), then the intention would be to use similar coatings to those used for Oyster 1 and Oyster 2a. This would include, in compliance with North Sea standards, cathodic protection in the form of aluminium-zinc alloy sacrificial anodes. Other more environmentally friendly coatings and corrosion protection techniques are also being investigated.

If the Oyster 2b and Oyster 2c devices are constructed from an alternative material (see Flap Design 2 in Table 6.1) then the type of antifouling used for those materials may be integral to the material. Corrosion protection on sections constructed from steel (such as the baseframe) will be provided by a combination of coatings and cathodic protection.

4.6 Installation

4.6.1 Schedule of operations

The installation of Oyster 2b and Oyster 2c will be phased over a period of two years with Oyster 2b installation commencing in summer 2012 and Oyster 2c installation commencing in summer 2013. If possible, both Oyster 2b and Oyster 2c will be installed in summer 2012.

Installation of the Oyster 2b and Oyster 2c devices will be broken down into several phases. The indicative schedule of activities will be as follows in both 2012 and 2013. If both devices are installed in 2012 the activities are likely to take place from May 2012 to September 2012.

Operation	2012					2013				
	M	J	J	A	S	M	J	J	A	S
Seabed preparation										
Installation of mooring rock anchors										
Installation of latching anchors										
Installation vessel mobilised										
Oyster 2b installation										
Oyster 2c installation										
Installation of Oyster 2b / Oyster 2c umbilical										
Installation of stabilising rock anchor supports										
Pipeline hook up										
Commissioning										
Oyster 2b operational										
Oyster 2c operational										

Table 4.4 Indicative Installation Programme

4.6.2 Vessel requirements

Table 4.5 below provides details of the vessel requirements for each phase of the project and the number of days the vessels are likely to be on site throughout the duration of deployment. It should be noted that as the monopile foundations will have been pre installed in summer 2011, there is no requirement for the use of a jack up barge during the installation of the Oyster 2b and Oyster 2c devices.

Activity	Vessel type	Days on site (per WEC)
Device installation	Tug	3
	2 x Multi-cat	Multi-cat A - 20 Multi-cat B - 3
	Dive boat	20
Installation of Latching Anchors	Multi-cat	20
	Dive boat	20
Routine maintenance	Multi-cat	Per 5 years - extended 20 day maintenance period
	Dive boat	10 days every 6 months
Decommissioning	Tug	3
	Multi-cat	20
	Dive boat	20

Table 4.5 Vessel Activities

4.6.3 Seabed and foundation preparation

To enable the expected power output, Aquamarine Power anticipates that the gaps under the Oyster 2b and Oyster 2c flaps will be filled with accropodes (man made unreinforced concrete objects designed to resist the action of waves), gabions (cages filled with rock) or rock bags (bags filled with rock).

Four rock anchors may also be installed for each device to be used during installation to enable the devices to be lowered safely and securely onto their monopile foundations (previously consented, see Table 1.1).

Two sets of latching anchors per WEC will be installed next to each Oyster device at the seaward side of the flap. The latching anchors will be used to secure the Oyster flap into the closed position (horizontal to the seabed) for maintenance operations throughout the lifetime of the project.

The Oyster 2b and Oyster 2c monopile foundations will be prepared for installation in 2011 (consented under FEPA and CPA consent already, see Table 1.1), however small areas of kelp may need to be removed from the seabed to allow for the positioning and drilling of the rock anchors (installation and stabilising), latching anchors and the pipeline tie-ins/interconnecting pipelines.

4.6.4 Installation of device

It is currently unconfirmed where the Oyster 2b and Oyster 2c devices will be fabricated and assembled. Following final assembly, the Oyster 2b and Oyster 2c devices will be transported

to Orkney. It is possible the Lyness port facility will be used in Scapa Flow, though a final decision on an Orkney base is yet to be made.

Oyster 2b and Oyster 2c have natural buoyancy which allows the devices to float and there is no requirement for any seawater ballast during tow. The devices will therefore be wet-towed to the installation site and positioned over the pre-installed monopile foundations. Guides will be used to start a ballasting operation to lower the devices over the piles. The Oyster 2b and Oyster 2c devices will then be secured to the monopiles using grout (present design works are considering latching options to fix the device into position). During grouting, routine flushing of grout lines with water discharging grout to the sea will occur. Grout will be cured over a period of up to three days.

4.6.5 Materials

Table 4.6 details the types and quantities of materials to be deposited in the offshore environment.

Material	Grade/Spec	Quantity (per WEC)	Comment
Seabed Preparation			
Kelp (Removal)	Kelp	Under WEC – 695 m^2	
		Under interconnecting pipelines & stabilising anchors – 1071 m^2	Assumes 7 m wide corridor (total, not per WEC)
		Under latching & rock anchors – 110 m^2	Assumes lowest rock level (i.e. worst case for amount of kelp removed – likely to be ~70 m^2)
Rock anchors (installation)	Steel	4 sets (each set to include 3 anchors) at 700 kg per anchor (2800 kg total)	These will be installed on both/either sides of each device location to be used during installation to enable the devices to be lowered safely and securely onto its monopile foundation. The rock anchors will be bolted to the seabed with standard injection mortar system (Hilti HIT-RE 500)
	Grout	200 kg per anchor (800 kg total)	
Foundation Preparation			
Gap closures – rock or grout filled bags, rock filled gabions, or accropodes	Stone and/or sandstone	624 tonnes	

Material	Grade/Spec	Quantity (per WEC)	Comment
Latching anchors	Carbon steel	2 sets of latching anchors (each set to include 4 anchors) at 12 tonnes per set (24 tonnes total)	The latching anchors will be installed next to each device and will be used for latching the device into a closed position on the seabed. The anchors will be drilled into the seabed and secured with grout
Grouted plinth	Cementitious Grout	~500 tonnes	
Latch baseframe	Carbon Steel	40 tonnes	
Latch template frame	Carbon Steel	40 tonnes	
Fender	Rubber	2 tonnes	
Drill Cuttings	Rock	6 tonnes	
Grout (onto monopiles)	Cementitious Grout	~ 2 tonnes	Surplus grout in the grout lines will be flushed out and discharged to sea
Device Components			
Flap **Design 1**[5] (steel)	Carbon steel	400 tonnes	Please note that Flap Design 1 ***OR*** 2 will be used and all other components of the device will remain the same
	Glass Reinforced Plastic (GRP) shell with foam infill	20 tonnes	
Flap **Design 2** (combination of steel and/or composites, elastomers or marine grade rubbers	Combination of steel and/or composites, elastomers or marine grade rubbers	Unknown (but would not exceed 420 tonnes)	The design of the flap has not yet been confirmed. If it is Flap Design 2 there would be a proportion of steel and/or composites, elastomers or marine grade rubber and would not exceed 420 tonnes
Baseframe	Carbon steel	200 tonnes	
Hinge assembly	Carbon steel	100 tonnes	
Hydraulic modules	Carbon steel	50 tonnes	

[5] Please note that each device will utilise either Flap Design 1 or Flap Design 2.

Material	Grade/Spec	Quantity (per WEC)	Comment
Sacrificial anodes	Aluminium Alloy	10,000 kg	
Coatings and Protection *(please note that the materials listed below are for Flap Design 1 – steel. If Flap Design 2 is taken forward the coatings and protection would be similar or integral to the material used)*			
Paint	Glass Flake Epoxy	5,000 m^2	
Baseframe coating	1 coat Interzone 954	450 µm	
Flap coating (1)	2 coats Intershield 300	150 µm thick (per coat)	
Flap coating (2)	1 coat Intersleek 737	100 µm	
Corrosion protection	Corrosion protection will be provided by a combination of cathodic protection (anodes) and coating (paint) provided above		
Interconnecting Pipelines and Communications Design 1 – uses rigid spools and steel pipe support frames *(please note that these volumes are based on the Oyster 2b and Oyster 2c connections)*			
Hydraulic pipelines – high pressure	Steel	20 tonnes	
Hydraulic pipelines – low pressure	Glass reinforced epoxy	5 tonnes	Other materials are being investigated for use in the low pressure pipelines
Umbilical	Plastic coated communication cables	195 m in length with a diameter of 25 mm	The umbilical carries a combination of electrical cables and fibreoptics. It will be routed within a steel or plastic trunking system (approx. 100 mm wide box)
Spool support protection frames	Carbon steel	60 tonnes	
Spool protection frames paint	Glass Flake Epoxy	1,000 m^2	
Sacrificial anodes	Aluminium Alloy	1,000 kg	
Corrosion protection	Corrosion protection will be provided by a combination of cathodic protection (anodes) and coating (paint) provided above		
Grout formwork pipe supports	Grout	43 tonnes dry mass, local supports underneath pipes	Approximate estimates
Stabilising rock anchor supports	Steel	15 sets (each set to include 4 anchors) = 1.5 tonnes	The rock anchors will be manually drilled and bolted to the seabed. The maximum depth of anchor will be 1.5 m with a diameter of 30 mm. The rock anchors will be bolted to the seabed with standard injection mortar system (Hilti HIT-RE 500)

Material	Grade/Spec	Quantity (per WEC)	Comment
	Grout	750kg	
Interconnecting Pipelines and Communications Design 2 - uses flexible hose & concrete or plastic mattresses (please note that these volumes are based on the Oyster 2b and Oyster 2c connections)			
Hydraulic pipelines – high pressure	10" flexi hose	20 tonnes	
Hydraulic pipelines – low pressure	10" flexi hose	20 tonnes	
Umbilical	Plastic coated communication cables	195 m	The umbilical carries a combination of electrical cables and fibreoptics
Concrete/plastic mattresses	Approximately 1 tonne per m	163 tonnes	
Stabilising rock anchor supports	Steel	15 sets (each set to include 4 anchors) = 1.5 tonnes	The rock anchors will be manually drilled and bolted to the seabed. The maximum depth of anchor will be 1.5 m with a diameter of 30 mm. The rock anchors will be bolted to the seabed with standard injection mortar system (Hilti HIT-RE 500)
	Grout	750kg	

Table 4.6 Material Requirements

4.6.6 Commissioning

Aquamarine Power will commission the Oyster 2b and Oyster 2c devices according to a written commissioning plan. The key milestones of this plan are the commissioning of sub-systems followed by commissioning of the system as a whole:

- Pressure testing
- Electrical component testing
- Visual examinations and functional testing of the mechanical, electrical and instrumentation components
- Offshore commissioning (de-ballasting activity to allow the flap to rise to its vertical position)
- Post-installation seabed survey and technical survey of the Oyster 2 WECs

Following successful commissioning, the commissioning contractor will submit a comprehensive documentation package confirming the system is ready to operate which Aquamarine Power will accept and operations will commence.

4.7 Maintenance and servicing requirements

Oyster 2b and Oyster 2c has been designed to be compatible with diver-less maintenance although divers may be required to perform specific inspections.

A small workboat will be used for inspections only. A multi-cat vessel will be used for the removal and replacement of offshore equipment during daylight hours. Planned maintenance

is likely to be approximately 10 days every 6 months per WEC. At each 5 year mark more extended maintenance lasting up to 20 days may be carried out per WEC.

Unplanned maintenance during the winter months from October to April may be required. This maintenance will take place, weather permitting, over two to four day periods.

Equipment will be lifted from the device by cranes or winches onto the multi-cat (or other) vessel. Hydraulic modules will be unbolted by divers, raised to the surface and transported to the maintenance depot in Orkney.

Leak testing may need to be carried out using an environmentally friendly dye (Fluorescein Dye Liquid, used for Oyster 1 and approved for use by SEPA) which is put into the pipelines from shore to highlight where, if any, a leak may be present offshore. Use of the dye relating to discharge into the marine environment will be discussed and agreed with Marine Scotland and/or SEPA.

If biofouling or re-growth of kelp is proving to cause a hindrance during vital maintenance operations then cleaning and pressure washing, or small amounts of kelp clearance, in the areas of the Oyster device where maintenance is required will be carried out. This is likely to take place during planned maintenance activities.

4.8 Decommissioning

Aquamarine Power is committed to decommissioning the Oyster 2 Array at the end of its life and removing all equipment from the deployment site to a standard meeting industry best practice at the time. A Decommissioning Programme agreed with the DECC will be developed pursuant to Chapter 3 of the Energy Act 2004.

Decommissioning of the Oyster 2 devices will in effect be a reversal of the installation process. The phases of decommissioning, repeated for each device will be:

- Mobilisation of vessels to site;
- Secure the Oyster device;
- Cut interconnecting pipelines and retrieval to the vessel deck;
- Attachment of recovery rigging;
- Cutting of piles at seabed and using buoyancy aids allowing the Oyster device to float to the surface (with piles attached);
- Tow the Oyster device to the selected port for disassembly;
- Retrieval of all equipment and materials from the seabed onto the decommissioning vessels
- Seabed reinstatement including cutting of piles down to seabed level where required and seabed clear up; and,
- A post decommissioning seabed survey will be carried out.

4.9 Atmospheric emissions

No atmospheric emissions will be produced by the devices during their operation, however emissions will be produced by the vessels used to install, maintain and decommission the devices at the wave test site. Estimated emissions for each stage of the device's life are given in Table 4.7.

Calculation factors are based on UK Oil and Gas emissions factors and The Institute of Petroleum which provide guideline fuel consumption figures, which estimate a fuel consumption of around 18 tonnes per 24 hour day for general, large, working vessels. This fuel consumption

factor is an estimate for use of the multi-cats and tugs for installation, maintenance and decommissioning and does not take into account that the vessels will not be in use for 24 hours a day. As vessels may be smaller and more fuel-efficient than those presented in the guidelines, this estimate of atmospheric emissions is representative of the worst case. A local dive boat will also be used for small operations but the emissions from a boat this size are assumed to be insignificant.

Phase	Vessel	Fuel Consumption (tonnes/day)	Days	Atmospheric Emissions (tonnes)						
				CO_2	CO	NO_x	N_2O	SO_2	CH_4	VOC
Installation (including installation of latching anchors)	Multi-cat	18	86	4950	12.4	91.3	0.34	0.04	0.42	3.72
	Tug	18	6	346	0.90	3.93	0.02	0.00	0.01	0.13
Maintenance	Multi-cat	18	40	2300	5.76	42.5	0.16	0.02	0.19	1.73
Decommissioning	Tug	18	6	346	0.90	3.93	0.02	0.00	0.01	0.13
	Multi-cat	18	40	2300	5.76	42.5	0.16	0.02	0.19	1.73
		TOTAL	**89**	**10300**	**23.7**	**153**	**0.70**	**0.08**	**0.72**	**6.41**

Table 4.7 Estimated Atmospheric Emissions

The potential effects associated with the atmospheric emissions produced during drilling operations include:

- Global warming (greenhouse gases);
- Acidification (acid rain) and local air pollution; and
- Elevated levels of atmospheric emissions in the immediate area.

It is considered that the atmospheric emissions concentrations will be short-lived and probably not detectable within a short distance due to the dispersive nature of the winds in the area. The CO_2 emissions associated with the installation (split over two years), maintenance and decommissioning activities have been calculated and will contribute approximately 10,300 tonnes CO_2.

An exact figure for offshore emissions in UK waters does not exist, however it is possible to estimate what these emissions are. The Oil and Gas industry report atmospheric emissions annually to DECC (UKOOA, 2006) and vessel emissions within UK waters are presented in the UK Ship Emissions Inventory Report (Entec, 2010, for DEFRA[6]). By summing these totals, it is possible to put the atmospheric emissions associated with the proposed operations into national context and compare them with total UK offshore emissions. The total UKOOA Exploration and Production figure is 18,333,624 tonnes of CO_2 and the DEFRA figure is 40,401,000 tonnes of CO_2 giving a total of 58,734,624 tonnes of CO_2. Oyster 2b and Oyster 2c operations will therefore contribute to 0.017% of the total atmospheric emissions associated with offshore shipping and maritime activities during the course of the Oyster 2b and Oyster 2c project and therefore any cumulative impact is considered insignificant.

[6] DEFRA – Department of the Environment, Food and Rural Affairs

5. STAKEHOLDER ENGAGEMENT

5.1 Scoping Overview and Consultation

5.1.1 Introduction

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 ('the Regulations') implement Council Directive 85/337/EEC as amended by Council Directive 97/11/EC on the assessment of the effects of certain public and private projects on the environment. It relates to applications for consent to construct, extend or operate a power station under Section 36 of the Act.

Under the Regulations, Environmental Statements should describe the likely significant effects of the proposed project on the environment. Scoping of potential issues associated with physical and operational aspects of the project provides a basis for ensuring that the assessment is appropriately limited to issues of genuine potential significance. Under Regulation 7, the developer of a project requiring Environmental Impact Assessment may ask the Scottish Ministers, before submitting an application for a Section 36 consent, to state in writing their opinion as to the information to be provided in the Environmental Statement. This is called a 'Scoping Opinion'.

This section of the ES describes the consultation process that was undertaken as part of the scoping exercise and sets out conclusions as to the issues that require addressing in detail in the ES.

5.1.2 Scoping Consultation

In January 2010 Aquamarine Power requested a formal Scoping Opinion from the Scottish Ministers by submitting a Scoping Report for the 2.4 MW project to the Energy Consents & Deployments Unit (ECDU) whose role in marine renewable energy projects is now undertaken by Marine Scotland. At the time of submission of the Scoping Report it was intended to develop the three-device 2.4 MW Oyster 2 project in one phase, including onshore works. However, through discussions with Marine Scotland and Orkney Islands Council (OIC) it was agreed that the project could be phased with three independent applications:

- Application in 2010 for planning permission to OIC for the onshore hydroelectric plant and associated works, including technical reports (archaeology, habitats and otters, landscape and visual, and hydrology). Consents granted (see Section 1)
- Application in 2010 to Marine Scotland through EMEC for FEPA and CPA licences for a single device (Oyster 2a), and foundation monopiles for two further devices. Consents granted (see Section 1)
- Application in 2011 through EMEC under Section 36 of the Electricity Act 1989 and EIA/ES under the Electricity (Applications for Consent) Regulations 1990 and the associated Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 for the Oyster 2 Array (3 devices, 2.4MW). Subject to consent under this application.

In April 2010 the ECDU issued their Scoping Opinion which identified the issues that should be addressed and included in the EIA (for the entire project).

During the preparation of the Scoping Report, Aquamarine Power consulted with the regulator and its advisors, as well as local stakeholders, regarding the project as a whole and, in some

cases, specific aspects of the project. As the proposed development location is within the EMEC wave test site, EMEC has already built up established relationships with a wide range of local and national stakeholders relevant to the proposed project. Aquamarine Power's stakeholder engagement strategy has therefore built on, rather than duplicated the work and relationships established by EMEC, in particular in relation to local fisheries and navigational interests.

Initially, a letter detailing the proposed project and EIA was distributed to a list of stakeholders which was agreed with EMEC. Where appropriate this was followed up with face to face meetings.

Aquamarine Power and EMEC agreed a list of stakeholders who were sent a copy of the Scoping Report, by the ECDU, and who would be consulted by Aquamarine Power and EMEC. The list reflected previous discussions held by EMEC with certain stakeholders and the ECDU, and was therefore shorter than the normal distribution list for Section 36 applications. This list also included a number of local organisations who would not normally be included as part of Section 36, but were issued a copy of the Scoping Report via EMEC due to the relevance of the proposed development in relation to their specific activities.

At the time of distribution of the Scoping Report, the Marine Licensing system (under the Marine (Scotland) Act 2010) was not in place, however the organisations contacted included the majority of those that are now statutory consultees for Marine Licence applications and /or members of the Marine Renewables Facilitators Group (MRFG).

5.1.3 Post-Scoping Consultation

The consultation process has continued throughout the EIA to:

- Ensure that statutory and other bodies with a particular interest in the environment are informed of the proposal and provided with an opportunity to comment;
- Obtain baseline information regarding existing environmental site conditions;
- Establish key environmental issues and identify potential effects to be considered in the EIA;
- Identify those issues which are likely to require more detailed study and those that may be justifiably excluded from further assessment; and
- Provide a means of identifying the most appropriate methods of impact assessment.

In a meeting held in May 2010, Aquamarine Power, Marine Scotland and SNH discussed and agreed the scope of information to be submitted in support of their 2010 application for FEPA and CPA licences for Oyster 2a and additional piles. This scope included a requirement for impact assessments at the standard expected in an EIA/ES under the Regulations; Underwater Noise, Seabed Impacts and a Navigation Safety Risk Assessment. These assessments therefore also have provided important input to the EIA for the Oyster 2b and Oyster 2c EIA and marine licence application.

In addition Marine Scotland requested that Aquamarine Power include outline contents for this ES. In a meeting held in February 2011, Aquamarine Power, Marine Scotland and SNH discussed and agreed the content of this ES, including the broad scope of the impact assessments being undertaken.

All issues raised during scoping and subsequent consultations as part of the EIA are detailed in the relevant impact assessment section in the ES.

5.1.4 Summary of Stakeholder Engagement

Table 5.1 provides an overview of the stakeholders involved in engagement activities throughout the EIA.

Consultation	Stakeholders
EIA Scoping / Preliminary Hazard Analysis (PHA) Scoping Report submitted January 2010	Association of Salmon Fishery Boards Chamber of Shipping Civil Aviation Authority – safety regulations County Archaeologist DECC – Decommissioning Environmental Concern Orkney Fisheries Committee (and Inshore Fisheries Group – Marine Directorate, Scottish Government) Historic Scotland JNCC Marine Safety Forum Marine Scotland Maritime and Coastguard Agency MSP for Orkney Northern Lighthouse Board Orkney Biodiversity Office Orkney Dive Boat Operators Association Orkney Fisheries Association Orkney Fisherman's Society Orkney Field Club Orkney Islands Council (OIC) – including Marine Services and planning and transport Orkney Renewable Energy Forum Orkney Surf Club Royal Society for the Protection of Birds Royal Yachting Association Scottish Environment Protection Agency Scottish Fishermen's Federation Scottish Government (ECDU) Scottish Natural Heritage (SNH) – including onshore and offshore case officers Scottish Surfing Federation Scottish Water Sea Mammal Research Unit Stromness Community Council The Crown Estate Transport Scotland Visit Orkney
Oyster 2 Strategy Discussions May 2010	Marine Scotland SNH OIC

Consultation	Stakeholders
Oyster 2a FEPA / CPA Applications July 2010	Marine Scotland (and relevant advisors) ***Note – this application was for less than 1 MW therefore no Section 36 application or statutory ES.***
Oyster 2a, 2b & 2c (and other Oyster projects) Meetings February 2011 & May 2011	Marine Scotland (Licensing Operations Team, LOT) Marine Scotland (Science) SNH

Table 5.1 Summary of Consultation Activities

5.1.5 Community Consultation

Since the commencement of its activities in Orkney in 2009, Aquamarine Power has endeavoured to consult with the local Orkney community about its activities in the county. This has been achieved through public events as well as issuing regular updates via the local press and radio.

In addition to the formal consultations undertaken during EIA Scoping a public event was held on Wednesday 17 February 2010 in Stromness. Prior to the event notice was included in the local press, Radio Orkney, and flyers were sent round numerous organisations and individuals within the local area.

The event consisted of a series of mounted boards giving the background, rationale and benefits of the proposed project, plus details of the design and layout of the project that were known at the time. Members of the public were able to attend the informal drop-in session throughout the afternoon and early evening and had the opportunity to speak to members of the Aquamarine Power project team and environmental consultants, Xodus Aurora. Visitors were also invited to leave comments.

Aquamarine Power also hosted an evening presentation at which several members of the project team spoke about various aspects of the project including the project timescale, purpose, how engineering design was evolving from Oyster 1, and the environmental issues associated with Oyster 2 (note, the public event was held at a time prior to selecting a three phase approach to applications).

The results from the comments forms and discussions at the event have been collated and used to inform elements of the project. The majority of comments related to the onshore elements of the project.

6. ENVIRONMENTAL OVERVIEW

The environmental characteristics of the Billia Croo wave test site have been investigated as part of the EMEC wave test site development EIA and subsequent projects undertaken by EMEC. EMEC has published an Environmental Description of the area (EMEC 2009). This description has been referenced during the Oyster 2b and Oyster 2c EIA, but not been repeated in this document.

EMEC, together with Scottish Natural Heritage (SNH), has compiled an environmental sensitivities chart for the Billia Croo wave test site which provides an overview of the key environmental characteristics of the wave test site (EMEC 2009) (below). Additional notes to put the Oyster 2b and Oyster 2c deployment location into context within the wider wave test site have been added in bold italics. **Detailed descriptions of the environmental baseline are provided where appropriate in specific impact assessment reports and chapters.**

Additional to the data presented in the wave test site environmental description, EMEC undertakes marine wildlife monitoring (by visual observation) of the wave test site to collect data on marine wildlife (basking sharks, cetaceans, pinnipeds and birds) presence and activity in the wave test site. This monitoring began in April 2009.

In addition to the EMEC collected data, Aquamarine Power has undertaken its own marine wildlife monitoring since April 2010 which has focussed on the inner bay area of the wave test site (within which the Oyster projects are located). Aquamarine Power has also undertaken a seabed survey to characterise the seabed at the deployment site. The specific details and results of this monitoring are presented in the relevant impact assessment chapters of this ES.

Species Group	Months											
Key:	**High**	**Moderate**	**Low**	**Minor Interaction**	**Unclear due to lack of data**							
Birds (*see note*)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**

Birds are present throughout the year at Billia Croo with the spring and summer breeding months considered to be the most sensitive as this is the time when greatest concentrations of birds will be present and may be particularly vulnerable to any pollution. Of the birds present, none are internationally or nationally important aggregations. The key issue to consider is collision risk.

Wildlife monitoring additional to the established EMEC wildlife monitoring is being undertaken by Aquamarine Power to observe the use of the area between the proposed development site and the coast (this area also includes the deployment location of Oyster 1). The use of this area by bird species is discussed in more detail in Section 8.

Species Group	Months											
Key:	**High**	**Moderate**	**Low**	**Minor Interaction**	**Unclear due to lack of data**							
Fish / Shellfish	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
The Billia Croo site (and Orkney as a whole) is located within spawning and nursery areas of a number of fish species, although none of a protective status. There is also commercial fisheries both inshore (shellfish) and further offshore (trawling) from the wave test site. ***EMEC has commenced a project using funding from the Scottish Government to turn the inner area of the wave test site into a Scientific Monitoring Zone. Juvenile lobsters were released into the area in autumn 2010 as part of this project which is supported by local fishermen.***												
Plankton	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
A spring phytoplankton bloom of diatoms and dinoflagellates occurs between March and May. The main components of the zooplankton are copepods, which form and important link in the food chain.												
Coastal/Seabed Habitats	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
From baseline EIA studies there is no evidence to indicate any particular sensitivity. ***A site-specific survey of seabed habitats has been carried out by Aquamarine Power to identify the species and habitats present at the proposed development site. The details of this are summarised in Section 9.***												
Basking Sharks	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Basking sharks are regularly spotted in Orkney waters during the summer and are a UK BAP priority species; although there are no recorded sightings at the wave test site [EMEC collected data]. The key issues to consider are collision risk and installation/operation/decommissioning disturbance. ***Since this table was compiled, additional wildlife monitoring carried out by Aquamarine Power has included 10 sightings of basking sharks in the inner bay area.***												

Species Group	Months											
Key:	**High**		**Moderate**		**Low**		**Minor Interaction**		**Unclear due to lack of data**			
Marine Mammals	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Limited records exist for marine mammal sightings in the area. A few sporadic sightings include harbour porpoise, seals, minke whale, Risso and Orca, which are commonly observed species in Orkney waters. The nearest harbour seal haul out site is at Warebeth. The key issues to consider are collision risk and installation/operation/decommissioning disturbance. ***Wildlife monitoring additional to the established EMEC wildlife monitoring is being undertaken by Aquamarine Power to observe the use of the area between the proposed development site and the coast (this area also includes the deployment location of Oyster 1). The use of this area by marine mammal species is discussed in more detail in Section 8.***											
Otters	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Where suitable habitat is present along south west Orkney mainland coastline, otter resting sites, feeding areas and potential holts have been identified. Otters normally cub in the winter months in Orkney, although they can breed at any time of year. Due to the lack of evidence it is not possible to identify a seasonal sensitivity for the otter. The key issue to consider is disruption from shore based works. ***Included for completeness – not directly relevant to offshore activities/developments.*** *There is a known low-level presence of otter in the vicinity of Billia Croo. Booth (2010) suggests that there is no evidence to indicate that otters are regularly using the area around the onshore EMEC facility and that in the sea, otters prefer sheltered, shallow water in which to feed. Booth suggests that the beach at Billia Croo is steep and exposed and therefore less likely to be suitable.*											

Table 6.1 EMEC Environmental Sensitivities Table

Table 6.2 lists the designated sites in the vicinity of the Billia Croo wave test site and the sites that SNH indicated in the Scoping Opinion that would need to be considered in the EIA. These sites and their relationship to the wave test site are shown in Figure 6.1, page 75. The extent of this map and of the discussion of designated sites has been selected in order that it displays the wider designated sites discussed by stakeholders in the Scoping Opinion. The following conservation designations are included:

- SAC – Special Area of Conservation
- SPA – Special Protection Area
- SSSI – Site of Special Scientific Interest
- GCR – Geological Conservation Review
- NSA – National Scenic Area
- SLNCI – Site of Local Nature Conservation Importance

Designation	Site	Qualifying Interest
SAC SSSI GCR	**Stromness Heaths and Coasts** 14 km of the west mainland coastline stretching inland around Black Craig Adjacent to the development; the SSSI boundary also includes the area of the intertidal zone at Billia Croo. The South Stromness Coast Section and West Coast of Orkney GCR sites stretch approximately 0.5 km (varies along the coast) offshore and encompasses the proposed development area	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 fascinating examples of the Devonian Old Red Sandstone rocks. Fossilised remains form small masses of banded rock called stromatolites and the site is particularly noted for horse-toothed stromatolites. The coastline continues to change through erosion which has formed caves, arches, geos, stacks and shore platforms.

Designation	Site	Qualifying Interest
SPA SAC SSSI	**Hoy** Geographical extent covers the north and east of Hoy and its coastline and extends 2 km offshore 2.7 km from development	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*).
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 is within 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 mainland of 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	**Marwick Head** Geographical extent covers the cliffs at Marwick Head and extends 1 km offshore 13.3 km from development	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)

Designation	Site	Qualifying Interest
SAC SSSI	**Loch of Harray and Stenness** Geographical extent just covers the lochs inland from Billia Croo 5.4 km from development	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
SLNCI	**Brunt Hill** 1.75 km from development	Heavily grazed heather of ornithological interest
SLNCI	**The Loons** 2.76 km from development	Wetland with rough grassland and willow scrub of ornithological interest including raptor hunting site

Table 6.2 Conservation Designations in and Around the Billia Croo Wave Test Site

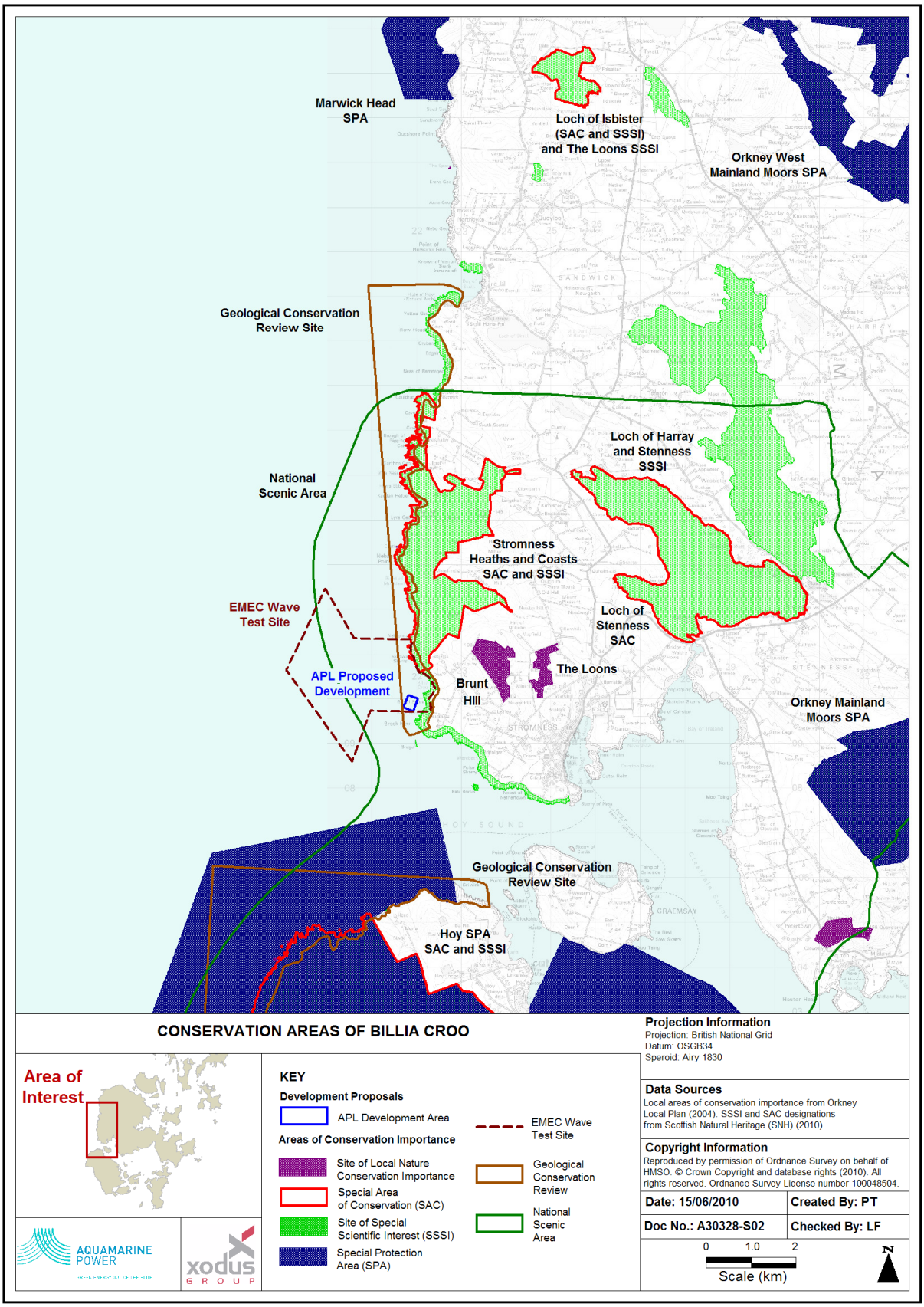

Figure 6.1 **Conservation Designations in the Vicinity of the Billia Croo Wave Test Site**

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7. ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY & ENVID

7.1 Introduction

This section of the ES describes the impact assessment methodology. The approach described covers the EIA regulations methodology. It should be noted that the navigational aspects of the project, as assessed in the NSRA have been conducted in accordance with the Marine Navigational Safety Risks of Offshore Wind Farms contained in the DTI/BERR publication - Guidance on the Assessment of the Impact of Offshore Wind Farms and is required to address the issues raised in the Maritime and Coastguard Agency's (MCA) Marine General Notice MGN 371(M+F) – Proposed Offshore Renewable Energy Installations (OREI) – Guidance on Navigational Safety Issues. This assessment methodology is described within the NSRA document.

7.2 Environmental Impact Assessment (EIA) Methodology

7.2.1 EIA and NSRA Process

The EIA and associated NSRA process requires an understanding of the proposed installation, operation and decommissioning of the Oyster 2 project and the environment upon which there may be an impact. Central to the process is the systematic identification of issues that could impact the environment, including other users of the environment. Once identified, these issues have to be assessed to define the level of potential impact they present to the environment, so that measures can be taken to remove or reduce such effects through design or operational measures (mitigation). Additionally this process identifies those aspects of the proposed project that may require monitoring.

Cumulative effect and interrelation between each factor is considered in addition to the factors in isolation.

Key stages of the EIA are defined below:

- Defining the project;
- Why is the project required and what other alternatives are there;
- Scoping stage (EIA Scoping Report and Navigational Preliminary Hazard Analysis(PHA)) to identify the potential effects and how these should be assessed;
- Define the scope of the EIA and NSRA based on the responses to the scoping stage;
- Describe the baseline environment and assess the sensitivity of the receptors / resources likely to be impacted;
- Carry out consultation throughout the EIA and NSRA processes;
- Assessment of effects:
    - Assess the magnitude of the possible environmental effects;
    - Evaluate the significance of these predicted effects, i.e. consideration of sensitivity of receptors;
    - Develop mitigation measures and establish how they are to be integrated into the project;

- Evaluate the significance of the residual effects;
- Assess potential cumulative effects;

- Production of an ES and NSRA reports covering all findings and summarise in a non-technical summary; and
- Implement mitigation measures and environmental monitoring as required.

The assessment process covers all stages of the project from installation through to the decommissioning phase. All effects are taken into account throughout this period regardless of their duration (e.g. short-term vessel activities to longer term seabed modification effects). The environment is considered to include both ecological and socio-economic components.

Spatially the environment considered is within the vicinity of the site where the environment is likely to be impacted / altered. Therefore, the size of this considered environment will alter dependant on the identified impact (e.g. underwater noise effects will be over a larger spatial scale than sub tidal habitat modification).

The impact of effects has been considered for all three primary stages of the development. These are:

- The Installation Phase. This covers all offshore installation activities associated with the installation of Oyster 2b and Oyster 2c.
- The Operational and Maintenance Phase. This phase begins after the installation phase has reached completion and Oyster 2b is commissioned in 2012, and after Oyster 2c is commissioned in 2013 (or if both device are installed together, after both have been commissioned in 2012)
- The Decommissioning Phase. The decommissioning of the project after it has completed its operational life.

7.2.2 Significance of Environmental Effects

The regulations require that the EIA should consider the significance of the effects of the development on the environment. The decision process related to defining whether or not a project is likely to significantly impact on the environment is the core principal of the EIA process. The regulations themselves do not provide specific definition relating to what significance actually is, however the methods used for identifying and assessing effects should be transparent and verifiable. The method developed here has been developed in accordance with the principals and guidance provided by SNH in their handbook on EIA (SNH, 2005).

The approach to significance and the EIA methodology has been defined thoroughly for this EIA and is presented at Appendix A.

7.2.3 Cumulative impacts

Cumulative impacts are considered throughout the EIA process and discussed in each impact chapter. The Crown Estate has commissioned a strategic study into cumulative impact assessment for marine renewable projects; however nothing has been published on this study to date.

7.2.4 Consideration of Design Options

The EIA has assessed any design options as they relate to the specific study areas. In all cases the worst case option has been chosen to assess particular impacts in the greatest detail.

7.2.5 Mitigation and Monitoring

Where significant (ranked Moderate or higher) effects related to the deployment of Oyster 2b and Oyster 2c exist, it is important to consider mitigation measures. Such measures should remove, reduce or manage the effect to a point where the residual significance of that impact is reduced to an acceptable level.

Monitoring is also considered an important post-consent tool. This will allow the effects of any mitigation measures to be monitored and also study the accuracy of predicted effects. Strategic Research

In addition to research and monitoring projects that have been developed by EMEC (as previously described), Marine Scotland, SNH and The Crown Estate have commissioned a number of research studies that are aimed at informing potential impacts from the emerging marine renewable energy industry. Many of these relate to SNH's Research Strategy 2010 – 2013, and more specifically to Research Priority 5.1, 'Understanding the potential impacts of marine renewable developments on the marine environment'.

Strategic research covers the following areas:

- Developing guidance on survey and monitoring;
- Supporting monitoring of deployed devices;
- Commissioning or contributing to resource surveys, to inform site selection and subsequent assessments;
- Supporting development of techniques or technologies to detect and record species present around turbines;
- Supporting the development of locational guidance;
- Understanding the significance of potential impacts upon species and habitats and their conservation status; and,
- Identifying approaches for device management and operation that will minimise or avoid environmental impacts.

Where relevant, and where published information is presently available, this strategic research has been used to inform the EIA for Oyster 2b and Oyster 2c. However it should be noted that many of the studies are still ongoing and as yet there are limited published results.

7.3 Environmental Issues Identification

This section describes the results of the ENVID process. The overall objective of an ENVID is to identify the potential environmental impacts associated with the proposed project and agree practicable measures to ensure minimum harm to the environment throughout the life of the project.

The ENVID process involves assessing those issues that have been identified 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 and the ongoing EIA process, and ultimately to provide a holistic, environmentally sensitive design. Due to the potential navigational issues that are associated with the deployment of marine renewables energy devices at sea, this EIA has also been informed by a NSRA.

The ENVID process has been applied throughout the Oyster 2 project. An initial ENVID was undertaken during EIA scoping and the results incorporated into the EIA Scoping Report. This was carried forward and updated during the full EIA following receipt of the Scoping Opinion.

All stages of the project development were considered, from installation through operation and maintenance to decommissioning, in line with the methodology presented in Section 7.2 and Appendix A. The outcomes of the ENVID are documented in the ENVID matrix at Appendix A and summarised in Table 7.1.

No issues were identified as being of major or severe significance. The effects from some activities were identified as being potentially of moderately significance and therefore require mitigation measures and/or detailed impact assessment. These are the key issues that have been addressed during the EIA process. A number of other issues were identified as being Minor. Although not assessed as significant, these issues require management. Those issues rated as negligible were not considered further in this ES and are excluded from the summary table below.

Issues from ENVID	Sign[7]	ES Section / Management	Res. Sign.
Key: **Moderate**	**Minor**	**Negligible**	
Installation, Maintenance & Decommissioning			
Noise and vibration (vessel engines) resulting in disturbance to wildlife		S 8 Marine Wildlife	
Potential increased navigation risk to vessels due to the presence of working vessels and plant associated with the Oyster 2 project		S 10 Navigation	
Potential for increased risk of incident from presence of Oyster 2 project related vessels at support facilities (e.g. Lyness) and through constrained waters (e.g. Hoy Mouth) used to access the site		S 10 Navigation	
Potential risk to fishing vessels due to presence and limited manoeuvrability of vessels. Hazard presented to fisheries by vessel moorings and subsea pipelines		S 10 Navigation	
Exclusion / restriction of an area used for fishing, and knock on effects, particularly on creel fishing		Specifically addressed through the EMEC **Inshore Crustacea Fisheries Project**	
Direct and indirect displacement of wildlife during installation and decommissioning		S 8 Marine Wildlife	

[7] Sign = significance

Issues from ENVID	Sign[7]	ES Section / Management	Res. Sign.
Key: **Moderate**	**Minor**	**Negligible**	
Equipment lost during drilling or lowering/raising of the device components to/from the seabed during installation, maintenance and decommissioning		S 11 Accidental Events	
Installation			
Modification and disturbance of seabed and loss of and disturbance to seabed habitats; including physical disturbance and kelp removal		S 9 Seabed Interactions	
Modification of seabed habitat from drilling discharges associated with anchor installation		S 9 Seabed Interactions	
Installation noise - disturbance to fish and marine mammal species during the drilling of anchors		S 8 Marine Wildlife	
Operation			
Wildlife interaction - avoidance / displacement		S 8Marine Wildlife	
Wildlife interaction - collision / entanglement		S 8 Marine Wildlife	
Wildlife interaction - acoustic disturbance		S 8 Marine Wildlife	
Operation & Maintenance			
Modification of seabed and intertidal habitats from the long term presence of the devices		S 9 Seabed Interactions	
Damage caused to fishing gear due to presence of devices and associated subsea infrastructure		S 10 Navigation	
Exclusion / restriction of fishing activities from deployment area		Specifically addressed through the EMEC **Inshore Crustacea Fisheries Project**	
Navigation risk due to the presence of devices in the water column		S 10 Navigation	
Increased navigation risk from presence of maintenance vessels between the deployment area and local harbours		S 10 Navigation	
Discharge from the devices' hydraulic systems (including pipelines)		S 11 Accidental Events	
Loss of device components		S 11 Accidental Events	
Decommissioning			
Disposal of component parts		S 11 Accidental Events	
Kelp clearance and cutting down of piles to seabed level		S 9 Seabed Interactions	

Table 7.1 Environmental Issues Identified by ENVID Process, and Residual Significance

7.3.1 Issues Scoped Out

During the ENVID process a number of potential issues were identified but, through stakeholder engagement or consideration during EIA scoping, were considered to be of negligible significance. The following issues were therefore scoped out of this EIA:

- **Atmospheric Emissions (vessels)** - Atmospheric emissions are rapidly dispersed naturally. Winds in Orkney average Force 3 / 4 in summer and Force 6 in winter.
- **Visual and Seascape (vessels and devices)** – Considered negligible against a backdrop of existing vessel activity and device testing at EMEC.
- **Waste Disposal (vessels)** – No waste disposed of overboard and all wastes will be disposed of in line with legislative requirements.
- **Archaeology and Cultural Heritage (installation)** – Desk based assessment and review of survey data confirmed no likelihood for disturbance of anything of archaeological or cultural heritage importance (ORCA, 2010).
- **Waves, Currents and Coastal Processes (presence of infrastructure)** – reduction in wave power is likely to be negligible in high energy environments such as at Billia Croo. The amount of sediment in the area is very small, so unlikely there will any significant changes to sediment transport or coastal processes. Any scour effect on the seabed is also likely to be limited due to the lack of sediment.
- **Leaching of Antifoulants (operation)** - Any nominal leaching will be rapidly dispersed in the turbulent receiving environment.

In addition during the ENVID process, the positive economic potential of the Oyster 2b and Oyster 2c project was highlighted. This is reinforced by information from the installation of Oyster 1 at EMEC when Aquamarine Power made considerable use of local Orkney based services totalling over £1M spent. It was therefore considered that no further investigation into the economic effects (positive or negative) of Aquamarine Power's Oyster 2 project would be necessary.

8. MARINE WILDLIFE IMPACT ASSESSMENT

The table below provides a list of all the supporting reports and documents that have been produced for the Oyster 2 project related to the marine wildlife impact assessment, and their location on the CD which accompanies this ES.

Relevant Document	Location on Accompanying CD
Assessment of underwater noise from Oyster 2 installation (Subacoustech, 2010)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife / Underwater Noise
Underwater noise impact assessment (Xodus, 2010a)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife / Underwater Noise
Assessment of underwater noise from latching anchor drilling (Subacoustech, 2011)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife / Underwater Noise
Analysis of wildlife monitoring (Craigton Ecological Services, 2011)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife / Marine Wildlife Monitoring Analysis
Marine wildlife impact assessment (Xodus, 2011a)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife
EMEC marine wildlife data summary report (Xodus, 2011b)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife / Marine Wildlife Monitoring Analysis

8.1 Introduction

This section assesses the potential for impact that the deployment of the Oyster 2b and Oyster 2c devices, to be installed during Phase 2 of the Oyster 2 Array project at Billia Croo, Orkney, may have on marine wildlife, the possible magnitude of any impact and to specify appropriate mitigation measures where appropriate. The assessment draws on fieldwork and desk based research. Reference is also be made to the background information and assessment presented for the Oyster 2a device (See Table above).

This study has considered the installation, operation and decommissioning of two Oyster 2 devices (Oyster 2b and Oyster 2c) at the EMEC wave test site; the monopile foundations and pipelines to shore have been the subject of previous assessment and consent (Xodus, 2010c).

Legislation and agreements relevant to the marine wildlife impact assessment are described in the full marine wildlife impact assessment (Xodus, 2011a). Similarly, the outcome of the consultation process and the responses to those comments are also detailed in the full marine wildlife impact assessment (Xodus, 2011a).

8.2 Baseline Conditions

Two marine wildlife surveys have provided data to inform the marine wildlife impact assessment:

- EMEC commenced marine wildlife monitoring of the wave test site from an observation point at Black Craig in March 2009. Two years of EMEC collected data (March 2009 – February 2011) have been made available to Aquamarine Power for this EIA.
- Aquamarine Power commenced marine wildlife monitoring of the inner bay area of the wave test site in April 2010. One full year of data (April 2010 – March 2011) has been analysed to inform this EIA. Observations of seabirds, marine mammals and marine

megafauna are made using a site-specific methodology developed by Dr Nigel Harding of Craigton Ecological Services (Harding, 2010).

It should be noted that at present there is no published guidance on marine wildlife survey methodologies for marine (wave and tidal) energy developments. However, the survey methodology developed for the Oyster 2 Array project has been discussed and agreed with Marine Scotland and SNH during the course of the EIA.

The Aquamarine Power commissioned wildlife monitoring at Billia Croo consists of a single vantage point survey to accurately record all marine wildlife sightings (i.e. seabirds, marine mammals and basking sharks). Full details of the core methodology can be found in the Analysis of Wildlife Monitoring (Craigton Ecological Services, 2011).

The marine wildlife data collected by Aquamarine Power includes data obtained from the inner bay area to 1,500 m offshore and was collected from April 2010 to March 2011, supplemented by the EMEC monitoring over the wider wave test site (out to the horizon); therefore survey coverage is deemed to be sufficient and data considered to be of good quality, for use within the ES.

8.2.1 Marine Mammal Species

Seventeen cetacean species have been recorded in Orkney Waters since 1980 (SeaWatch Foundation, undated), with data from the SeaWatch Foundation highlighting the importance of Orkney waters; seven cetacean species (representing 25% of the UK cetacean fauna) are recorded throughout the year. In addition to cetacean species, both the common (harbour) and grey seal are commonly found in Orkney waters, however there are no known or significant seal populations in close vicinity of the site and Billia Croo is not considered to be as important as other areas in Orkney.

Site specific data collected by both EMEC (for the wider wave test site) and Aquamarine Power (for the inner bay area), provide more detail of the specific marine mammal species present in the immediate and surrounding area of the proposed Oyster 2 Array. Overall numbers of marine mammals observed were low. These data indicate that grey seals, harbour seals and harbour porpoise are the most commonly observed marine mammal species occurring within the proposed development area of the Oyster 2 Array project. In addition, Risso's dolphin and harbour porpoise have also been observed during Aquamarine Power monitoring within the inner bay area of the EMEC wave test site. Data on all other species observed indicates that they have only been observed further offshore in the deeper offshore waters of the wave test site.

A full baseline description of marine mammals, placing observations into a wider Orkney and UK context, is provided in the marine wildlife impact assessment report, Xodus 2011a, on the CD accompanying this ES.

8.2.2 Fish Species

Scientific literature was consulted to provide a baseline for fish species occurring in Orkney waters; however only limited information exists in relation to the fish species present at Billia Croo. It is known that basking sharks are regular visitors to Orkney waters, although numbers vary year to year (Orkney Field Club, 2009). Due to its protected status, known occurrence in waters surrounding the proposed development site and high sensitivity to potential impacts, basking sharks were considered to be a key fish species within the EIA. Site specific data collected by EMEC and Aquamarine Power included a total of 16 sightings of basking sharks

during 2010 – 2011, although Aquamarine Power observations of the inner bay area suggest that a maximum of one individual is likely to be observed in any one month.

8.2.3 Seabird Species

There are several areas along the west coast of the Orkney mainland which provide important habitats to a large variety of bird species, including breeding colonies and wintering sites. The most important sites are designated as internationally or nationally important areas, specifically, Marwick Head Special Protection Area (SPA) and Hoy SPA. These sites were identified and raised by SNH during the EIA scoping process, and therefore have been considered in relation to the proposed Oyster 2 Array. SPA interest species, with both individual species populations and seabird assemblages have significance at local, national and international levels; therefore these species were considered within the EIA. These include Arctic skua (*Stercorarius parasiticus*), fulmar (*Fulmarus glacialis*), great black-backed gull (*Larus marinus*), great skua (*Catharacta skua*), guillemot (*Uria aalge*), kittiwake (*Rissa tridactyla*), puffin (*Fratecula arctica*), red-throated diver (*Gavia stellata*), shag (*Phalacrocorax aristotelis*) and eider (*Somateria mollissima*).

The seabird assemblage occurring at the inner bay area is relatively diverse, with a total of 22 species recorded during the Aquamarine Power wildlife monitoring. Several species are notable for an almost constant presence at the site throughout all seasons; including fulmar, gannet, shag, eider, guillemot, great skua and common gull. Fulmar was observed in high numbers throughout the wildlife monitoring, with the greatest number of birds recorded in the breeding and post/late breeding season. Gannet, also recorded throughout the year, was observed in greatest numbers during the breeding and wintering seasons. Guillemot, also recorded in relatively high numbers throughout the year, was observed in greatest numbers during the breeding season. Common gull observations, although recorded at the inner bay throughout the year, were largely located to the north-east of the proposed Oyster 2 Array, adjacent to the coastline, with greatest numbers occurring in the autumn.

Notably, shag was recorded in close proximity to the proposed Oyster 2 Array (i.e. within 100 - 600m) throughout the year, with greatest numbers occurring in autumn and winter. Eider, also recorded in greatest numbers during the winter, showed a distinct distribution throughout the year, with the majority of observation located to the east of the proposed Oyster 2 Array, adjacent to the coastline. In addition to these species, red-throated diver and puffin were also recorded in relatively lower numbers and noted as largely seasonal visitors.

A full baseline description of seabirds, placing sightings from both Aquamarine Power and EMEC wildlife monitoring into context, is provided in the marine wildlife impact assessment report, Xodus 2011a, on the CD accompanying this ES.

8.3 Impact Assessment

8.3.1 Assessment Methodology

As described in the EIA Methodology & ENVID chapter (full details of the assessment methodology are given in Appendix A), definitions for the sensitivity of receptors and magnitude of change have been developed on a topic by topic basis. The definitions for marine wildlife are provided in the marine wildlife impact assessment report (Xodus 2011a) which is on a CD accompanying this ES.

8.3.2 Baseline Summary and Sensitivity of Species Taken Forward for Assessment

Following consideration of the desk and field study results, the species listed in Table 8.1 have been selected for assessment. The table also summarises the sensitivity of the species listed.

Taxon	Species Selected for Assessment	Sensitivity
Marine Mammals	All cetacean species Grey Seal Harbour Seal	Wildlife monitoring has identified use of marine habitats by marine mammals within the development footprint and surrounding environment All cetacean species are classified as European Protected Species Cetaceans and seals are considered significant at regional, national and international levels **High sensitivity**
Fish	Basking shark	Basking sharks have been recorded in the surrounding environment and within 600m of the development Basking sharks are listed as vulnerable on the IUCN red list and are fully protected under Schedule 5 of the Wildlife and Countryside Act (1981) against disturbance in British waters **High sensitivity**
Seabirds	Arctic skua Fulmar Great black-backed gull Great skua Guillemot Kittiwake Puffin Red-throated diver Shag Eider	All seabird species which qualify as interest features of Hoy or Marwick Head SPA have been selected for assessment due to their ecological significance and high sensitivity. In addition to SPA species, other potentially locally or regionally significant species have been selected **High/very high sensitivity**

Table 8.1 Summary of Species Selected for Assessment and their Sensitivity

8.3.3 Identification of Potential Impacts

A summary of the potential environmental impacts that may be associated with marine mammals, fish and seabird species is summarised in Table 8.2, below.

Taxon	Potential Impacts
Cetaceans, Seals, Fish	▪ Physical damage from anchor drilling and vessel noise ▪ Auditory damage from anchor drilling and vessel noise ▪ Auditory damage from movement/presence of wave energy converters ▪ Indirect impacts due to effects on prey species

Taxon	Potential Impacts
Cetaceans, Seals, Fish, Seabirds	▪ Disturbance/displacement from anchor drilling and vessel noise/presence ▪ Physical damage from movement/presence of wave energy converters ▪ Disturbance/displacement from movement/presence of wave energy converters ▪ Habitat exclusion and/or creation ▪ Contamination from accidental discharges and spills

Table 8.2 Overview of Potential Marine Wildlife Impacts

The following sections briefly describe the results of impact assessment for marine mammals, fish and seabirds, for installation, operation and maintenance, and decommissioning. Further detail on specific species and how the significance rankings have been reached may be found in the marine wildlife impact assessment report (Xodus 2011a) which is on a CD accompanying this ES.

8.3.4 Marine Mammals

Subacoustech were commissioned to undertake an assessment of underwater noise effects from the Oyster 2 Array. Their initial assessment (Subacoustech, 2010) undertaken to support the environmental assessment for Phase 1 of the Oyster 2 Array modelled noise associated with the drilling of the pile/monopole foundations and installation vessels (including a jack-up drilling barge). This assessment has been updated (Subacoustech, 2011) to consider the underwater noise impacts from the anchor drilling operations required as part of Phase 2 of the Oyster Array project. This work has included the modelling of underwater noise propagation.

The modeling results show that the levels emitted from the drilling of anchors and general vessel activity associated with Phase 2 of the Oyster 2 Array are not sufficiently high to cause physical or auditory damage to any cetaceans or seals. Although some disturbance may be exerted within a few metres (< 10 m) of anchor drilling activities, the noise emitted from vessels, will extend over a greater area than the anchor drilling emissions and thus any individuals likely to demonstrate disturbance behaviour would be likely to encounter this reaction well outwith the range over which anchor drilling activities could possibly exert any impact. There is also no possibility that marine species would be exposed to a rapid rise in noise emissions from the anchor drilling against an ambient noise level as the vessels involved in the installation and construction activities will be operating throughout the installation period.

The majority of observations of cetaceans were outwith the potential zone of disturbance impacts. The only species observed with the potential area of disturbance is the harbour porpoise which is common throughout Orkney waters.

In terms of seals, grey seals are the species most likely to be present in the inner bay area during months when installation activities will take place. Overall the numbers of grey seals likely to be present are small, potential disturbance impacts will only be temporary in nature and due to the fact that the population of grey seals in Orkney is relatively healthy (SMRU 2011b estimate that 959 out of an estimated population of 15,976 grey seals in Orkney and along the north coast of Scotland, could be safely removed in 2010 without threatening the population) the proposed installation activities are expected to result in only minor impact to this species.

The Orkney harbour seal population is in a parlous state, having declined greatly in recent years. SMRU 2011b estimate that only 18 out of an estimated population of 2989 common seals in Orkney and along the North coast of Scotland, could safely be removed in 2010 without threatening the population. This species is therefore considered to be more sensitive to

potential impacts compared to grey seals. However at the proposed location of the Oyster 2 Array, this species was observed in greatest numbers during the autumn and winter months, i.e. generally outwith the proposed installation period. The likelihood of an impact occurring due to temporary installation or decommissioning activities is therefore considered to be remote.

The overall level of impact significance for marine mammals has been assessed as minor and therefore not significant.

Natura interests

Grey seal - Based on the information provided above it is not thought that the proposed Oyster 2 Array will result in any detrimental effect on the Faray and Holm of Faray SAC, or any other grey seal SAC in Scotland.

Harbour seal - The proposed development is c. 65 km swimming distance from the nearest harbour seal SAC at Sanday, and clearly falls outside the main areas used by adults from Sanday and other nearby islands (Eynhallow, Rousay and Stronsay) as shown by tagging studies (SMRU 2011a). However, tagging studies of pups show that they wander much more widely, and could potentially visit the development area (SMRU 2011a). Based on the nature of activities during installation, construction and decommissioning and the testing of the Oyster technology at Billia Croo it is very unlikely that these will result in the killing of harbour seals and therefore unlikely to result in the removal of any individuals from this or any other harbour seal SAC population in Scotland.

8.3.5 Fish

Basking sharks have been recorded at Billia Croo and within the inner bay area; due to their known occurrence at the site, slow swimming speeds and medium/high sensitivity, the level of potential consequence to basking sharks has been assessed as moderate. If present within the inner bay area or wider site at the time of installation or maintenance, basking sharks may be affected by increased vessel traffic/presence and underwater noise; causing localised disturbance and displacement of this species. Residual impacts on basking sharks have been assessed as minor, due to the low vessel speeds and largely stationery vessels likely to be employed in the inner bay area during maintenance activities, therefore providing basking sharks (if present), with the opportunity to leave the area where potentially disturbing activities may occur.

8.3.6 Seabirds

The potential for impact to seabird species has been assessed as either minor or moderate significance, depending on the species abundance and seasonal presence at the site, and on the specific activities that will be undertaken at different times of the year.

Due to the number of seabird species considered in the impact assessment and the differences in their physiology and habitat use (influencing their specific sensitivities to the different types of activity associated with the second phase of the Oyster 2 Array project), the marine wildlife impact assessment has assessed impacts on a species by species basis; considering construction and installation, operation and maintenance and decommissioning.

The potential impacts during construction and installation, maintenance and decommissioning relate to disturbance effects from the installation/decommissioning activities, the presence of vessels and the potential for pollution from accidental events. These activities, with the exception of occasional maintenance vessel visits, are likely to take place during the spring and

summer months and therefore it is those species present at this time of the year that have the greatest potential to be impacted, including fulmar, guillemot, razorbill and unidentified auk species. Gannet can also be expected to be present in the later breeding/post breeding season months. Should installation activities continue on into autumn, this is the time when greatest number of gull species (common, herring and great black backed) may be present.

For all species, the potential impacts arising from installation or construction, or decommissioning, of the Oyster 2 Array project are considered to be minor or negligible and therefore not significant. With no specific mitigation proposed for installation activities, the residual impact remains as minor or negligible and not significant.

During operation of Oyster, the impacts are relatively unknown and for some species the significance of potential impacts is considered to be moderate. It is proposed to continue marine wildlife monitoring in order to understand exactly what the impacts might be and their extent. With the implementation of an appropriate monitoring programme it is considered that the residual impact significance may be reduced to minor and not significant.

With regard to the potential for pollution events to have a significant impact on seabirds, the potential impact is rated as minor for some species and negligible for others. Given that appropriate measures and best practice will be employed on vessels and during operation of the Oyster 2 Array Project, it is considered appropriate that the residual impact is reduced to (or remains at) negligible and not significant.

Natura interests

The marine wildlife impact assessment report (Xodus 2011a) places the observations of each seabird species into context with Natura sites, specifically Hoy and Marwick Head SPAs. Table 8.3 below provides a summary of each species placed into context with these Natura sites.

Species	Natura Context
Arctic skua	Billia Croo is within easy foraging range (Langston 2010) of arctic skuas breeding within the Hoy SPA, for which this species is a qualifying interest as part of the seabird assemblage. On Hoy and South Walls, numbers have declined precipitously from 72 pairs in 2000 (59 pairs within the SPA) to just 12 pairs in 2010 (Meek 2011). If it is assumed (very conservatively) that every bird seen at Billia Croo during June (during the Aquamarine Power survey) was a breeding arctic skua from the Hoy and that only one bird from any pair was out at sea at any one time then this suggests up to 25% of the birds foraging from the Hoy breeding colony could potentially have been in the Billia Croo study area at any one time. However, during the breeding season, arctic skuas were only recorded within the study area on 2 dates, suggesting it is not a regularly used foraging area. Furthermore, given the large potential foraging range of this species (Langston 2010), and that they mainly forage by kleptoparasitism of other seabirds, it is thought extremely unlikely given its small scale that the proposed Oyster 2 Array could have any detrimental effect on the Hoy breeding population.
Guillemot	Billia Croo is easily within foraging range (Langston 2010) of birds breeding within the Hoy and Marwick Head SPAs. For Hoy SPA, guillemots are a qualifying interest as part of the seabird assemblage. For Marwick Head they are a qualifying interest in the own right, as a European population of importance, constituting 1.1% of the western European biogeographic population, as well as part of the seabird assemblage. During Seabird 2000 (1998-2000) c.14,590 pairs of guillemot bred on Hoy and South Walls (pairs calculated by multiplying 21,777 individuals on breeding ledges by 0.67, Mitchell et al. 2004) of which c. 13,400 pairs (SPA site citation) bred within the SPA. At Marwick, c. 23,235 pairs (34,679 individuals on breeding ledges multiplied by 0.67 (Mitchell et al. 2004)) were recorded during the same survey. If it is assumed that every one of the maximum count of 20 individuals recorded during the Aquamarine Power survey during the breeding season were from the Hoy SPA, and that only one bird from any pair was out at sea at any one time, then this suggests that a maximum of 0.15% of the birds foraging from the Hoy breeding colony could potentially have been in the Billia Croo study area at any one time. The corresponding figure for the Marwick colony is 0.09%. These figures would be much lower if only birds within 600m of the devices were considered. Thus, although on the basis of their diving behaviour potentially exposing them to physical contact with the devices, and being moderately sensitive to disturbance and inflexible in habitat requirements (King et al. 2010) guillemots could potentially have been sensitive to the proposed development, the very small numbers of birds recorded in the vicinity of the devices means that any detrimental effect on the Marwick Head and Hoy SPA populations is extremely unlikely.

Species	Natura Context
Kittiwake	Billia Croo is easily within foraging range of birds breeding at either the Hoy or Marwick Head SPAs (Langston 2010), for both of which sites kittiwakes are a qualifying interest as part of the seabird assemblage. However, with just a single sighting of a single bird during the breeding season it is seen as extremely unlikely that the proposed development would have a detrimental impact on either of these populations.
Fulmar	The estimated 35,000 pairs fulmar breeding in the Hoy SPA are a named component of the seabird assemblage which is one of its qualifying interests (SPA citation, Mitchell *et al*. 2004). Billia Croo is within easy foraging range of these birds (Langston 2010). However even if we assume every bird feeding at Billia Croo during the breeding season originated from Hoy, the peak count during the breeding season of 241 birds only represents 0.7% of breeding birds from this colony potentially at sea at any one time (assuming one member of each pair remains at the nest). The concentration of birds away from the devices further reduces the number of birds potentially exposed to them.
Great black-backed gull	Billia Croo is within easy foraging range (Langston 2010) of great black-backed gulls breeding within the Hoy SPA, for which this species is a qualifying interest as part of the seabird assemblage. In 2000, when it was designated, the Hoy SPA held 570 pairs of Great Black-backed gulls (c..3% of the GB population), including 207 pairs in the Burn of Forse colony, and 176 pairs in the Stourdale colony (Mitchell et al. 2010). In 2000, numbers in these two colonies had declined greatly over the previous decade, and this decline has continued so that in 2009 the Burn of Forse colony, held only about 40 adults in July, and the Stourdale colony, had only 16 apparently occupied nests (Williams 2010). Thus, the numbers of breeding pairs of great black backed gull on Hoy in 2010 was probably no greater than 50. If it is assumed (very conservatively), that every one of the 18 birds seen at Billia Croo on the 14th June was a breeding adult from the Hoy SPA, and that only one bird from any pair was out at sea at any one time, then this suggests that up to 36% of the birds foraging from the Hoy breeding colony could potentially have been in the Billia Croo study area at any one time. Although these numbers are probably unrealistically high, with the low number of birds remaining on Hoy, even very small numbers feeding at Billia Croo could potentially be numerically significant. However, given the large potential foraging range of this species (Langston 2010), and very catholic diet it is thought extremely unlikely given its small scale and location that the proposed Oyster 2 Array could have any detrimental effect on the Hoy breeding population.

Species	Natura Context
Great skua	Billia Croo is within easy foraging range (Langston 2010) of great skuas breeding within the Hoy SPA, for which this species is a qualifying interest on the basis of Hoy supporting 14% of the world biogeographic population. The estimated numbers of great skuas breeding on Hoy and South Walls has declined from 2,209 pairs in 2000 (1,900 pairs in the SPA according to the SPA citation) to 1,710 pairs in 2010, of which an estimated 1,406 pairs (calculated by subtracting 304 pairs outside the SPA in 2008) were within the SPA (Meek 2011). If it is assumed (very conservatively), that every bird seen at Billia Croo during June was a breeding great skua from the Hoy SPA, and that only one bird from any pair was out at sea at any one time then this suggests that up to 1% of the birds foraging from the Hoy breeding colony could potentially have been in the Billia Croo study area at any one time. Given this relatively low percentage, and the large potential foraging range of this species (Langston 2010), and that in the Northern Isles they mainly forage on fishery discards and sandeels (Votier et al. 2003), it is thought extremely unlikely given its small scale and location (i.e. not on a key feeding habitat such as sandbank suitable for spawning sandeels) that the proposed Oyster 2 Array could have any detrimental effect on the Hoy Great skua population.
Puffin	Puffins are a qualifying interest for the Hoy SPA, with a cited population of 3,500 pairs. Even if we assume that all 4 of maximum count of four birds were from this colony, and that only one bird from each pair was out at sea at any one time this represents only 0.1% of the estimated foraging population. This plus the low number of dates when birds were present, and their absence from the immediate vicinity of the Oyster 2 Array suggests that it is extremely unlikely that the proposed development would have an adverse impact on the Hoy SPA puffin population.
Red-throated diver	Billia Croo is within the potential foraging range (Langston 2010) of birds breeding within either the Hoy or Orkney Mainland Moors SPAs. However, apart from the possible exception of the single bird observed during August (during the Aquamarine Power survey), there was no evidence of any birds using the Oyster 2 Array area during the breeding season, nor evidence of birds regularly flying to and from breeding lochs to feed. Thus there was no evidence of breeding birds from either of these SPAs using the study area for foraging.

Table 8.3 Summary of each Selected Species placed into Context with Hoy and Marwick Head SPAs

8.4 Management and mitigation

The following measures are discussed in the marine wildlife impact assessment report (Xodus 2011a) and have been used to reach the residual impact significance rankings discussed in the species specific sections above.

During an operation (e.g. installation, maintenance, decommissioning) involving vessels, vessels will move slowly onto site and remain slow moving or stationary throughout the installation period. Marine mammals and basking sharks (if present at the site or within the surrounding environment) will therefore be exposed to a slow rise in noise levels and disturbance of the water surface. Therefore marine mammals and basking sharks will have the opportunity to move away from the small area (90 – 500 m) in which vessels may exert any significant impact.

Although the anchor drilling operations are not expected to result in any significant disturbance or displacement of marine mammals, it should be noted that anchor design will aim to minimise drilling time without compromising the technical performance of the anchor.

Due to the nature of the vessels and drilling activity associated with Phase 2 of the Oyster 2 Array, no further specific mitigation measures, for example deployment of a Marine Mammal Observer (MMO), are considered necessary during installation.

There is still some uncertainty over the impacts that the operation of the Oyster technology may have on marine mammals, basking sharks and seabirds; therefore continued marine wildlife monitoring at Billia Croo (during the operational phase of the Oyster 2 Array), and collection of the underwater acoustic signature of the Oyster 2 Array will establish if there are any long term disturbance impacts from the presence and movement of the devices.

Further consultation with Marine Scotland will establish the need for a European Protected Species (EPS) licence with regards to potential to impact whales and dolphins.

Aquamarine Power is aware of the recently implemented Seal Licence system under the Marine (Scotland) Act 2010. Consultation with Marine Scotland will establish any potential requirement for such a licence with regard to Phase 2 of the Oyster 2 Array.

8.5 Cumulative Impacts

Aquamarine Power is not aware of any other proposals to deploy wave energy technologies in the inner bay area, adjacent to the Oyster 2 Array project installation site. The Oyster 1 WEC, deployed in 2009, was recently removed from its berth approximately 33 m to the north east.

Considering the surrounding waters comprise part of the EMEC test centre, there is potential that other renewable devices will be installed in the region over the life of the Oyster 2 Array project. There have been announcements in the local Orkney press of at least 3 other devices being tested at the wider EMEC wave test site from 2011 onwards. All other existing test berths at the wave site are located further offshore in deeper waters and therefore outwith the immediate vicinity of the Oyster 2 Array; it is assumed that this is where future wave energy devices will be deployed. Although as yet there is no empirical data on zones of influences from the operation to such devices, it is expected that impacts are likely to be limited to the immediate vicinity (tens of metres) of devices. The small area of sea potentially impacted means that should similar developments be located in the wave test site and/or in similar water depths to Oyster, then the potential for cumulative impact in terms of percentage of habitat affected would be low.

Areas of disturbance of marine wildlife could be slightly greater during installation and decommissioning when there are likely to be several vessels associated with the activities taking place. However the EMEC permit to work system controls simultaneous activities at the wave test from a safety perspective and this will also result in advantages from an environmental perspective in terms of controlling the levels of vessel activity taking place at the wave test site at any one time.

8.6 Conclusions

The principal known impact to marine wildlife from the proposed Oyster 2 Array Project will be the potential for disturbance and displacement of marine wildlife from the inner bay at Billia Croo during the installation phase of the proposed development, with potentially disturbing activities to marine mammals, fish and seabird species occurring in close proximity to the proposed development site during device installation and maintenance. This disturbance impact is expected to be temporary in nature, with short intermittent periods of disturbance from vessel traffic and vessel presence during maintenance activities.

During operation there is an uncertainty factor applied to the impact assessment whereby the likelihood of any impact occurring is deemed to be 'possible'. This is due to the novel nature of the Oyster technology and the lack of existing evidence for or against its potential impacts.

Considering the above alongside mitigation measures proposed for the slowing down of vessels travelling to site, anchor drilling design, continuation of wildlife monitoring and measurement of the underwater acoustic signature of the Oyster 2 Array, disturbance and displacement impacts to marine wildlife will be minor or negligible and therefore not significant.

9. SEABED INTERACTIONS IMPACT ASSESSMENT

The table below provides a list of all the supporting reports and documents that have been produced for the Oyster 2 project related to the seabed impact assessment, and their location on the CD which accompanies this ES.

Relevant Document	Location on Accompanying CD
Assessment of kelp removal (Cliff Johnston, 2010)	See Appendix B of Xodus 2010b, Seabed Impact Assessment
Seabed impact assessment (Xodus, 2010b)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife / Seabed Interactions

9.1 Introduction

This section assesses the potential for impact that the deployment of the 800 kW Oyster 2b and 800kW Oyster 2c devices, to be installed during Phase 2 of the Oyster 2 Array project at Billia Croo, Orkney, may have on the seabed environment, the possible magnitude of any impact and to specify appropriate mitigation measures where appropriate. The assessment draws upon field work conducted at the installation site, desk-based research and Aquamarine Power's experience of deployment of Oyster 1. Reference is also be made to the background information and assessment presented for the Oyster 2a device (Xodus, 2010b).

This study has considered the installation, operation and decommissioning of two Oyster 2 devices at the EMEC wave test site; the monopile foundations and pipelines to shore have been the subject of previous assessment and consent (Xodus, 2010b).

Legislation and agreements relevant to the seabed work being undertaken during Oyster 2b and Oyster 2c installation are described in the previous impact assessment (Xodus, 2010b). Similarly, the outcome of the consultation process and the responses to those comments are also detailed in the previous assessment (Xodus, 2010b). No further issues related to impact on the seabed were raised during consultation undertaken on this Oyster 2b and Oyster 2c specific application.

9.2 Baseline Conditions

9.2.1 Desk Study

The desk and field studies undertaken as part of the previous impact assessment for the installation of the monopiles and Oyster 2a device (Xodus, 2010b) are summarised as below. These data are also directly relevant to this present impact assessment:

- Desk-based review of existing data sources to provide advice on the habitats and species that may be present at the Oyster 2 installation site;
- Specific assessment of the clearance of kelp from the seabed during the installation of Oyster 2 (Johnston, 2010); and
- Pre-installation ROV footage of the seabed in the area that the Oyster 2 devices will be installed was collected during May 2010. The positions of ROV transects and drops onto the seabed are shown in Figure 9.1, page 96.

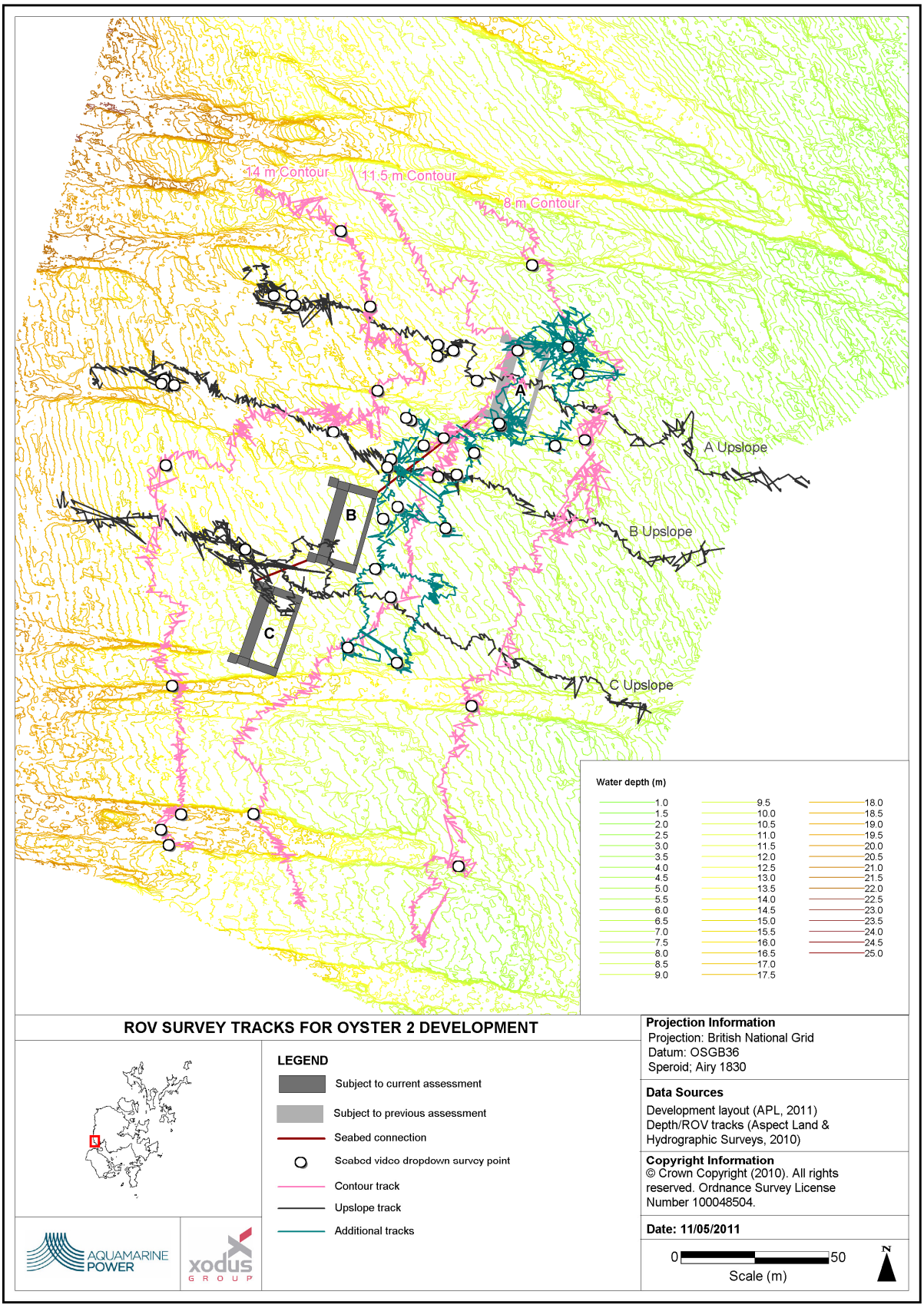

Figure 9.1 **ROV sampling transects and 'drops' to seabed**

9.2.2 Surveys

Regional

Benthic surveys undertaken at the wave test site (EMEC, 2009) indicate that the zone in which Oyster 2b and Oyster 2c will be deployed comprised exposed bedrock dominated by a dense kelp *Laminaria hyperborea* 'forest' that thinned to kelp 'park' as depth increased. A sparse understorey of red seaweeds was present alongside sparse fauna and algal crusts. Species present include the edible sea urchin *Echinus esculentus*, dead man's fingers *Alcyonium digitatum* and some grazing-tolerant fauna. Also present in the infralittoral zone (although also in the circalittoral) were steep exposed rock features and gullies. The vertical rock faces in these, likely to be wave/tide-swept, were typically dominated by dead man's fingers and the bryozoan *Securiflustra securifrons*.

A seabed diver video survey was conducted on behalf of Aquamarine Power around the Billia Croo installation site for Oyster 1 in approximately 12 m water depth. The exposed bedrock was dominated by an almost impenetrably dense covering of kelp. A dense foliose red seaweed community was found growing between the holdfasts and epiphytically on the kelp stipes. Below the canopy, algal species such as the red seaweeds *Odonthalia dentata* and *Drachiella spectabilis* were reported, as well as numerous bryozoans. Between the kelp were walls and gullies dominated by extensive faunal communities that included encrusting calcareous algae and sponges, along with low numbers of grazing species (such as urchins). Sea stars were the most common faunal species.

Site-specific ROV survey

Analysis of the Oyster 2 development area ROV footage from May 2010 found that the seabed over the whole survey area (Figure 9.1) consisted of wave-exposed bedrock dominated by kelp, intersected by occasional steep-sided gulleys. Two biotopes, similar to the habitat recorded from the nearby Oyster 1 site, were identified across the survey area; kelp park (IR.HIR.KFaR.LhypR.Pk) and kelp forest (IR.HIR.KFaR.LhypR.Ft). The forest biotope was present at the Oyster 2b and Oyster 2c installation sites, with park being restricted to slightly deeper water.

The kelp stipes were almost always encrusted with red algae (including *Phycodrys rubens*) and white bryozoa *Electra pilosa*. In small areas on some plants the bryozoan *Membranipora membranacea* was recorded (this growth would be expected to be greater later in the growing season) and the kelp was generally noted to be in good condition. Beneath the kelp, *Pomatoceros* sp. and a bryozoan turf was recorded from the exposed, rocky surfaces. Grazing on this turf were occasional occurrences of *E. esculentus*, with *Asterias rubens* present also. On exposed rock faces and in gullies where kelp was not such a dominating feature, *A. digitatum* was occasionally abundant, although more often in lower densities, with *E. esculentus* and *Pachymatisma johnstonia*.

The regional and site specific surveys described in this section are dealt with in greater detail in the Oyster 2a impact assessment (Xodus, 2010b), which is provided electronically on the CD accompanying this ES.

Sensitive species/habitats

The desk review suggested that a number of UK Biodiversity Action Plan (UKBAP) priority benthic habitats (blue mussel beds, horse mussel beds, littoral caves and overhangs, maerl beds, sublittoral sands and gravel, tide-swept channels and infralittoral rock and wave surge gullies and caves; UKBAP, 2007) and those habitats listed on the draft Scottish priority marine features (PMF) list (blue mussel beds, horse mussel beds, kelp and seaweed communities on

sublittoral sediment, maerl beds, native oyster beds, seagrass beds and tide-swept algal communities; SNH, 2010) could be present in the region.

Similarly, a number of UKBAP priority benthic species (molluscs *Atrina fragilis* and *Ostrea edulis*; UKBAP, 2007), Orkney Local Biodiversity Action Plan species (the mollusc *Amauropsis islandicus*; OLBAP, 2008) and PMF species (molluscs *Arctica islandica* and *Atrina pectinata*; SNH, 2010) may also be present.

Despite this, no UKBAP, OLBAP or PMF habitats or species and were observed during the ROV survey and were not recorded in other surveys conducted close to the Oyster 2 installation site. The species that were observed were those expected to be associated with the kelp park and forest recorded across the survey site. IR.HIR.KFaR.LhypR.Ft is not listed under any importance categories (MarLIN, 2008) but this biotope is a reef biotope and reef is listed on Annex I of the EU Habitats Directive.

9.3 Impact Assessment

9.3.1 Assessment Methodology

As described in the EIA Methodology & ENVID chapter (full details of the assessment methodology are given in Appendix A), definitions for the sensitivity of receptors and magnitude of change have been developed on a topic by topic basis. The sensitivity of benthic receptors to the installation of the Oyster 2b and Oyster 2c devices considers the specific nature of the receptors and their capability to accommodate change (Table 9.1) whilst the assessment of the magnitude of change upon the receptor takes into account the timing, scale, duration and recovery from an impact (Table 9.2).

Sensitivity of Receptor	Definition
Very high	Sites of international designation (e.g. SAC, SPA) or species/assemblages which form qualifying interests of internationally designated sites; Globally threatened species or habitats (e.g. IUCN list); Species which are considered to be present in internationally important numbers or habitats comprising an internationally important proportion of that habitat.
High	Nationally important sites (e.g. SSSI) or species/assemblages which form qualifying interests of nationally designated sites; Species/assemblages which contribute to an international site but which are not listed as qualifying interests; Ecologically sensitive species/habitat (e.g. rare) or present in nationally important numbers/area.
Medium	Sites of local value; Habitats on Annex I or species on Annex II of the EC Habitats Directive; Species listed in Schedule 1 of the Wildlife and Countryside Act

	1981 (as amended); Species present in regionally important numbers; Species/assemblages which contribute to a national site but which are not listed as qualifying interests; Species occurring within international/national sites but are not crucial to the integrity of the site; Species listed as priority species in the UK Biodiversity Action Plan (BAP).
Low	Sites not containing features that would meet the criteria for sites of local value, but nevertheless having some biodiversity value; Any other species of conservation interest (e.g. Local BAP species, Scottish Priority Marine Features).
Negligible	Habitat/species of no conservation concern.

Table 9.1 Definitions for sensitivity of receptor

Magnitude of Impact	Definition
Severe	Widespread total loss or very major alteration to species and habitat such that the condition of features of qualifying interest will be fundamentally altered; Little or no recovery anticipated.
Major	Widespread change to characterising species or lasting change to habitat leading to medium-term damage; Recovery anticipated taking several years following decommissioning.
Moderate	Change to benthic species in a localised area (confined to project footprint and immediate locality) for project duration, but no lasting change to habitat; Good recovery potential following decommissioning (approximately 2 years).
Minor	Change from baseline conditions measurable but within scale of natural variability, and confined to project footprint; Temporary alteration or effects confined to a small percentage of available habitat, with rapid recovery likely.
Negligible	Effects unlikely to be discernable or measurable.

Table 9.2 Definitions for magnitude of impact

The ENVID (described in Section 7.3) identified the potential seabed impacts associated with the proposed project and assessed the 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.

All stages of the project development were considered (from installation through operation and maintenance to decommissioning), in line with the methodology presented in Appendix A and Table 9.1 and Table 9.2 above. The issues raised by the ENVID relevant to this seabed impact assessment are:

- Modification and disturbance of seabed and loss of and disturbance to seabed habitats; including physical disturbance and kelp removal;
- Modification (or contamination) of seabed habitat from drilling discharges associated with anchor installation; and
- Modification of seabed and intertidal habitats from the long term presence of the devices.

9.3.2 Installation

Introduction

The installation operations for Oyster 2b and Oyster 2c with the potential to impact on the seabed habitat and species (quantified below) include:

- Preparation of the seabed, including the clearance of kelp;
- Installation of the Oyster 2b and Oyster 2c wave energy converter flaps, including gabions between the frame and seabed;
- Installation of rock anchors, used to position the wave energy converters during installation;
- Installation of the wave energy converter latching anchors;
- Placement of interconnecting pipelines and installation of associated stabilisation anchors and mattresses; and
- Discharge of small amounts of drill cuttings during anchor drilling activities.

No areas of significant sediment cover are found at the development site and issues related to sediment, such as re-suspension and consequent smothering of benthic species, are not likely consequences of installation. The footprint of the installation activities is therefore not expected to extend much outwith the area cleared for kelp (within which the mattresses are placed). Where impacts do occur outside the kelp clearance footprint these will be related to the drill cuttings from the anchor (latching, stabilising and rock anchors) drilling activities.

Quantification of impact

The ROV survey revealed that the rocky area in which Oyster 2b and Oyster 2c are to be installed is covered with dense kelp. Access to the seabed is required in order to facilitate installation of the Oyster devices and associated interconnecting pipelines and, as such, some clearance of kelp is required. The estimates for removal are given in Table 9.3.

Kelp Removal Reason	Kelp Removal Area
Under each of the two WEC base frames	1,390 m^2
Interconnecting pipelines and stabilising anchors (includes areas within which mattresses placed)	1,071 m^2
Latching and rock anchors	220 m^2
Total (worst case)	**2,681 m^2**

Table 9.3 Estimated seabed impact areas

Removing 2,681 m^2 would remove approximately 0.01% of the available kelp habitat in the Orkney west coast region (Johnston, 2010). Considering the volume of kelp removed, the kelp assessment considers that, assuming a kelp standing crop employed in the wider kelp forest resource of 10 kg/m^2, an estimate of approximately 27 tonnes will be removed. As the clearing plan only requires the removal of large canopy plants, the final quantities cleared will be lower (Johnston, 2010).

Regarding the fate of the kelp that is cut by divers, the specific kelp assessment (Johnston, 2010) concludes that the most practical disposal route is to leave the cut weed on the seabed onsite in the vicinity of the cutting operation where it can join the major storm cut weed pathway into the kelp/coastal ecosystem. This is considered to be the most environmentally sensible option, particularly when the cut kelp quantities are compared with the storm cut/cast weed from the area (20% of the kelp cut during installation would be lost during storm activity; Johnston, 2010). This method will retain the detritus contribution to the forest environment and remove the energy/emission costs associated with shipping to shore for land use/disposal (Johnston, 2010). In addition to the kelp that would be cleared, any individuals that rely on kelp as a substrate (e.g. red foliose algae, bryozoans) would be removed also.

Impacts of installation will be restricted to within the footprint of the infrastructure/activities themselves (for example, there will be no sediment re-suspension). Any sessile species present on the seabed on which such infrastructure will be placed or drilling will take place would potentially be destroyed or damaged. However, the ROV survey noted that there were no species considered to be of conservation significance recorded at the site and that there were no large aggregations of species that would suggest elevated numbers compared to other sites in the vicinity of the survey area. No species of local significance were recorded.

The presence of a kelp canopy controls the structure of communities beneath and it is possible that removal of the kelp canopy will reduce the density of any species that rely on that cover in the areas that are cleared of kelp. However, in the case of Oyster 2b and Oyster 2c, the areas that are cleared of kelp canopy (but not of smaller kelp plants) will be used to place the Oyster structure and pipelines. It is likely that any change in hydrodynamics or any increase in shading from the Oyster 2 infrastructure will exert a much smaller effect on the marine environment than the baseline wave-surge energy inherently present. It is therefore likely that the presence of two devices and the associated infrastructure will have little or no impact on the kelp communities in the region of the Oyster 2b and Oyster 2c devices and infrastructure.

In addition to the footprint of the Oyster infrastructure, the anchors (rock, stabilising, latching) will be fixed to the seabed using drilled holes and a small volume of rock broken into very small pieces will be discharged onto the seabed. The intense wave action of the area means that these drill cuttings will be dispersed into the wider marine environment. The nature of the west coast region is such that naturally occurring material (including rock and other debris) is

constantly moved around by tide and wave action. As such, the occurrence of rock debris (albeit not usually in the form of drill cuttings) is unlikely to be a novel event. Depending on prevailing sea and weather conditions at the time of discharge, there is the possibility that some of the cuttings may be washed ashore, but the small volume means that there would be very little impact, if any, on the intertidal zone. It should be noted that no such impact was observed as a result of Oyster 1 drilling activities.

Where the cuttings (and, indeed, any of the seabed structures) do cause damage through being placed or moved onto species present in the region, those species (as a group or individually) will be expected to regenerate successfully where damage has not been extensive or, where damage is such that recovery is not expected, be replaced through reproductive activity and inward movement of the same species from the surrounding marine environment. The ROV survey reported that the habitat surrounding that which may be impacted is the same as that encountered in the wider installation area.

Management and mitigation

One of the key factors in reducing the potential environment impact will be to reduce the area of kelp to be removed. Aquamarine Power will ensure that the area of kelp cleared will be restricted to the footprint and the immediate vicinity of the Oyster 2b and Oyster 2c devices and associated pipelines and drilling points and only large canopy plants will be removed where at all possible. The installation layout will be clearly defined and communicated to all personnel involved in kelp clearance.

Whilst it is possible that a number of mattresses may be required to provide protection, these are likely to fall within the area already cleared for kelp and will thus remove no additional area of seabed habitat or kelp from use.

The various types of anchors (rock, latching and stabilisation) required will be designed to the minimum practical depth, thus limiting the volume of drill cuttings discharged to the marine environment.

A detailed environmental monitoring plan has been developed for Oyster 2a in consultation with relevant agencies and this will be updated to include Oyster 2b and Oyster 2c prior to installation commencing. This monitoring plan includes monitoring of the seabed to establish the kelp recovery and impacts from drill cuttings discharge. Additionally, to ensure that any potential environmental impacts are minimised, and in line with EMEC requirements/FEPA commitments, Aquamarine Power have undertaken a pre-installation survey (summarised above and detailed in Xodus, 2010b) which will provide a baseline for the post installation monitoring.

Residual impact

The area of kelp likely to be removed during the Oyster 2 installation is estimated to correspond to 2,681 m^2; the total area of seabed impact is not anticipated to extend much beyond this area. This corresponds to a very small percentage of the kelp forest habitat available locally and an even smaller percentage of that available regionally and nationally. Thus, a large area of undisturbed kelp park and forest habitat will continue to be available directly adjacent to the Oyster 2b and Oyster 2c devices to any species that relies on it. The kelp removal assessment concluded that the environmental consequences of kelp cutting are insignificant in comparison to available standing crop levels and natural loss processes (Johnston, 2010). Approximately 20% of the kelp that will be cut during the installation activities would be lost in any case by natural processes occurring as a result of storm activity (Johnston, 2010). Anecdotal experience from Oyster 1 installation suggests that kelp rapidly recovers.

The footprint that extends beyond the area of kelp removal corresponds to that which the Oyster 2b and Oyster 2c devices will shade and over which drill cuttings may be dispersed. It is not considered that any possible shading will impact in any noticeable way on the kelp communities in the region and drill cuttings are expected to be widely dispersed such that no negative impacts are anticipated.

Protected Sites

The nearest SPA, designated for the aggregation of breeding birds, is located approximately 2.5 km to the south and is consequently outwith any area that may be impacted by the drill cuttings dispersion. Even if an impact were to be exerted within this region, or within habitat used by species within this region, the impact is unlikely to be significant since the impact would be extremely limited both temporally and spatially and will not impact upon the available resources. The nearest SAC, located approximately 0.6 km to the north, is the Stromness Heaths and Coast SAC, designated for two upland habitats and for the supralittoral rock habitat 'Vegetated Sea Cliffs'. These habitats are outwith any potential area of impact.

The South Stromness and West Coast of Orkney GCR sections, which encompass the Oyster 2b and Oyster 2c deployment area, are designated for exposures of non-marine Devonian rock strata and coastal geomorphology in an active system. GCR sites are non-statutory sites identified by the statutory nature conservation agencies as having national or international importance for earth science conservation on the basis of their geology, palaeontology, mineralogy or geomorphology (JNCC, 2010). Although GCR site identification does not itself give any statutory protection, many GCR sites have been notified as Sites of Special Scientific Interest (SSSI); this is the case for the two GCR designations in question which fall under the designation of Stromness Heaths and Coasts SSSI.

The activities described herein for the Oyster 2b and Oyster 2c devices are not expected to impact upon the integrity of any SSSIs in the area. Drilling activities which may have such an impact (that is those described in the previous assessment, including installation of the monopile foundations) have been consented through the Onshore Planning Permissions (Temporary 10/339/PP, Permanent 10/340/PP) that were awarded in September 2010. In addition, the interactions between Oyster 2b and Oyster 2c and the seabed will not have any direct impacts on the features for which the GCR sites are designated.

Conclusion

The Oyster 2b and Oyster 2c installation activities will result in only a small area of benthic habitat impact of a habitat that is available in the immediate locality of the installation sites and across the wider Orkney coastline. ROV surveys suggest that the area does not host benthic species of local, national or international concern. Considering a receptor sensitivity of 'Medium', a magnitude of impact of 'Minor' and a likelihood of 'Possible' , a significance ranking of 'Minor' is assigned to the clearance of kelp and physical disturbance from installation activities. The activity is therefore considered to be not significant, although some management will be required to ensure impacts remain within acceptable limits (such management is detailed above) and post installation monitoring will be undertaken to verify these predicted impacts.

9.3.3 Operation and Maintenance

There will be no interaction with the seabed during normal operating conditions and thus no impact on the seabed through the operation of Oyster 2b and Oyster 2c.

It is likely that the presence of the Oyster devices will cause some changes to the hydrodynamic regime in the surrounding area. It is expected that localised currents will be created in the immediate vicinity of the device but any changes further afield will be small. Since Oyster extracts power from the waves, there will be a shadow effect with a reduction in wave power on the shoreward side of the three Oyster 2 devices but this reduction is likely to be negligible and unlikely to result in any significant effects over and above the natural variation that takes place along such an exposed coastline. There will also be a small amount of wave reflection of the seaward side of the device but it is expected that this effect will be limited to the immediate vicinity of the device. As the amount of sediment in the area is very small, there will be no significant changes to sediment transport.

To enable confirmation of the absence or limited extent of any impact, Aquamarine Power will undertake a post-installation seabed survey of the Oyster 2 site.

Maintenance will occur as a fixed maintenance and inspection period lasting approximately 10 days every six months for each WEC. At each five year mark an extended maintenance programme lasting up to 20 days per WEC may be required. Such planned maintenance could impact upon the seabed where an interaction was to occur. However, the Oyster 2b and Oyster 2c devices have been designed to be compatible with diver-less maintenance (although divers may be required to perform specific inspections) and it is envisaged that a multi-cat vessel will be used for the removal and replacement of offshore equipment, resulting in no additional seabed footprint. If any unexpected interaction does occur it would likely be within the original seabed footprint defined during the installation period.

The possible risk of fluid being discharged during maintenance activities is considered in the Accidental Discharges section (Section 11).

Considering a receptor sensitivity of ‘Medium’, a magnitude of impact of ‘Negligible’ and a likelihood of ‘Possible’, a significance ranking for the operation and maintenance phase of ‘Negligible’ is assigned.

9.3.4 Decommissioning

Aquamarine Power is committed to decommissioning and removing all equipment from the deployment site to a standard meeting industry best practice at the time. A Decommissioning Programme agreed with DECC will be developed pursuant to Chapter 3 of the Energy Act 2004. As Oyster 2b and Oyster 2c are likely to be decommissioned in the same phase as Oyster 2a, shared infrastructure is included here. Aspects of the decommissioning process that have the potential to interact with the seabed environment include:

- Cutting and retrieval of interconnecting pipelines;
- Piles will be cut down to seabed level which will require access by divers and thus potentially clearance of kelp; and
- All equipment and material from the seabed will be retrieved onto the decommissioning vessels thus some access by divers and clearance of kelp may be required.

Very little impact would be exerted on the seabed itself and where interaction does occur it would largely be within the same seabed footprint as during installation. Removal of all seabed infrastructure would return the areas originally cleared of kelp and utilised by the Oyster 2b and Oyster 2c devices and associated infrastructure to a stage where re-colonisation by species typical of the region could occur. The underlying seabed (exposed rock) will remain almost unchanged, the only exceptions being where drilling has occurred.

The recovery of the kelp forest and kelp park biotopes is discussed in detail in the Oyster 2a impact assessment (Xodus, 2010b, provided electronically on the CD accompanying this ES) and is summarised here. In terms of the kelp habitats, a kelp canopy will be restored following decommissioning, although additional time (two to three years) may be required to restore plants of older ages (Johnston, 2010). A typical average life of the kelp in the forest is around four to five years. Oyster 2b and Oyster 2c will be located in shallower waters and recovery rates are likely to be at the upper end of the scale. In addition to a rapid recovery rate, the habitat in the immediate vicinity of the Oyster 2 site contains the same species that are found at the sites to be cleared of kelp. These surrounding areas can, and are likely to, act as a source of young kelp that will repopulate the areas that have been cleared. Other sessile organisms are likely to also repopulate the area through reproduction and settlement. Mobile organisms will be capable of repopulating the area both through dispersive reproductive and by migrating into the newly re-available habitat from nearby unaffected areas.

Aquamarine Power will undertake a post-decommissioning seabed survey of the Oyster 2 development. These results of this survey, in addition to the pre- and post-installation surveys, will contribute to the database of information that will be used in EIA studies for similar wave energy generation projects in similar habitats in the future. It will contribute to assessing the overall impact of installation of such devices, including enhancing the understanding of how drill cuttings are dispersed in the environment and how they interact with benthic habitats.

Considering a receptor sensitivity of 'Medium', a magnitude of impact of 'Negligible' and a likelihood of 'Possible' , a significance ranking for the decommissioning phase of 'Negligible' is assigned.

9.4 Cumulative Impacts

Faber Maunsell and Metoc (Strategic Environmental Assessment (SEA) for Scottish Marine Renewables, 2007) report that, with regards to cumulative impacts, there is likely to be capacity for the potential wave energy resource to be exploited with minimal effects on the environment, providing that sites are selected carefully, appropriate mitigation is implemented and where necessary site specific surveys are carried out prior to any development taking place.

Other than the existing Oyster 1 device and soon to be installed Oyster 2a device, Aquamarine Power is not aware of any other operations being undertaken on the seabed in the immediate vicinity of the Oyster 2b and Oyster 2c installation site. It is likely, considering that the surrounding waters are part of the EMEC test centre, that other renewable devices will be installed in the region over the life of the Oyster 2 project. All other existing test berths at the wave site are located further offshore in deeper waters and therefore outwith the area of kelp forest and kelp park, meaning there is little potential for cumulative impacts on these habitat types.

There is the possibility of cumulative impact between Oyster 2a and Oyster 2b and Oyster 2c. However, the very small area of seabed being cleared of the species/habitats currently present means that the potential for cumulative impact in terms of percentage of habitat temporarily removed is very low (approximately 0.02% of west coast Orkney kelp habitat compared to 20 - 25% natural removal by winter storms; Johnston, 2010).

Cumulative impacts with development outwith the marine renewable industry are unlikely as no such other developments are foreseen in the area.

9.5 Conclusions

The key seabed impacts resulting from installation of Oyster 2b and Oyster 2c, similar to that from Oyster 2a (Xodus, 2010b), are related to the seabed habitat removed from use (corresponding to the area of kelp forest cleared) and the discharge of cuttings. Although the habitat is considered to be 'Reef' as defined under Annex 1 of the Habitats Regulations, the area impacted is very small and represents a very low proportion of that habitat type available locally, regionally and nationally, even when considered cumulatively with Oyster 2a. The integrity of other protected sites (for example, GCR and SSSI) is not likely to be affected by the development.

Considering the above along with the suite of mitigation measures that will be employed during the construction/installation, operation/maintenance and decommissioning stages, it is concluded that installation of the Oyster 2b and Oyster 2c devices and related infrastructure will not have a significant negative impact on the benthic environment.

10. NAVIGATIONAL SAFETY RISK ASSESSMENT

The table below provides a list of all the supporting reports and documents that have been produced for the Oyster 2 project related to the navigational safety risk assessment, and their location on the CD which accompanies this ES.

Relevant Document	Location on Accompanying CD
Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c Navigational Safety Risk Assessment (NSRA) (ARC, 2010a)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife / Navigational Safety Risk Assessment
Oyster 2b and Oyster 2c NSRA Addendum (PMSS, 2011)	OFFSHORE / Oyster 2 Array Project ES and Supporting Studies / Marine Wildlife / Navigational Safety Risk Assessment

10.1 Introduction

The information that follows is derived from two sources:

- The NSRA conducted by Abbott Risk Consulting (ARC) Ltd for Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c (ARC, 2010a); and,
- An addendum to the NSRA conducted by Project Management Support Services (PMSS) Ltd accounting for the installation and operation of Oyster 2b and Oyster 2c (PMSS, 2011).

The NSRA and addendum have been undertaken in accordance with Marine General Guidance Notice MGN 371 (M + F) – Offshore Renewable Energy Installations (OREI): Guidance on UK Navigational Safety and Emergency Response Issues.

In addition to the Oyster 2b and Oyster 2c project components that are the subject of this EIA, the addendum to the NSRA assesses the potential for risks to navigation which may be posed as a result of minor changes to the pile/foundation design (from twin pile to monopile foundation) which have arisen in the intervening period between the submission of the NSRA in 2010 and this EIA/ES, but that are already permitted under the Coast Protection Act (CPA Licence 2SPC\1\9\19). These issues are not considered further in this ES as they are subject of a separate consent.

The original Oyster 2a NSRA (ARC, 2010a) and Oyster 2b and Oyster 2c addendum (PMSS, 2011) are provided on the CD accompanying this ES. A summary of the main points, relating to the Oyster 2b and Oyster 2c project only, is provided in Sections 10.2 to 10.6.

10.2 Baseline conditions

Navigational safety risks of deploying wave energy converters at Billia Croo were assessed in the original EMEC commissioned wave test site NSRA (ARC, 2008) and in the updated NSRA for the extension to the EMEC wave test site (ARC, 2010b). Automatic Identification System (AIS) and Vessels Monitoring System (VMS) data has been used to assess existing traffic patterns in the area.

10.2.1 Traffic passing close to or within the wave test site

Data showing traffic passing close to or within the test area has been investigated and in most cases consists of:

- Vessels engaged in maintenance of the Billia Croo wave test site buoys;
- Vessels engaged in installation / maintenance / survey activities within or adjacent to the EMEC wave test site; and,
- Vessels engaged in site investigation survey work of adjoining areas for potential offshore renewable energy installations.

The latter two activities have been much more in evidence during 2009 and 2010.

10.2.2 Traffic types

The types of vessels identified as using Hoy Mouth as an entry / exit point to Scapa Flow / Stromness are:

- Ferries plying the route between Stromness and Scrabster;
- Vessels engaged in fishing off the west coast of mainland Orkney;
- RNLI Lifeboats engaged in Search and Rescue (SAR) activities;
- Dive boats on passage to dive sites; and,
- Yachts on passage to or from Scapa Flow / Stromness, including up the west coast of mainland Orkney.

A significant number of cruise ships visit Orkney each year, particularly between April and September. None of these visits are known to use the passage through Hoy Mouth or along the west coast of mainland Orkney and will therefore be unaffected by the proposed project. There are no military exercise areas immediately adjacent to the test site and there are no indications of the area being a transit route for anything other than surface vessels.

10.2.3 Future traffic patterns

A renewables / industry support base is being created in Scapa Flow at Lyness on Hoy. This will likely increase traffic movements approaching and departing various waters within Orkney including the EMEC wave test site and the inner bay area where the Oyster 2 wave energy converters are proposed for deployment. There is a possibility that the increase in oil and gas exploration to the west of Orkney could increase support vessel traffic however this will use a similar route to the Northlink ferry between Stromness and Scrabster and would largely be unaffected by additional devices in the inner bay area of the EMEC wave test site. It is not considered that fishing traffic in the area is likely to increase.

In light of the seabed lease option agreements established between The Crown Estate and wave and tidal energy developers following the first marine licensing Round for the PFOW, there are several other wave energy developments proposed in the surrounding areas off the west coast of mainland Orkney. These developments are likely to involve the use of maintenance and support vessels of various type and size, transiting from Hoy Mouth to sites along the west coast.

10.3 Potential impact

To assess the potential impacts on navigational risk the effects of the proposed project on current and future traffic including fishing vessels, ferries and other large vessels, RNLI

lifeboats, Orkney dive boats, sailing and motor yachts and other vessel types have been considered in detail and are documented in the original Oyster 2 NSRA (ARC, 2010a).

Whilst the addition of Oyster 2b and Oyster 2c project components introduces slight changes to the hazards identified in 2010, the same potential risks remain:

- Failure of the device or infrastructure leading to buoyant components becoming a hazard to shipping; and,
- Creel fishing boats colliding with (or gear snagging on) the devices, monopile foundations or seabed infrastructure.

10.4 Management and mitigation

The risks identified above are considered to be addressed by the same mitigation measures as recommended in the 2010 report (ARC, 2010a). These mitigation measures are not the sole responsibility of Aquamarine Power but also require consideration and action by EMEC and the UKHO, and were also recommended in the wave test site NSRA (ARC 2010b):

- The shallow water test site should be charted as a separate area (maintaining a clear and adequate inshore channel) in order to show the extent of the possible hazards presented by the installation of devices there. EMEC should take the responsibility to consider this recommendation and implement any required actions.
- The starboard lateral buoy should be replaced with a special mark (only providing the recommendation above is implemented). This is the responsibility of Aquamarine Power (in liaison with EMEC).
- The UKHO should change the coverage of the relevant charts to ensure that the nature of hazards contained within the wave test site and other proposed marine renewable energy developments on the west coast of mainland Orkney are appropriately charted.

In addition, Aquamarine Power will:

- In advance of works commencing, broadcast all works by appropriate Notices to Mariners and Navigational Warnings;
- Comply with EMEC notifications procedure;
- Ensure all vessels undertaking work comply with COLREGS;
- Hold a HIRA meeting/workshop with EMEC, to be attended by all contractors;
- Agree with EMEC the method statement for the works; and,
- Consider arrangements for notification of installation activities to specific local sea users, such as Orkney Marinas and Stromness Sailing Club.

10.5 Residual impact

Should the recommendations presented in the 2010 Oyster 2a NSRA (ARC, 2010a) and subsequent addendum (for Oysters 2b and Oyster 2c) (PMSS, 2011); the residual impact is assessed to be tolerable, or **minor** and therefore not significant.

10.6 Cumulative Impact

The 2010 NSRA report (ARC, 2010a) identifies cumulative impacts as part of the assessment process as discussed above in 'Future traffic patterns'. This includes other renewable developments as well as other commercial and recreational activities associated with the routes around the wave test site. At the present time both the Lyness redevelopment project and potential wave energy developments off the west coast of the Orkney mainland are at very early planning stages and little detail is available on the vessel traffic patterns that might be associated with them. Therefore, at this stage, it is not possible to undertake a detailed assessment of potential cumulative navigational risks except to say that future developments will, potentially, influence overall navigational risks in the area as a whole in the future.

11. ACCIDENTAL DISCHARGES

The table below provides a list of all the supporting reports and documents that have been produced for the Oyster 2 project related to the accidental discharges assessment, and their location on the CD which accompanies this ES.

Relevant Document	Location on Accompanying CD
No further documents supplied with this ES.	

11.1 Introduction

This section assesses the potential for accidents or the occurrence of non-routine events likely to impact on the environment. It covers all phases of the project from installation, through operation and maintenance, and to decommissioning. This section focuses on the potential for oil, fuel or hydraulic fluid leaks or spills associated with the project i.e. accidental or non-routine events that could result in pollution in the marine environment.

Whilst there is the potential for accidental or non-routine events which may pose a hazard to navigation these are assessed through the full NSRA (Section 10) and are not the subject of this section.

11.1.1 Legislation and Guidance

Whilst there is no specific legislation or published guidance regarding accidental or non-routine pollution events associated with marine renewable energy developments the following applies:

- The International Convention for the Prevention of Pollution from Ships (MARPOL) covers pollution of the marine environment by ships from operational or accidental causes.
- Regulation 37 of Annex I of MARPOL requires that all ships of 400 gross tonnage (GT) or more carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP).

In addition to the above, the EMEC wave test site is not within a site protected by European Law under the Conservation (Natural Habitats &c) Amendment (Scotland) Regulations 2007. However, there is the potential that species from nearby protected sites will be using the wave test site area at the time of any accidental or non-routine event. Similarly EPS, which includes all cetacean species, and basking sharks which have full protection from capture or disturbance in British waters (up to 12 miles offshore) under a 1998 listing on Schedule 5 of the Wildlife and Countryside Act (1981) (as amended) and the Nature Conservation (Scotland) Act 2004, are known to use the wave test site for passage or feeding.

Due to the closed loop hydraulic system on Oyster 2a, SEPA confirmed that they did not need to authorise the use of hydraulic additives in the system under CAR Regulations.

11.1.2 Assessment Terminology

The following sections look at the identification of accidental / non-routine events during all phases of the project (excluding events that may pose a hazard to navigation). Consistent terminology for likelihood or probability has been applied throughout this ES and is applied here.

Table 11.1 below defines the terminology used to assess the likelihood / probability of accidental/non-routine events. As described in the methodology in Appendix A, the potential consequence (in this instance taking into account management and mitigation) of an accidental/non-routine event is combined with likelihood or probability to give an overall residual impact and significance ranking.

Probability Category		Definition
5	Likely	Event likely to occur more than once over the lifetime of the project
4	Possible	Possible the event will occur within the lifetime of the project
3	Unlikely	Event could occur within the lifetime of 10 similar projects, or the event has occurred on similar projects
2	Remote	A Similar event has occurred somewhere in the industry or similar industry but is not likely to occur with current practices and procedures
1	Extremely Remote	Extremely remote event that has never occurred within the industry or similar industry but is theoretically possible
0	Will Not Occur	Will not occur

Table 11.1 Terminology adopted to describe likelihood / probability

11.2 Identification of Accidental/Non-Routine Events

Hazard Identification and Risk Assessment (HIRA) workshops undertaken prior to previous Oyster deployment, and the ENVID (see Appendix A) undertaken for this project identified potential pollution events. Table 11.2 below summarises the potential accidental / non-routine pollution events, the potential spill inventory and what their likelihood is.

Event	Potential Inventory	Likelihood
Hydraulic fluid leakage from the hydraulic system (all project phases)	~ 12,400 litres for whole system (maximum inventory)	Due to the novel technology this event has been assigned a probability of '4' **Possible**
Leaks from underwater anchor drilling equipment and other handheld subsea hydraulic power tools (ancillary equipment)	Few litres	**Possible**
Oil and chemical spills and leaks from vessels (all project phases) resulting in total inventory loss	100's of litres	Based on best available data at present for offshore support vessels, assuming offshore vessels with a marine diesel inventory of 600 litres having an incident resulting in total loss of fuel inventory (taken from DETR (1999) the probability is one incident every 13,067 vessel years. This event is therefore assigned a probability of '1' **Extremely Remote**

Event	Potential Inventory	Likelihood
Oil and chemical spills and leaks from vessels (all project phases) resulting in partial inventory loss	10's of litres	The most frequently recorded spills from vessels offshore is associated with upsets in bilge treatment systems and the loss of chemicals or oil to the marine environment is usually small (UKOOA, 2006). This event is assigned a probability of '3' **Unlikely**

Table 11.2 Identification of Accidental/Non-Routine Events

11.3 Potential Environmental Effects

Spilled oil at sea can have a number of environmental and economic effects. Actual effects depend on a wide range of factors including volume and type of oil/fluid spilt, and the sea and weather conditions at the time of the spill and whether environmental sensitivities are present in the path of a spill. These environmental sensitivities will have spatial and temporal variations.

Vessels

The impact from small oil spills or leaks will be localised to the immediate vicinity of the spill and spilt oil will quickly disperse in the dynamic waters of the west coast of Orkney. Spills / leaks will most likely be small and originate from vessels during the installation phase of the project. There is also the remote likelihood of a large fuel spill, which could result in significant areas of pollution of the surrounding sea and adjacent coastline.

Drilling

Drilling activities associated with the installation of the various anchors related to the Oyster 2b and Oyster 2c project, will involve the use of a seabed mounted drilling frame or diver-held drilling equipment. The drilling equipment will have a relatively small (few litres) inventory of oil/fluid and any loss of this will be rapidly dispersed in the immediate water column.

Hydraulic System

The impact from loss of fluids from the Oyster hydraulic system will be limited due to the quantities and types of fluids in use, with a maximum inventory of up to 12,400 litres. Fluids are mostly water-based, biodegradable and have low aquatic toxicity, or are heavily diluted. In addition, the majority of the fluid inventory is combined with over 200,000 litres of fresh water therefore any loss of fluid would not be of a high concentration.

11.4 Management and Mitigation

The following management and mitigation measures will be employed, where appropriate, for the Oyster 2b and Oyster 2c project:

- Aquamarine Power has developed its own Emergency Response Plan which will address the response to accidental / non-routine events, including pollution related events. Aquamarine Power's Emergency Response Plan will be dovetailed with EMEC procedures as appropriate.
- EMEC has in place an Integrated Management System (IMS) manual. This sets out the requirements for dealing with spills or leaks stating that *the developer shall be responsible for all emergency responses and draw up appropriate procedures in*

conjunction with EMEC so as to ensure an optimal response is maintained across the whole site. In addition, EMEC operates a Permit to Work system.

- All vessels associated with the Oyster 2b and Oyster 2c project will comply with IMO/MCA codes for prevention of oil pollution and, where appropriate, will have onboard SOPEPs (i.e. vessels over 400GT).
- All contracted vessels will carry oil and chemical spill mop up kits.
- As far as possible vessels with an established track record of operating in similar waters where the conditions can become severe over a short period of time will be employed. They will also be familiar with operating conditions in the area and will adhere to all appropriate navigational standards and practices.
- Installation and major routine (planned) maintenance activities will only take place in instances where Aquamarine Power are confident that there is no risk of bad weather to avoid incidences leading to an increased risk of accidental/non routine events.
- Hydraulic and accumulator modules are designed to be isolated if necessary. Any problems will result in the problem module being isolated from the rest of the system before it is retrieved; this will prevent the release of large quantities of fluid into the water.

11.5 Residual Impact

The likelihood of a major oil spill from a vessel is extremely remote. Although the receiving environment may be considered sensitive to oil or fluid leaks and spills the quantity and type of oils and fluids, the dispersion effect of the high energy environment and the implementation of a series of management and mitigation measures will limit the potential effect on the environment. Established procedures and practices in place will ensure than an efficient and effective response will be implemented to safeguard personnel and minimise potential environmental effects. The residual significance of the Oyster 2b and Oyster 2c project in relation to accidental / non-routine events is considered to be negligible and therefore not significant.

11.6 Cumulative Risk

The EMEC wave test site has been designed for multiple technologies to be tested at the site at one time. EMEC's IMS manual and Standard Operating Procedures (SOPs) and specifically its Permit to Work system, will control multiple activities on site at any one time. This is an important factor in reducing the cumulative risk of pollution related events.

12. ENVIRONMENTAL MANAGEMENT AND MONITORING

The table below provides a list of all the supporting reports and documents that have been produced for the Oyster 2 project related to environmental monitoring, and their location on the CD which accompanies this ES.

Relevant Document	Location on Accompanying CD
Environmental Monitoring Plan – Oyster 2a and Monopile Foundations for Oyster 2b and Oyster 2c Project (Aquamarine Power, 2011)	OFFSHORE / Environmental Monitoring Plan - Oyster 2a and Additional Foundation Piles

12.1 Introduction

The Oyster 2 project will use wave energy to produce sustainable electricity. However the installation of any project in the marine environment has the potential to impact on the environment and other users of the area. Whilst the potential effects have been assessed through EIA and presented in this ES it is necessary to manage the project and implement mitigation to ensure that the project is sustainable and to minimise or mitigate any ongoing effects on the marine environment.

This section describes how environmental management and mitigation measures will be incorporated into the installation, operation and decommissioning phases of the project.

12.2 Environmental management plan

Environmental management of a project comes through the EIA process, including production of the ES, receipt of consent conditions, during stakeholder engagement, implementation of a monitoring programme, and installation, operation and decommissioning.

As a responsible developer, Aquamarine Power is keen to participate in managing and evaluating the potential impacts of the Oyster technology.

Whilst an understanding of the environment at the EMEC wave test site has informed the evolution of the Oyster 2b and Oyster 2c project, the chapters of this ES also state a number of management or mitigation commitments that have been developed during the impact assessment process and including the consideration of feedback from stakeholders. These commitments are stated in Table 12.1 below.

These commitments will be implemented as part of the management of the project through communication with the project team and any contractors with whom Aquamarine Power engages. Some commitments will also form part of a broader environmental monitoring strategy (see Section 12.3).

1. Marine Wildlife	
1.1	Continue wildlife observations post-installation to aid understanding of potential impacts on marine wildlife from the Oyster technology
1.2	Measure the underwater acoustic signature of the Oyster 2 array
1.3	During an operation involving vessels, vessels will move slowly onto site and remain slow moving or stationary throughout the installation or maintenance period

1.4	Anchor (rock, latching and stabilisation) design will aim to minimise drilling time (and therefore period over which disturbance may occur) without compromising the technical performance of the anchor	
2. Seabed Interactions		
2.1	Restrict the area of kelp removed to the footprint and immediate vicinity of the Oyster 2b and Oyster 2c devices and associated seabed infrastructure	
2.2	Ensure mattresses are restricted to the areas already cleared for kelp	
2.3	Design of anchors (rock, latching and stabilisation) will be to the minimum practical depth in order to reduce the volume of drill cuttings discharge	
2.4	Undertake a post-installation seabed survey	
2.5	Undertake a post-decommissioning seabed survey following decommissioning of the project	
3. Navigation		
3.1	Broadcast all works by appropriate Notices to Mariners and Navigational Warnings	
3.2	Comply with EMEC notifications procedure	
3.3	All vessels undertaking work will comply with COLREGS	
3.4	Hold a HIRA meeting/workshop with EMEC, to be attended by all contractors	
3.5	Communicate the method statement for the works with EMEC	
3.6	Consider arrangements for notification of installation activities to specific local sea users, such as Orkney Marinas and Stromness Sailing Club	
In addition to the Aquamarine Power commitments listed above, the EMEC wave test site NSRA was updated in 2010 (ARC, 2010) and recommended further mitigation on charting and navigational markings. These are listed below alongside the organisation with the primary responsibility		
3.7	The shallow water test site should be charted as a separate area (maintaining a clear and adequate inshore channel) in order to show the extent of the possible hazards presented by the installation of devices there	EMEC/UKHO
3.8	The starboard lateral buoy should be replaced with a special mark (only providing the recommendation above is undertaken)	Aquamarine Power
3.9	The UKHO should change the coverage of the relevant charts to ensure that the nature of hazards contained within the wave test site and other proposed marine renewable energy developments on the west coast of mainland Orkney are appropriately charted	UKHO
4. Accidental Discharges		
4.1	Undertake all activities in accordance with the EMEC permit to work system	
4.2	Ensure all Aquamarine Power emergency procedures are in accordance with EMEC SOPs and Emergency Response Plans	
4.4	Where appropriate, vessels will have onboard SOPEPs, or equivalent procedures and will comply with IMO/MCA codes for prevention of oil pollution	

4.5	Vessels will carry oil and chemical spill mop up kits
4.6	Installation and major routine (planned) maintenance activities will only take place in instances where Aquamarine Power are confident that there is no risk of bad weather to avoid incidences leading to an increased risk of accidental/non routine events.
4.7	Where possible, vessels & skippers with an established track record of operating in similar waters where the conditions can become severe over a short period of time will be employed. They will also be familiar with operating conditions in the area and will adhere to all appropriate navigational standards and practices

Table 12.1 Oyster 2b and Oyster 2c Commitments

12.3 Environmental monitoring strategy

There are considered to be two different types of monitoring:

- Performance Monitoring – to assess the project against regulatory and corporate environmental requirements; assessing progress against goals as well as gathering information to track overall environmental performance.
- Impact Monitoring – to understand the potential for, or extent of, impacts of the Oyster technology.

Performance and impact monitoring are both important components of the environmental monitoring strategy for the project. This builds on work already undertaken to understand the potential environmental impacts from the deployment of Oyster 1. Environmental monitoring for Oyster 2b and Oyster 2c will also build on the monitoring undertaken during the installation and operation of Oyster 2a; the strategy for which is presented in an Environmental Monitoring Plan (EMP) (Aquamarine Power, 2011).

12.3.1 Monitoring of Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c

Aquamarine Power has submitted an EMP to Marine Scotland for the Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c. The EMP includes an outline of monitoring proposals under the following topics:

- Seabed monitoring;
- Marine Mammal Observer (MMO) observations during installation;
- Marine wildlife monitoring;
- Measurement of underwater noise; and
- Biofouling.

The more complex of these topics, where a scope of work is necessary, are supplemented by a separate monitoring protocol.

The monitoring proposed or required for Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c has been informed by evidence and experience from the installation and operation of Oyster 1, also at the EMEC wave test site.

Aquamarine Power, subject to being granted consent for the Oyster 2b and Oyster 2c project, will update the existing Oyster 2a EMP to include consideration of Oyster 2b and Oyster 2c and, where appropriate, the specific monitoring protocols that it relates to. This approach has already been endorsed by feedback provided from Marine Scotland on the Oyster 2a EMP.

12.3.2 Performance monitoring

Aquamarine Power proposes that the monitoring strategy for the Oyster 2b and Oyster 2c project incorporates the following performance monitoring measures:

- Seabed monitoring – Aquamarine Power will monitor the recovery of kelp during the course of the project, and the dispersal of any drill cuttings which remain on the seabed following installation. In addition, Aquamarine Power will record footage of the seabed post-installation and post-decommissioning which, alongside pre-installation footage, will provide a record of how seabed species interact with Oyster over time, as well as a comparison of the pre-installation seabed with the post-decommissioning seabed.

- Biofouling – Following deployment of Oyster 2b and Oyster 2c, if it is found that the biofouling is becoming an issue then the operations team may implement a process to record biofouling of the devices.

In addition to these active performance monitoring measures, Aquamarine Power will, in line with its internal procedural requirements, record any incidents of accidental discharges during the operation of Oyster 2b and Oyster 2c.

12.3.3 Impact Monitoring

Aquamarine Power's environmental monitoring also includes impact monitoring measures. These will expand on those listed above in the Oyster 2a and monopile foundations for Oyster 2b and Oyster 2c EMP (Aquamarine Power 2011), namely:

- Marine wildlife monitoring – Aquamarine Power will continue the marine wildlife monitoring of the inner bay area around the Oyster 2 Array, particularly looking at any disturbance or displacement effects, or general wildlife interactions with the Oyster 2 Array. Data analysis will be undertaken within schedules agreed with Marine Scotland and the survey methodology adapted as required in light of the results of analysis. Ongoing discussions with Marine Scotland will inform the level of effort and how long monitoring will continue.

- Underwater noise monitoring – Aquamarine Power will continue to develop its underwater noise monitoring protocol, in conjunction with Marine Scotland and EMEC, in order to establish an underwater acoustic signature for the Oyster technology.

The impact monitoring proposed is based on what is feasible at the scale of this project. In addition, Aquamarine Power is aware of a number of studies commissioned by Marine Scotland, Scottish Natural Heritage and The Crown Estate which involve research or further investigation into the potential environmental impacts of marine (wave and tidal) renewable energy projects and how to monitor them. Where appropriate, the results of these studies will be used by Aquamarine Power to aid understanding of the Oyster technology.

12.4 Conclusion

The monitoring strategy presented here is an important aspect of Aquamarine Power's wider development strategy. Monitoring undertaken for Oyster 2b and Oyster 2c (and for the Oyster 2 Array as a whole) needs to be fit for purpose and appropriate to the scale of development and the projects' location within the EMEC wave test site. However, monitoring is also undertaken to help define the likely extent of any potential impacts or identify performance improvements in the context of the intended commercial development of the Oyster technology. This monitoring strategy has been designed to meet all of these criteria.

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APPENDIX A EIA METHODOLOGY AND ENVID

Introduction

This Appendix provides details on the Environmental Impact Assessment (EIA) methodology used for the Oyster 2b and Oyster 2c project, and presents the results of the Environmental Issues Identification (ENVID) processes that have taken place during the EIA process.

Significance of Environmental Effects

The regulations require that the EIA should consider the significance of the effects of the development on the environment. The decision process related to defining whether or not a project is likely to significantly impact on the environment is the core principal of the EIA process. The regulations do not provide specific definition relating to what significance actually is, however the methods used for identifying and assessing effects should be transparent and verifiable. The method developed here has been done so in accordance with the principals and guidance provided by SNH in their handbook on EIA (SNH, 2005).

After reviewing various approaches to the evaluation of significance, certain common policies exist which have been taken into account for each of the effects related to the proposed project. These include:

- Environmental significance is a value judgement;
- The degree of environmental significance is related to the specific impact;
- The significance of the impact is related to sensitivity of the receptor and its capacity to accommodate change;
- The amount any type of change, often referred to as the impact magnitude which includes timing, scale, size, and duration of impact; and
- Potential effects of the proposed project may be wide ranging in nature, for example they could be direct, indirect; short, medium or long term, permanent or temporary and have positive or negative effects;
- The likelihood of a specific effect occurring. For example, an effect which is unlikely, or the likelihood of which is uncertain, may be significant if a serious or irreversible adverse effect would be the outcome of it occurring.

As the determination of the significance of an impact is subjective, primarily based on professional judgement, this highlights the requirement for a thorough scoping and consultation process throughout the development of the project.

Once the scope of the EIA studies has been established, it is particularly important to standardise the description and assessment of all the effects due to the development. Despite this being a subjective process, a defined methodology, outlined below, is used to make the assessment as objective as possible. As the environmental factors under consideration can vary considerably depending on what is being assessed, there is likely to be some variation in this process.

The evaluation of impact significance follows the following process:

- Identification of the baseline conditions and the sensitivity of the receptor.
- Identification of the magnitude of change upon the receptor.

- Assessing the consequence of an impact based on regulatory, stakeholder and environmental factors.
- Assessing the likelihood of impact.
- Identification of the impact significance.

Definitions for the sensitivity of receptors and magnitude of change have been developed on a topic by topic basis and are described and presented in each topic chapter. The sensitivity of a receptor to the proposed project considers the specific nature of the receptor (or group of receptors) and it's (their) capability to accommodate change. Assessment of the magnitude of change upon the receptor takes into account the timing, scale, duration and recovery from an impact. The categories used for sensitivity and magnitude are given in the table below.

Sensitivity of Receptor	Magnitude of Impact
Very high	Severe
High	Major
Medium	Moderate
Low	Minor
Negligible	Negligible

Sensitivity and Magnitude Categories

The sensitivity of receptor and magnitude of impact are combined to define the environmental consequence of the impact. The environmental consequence may then be combined with a stakeholder and regulatory context to give an overall consequence ranking. An average of the consequence rankings for each of environmental, stakeholder and regulatory categories is used to give an overall consequence ranking.

Magnitude	Sensitivity				
	Very High	**High**	**Medium**	**Low**	**Negligible**
Severe	Severe	Severe	Major	Moderate	Minor
Major	Severe	Major	Major	Moderate	Minor
Moderate	Major	Major	Moderate	Minor	Negligible
Minor	Moderate	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

Environmental Consequence Rankings

ID	Consequence	Environmental	Regulatory	Stakeholder
5	Severe	See previous table for environmental consequence rankings	**Activity** prohibited. Likely major breach in compliance resulting in prosecution	International concerns
4	Major		Possible major non-compliance	National concerns
3	Moderate		Possible minor non-compliance	Regional concerns
2	Minor		Regulatory terms or corporate policy set defined conditions	Local concerns
1	Negligible		No specific statutory control	Individual concerns
0	Positive		N/A	No public interest or improves aspect of community importance

Overall Consequence Rankings

In order to finally assess the significance of impact (or risk), the overall consequence ranking is combined with a frequency/probability of the impact occurring.

Frequency / Probability Category		Definition
5	Continuous / Likely	Continuous or permanent change over more than 5 years. Event likely to occur more than once over the lifetime of the project
4	Regular / Possible	Continuous or permanent change over less than 5 years, or a regular event over more than 3 years. Possible the event will occur within the lifetime of the project
3	Intermittent / Unlikely	Regular change over less than 3 years or intermittent change over more than 3 years. Event could occur within the lifetime of 10 similar projects, or the event has occurred on similar projects
2	One-off Event / Remote	One-off event over the lifetime of the project with duration of several weeks, or an event happening once per year for less than 24 hours. A Similar event has occurred somewhere in the industry or similar industry but is not likely to occur with current practices and procedures
1	One-off Event / Extremely Remote	One-off event over the lifetime of the project with duration of less than 5 days. Extremely remote event that has never occurred within the industry or similar industry but is theoretically possible
0	Will Not Occur	Will not occur

Probability and/or Frequency Definitions

The overall impact significance ranking is derived by combining consequence and likelihood via the matrix presented in the table below.

Consequence		Likelihood					
		5	4	3	2	1	0
5	Severe	25	20	15	10	5	0
4	Major	20	16	12	8	4	0
3	Moderate	15	12	9	6	3	0
2	Minor	10	8	6	4	2	0
1	Negligible	5	4	3	2	1	0
0	Positive	0	0	0	0	0	0

Significance Rankings

In terms of the significance of impacts in relation to the EIA regulations:

- **Severe** – Intolerable risk/highly significant – requires immediate action
- **Major** – Intolerable risk/highly significant – requires action
- **Moderate** – Significant – requires additional control measures and/or management
- **Minor** – Not significant – however will require some management to ensure remains within acceptable limits
- **Negligible** – Not significant
- **Positive** – to be encouraged

Cumulative impacts are considered throughout the EIA process and discussed in each impact chapter. The Crown Estate has commissioned a strategic study into cumulative impact assessment for marine renewable projects, however nothing has been published on this study to date.

Consideration of Design Options

The EIA has assessed any design options as they relate to the specific study areas. In all cases the worst case option has been chosen to assess particular impacts in the greatest detail.

Mitigation and Monitoring

Where significant (ranked Moderate or higher) effects related to the deployment of Oyster 2b and Oyster 2c exist, it is important to consider mitigation measures. Such measures should remove, reduce or manage the effect to a point where the residual significance of that impact is reduced to an acceptable level.

Monitoring is also considered an important post-consent tool. This will allow the effects of any mitigation measures to be monitored and also study the accuracy of predicted effects.

Monitoring is a key component of the 'Survey, Deploy and Monitor' strategy which will aid the development of the marine renewable industry whilst improving understanding of how individual technologies interact with the environment.

Environmental Issues Identification (ENVID)

The ENVID process involves assessing those issues that have been identified 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 and the ongoing EIA process, and ultimately to provide a holistic, environmentally sensitive design. Due to the potential navigational issues that are associated with the deployment of marine renewables energy devices at sea, this EIA has also been informed by an NSRA.

The ENVID process has been applied throughout the Oyster 2 project. An initial ENVID was undertaken during EIA scoping and the results incorporated into the EIA Scoping Report. This was carried forward and updated during the full EIA following receipt of the Scoping Opinion. The results of the ENVID process are summarised in the ENVID matrix. The following pages present the ENVID matrix.

	Process	Activity	Aspect	Routine or Non-Routine	Receptors																Consequence				Frequency/Probability	Final (Whole Integer)	Significance	Comments	Residual Consequence	Residual Probability/Frequency	Residual Impact/Significance
					Water Quality/Bathymetry	Seabed/geological/sediment transport	Flora and Fauna	Conservation	Air Quality (local)	Metocean	Ozone Depletion	Global warming	Resource and Energy Use	Other Sea Users/Neighbours	Terrestrial	Landscape/Seascape	Archaeology	Waste	Legal compliance	Reputation and/or Stakeholder	Liability	Regulatory	Environmental	Stakeholder	Final							
1	Installation, maintenance & decommissioning	Vessel activities	Atmospheric emissions	R					✓													1	1	1	1	3	1	3	Atmospheric emissions are rapidly dispersed naturally. Winds in Orkney average Force 3 / 4 in summer and Force 6 in winter	1	1	1
2	Installation, maintenance & decommissioning	Vessel activities	Noise and vibration (engines) resulting in disturbance to wildlife	R			✓	✓														3	3	3	3	4	3	12	Installation is planned for April - September 2012 for Oyster 2b and between April and September 2013 for Oyster 2c. If possible the installation of both Oyster 2b and Oyster 2c will be in April to September 2012. Installation will be undertaken by multi-cats, tugs and dive boats Routine maintenance is expected to be 10 days every 6 months between May and September using a small workboat, for each Oyster device Decommissioning would be expected to take up to 30 days	1	2	2
3	Installation, maintenance & decommissioning	Vessel activities	Visual and seascape impacts due to vessel activity - within a National Scenic Area	R				✓						✓		✓				✓		2	1	1	1	3	1	3	Installation is planned for April - September 2012 for Oyster 2b and between April and September 2013 for Oyster 2c. If possible the installation of both Oyster 2b and Oyster 2c will be in April to September 2012. Installation will be undertaken by multi-cats, tugs and dive boats Routine maintenance is expected to be 10 days every 6 months between May and September using a small workboat, for each Oyster device Decommissioning would be expected to take up to 30 days Vessels taken off site when not in use; expected to be a temporary and intermittent impact of short duration in an area of existing concentrated vessel activity (EMEC Wave Test Site)	1	1	1
4	Installation, maintenance & decommissioning	Vessel activities	Waste disposal from vessel operations	NR	✓													✓	✓			2	1	1	1	1	1	1	All wastes will be disposed of in line with legislative requirements. No waste will be disposed of overboard	1	1	1

	Process	Activity	Aspect	Routine or Non-Routine	Receptors																Consequence				Frequency/Probability	Final (Whole Integer)	Significance	Comments	Residual Consequence	Residual Probability/Frequency	Residual Impact/Significance
					Water Quality/Bathymetry	Seabed/geological/sediment transport	Flora and Fauna	Conservation	Air Quality (local)	Metocean	Ozone Depletion	Global warming	Resource and Energy Use	Other Sea Users/Neighbours	Terrestrial	Landscape/Seascape	Archaeology	Waste	Legal compliance	Reputation and/or Stakeholder	Liability	Regulatory	Environmental	Stakeholder	Final							
5	Installation, maintenance & decommissioning	Vessel activities	Potential increased navigation risk to vessels due to the presence of working vessels and plant associated with the Oyster 2 project; particularly fishing and recreational vessels which are the most frequent users of the area	R										✓						✓		4	1	2	4	3	4	12	The navigational risks for the installation, maintenance and decommissioning phases have been addressed in a NSRA in accordance with current MCA and DECC guidance. This involved consultation with both local and national stakeholders. The risks associated with installation operations conducted concurrently with other developers (Simultaneous Operations - SIMOPS) will be addressed by additional Hazard Identification and Risk Assessment (HIRA) under the EMEC permit to work system	2	1	2
6	Installation, maintenance & decommissioning	Vessel activities	Potential for increased risk of incident from presence of Oyster 2 project related vessels at support facilities (e.g. Lyness) and through constrained waters (e.g. Hoy Mouth) used to access the site	R										✓						✓		4	1	2	4	3	4	12	The navigational risks for the installation, maintenance and decommissioning phases have been addressed in a NSRA in accordance with current MCA and DECC guidance. This involved consultation with both local and national stakeholders. The risks associated with installation operations conducted concurrently with other developers (Simultaneous Operations - SIMOPS) will be addressed by additional Hazard Identification and Risk Assessment (HIRA) under the EMEC permit to work system	2	1	2
7	Installation, maintenance & decommissioning	Vessel activities	Potential risk to fishing vessels due to presence and limited manoeuvrability of vessels. Hazard presented to fisheries by vessel moorings and subsea pipelines	R										✓						✓		4	1	2	4	3	4	12	Risk mitigation / control has been determined by the NSRA, including the promulgation of maritime safety information through appropriate channels, and the suitability and competence of marine contractors and vessels. In addition, the risks associated with vessel operations will be addressed by the additional Hazard Identification and Risk Assessment (HIRA) under the EMEC permit to work system	2	1	2
8	Installation, maintenance & decommissioning	Vessel activities	Exclusion / restriction of an area used for fishing, and knock on effects, particularly on creel fishing	R										✓						✓		2	2	3	2	3	2	6	EMEC has ongoing consultation with local fishermen with regard to any issues associated with the wave test site; consultation with local fisheries representatives with regard to this specific deployment did not raise any significant issues. EMEC has commenced a fisheries research project involving local fishermen	1	1	1

	Process	Activity	Aspect	Routine or Non-Routine	Receptors																Consequence				Frequency/Probability	Final (Whole Integer)	Significance	Notes, Environmental Management or Mitigation	Residual Consequence	Residual Probability/Frequency	Residual Impact/Significance
					Water Quality/Bathymetry	Seabed/geological/sediment transport	Flora and Fauna	Conservation	Air Quality (local)	Metocean	Ozone Depletion	Global warming	Resource and Energy Use	Other Sea Users/Neighbours	Terrestrial	Landscape/Seascape	Archaeology	Waste	Legal compliance	Reputation and/or Stakeholder	Liability	Regulatory	Environmental	Stakeholder	Final							
9	Installation, maintenance & decommissioning	Vessel activities	Oil spill to sea from vessels	NR	✓															✓		3	3	3	3	2	3	6	The risk of collision (leading to oil spill) has been addressed in the NSRA. In addition, the risk from Simultaneous Operations (SIMOPS) will be addressed in a separate HIRA All marine subcontractors' vessels will have a valid Shipboard Marine Pollution Emergency Plan including a Shipboard Oil Pollution Emergency Plan (SOPEP) or equivalent procedures as required. All vessels are audited in accordance with MCA regulations and where appropriate carry oil and chemical spill mop-up kits	1	1	1
10	Installation, maintenance & decommissioning	Vessel activities	Direct and indirect displacement of wildlife during installation and decommissioning	R			✓	✓														3	3	5	5	3	5	15	EMEC and Aquamarine Power wildlife monitoring is helping to establish the use of the area by bird species	1	2	2
11	Installation, Maintenance & Decommissioning	Installation and decommissioning of Oyster devices, components and seabed infrastructure	Equipment lost during drilling or lowering/raising of the device components to/from the seabed during installation, maintenance and decommissioning	NR										✓						✓	✓	4	2	4	4	2	4	8	Towing vessels operated by MCA approved crew Installation methodologies and procedures will be subject to an appropriate risk assessment Full inspection during fabrication process. If an individual line or attachment fails it will not result in the disconnection of the device from its position EMEC has a series of Emergency Response Plans (ERPs) and Standard Operating Procedures (SOPs) and all plans drawn up by Aquamarine Power will be fully integrated with these	1	1	1
12	Installation	Installation of anchors and foundation preparation	Modification and disturbance of seabed and loss of and disturbance to seabed habitats; including physical disturbance and kelp removal	R	✓	✓	✓											✓				2	3	3	3	4	3	12	Specialist study undertaken to investigate kelp recovery issues (Johnston, 2010) Seabed survey undertaken of the proposed deployment area Impact assessment undertaken to assess seabed impacts	1	2	2

	Process	Activity	Aspect	Routine or Non-Routine	Receptors																Consequence				Frequency/Probability	Final (Whole Integer)	Significance	Notes, Environmental Management or Mitigation	Residual Consequence	Residual Probability/Frequency	Residual Impact/Significance
					Water Quality/Bathymetry	Seabed/geological/sediment transport	Flora and Fauna	Conservation	Air Quality (local)	Metocean	Ozone Depletion	Global warming	Resource and Energy Use	Other Sea Users/Neighbours	Terrestrial	Landscape/Seascape	Archaeology	Waste	Legal compliance	Reputation and/or Stakeholder	Liability	Regulatory	Environmental	Stakeholder	Final							
13	Installation	Installation of anchors and foundation preparation	Contamination of seabed habitat from drilling mud discharges	R	✓	✓	✓											✓				2	3	3	3	4	3	12	Seabed survey undertaken of the proposed deployment area Impact assessment undertaken to assess seabed impacts	1	2	2
14	Installation	Installation of anchors	Installation noise - disturbance to fish and marine mammal species during the drilling of anchors	R			✓	✓														4	4	5	4	3	4	12	Installation is planned for April - September 2012 for Oyster 2b & 2c, although there is an option to install Oyster 2c between April and September 2013. If possible the installation of both Oyster 2b and Oyster 2c will be in April to September 2012. Drilling of anchors may take up to approximately 20 days for each of Oyster 2b & 2c. Subacoustech Environmental Limited commissioned to review previously completed underwater noise assessment with regards the drilling of anchors. Impact assessment undertaken to assess impacts on marine wildlife	1	2	2
15	Installation	Installation of anchors and foundation preparation	Damage to marine archaeological and cultural heritage interests	R													✓					2	1	3	2	2	2	4	A desk based assessment identified that there is no known presence of archaeology in the area, and that the likelihood of survival of such items in the environment at Billia Croo is minimal (ORCA, 2010) County Archaeologist confirmed no further work required	1	1	1
16	Installation	Installation and decommissioning of anchors and foundation preparation	Economic impact during installation and decommissioning	R																					0			0	During installation of Oyster 1 at EMEC, Aquamarine Power made considerable use of local Orkney based services (£1M+).			0
17	Installation	Installation of WECs onto monopile foundations	Discharge of grout during routine flushing of grout lines	R	✓		✓															1	1	1	1			3	Very small quantities likely to be rapidly dispersed in the receiving environment	1	1	1

	Process	Activity	Aspect	Routine or Non-Routine	Receptors																Consequence				Frequency/Probability	Final (Whole Integer)	Significance	Comments	Residual Consequence	Residual Probability/Frequency	Residual Impact/Significance
					Water Quality/Bathymetry	Seabed/geological/sediment transport	Flora and Fauna	Conservation	Air Quality (local)	Metocean	Ozone Depletion	Global warming	Resource and Energy Use	Other Sea Users/Neighbours	Terrestrial	Landscape/Seascape	Archaeology	Waste	Legal compliance	Reputation and/or Stakeholder	Liability	Regulatory	Environmental	Stakeholder	Final							
18	Operation	Operation of Oyster devices	Wildlife interaction - avoidance / displacement	R			✓	✓														3	4	5	4	3	4	12	Aquamarine Power survey and data analysis of inner bay area, and use of EMEC collected data Impact assessment undertaken to assess impacts on marine wildlife (birds, marine mammals and fish) EPS licenses will be applied for as required Ongoing marine wildlife monitoring of inner bay area	2	1	2
19	Operation	Operation of Oyster devices	Wildlife interaction - collision / entanglement	R			✓	✓														4	4	5	4	3	4	12	No information / data is presently available to ascertain if this is a significant issue. No industry wide accepted method of monitoring interactions with wave devices. Operational monitoring of Oyster 1 has not indicated the potential for any significant effects. Impact assessment undertaken to assess impacts on marine wildlife (birds, marine mammals and fish). EPS licences will be applied for as required	2	1	2
20	Operation	Operation of Oyster devices	Wildlife interaction - acoustic disturbance	R			✓	✓														4	4	5	4	3	4	12	It is not anticipated that there will be any significant acoustic output associated with the operation of Oyster 2, however Aquamarine Power are proposing to investigate and monitor the operational acoustic signature of Oyster 2a relative to the high-energy baseline environment to help inform future impact assessment EPS licenses will be applied for as required	2	1	2

	Process	Activity	Aspect	Routine or Non-Routine	Receptors																Consequence				Frequency/Probability	Final (Whole Integer)	Significance	Comments	Residual Consequence	Residual Probability/Frequency	Residual Impact/Significance
					Water Quality/Bathymetry	Seabed/geological/sediment transport	Flora and Fauna	Conservation	Air Quality (local)	Metocean	Ozone Depletion	Global warming	Resource and Energy Use	Other Sea Users/Neighbours	Terrestrial	Landscape/Seascape	Archaeology	Waste	Legal compliance	Reputation and/or Stakeholder	Liability	Regulatory	Environmental	Stakeholder	Final							
21	Operation & Maintenance	Presence of Oyster 2b, 2c and seabed infrastructure	Changes in near field and far field wave and current regimes due to presence of devices in the water column. This site is within a large GCR site designated for its coastal geology	R	✓	✓																1	2	1	1	2	1	2	It is likely that the presence of the Oyster devices will cause some changes to the hydrodynamic regime in the surrounding area. It is expected that localised currents will be created in the immediate vicinity of the device but any changes further afield will be small. Since Oyster extracts power from the waves, there will be a shadow effect with a reduction in wave power on the shoreward side of the three Oyster 2 devices but this reduction is likely to be negligible and unlikely to result in any significant effects over and above the natural variation that takes place along such an exposed coastline. There will also be a small amount of wave reflection of the seaward side of the device but it is expected that this effect will be limited to the immediate vicinity of the device. As the amount of sediment in the area is very small, there will be no significant changes to sediment transport	1	1	1
22	Operation & Maintenance	Presence of Oyster 2b, 2c and seabed infrastructure	Modification of seabed and intertidal habitats from the long term presence of the devices and vessel moorings	R		✓	✓															2	3	3	3	4	3	12	Evidence from Oyster 1 after 6 months suggested a rapid accumulation of flora will be expected on and around the devices and seabed infrastructure Impact assessment undertaken to assess seabed impacts	1	2	2
23	Operation & Maintenance	Presence of Oyster 2b, 2c and seabed infrastructure	Scouring around device foundations and other subsea infrastructure	R		✓	✓															1	2	2	2	2	2	4	Seabed survey indicated little sediment present across the deployment site. No scouring issues anticipated	1	1	1
24	Operation & Maintenance	Presence of Oyster 2b, 2c and seabed infrastructure	Visual and seascape impact	R										✓		✓				✓		2	1	1	1	3	1	3	Long term impact of devices breaking the surface in an NSA Located in a designated wave test site alongside a number of other surface-piercing devices Visibility of device is limited to some nearby residences and walking and transport routes in the immediate vicinity Majority of devices will be below the sea surface although at low water up to approximately 4 m of the device may be visible above the surface	1	1	1

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25	Operation & Maintenance	Presence of Oyster 2b, 2c and seabed infrastructure	Damage caused to fishing gear due to presence of devices and associated subsea infrastructure	R										✓						✓		2	2	4	4	3	4	12	Risk mitigation / control has been determined by the NSRA, including appropriate marking in accordance with IALA Recommendation O-139 and as agreed with the NLB, the promulgation of maritime safety information through appropriate channels, and appropriate charting of the deployment area	1	1	1
26	Operation & Maintenance	Presence of Oyster 2b, 2c and seabed infrastructure	Exclusion / restriction of fishing activities from deployment area	R										✓						✓		2	2	3	4	3	4	12	EMEC has ongoing consultation with local fishermen with regard to any issues associated with the wave test site; consultation with local fisheries representatives with regard to this specific deployment did not raise any significant issues. EMEC has commenced a fisheries research project involving local fishermen	1	1	1
27	Operation & Maintenance	Presence of Oyster 2b, 2c	Navigation risk due to the presence of devices in the water column	R										✓							✓	4	1	4	4	3	4	12	The navigational risks for the presence of the Oyster 2 Array have been addressed in a NSRA in accordance with current MCA and DECC guidance. This involved consultation with both local and national stakeholders	2	1	2
28	Operation & Maintenance	Use of local harbour facilities by maintenance vessels	Increased navigation risk from presence of maintenance vessels between the deployment area and local harbours	R										✓							✓	4	1	2	4	3	4	12	Risk Mitigation / Controls have been determined by the NSRA including liaison/communication with the harbour authority, use of facilities of adequate size and development of management plans in line with the EMEC SOPs	2	1	2
29	Operation & Maintenance	Discharges to sea	Leaching of antifoulants into water column	NR	✓																	2	2	2	2	2	2	4	Any nominal leaching will be rapidly dispersed in the turbulent receiving environment	1	1	1
30	Operation & Maintenance	Discharges to sea	Discharge from the devices' hydraulic systems (including pipelines)	NR	✓									✓				✓				2	3	3	3	2	3	6	Wherever possible environmentally friendly / non-toxic fluids have been selected. In the unlikely event of a leak / spill to sea the relatively small, and already dilute, inventory will be quickly dispersed in turbulent waters Natural degradation of such small inventories is considered the best approach EMEC has a series of ERPs and SOPs and all plans drawn up by Aquamarine Power will be fully integrated with these	1	1	1

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					Water Quality/Bathymetry	Seabed/geological/sediment transport	Flora and Fauna	Conservation	Air Quality (local)	Metocean	Ozone Depletion	Global warming	Resource and Energy Use	Other Sea Users/Neighbours	Terrestrial	Landscape/Seascape	Archaeology	Waste	Legal compliance	Reputation and/or Stakeholder	Liability	Regulatory	Environmental	Stakeholder	Final							
31	Operation & Maintenance	Operation of Oyster devices	Loss of device components	NR										✓							✓	4	2	3	4	2	4	8	Engineering design will undergo third party verification to confirm suitability for deployment in extreme environmental conditions HIRA undertaken prior to installation which will identify suitable mitigation / contingency	1	1	1
32	Decommissioning	Waste disposal of components	Disposal of component parts on culmination of testing period	NR														✓				4	2	3	4	2	4	8	All items disposed of will be done so in line with legislative requirements and commitments made in the decommissioning plan at the time of disposal to avoid unnecessary environmental impact	1	1	1
33	Decommissioning	Removal of components	Clearance of kelp and cutting down of piles to seabed level	R	✓	✓	✓											✓				2	2	2	2	2	3	6	Specialist study undertaken to investigate kelp recovery issues (Johnston, 2010) Seabed survey undertaken of the proposed deployment area Impact assessment undertaken to assess seabed impacts	1	1	1