Environmental Appraisal (EA)

for the

Argyll Tidal Demonstrator Project

(December 2013)

A single unit demonstration of Nautricity's CoRMaT tidal stream turbine technology to be deployed in the coastal waters of the Mull of Kintyre, Scotland.

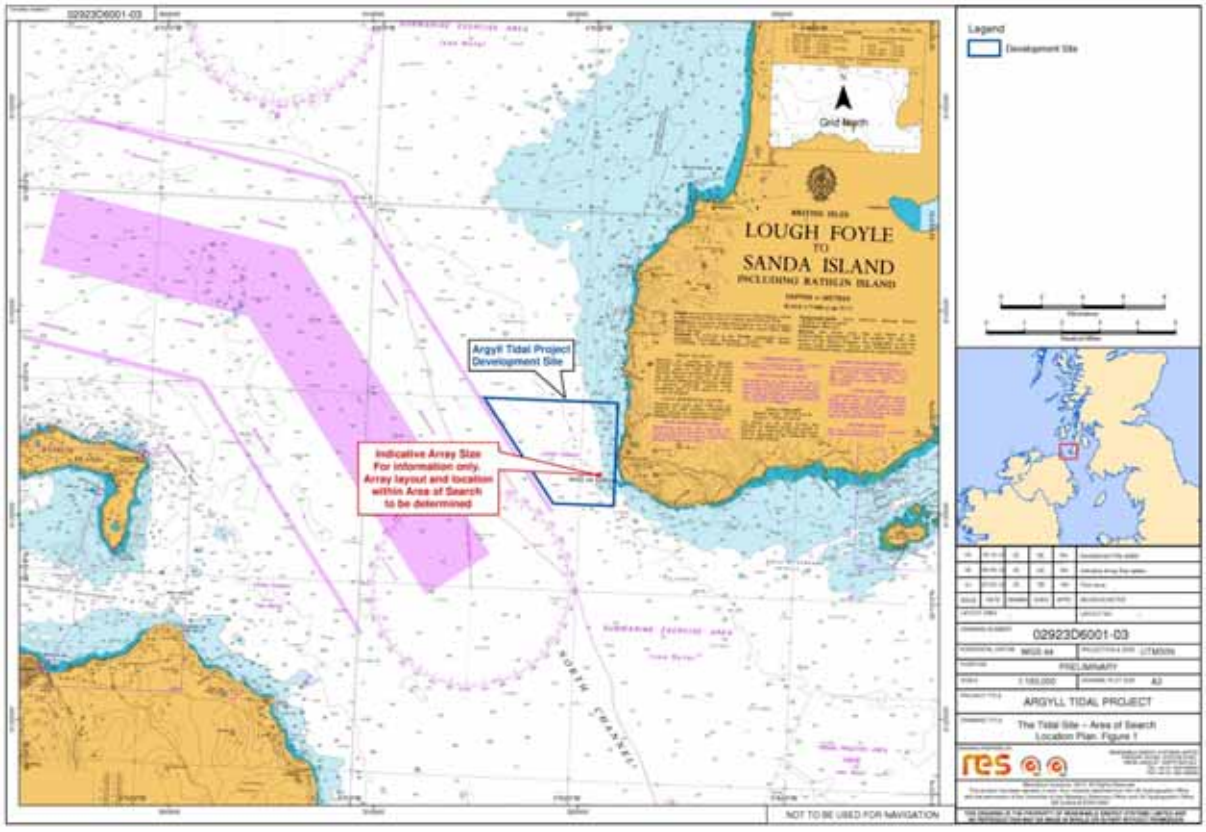
CoRMaT at the Port of Montrose

1 INTRODUCTION

1.1 BACKGROUND

1. In October 2011, Argyll Tidal Limited (ATL) ("the Applicant") entered into an Agreement for Lease with The Crown Estate under Section 3 of the Crown Estate Act 1961. This agreement initiated the investigation of the potential for development of a demonstration tidal energy array of up to 3 MW scale ("the Development") to be located in the North Channel off the western coast of the Mull of Kintyre, Argyll and Bute, Scotland ("the Development Site"). The Development Site location is shown on Figure 1.1.

Figure 1.1 – Development Site location



2. ATL is working with Nautricity Limited (NL), a Scottish developer of tidal generation technology. NL has developed the 500 kW CoRMaT device. It was originally proposed that up to 6 of these devices would be deployed at the Development Site subject to the appropriate consents and licences being granted. Consent to construct and operate the Development would fall under Section 36 of the Electricity Act 1989 and a Marine Licence would also be required under the Marine Scotland Act 2010.

3. Schedule 2 of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations (2000) requires that all projects falling under S36 of the Electricity Act be screened to determine whether an Environmental Statement will be required to accompany the consent application. Accordingly, an opinion on a proposed scope for environmental impact assessment was requested from the Marine Scotland Licensing Operations Team (MS-LOT) in June 2012. MS-LOT responded to this request in September 2012.

4. During the feasibility and design stages of the Development and in parallel to the environmental monitoring that was undertaken to support the associated EIA, ATL sought a grid connection offer

from the local Distribution Network Operator (DNO) Scottish Hydro Electric Power Distribution (SHEPD). Due to Transmission Network constraints in the wider Argyll and Bute region and the limited capacity of the local Distribution Network, for technical reasons it became clear that without construction of extensive and costly new grid infrastructure it would not be possible to connect more than a single CoRMaT device to the existing electricity network.

5. The Applicant decided to abandon plans for a multi-device array and refocused the Development to a single 500kW device demonstration. As the capacity of the Development was now less that 1MW, MS-LOT confirmed that the Development could be consented under a Marine License only. MS-LOT also confirmed that consent application would require robust supporting environmental information rather than a formal Environmental Statement (ES) under the Environmental Impact Assessment (EIA) Regulations.

6. As the Development would also include onshore elements to facilitate the connection of the device to the existing grid connection, an onshore planning application to the local planning authority would also be required.

7. ATL appointed RES Offshore[1] ("the Agent"), a business of Renewable Energy Systems Limited (RES), to undertake the development activities for the site and to secure the necessary consents to enable deployment of the single CoRMaT device.

1.2 DOCUMENT PURPOSE AND STRUCTURE

8. The Applicant is applying to MS-LOT for a Marine License to deploy and operate the Development and to Argyll and Bute Council for planning permission for the onshore elements of the Development.

9. This document is an Environmental Appraisal (EA) for the Development that has been collated by the Agent to provide information to MS-LOT, Argyll and Bute Council, statutory consultees and other interested parties about the proposed development and its likely environmental effects. The purpose is to identify likely significant environmental impacts so that these can be taken into account in arriving at the planning and consenting decisions.

10. The document has been informed by a range of desk studies, onshore and offshore site investigation, consultation with stakeholders and a 12 month environmental monitoring programme. Although the scoping responses received relate to a larger multi-device array that is not being advanced, the information provided is of relevance and has been considered in the Development design and this EA.

[1] www.res-offshore.com

12. The document contains information on all of the relevant environmental matters and consists of the following chapters:

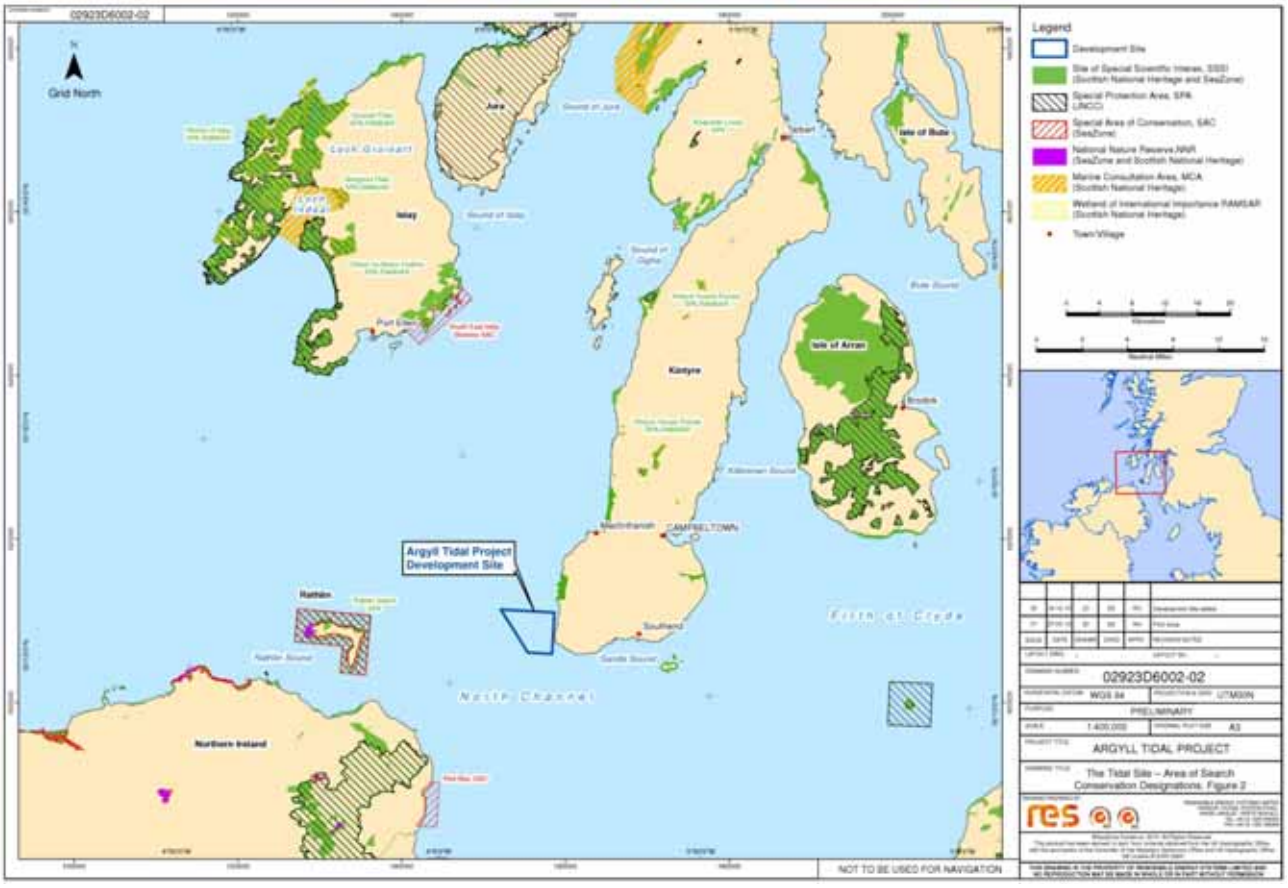
    1. Introduction
    2. Legislation and Policy
    3. Site Selection and Project Evolution
    4. Project Description
    5. Installation, Operation and Decommissioning
    6. Physical Environment
    7. Benthic Ecology
    8. Marine Mammals
    9. Basking Shark
    10. Fish and Shellfish
    11. Marine Birds
    12. Cultural Heritage
    13. Commercial Fisheries, Shipping and Navigation and Military
    14. Seascape, Landscape, Tourism and Recreation, Socio-Economics and Traffic
    15. Terrestrial Ecology
    16. Summary

13. Although the document is not a formal EIA, in general the individual chapters seek to determine the characteristics of the site, consider the potential effects of the Development, consider any mitigation measures that will minimise the potential effects and then conclude whether any residual effects are likely to be significant.

14. Finally, irrespective of whether a project requires EIA, assessment is required to adhere to relevant legislation relating to protected sites, habitats and species. Where relevant the chapters also consider whether there is likely to be a significant effect under the terms of the Habitats Regulations.

15. For information, the environmental designations in the wider region are shown on Figure 1.2 and discussed further in the relevant EA chapters.

Figure 1.2 – Environmental Designations



1.3 CONTACT DETAILS

16. Contact details for the Agent and the Applicant are provided below. Please direct enquiries to the Agent where possible.

The Agent

Trading Title	RES Ltd
Address	Colonsay House GSO Business Park East Kilbride Lanarkshire G74 5PG
Tel.	0141 404 5538
Name of Contact	Calum Robertson
Position within Company	Marine Energies Engineer
Email	calum.robertson@res-offshore.com

The Applicant

Trading Title	Argyll Tidal Ltd
Address	5 St. Vincent Place Glasgow G1 2DH
Tel.	0141 275 4850
Name of Contact	Cameron Johnstone
Position within Company	Chief Executive Officer

2 LEGISLATION AND POLICY

2.1 INTRODUCTION

1. In this chapter we outline our understanding of the key policies and legislation governing the development. Aspects covered are:

    - general greenhouse gas and renewable policies,
    - marine planning,
    - the licensing and consenting regime,
    - environmental legislation.

2.2 GENERAL GREENHOUSE GAS AND RENEWABLES POLICIES

2.2.1 International

2. At present, there are no internationally agreed and binding targets for reductions in greenhouse emissions targets. The 1997 Kyoto Protocol, which set targets up to 2012 has now expired. As part of that agreement, the then 15 European Union member states committed to a collective 8% reduction. Beyond 2012, the EU has committed to a 20% reduction, again relative to 1990, by 2020.

3. Under the **EU Directive on Renewable Energy, 2009/28/EC**, there is a requirement for 20% of total energy consumption within the EU member states to be met by renewable by 2020. The target set for the UK is 15%.

2.2.2 United Kingdom

4. Through the Kyoto Protocol, the UK had a legally binding target to reduce emissions of greenhouse gases by 12.5% below 1990 levels in the period 2008-2012. That target was exceeded.

5. The **UK's fourth carbon budget** was legislated in June 2011. It covers the period 2023-27, and commits the UK to reduce greenhouse gas emissions by 32% in 2025 on 2012 levels (50% on 1990 levels). The budget is intended to maintain a cost-effective path to meeting the 2050 target in the Climate Change Act (i.e. to reduce emissions by at least 80% relative to 1990).

6. The **UK Renewable Energy Strategy** seeks to guide the UK towards achieving the target. It highlights that in order to meet the overall 15% target set by the EU for the UK, 30% of electricity should be generated from renewable sources. It states that much if this will come from wind but wave and tidal will also play an increasing and important role as the technology develops. A commitment to develop a Marine Energy Action Plan to help accelerate the sector has now been met which sets out key recommendations to make the mainstream deployment of wave and tidal technologies a reality before 2020.

2.2.3 Scotland

7. Scotland has ambition and commitment to do more than the rest of the UK in greenhouse gas reduction and renewable penetration.

8. The **Climate Change (Scotland) Act 2009** set a statutory framework for greenhouse gas emissions reductions in Scotland with a reduction target of at least 80% for 2050 and an interim 42% reduction target by 2020.

9. The Scottish Government has also committed to ensuring Scotland meets the EU's 2020 renewable energy target of 20% by setting a target to source 20% of energy demand from renewables by 2020. This is further broken down into 100% electricity; 11% heat; and 10% transport fuels.

10. The **2020 Routemap for Renewable Energy** in Scotland reflects the challenge of the Scottish Government's new target to meet an equivalent 100% demand for electricity from renewable energy by 2020. In terms of wave and tidal energy it identifies key areas on which the Scottish Government should focus which are maintenance of market incentives, positive grid regulation and ensuring availability of capital and innovation support.

11. The Scottish Government's **Marine Energy Road Map** charts a course for the development of wave and tidal power around Scotland. Annual progress reviews are being conducted.

2.3 MARINE PLANNING

12. Marine planning was consolidated by the **Marine (Scotland) Act 2010** with lead marine management responsibilities being vested with the new single agency, Marine Scotland.

13. Marine Scotland is currently undertaking plan development at national, regional and sectoral levels.

14. Scotland's first National Marine Plan, covering 'devolved' inshore and 'reserved' offshore waters, is in preparation, with consultation on the draft **National Marine Plan, 'Planning Scotland's Seas'**, recently closing (13 November 2013). The plan will be laid before parliament in summer 2014 with adoption scheduled for the end of 2014. The plan defines strategic policies and seeks to encourage sustainable development that provides economic and social benefits whilst maintaining the good health of the marine environment through protection and conservation measures. The plan sets objectives for particular groups of marine users, those for offshore and marine renewables being:

    - to promote the sustainable development of offshore wind, wave and tidal renewable energy in the most suitable locations.
    - to achieve sustainable economic growth through the development of offshore renewable energy.
    - to ensure joined up marine planning and efficient licensing processes to help facilitate sustainable offshore renewable energy development within Scottish waters.
    - to promote the development of an integrated terrestrial and marine electricity transmission grid in Scottish waters.
    - to contribute to achieving the renewables target to generate electricity equivalent to 50% of Scotland's gross annual electricity consumption from renewable sources by 2015 and 100% by 2020.
    - to contribute to achieving the decarbonisation target of 50gCO2/kWh by 2030 to cut carbon emissions from electricity generation by more than four-fifths.
    - to facilitate the development of demonstration facilities and projects for offshore wind, wave and tidal renewable energy devices.

15. Renewables policy 3 in the draft plan requires that there should be a presumption in favour of renewable energy developments in areas identified to support the Saltire Prize.

16. Regional planning is in its early stages with boundaries still to be formalised ahead of plan development. The Consultation Draft of the National Plan suggests the Mull-of-Kintyre as a boundary between the 'Clyde' and 'Argyll' regions.

17. Sectoral planning for offshore wind, wave and tidal is at an advanced stage with consultation recently closing on the plan options. Finalised plans are due to be submitted shortly to Scottish Ministers.

18. In advance of these formalised plans and to enable the wave and tidal industries to maintain momentum, Marine Scotland published in 2010 **'Further Scottish Leasing Round (Saltire Prize Projects) - Regional Locational Guidance'**. The assessment of the Mull-of-Kintyre suggested that the main restrictions on development were likely to be related to MoD and shipping interests but described the site as having "relatively few environmental interests".

2.4 GENERAL LICENSING AND CONSENTING LEGISLATION FOR THE PROPOSED TYPE OF DEVELOPMENT

19. Under Section 36 of **The Electricity Act (1989)** tidal stream developments in Scotland over 1MW require the consent of Scottish Ministers.

20. For projects below that threshold, S36 consent is not required, but there is still the need to be granted a marine license under the **Marine (Scotland) Act 2010**. For projects over 1 MW, both S36 consent and a marine license are required.

21. The marine license, issued by Marine Scotland on behalf of Scottish Ministers, supersedes the previous requirement for a license under the former Food and Environmental Protection Act 1985 (FEPA) and for a consent under the Coast Protection Act 1949 (CPA).

22. Inter-alia, a marine license is required to deposit any substance or object in the sea or on or under the seabed. The deployment of tidal devices and ancillary elements irrespective of the scale of development therefore requires a marine license.

23. Offshore renewable projects are all likely to have onshore elements. Whereas Scottish Ministers can grant deemed planning consent for onshore renewable projects captured by S36, no such provision exists for offshore S36 projects. Thus, consent for onshore infrastructure associated with an offshore renewable project, irrespective of size, must be sought from the local planning authority, in this case Argyll and Bute Council under the **Town and Country Planning (Scotland) Act 1997**.

2.5 THE DEVELOPMENT PLAN

24. The statutory Development Plan for Argyll and Bute is comprised of:

- The Argyll and Bute Structure Plan (2002)[1] ("the Structure Plan"); and
- The Argyll and Bute Local Plan (2009)[2] ("the Local Plan").

25. The Structure Plan sets out economic, social and environmental objectives to guide an investment strategy for Argyll and Bute. The Structure Plan contains general land use locational strategies which in turn frame the more detailed Local Plan.

26. The Local Plan sets out Argyll and Bute Council's aims and objectives with particular emphasis on sustainable development. The Structure Plan's economic, social and environmental objectives are carried over as the shared main objectives of the Local Plan.

[1] Argyll and Bute Council, (2002), "Argyll and Bute Structure Plan 2002", Available Online at: http://www.argyll-bute.gov.uk/sites/default/files/planning-and-environment/Argyll%20and%20Bute%20Structure%20Plan%202002.pdf
[2] Argyll and Bute Council, (2009), "Argyll and Bute Local Plan", Available Online at: http://www.argyll-bute.gov.uk/sites/default/files/planning-and-environment/written%20statement%202009.pdf

27. Chapter 9 of the Local Plan focuses on renewable energy and acknowledges that there is a context of strong encouragement for energy generated from renewable sources. The Local Plan lists the main renewable energy aims affecting Argyll and Bute as:

    - To increase the proportion of locally produced electricity exported from and consumed within Argyll and Bute;
    - To meet local energy requirement, energy research aspirations and energy export demands;
    - Where practicable, to achieve local self sufficiency or local surplus in energy requirements;
    - To facilitate the achievement of national energy targets without unacceptable detriment to the environment of Argyll and Bute;
    - To ensure effective siting of renewable developments which seeks to optimise energy; production and distribution without unacceptable detriment to the environment of Argyll and Bute; and
    - In addressing these issues to encourage effective partnership working with all stakeholders.

2.6 RELATED ENVIRONMENTAL IMPACT ASSESSMENT LEGISLATION

28. The need for environmental impact assessment derives from **Council Directive 85/337/EC**. Annex II of the directive lists those types of development that should be considered for EIA and instructs member states to develop criteria and thresholds. Annex II includes "industrial installations for the production of electricity".

29. Within Scotland, the directive is implemented through a range of legislation. Onshore, the principal legislation is the **Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011**. The need for EIA is governed by the nature, size and location of development.

30. The analagous general legislation in the marine environment is the **Marine Works (Environmental Impact Assessment) Regulations 2007**. Again, the need for EIA is driven by a consideration of nature, size and location of development. Generally, EIA in the context of marine licenses is governed by these regulations.

31. Specifically, for electricity production, whether onshore and offshore, Schedule 2 of the **Electricity Works (Environmental Impact Assessment) (Scotland) Regulations (2000)** requires that all projects falling under S36 of the Electricity Act be screened to determine whether an environmental statement will be required to accompany the consent application.

2.7 HABITATS LEGISLATION

32. Irrespective of whether a project requires EIA, it is required to adhere to relevant legislation relating to protected sites, habitats and species, specifically:

    - EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and
    - Fauna (the 'Habitats Directive'), implemented by:
        - Conservation (Natural Habitats &c.) Regulations 1994 (as amended).

  - Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended) (together "the Habitats Regulations").
- Directive 2009/147/EC of the European Parliament and of the Council on the Conservation of Wild Birds (the 'Birds Directive'), also implemented by the Habitats Regulations
- Wildlife and Countryside Act 1981.
- Nature Conservation (Scotland) Act 2004.
- Conservation of Seals Act 1970.

33. In terms of the Habitats Regulations, it is important for any application, irrespective of size, to understand how the development relates to Natura 2000 sites (Special Areas of Conservation, SACs, and Special Protection Areas, SPAs). A process of Habitats Regulation Appraisal (HRA) is needed to identify whether there are justifiable concerns to warrant the need for Appropriate Assessment (AA). This requires the applicant to provide the consenting authority with sufficient information to enable the latter to conduct an HRA and form a robust opinion.

34. For European Protected Species (EPS), Regulation 39 of the Conservation (Natural Habitats, &c.) Regulations 1994, makes it an offence deliberately or recklessly to 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 of deliberately or recklessly disturbing these creatures.

2.8 RELEVANCE OF LEGISLATION TO THE ARGYLL TIDAL LTD PROJECT

35. When discussions with Marine Scotland first opened on the potential development in early 2012, it was envisaged that a small array of up to 6 turbines with a combined rating of 3 MW would be deployed and that a first phase of 1 to 2 turbines would precede the complete array.

36. A Marine License would be required for the first phase but the second phase would require S36 consent in addition to a further marine license.

37. Onshore elements would require consent under the Town and Country Planning (Scotland) Act 1997 from Argyll and Bute Council in its capacity as local planning authority (LPA).

38. Due to the requirement under Schedule 2 for S36 consent for the full array, an opinion on a proposed scope for environmental impact assessment was requested (on 18 June 2012) from the Marine Scotland Licensing Operations Team (MS-LOT).

39. In terms of broad process, the opinion (issued in August 2012) stated:

> *"MS-LOT agrees with and encourages ATL's approach to produce one Environmental Statement (ES) that will cover both land based and offshore elements of the proposal. This should include details of all phases of the proposed development. The ES should state all licenses and consents being sought as well as those previously granted. There is no difficulty in issuing a Marine Licence for the first one to two tidal turbines with a subsequent Section 36 (S36) consent and additional Marine Licence for the full array. The Marine Licence application for Phase 1 will require robust supporting information, including a Habitats Regulations Appraisal (HRA) chapter. (RES's emphasis) The ES required for the S36 consent application will need to incorporate an assessment of the whole project including all turbines and phases. It is anticipated that in total, two Marine*

Licenses (one for the initial device(s) and another for the remaining devices) and one S36 consent will be required for this phased proposal."

40. Subsequent project development activity however identified severe grid limitations in the area and it has become apparent that only a single turbine can be accommodated without significant and expensive upgrade.

41. As such, the project has been scaled-back to a single machine. Such development does not require S36 consent and does not require an environmental statement. However the underlined element of the MS-LOT opinion is still relevant and the information reported in this volume is presented in discharge of that obligation.

3 SITE SELECTION AND PROJECT EVOLUTION

3.1 INTRODUCTION

1. This chapter details the evolution of the Argyll Tidal Demonstrator project from its origins to the point of submission of the Marine License Application and the onshore Planning Application.

2. The chapter opens with background context on The Crown Estate's site leasing process for wave and tidal power then introduces the Mull of Kintyre Demonstration Site and describes the drivers behind its selection. A brief overview of the development of Nautricity's CoRMaT technology follows.

3. The core content of the chapter outlines key development activities and findings during the feasibility and pre-consenting phases of the project with the aim of providing background context to project infrastructure descriptions presented in the following chapter.

3.2 DEVELOPMENT SITE SELECTION – BACKGROUND CONTEXT

4. Scotland has an estimated 10% of Europe's extractable wave power and 25% of its extractable tidal power, putting it in an ideal position at the forefront of this emerging sector.

5. In 2007, the Scottish Government published a Strategic Environmental Assessment (SEA) of the potential for coastal waters to the north and west of Scotland to support wave and tidal stream power generation industries. The report identified a very wide sea area with potential for wave power generation, and smaller areas, mainly in firths & sounds and around headlands, where tidal currents were sufficient to generate tidal power.

6. In March 2010, following a competitive tendering process, The Crown Estate released seabed rights for development of 1.6GW of wave and tidal energy capacity in the Pentland Firth and Orkney Waters (PFOW), thus assuring a significant medium-term market for wave and tidal technology.

7. Recognising the technical and commercial challenges in delivering projects of the scale envisaged for PFOW, The Crown Estate during 2011 began undertaking regular six–monthly exercises to release further seabed for development, but this time for smaller scale projects.

8. Three types of 'Agreement-for-Lease' have been offered under this 'Further Scottish Leasing (Saltire Prize Projects) and Demonstration Leases (FSL&DL)' process:

    - 'Engineering Demonstration' designed for individual or small numbers of turbines of up to 3 MW where the requirement is to enable demonstration of wave or tidal technologies that are not yet fully proven;

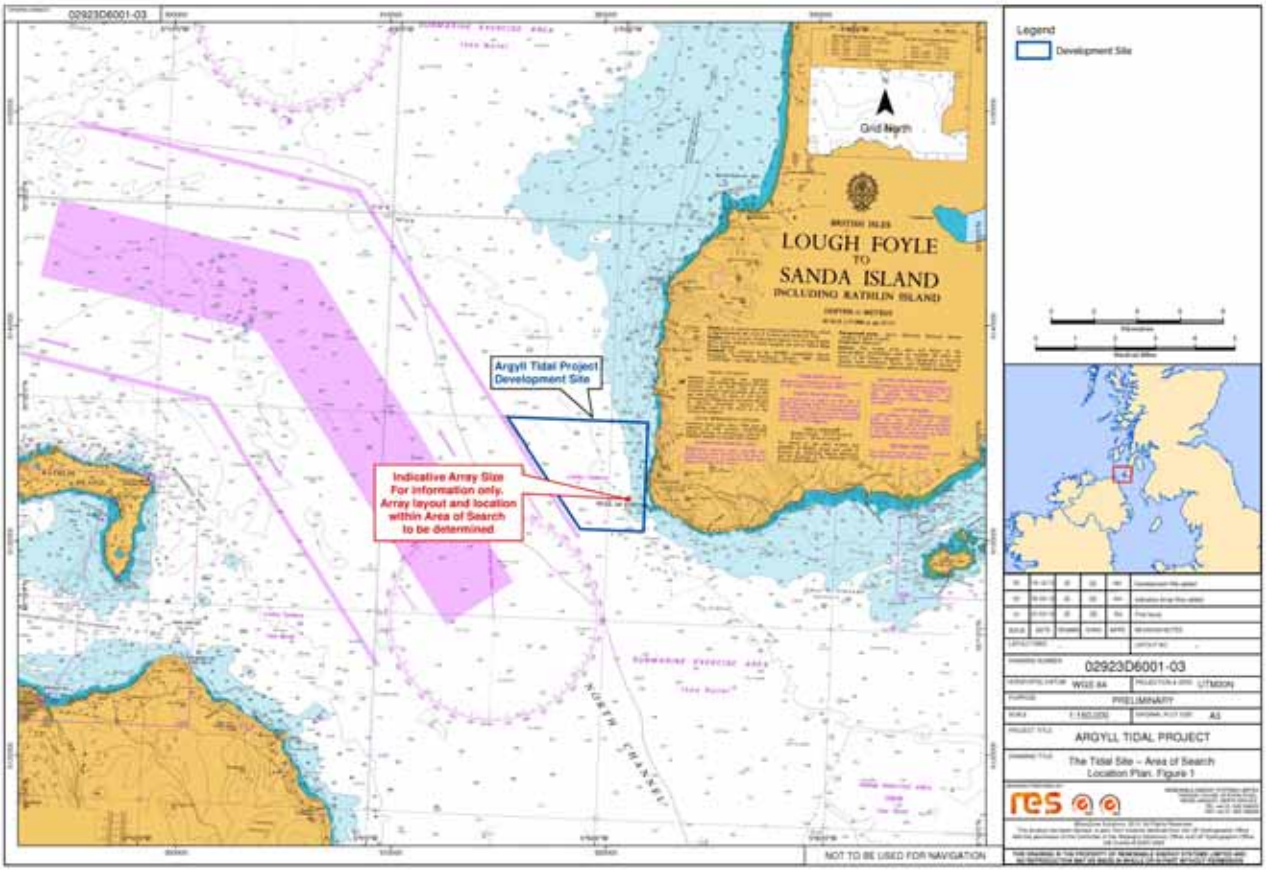
    - 'Commercial Demonstration' where the objective is to enable deployment of small arrays of up to 10 MW using proven technology as a stepping-stone to wider market development;

    - 'Commercial' where the aim is to enable deployment of medium-scale arrays of up to 30 MW for commercial exploitation using proven technology, specifically to compete in the Scottish Government's Saltire Prize competition.

9. In late 2011, Argyll Tidal was successful in securing an 'Agreement-for-Lease' for a Development Site located off the south-western coast of the Mull of Kintyre under the FSL&DL process. The 'Agreement-for-Lease' is for an 'Engineering Demonstration' scale project of up to 3 MW.

10. The location and extent of the Argyll Tidal Ltd Development Site is shown below in Figure 3.1.

Figure 3.1 – Argyll Tidal Demonstration Site



11. A Development Site can effectively be thought of as an area of search within which the project will be located. Only a small fraction of the Argyll Tidal Development Site will be required to host a project of 3MW scale.

3.3 DEVELOPMENT SITE SELECTION – MULL OF KINTYRE

12. The CoRMaT device with which the Argyll Tidal project will be developed aims to be commercially viable in sites of lower resource levels than those of the 'headline' tidal sites e.g. (UK) 'PFOW', 'Alderney', 'Anglesey' etc, thus significantly expanding the potential market for the technology. A moored foundation approach, as taken by Nautricity, both offers considerable weight savings and allows deployment in deeper waters than those viable for fixed foundation devices. From a technology suitability perspective, the Development Site near Kintyre was chosen for its water depths and resource levels – these are well matched to the moored Nautricity device and are less compatible with fixed tidal.

13. Additional factors contributing to the suitability of the Argyll Tidal Development Site location include:

- an absence of environmental designations on the site or in the immediate vicinity and
- the proximity of the site to the demand centre in Scotland (central belt).

3.4 NAUTRICITY TECHNOLOGY DEVELOPMENT

14. The Argyll Tidal demonstration project will deliver the first grid-connected generation from Nautricity's novel CoRMaT tidal turbine. A brief overview of the technology evolution to date is bulleted below.

- Initial research work was focussed on the fluid dynamics of power capture using contra-rotating rotors. 'Technology Readiness Level 1' proving of a conceptual CoRMaT device was completed with the award of a UK EPSRC RNET research grant (2000–2003) to the Energy Systems Research Unit, University of Strathclyde.

- Development and tow tank testing of a 1/30th-scale prototype device and 1/7th-scale sea tests of an additional prototype were successfully completed via a Scottish Enterprise Proof of Concept Award (2004-2007) taking the development process to 'Technology Readiness Level 2'.

- A 1/7th-scale device was tested in the Clyde (2006–2007) to characterise performance, structural loadings, and the robustness of materials. These tests confirmed sustained upscaled performance and completed 'Technology Readiness Level 3'.

- Sea testing of a 1/30th-scale, complete system prototype in the Sound of Islay in 2008 demonstrated:

    i. the practicality and functionality of the mooring system,

    ii. device stability and continuous alignment within an energetic tidal flow, and

    iii. proof-of-concept of a passively cooled, flooded, permanent magnet, contra-rotating generator.

- A 2-month trial took place in summer 2011 using the 1/30th-scale prototype tidal turbine installed alongside the HQS Wellington, moored at Temple Steps in the heart of London. The outcome of the trial was a confirmation of the dynamic stability of the device in an environment where waves, wakes & wash have a strong influence on the flow behaviour.

- Sea trials of CoRMaT at commercial scale are ongoing (from spring 2013) at one of EMEC's non grid-connected berths in the Sound of Shapinsay. The testing period is intended to prove system functionality at full scale with the previously untested element of an integrated 'hydrobuoy' unit tethered to the mooring system to provide both system buoyancy and operational lift. Deployment and recovery techniques are also being trialled and streamlined.

- The testing at EMEC is playing a central role in gaining experience for the Argyll demonstration deployment. Additionally, the activity is providing evidence of successful deployment, operation and recovery to support the commercial scale system certification process.

3.5 ARGYLL TIDAL PROJECT EVOLUTION

3.5.1 Technical background information

15. A number of technical elements of the CoRMaT device influence the infrastructure design of the demonstration project. It is important to understand these and their implications, a summary is offered below:

- The CoRMaT device generates at variable speed via a permanent magnet generator (PMG). The PMG is incorporated within a moored and neutrally buoyant nacelle; the weight and size of any on-board equipment is therefore restricted.
- Power conditioning and step-up to 11kV is required to meet Grid Code standards before injection of the generated output to the local Distribution Network.
- Converter and transformer equipment performs the power conditioning and step-up roles respectively; this equipment is bulky, heavy and, given the moored nature of the generation technology, cannot be housed within the nacelle.
- Offshore location outwith the nacelle presents huge technical challenge and cost, the converter and transformer equipment must therefore be located onshore.
- In order for the generated output to be compliant with Grid Code, this equipment must sit between the submarine export cable landing location and the Distribution Network point-of-connection.

16. The onshore infrastructure layout and grid connection strategy for the Argyll Tidal Demonstrator project must be in-line with the above requirement.

3.5.2 Feasibility - key activities and findings (Phase 0/1)

17. The initial phase of project development activity focused on high-level fact finding and feasibility assessment across a range of development, engineering and technical areas in order to inform early definition for project Scoping.

18. Initial investigation into the feasibility of grid connection to the local Distribution Network suggested this element of the project would present significant challenges. Discussions with Scottish Hydro Electric Power Distribution (SHEPD) advised that no more generation of any type could be connected onto the existing Argyll/Kintyre grid due to a bottleneck in the regional Transmission System. In order to overcome this bottleneck, Scottish Hydro Electric Transmission Limited (SHETL) has proposed a subsea transmission link from Crossaig (east coast of the Kintyre Peninsula) to Hunterston (south-west of Glasgow). This subsea link is currently scheduled for completion in 2016.

19. At the Scoping submission stage, it was decided to progress with development activity for a small tidal array of up to 3MW and to continue with the investigation of options for grid connection. The Scoping Report was prepared for a tidal array of up to 3MW and issued in June 2012 for stakeholder comment.

20. Key areas of subsequent activity during Phase 0/1 of the project were:

- Environmental – identification of any areas of environmental significance within or local to the Development Site and the likely effect on these of the installation and operation of

Nautricity's CoRMaT technology at up to 3MW scale; kick off of environmental monitoring activity (12 months).

- Property – establishment of land title for potential areas of interest and early contact with land owners.
- Technical – sourcing available site data (tide, flow, bathymetry) and completion of a 2-dimensional regional flow model to better understand the tidal resource variation throughout the area of interest.
- Engineering – refinement of the onshore and offshore definition of the project.
- Grid – baseline study and an assessment of connection options.
- Stakeholders / Users – improving understanding of commercial, leisure and military activity local to the Development Site.

21. Key outcomes of the above activity streams during the feasibility assessment phases of the project are detailed below.

    i. Environmental – for a summary of the environmental baseline studies and monitoring campaign, see Chapter 8 through Chapter 15.

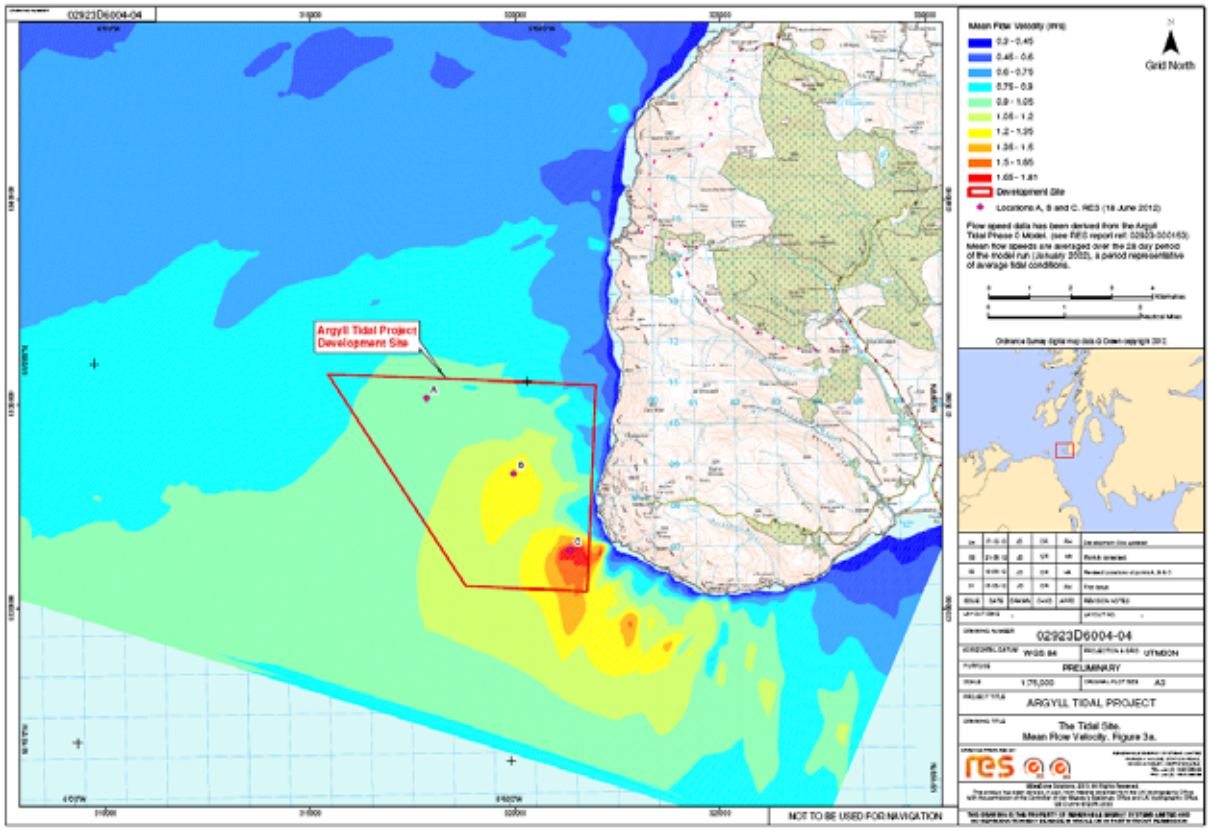
    ii. Grid – further investigation of connection options highlighted the physical limitations of the local Distribution Network and indicated only a single 500kW device could be grid connected at reasonable cost i.e. without extensive new overhead line construction or an unreasonably long offshore cable route. Wider Transmission Network constraints pre-2016 remained.

Technical – flow modelling activity confirmed the south-eastern corner of the Development Site to be the region of highest tidal resource with much of the northern and western areas too benign for development. An average flow speed resource map, generated from the results of the Phase 0 model, is shown below in

iii. Figure 3.2. Results should be taken as indicative only due to the coarse nature of the model input data and the uncertainties inherent in the modelling process. Relative variations are generally well represented by such models.

iv. For a single device demonstration project, a lengthy subsea export route is not economically viable. The coast local to the area of high tidal resource indentified is primarily sea cliffs – terrain widely considered to be unsuitable for cable landing. The most promising landing site local to the high resource region was identified approximately 1km south of the Mull of Kintyre lighthouse in the moderately sheltered bay of Port a' Chuilinn.

Figure 3.2 - Average flow speed resource map



22. The emerging picture at the end of Phase 0/1 was that of a single device project located in the south-eastern corner of the Argyll Tidal Development Site. A potential subsea export cable landing location was identified on the local coastal stretch and it was expected that grid connection would be to the Distribution Network overhead line spur supplying the fog signal, approximately 1 km south of the Mull of Kintyre lighthouse (see Figure 3.5 for locational details).

3.5.3 Definition for consenting - key activities and findings (Phase 2)

23. The constraint of grid connection capacity in the south-western region of the Kintyre Peninsula limited the scope of the project to deployment of a single device, an important consequence being that project scale was now under the 1MW trigger for full EIA.

24. Phase 2 of development activity focused on gaining the required project definition for the submission of the respective Marine License and Planning Applications for offshore and onshore elements alongside the preparation of assessments included within this Environmental Appraisal document.

25. Given the grid constraint-imposed reduction in planned project size (from 3MW to <500kW), the budget for and scope of survey activity and project assessment was adjusted accordingly – both were set to levels proportionate with project scale and legislative requirements.

26. Key areas of activity during Phase 2 of the project were:

- Property – negotiation of terms and finalisation of contractual agreements.
- Technical – geophysical, benthic and ADCP survey campaign, offshore deployment site and export corridor definition, coupled wave-tide modelling (extreme wave).

- Engineering – further refinement of the onshore and offshore definition of the project including assessment of access, onshore infrastructure layout and grid tie-in options.
- Grid – formal connection application process and offer acceptance.
- Stakeholders / Users – Navigational Risk Assessment (NRA) and associated stakeholder consultation.
- Environmental – completion of monitoring activity (12 months) and, following sufficient project definition, assessments (various) for this Environmental Appraisal.

27. Key outcomes of the above activity streams during Phase 2 are detailed below.

    i. Environmental – environmental assessments of the Development are contained in Chapter 8 through Chapter 15.

    ii. The scope of the offshore survey activity was limited by project scale and budget. Relevant work was completed in autumn 2012 via the INIS Hydro bathymetric survey campaign. It was decided, rather than duplicate effort, to scope project survey work around the results of this campaign. These were made public in summer 2013.

    iii. A near-shore data gap of approximately 200m seaward from the coast was identified and this region formed the scope of the project bathymetry survey campaign (completed late Nov 2013).

    iv. It was decided that a drop-down video campaign was an appropriate means of characterisation and assessment of the benthic environment (surveyed mid-Oct 2013).

    v. Additionally, a single Acoustic Doppler Current Profiler (ADCP) was deployed approximately 100m north-west of the target location (mid-October 2013) to gather site information on resource variations. The data recorded by this instrument will help to inform the final system design of the mooring system and foundations and to determine the device operating parameters.

28. Figure 3.3 below shows INIS Hydro bathymetric survey data, the near-shore project survey region, the landing site at Port a' Chuilinn bay (A), a fall-back landing site at the Mull of Kintyre lighthouse (B) and the target ADCP deployment location (red dot). Drop-down video work (a series of transects) was conducted within the "Survey Area of Interest". Figure 3.4 further below shows the data captured during the near-shore bathymetric survey campaign.

Figure 3.3 – Project survey boundaries and INIS Hydro survey results layer

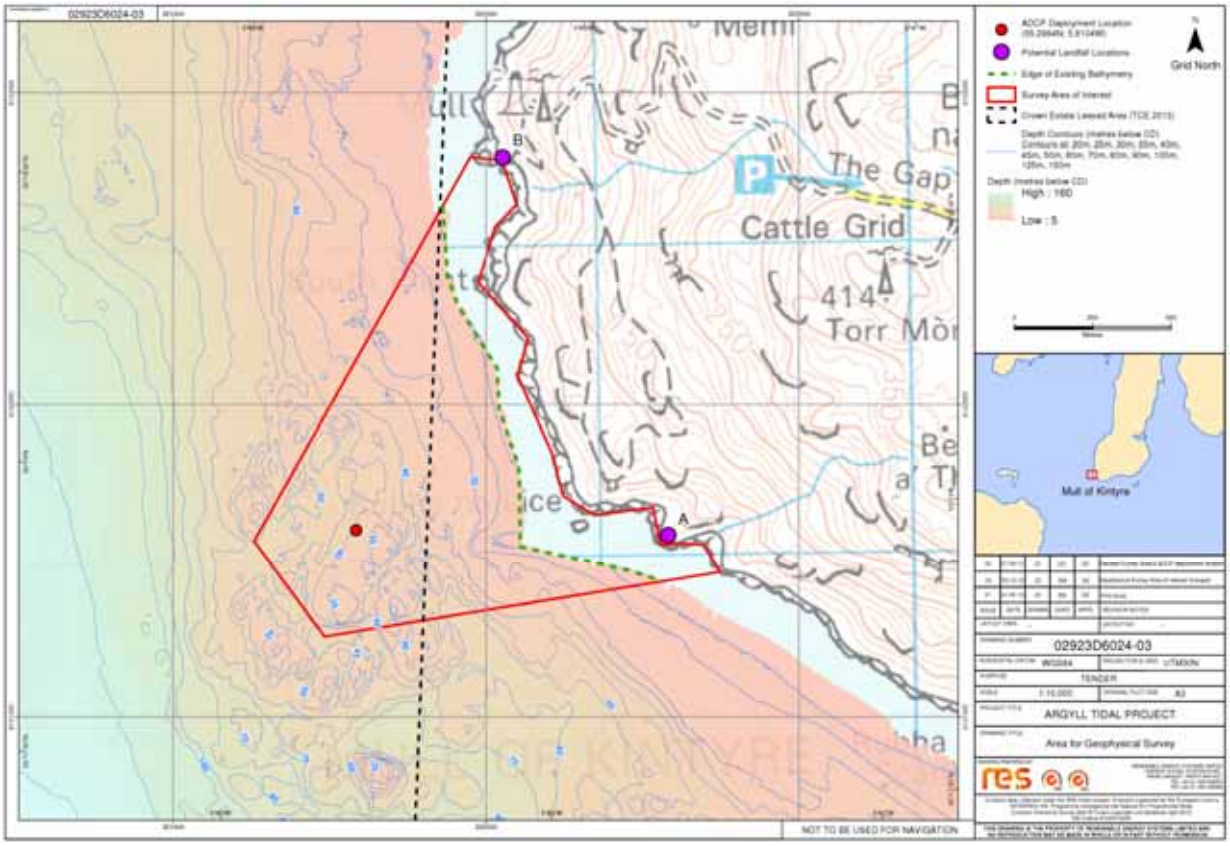
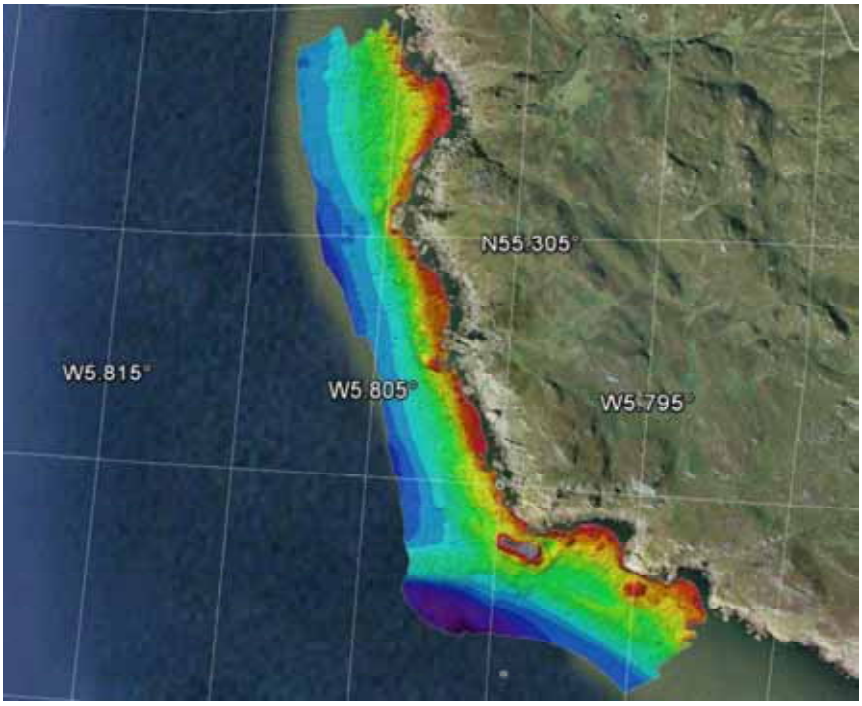


Figure 3.4 – Near-shore bathymetric survey results



29. The grid connection application process was iterative as Argyll Tidal (ATL) sought to maximise capacity and SHEPD explored various avenues for connection in a highly constrained region of the network. A connection offer was formally accepted by ATL in June 2013 and it is hoped to

energise in 2014. The associated works involve augmentation of the existing 11kV line from single to three-phase over a 9km section inland from the fog signal spur.

30. The development of offshore and onshore project definition to the point of this submission is outlined in Chapter 4.

3.6 PROJECT SITE SELECTION – OFFSHORE

3.6.1 Site selection criteria

31. The offshore site selection process drew upon a variety of information including desktop studies, modelling activity, offshore survey data and consultation. A choice for the device deployment area was made based on the requirement for a location with the following characteristics:

    i. High tidal resource – to both demonstrate the operational robustness of the technology and enable reasonable income stream from generation.

    ii. Suitable bathymetry – a shallow gradient route is preferred for routing the submarine cable connecting device with landing location. At the device end of this route, a relatively flat region of exposed bedrock is required for the installation of foundations. The target deployment depth for the demonstration device is in the 35-40m range.

    iii. Proximity to a suitable submarine export cable landing location – distance to shore and subsequent distance to a suitable grid connection location both have a strong bearing on the economic feasibility of the demonstration project.

    iv. The deployment and operation of the CoRMaT device and the associated offshore infrastructure should be planned with reasonable knowledge of local marine life and consideration of expert opinion on the likely impact of the project on species living within the deployment locality (see Chapter 7 of the EA for benthic analysis of the data recorded during the drop-down video survey campaign).

32. In addition to the above criteria, stakeholders were consulted on proposals during the NRA process to ensure plans for the offshore infrastructure did not unduly conflict with existing human activity in the local marine environment. Findings are presented in Chapter 13.

3.6.2 Data sources and the offshore site selection process

33. Key inputs to the offshore site selection process were the Phase 0 regional flow model results, the INIS Hydro bathymetric survey data and the preferred subsea export cable landing location.

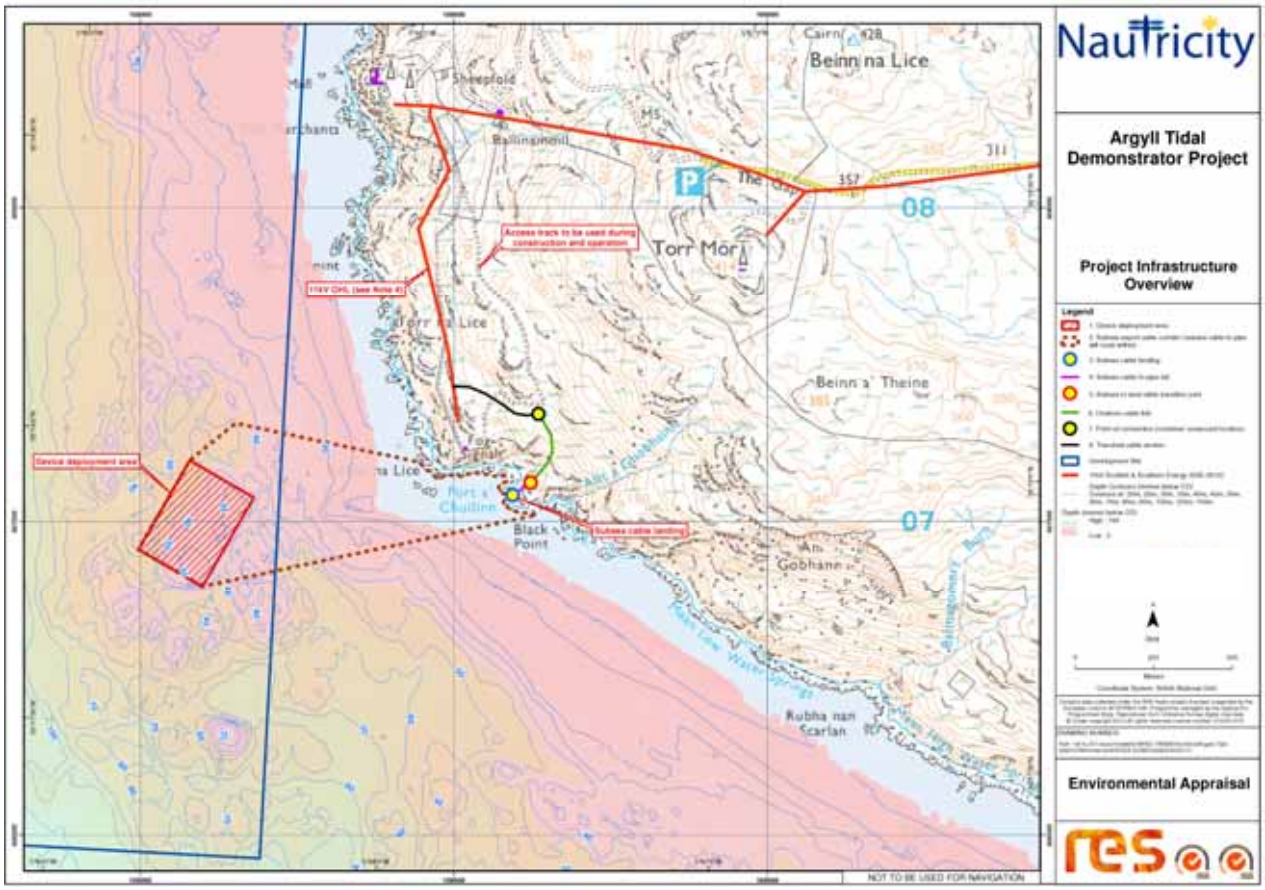
34. Assessment of the selection criteria using these inputs revealed a limited number of suitable deployment locations. The most suitable area, identified using the INIS Hydro bathymetric data, is a plateau of depth in the 30-45m range with an approximate footprint of 400m*250m – its location is centered approximately 1km west of the preferred subsea export landing location in the region of high resource identified by the Phase 0 flow model. This area was selected as the device deployment region for the purposes of the Marine License application – a suitable host location within for the CoRMaT system will be identified pre-construction.

35. A potential export cable route from the device deployment region arcs north-east then east of the identified deployment plateau area; the seabed to the south and east is uneven terrain characterised by scarps and sharp valleys and is unlikely to be suitable for export cable routing.

36. A detailed export route study will be conducted using the resource and bathymetric data collected during the project's offshore survey campaign. Due to survey delays affecting timely receipt of these data, a corridor approach has been taken to give an indication of route for environmental assessment and the Marine License Application process.

37. The device deployment area and subsea export cable corridor are shown in Figure 3.5.

Figure 3.5 – Project infrastructure overview



3.7 PROJECT INFRASTRUCTURE DEVELOPMENT – ONSHORE LAYOUT

3.7.1 Access assessment, electrical connection and choice of compound location

38. The project export cable landing location, as identified in Figure 3.5 above, is remote and land access is restricted to varying degrees in the local area that will host the project infrastructure.

39. Access constraints for construction and operation were therefore a key consideration in the selection of a suitable location for the project electrical compound. A number of additional factors were also influential; as well as being suitably accessible, the compound site must also be:

    i. in close proximity to the local electrical Distribution Network;

    ii. within a setting offering natural visual screening and

    iii. at a location where electrical connection to the subsea export cable landing location can be safely installed at reasonable cost.

40. Siting of the electrical compound at a secluded location adjacent to the telecoms mast at Torr Mor was investigated in tandem with a potential site in a natural depression, local to the fog signal south of the Mull lighthouse (again, see Figure 3.5 above for locational details of these sites).

41. For the potential compound site at Torr Mor, a trial delivery run using a flatbed trailer towed by a FasTrac tractor unit was conducted in August 2013 with the assistance of McFadyens Transport Ltd. The objective was proving the viability of delivery of the generator-side electrical equipment in a single container (dimensions: length 9m, width 2.5m, max. height 3.8m). The trial run was successful – passage at the pinch point of the route, a narrow bridge west of Carskiey Farm between Glenmanuilt and Feorlan, is shown below in Figure 3.6.

Figure 3.6 – Bridge crossing between Glenmanuilt and Feorlan

42. For the potential site local to the fog signal, additional access constraint is posed by the steep hairpin bends on the road from the car park at 'The Gap' to the Mull lighthouse. Figure 3.7 below details the restriction. The limitations on container delivery to the compound site local to the fog signal were assessed to be as follows:

    i. 4m in length and 2.5m in width with height not exceeding 3.5m;

    ii. maximum weight of 5000kg.

Figure 3.7 – Extreme hairpin bend on private road to Mull lighthouse

43. A walkover assessment of the access track running south from the Mull lighthouse to the fog signal determined that minor works will be required to enable safe passage of tracked construction vehicles and 4 x 4 access to the electrical compound location during the operational period. These are likely to include vegetation clearance, limited stabilisation works and the installation of a narrow watercourse crossing.

44. In terms of electrical equipment delivery, electrical compound construction and ease of operational access, the potential site at Torr Mor was preferred to the potential site local to the fog signal. The challenge with the Torr Mor site was safe installation of an electrical connection to the landing location at reasonable cost.

45. A site visit was conducted in late summer 2013 to assess the electrical connection options for both potential compound sites. Employees of RES and SSE's Programmes and Major Cabling divisions were in attendance.

46. The conclusions of this site survey were that an overhead line connection from the landing location to the Torr Mor site would:

    i. pose significant installation risk due to the extreme site terrain,

    ii. incur significant cost in both manpower and materials,

    iii. not offer a complete connection solution in-line with project requirements.

47. On balance, the project team concluded that the compound site local to the fog signal was the most viable location. The infrastructure layout presented in Figure 3.5 simply connects this

location by appropriate route with both the subsea export cable landing and the local Distribution Network overhead line spur supplying the fog signal.

4 PROJECT DESCRIPTION

4.1 INTRODUCTION

1. This chapter describes the Argyll Tidal Demonstrator project infrastructure on an element by element basis.

2. The descriptions of project elements move sequentially from the device deployment location to the point of tee-in to the local 11kV Distribution Network.

3. Offshore and onshore elements are presented separately.

4.2 ARGYLL TIDAL DEMONSTRATION PROJECT DESCRIPTION – OFFSHORE ELEMENTS

4. The tidal demonstration project at the Mull of Kintyre will comprise a number of offshore elements; the major components are summarised below.

5. Final specification of the device operational parameters and the foundation / mooring system elements will follow definition of the environmental conditions envelope at the deployment location – consideration of site Acoustic Doppler Current Profiler (ADCP) data (instrument awaiting recovery, December 2013) will be a key input to this process.

6. The offshore project elements are:

    i. a single 500kW CoRMaT tidal turbine;

    ii. 3 drilled and grouted pin foundations;

    iii. the mooring system, including a yaw limiter and a tethered hydrobuoy;

    iv. a subsea electrical cable, protected in a single run of narrow diameter drill pipe (4" to 6" outer diameter) and

    v. a protective surf-zone and landing j-tube of ~12" outer diameter drill pipe secured to a crevice feature in the inter-tidal rock.

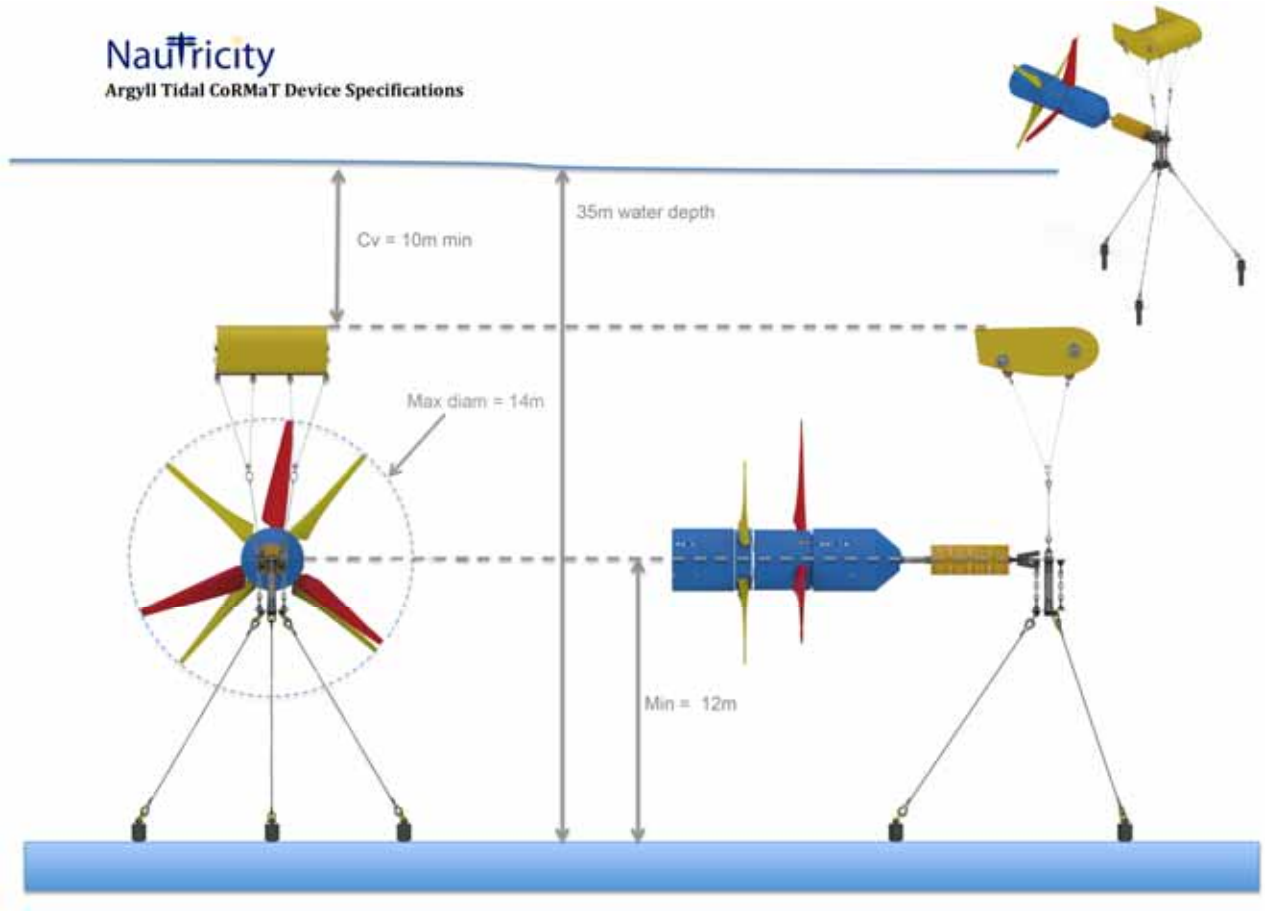
7. The marking requirement for the device will be determined through further discussion with the Northern Lighthouse Board and will draw upon the recommendations of the Navigational Risk Assessment (NRA) conducted by Marico Marine (the NRA report, 12UK875, is included in the appendix for Chapter 13).

8. Taking each of the above items in turn, a fuller description of the offshore elements of the project follows.

<u>i. CoRMaT Tidal Turbine</u>

9. The CoRMaT turbine (i) to be deployed at the Mull of Kintyre is shown below in Figure 4.1 alongside offshore elements (ii) foundations (shown above seabed) and (iii) the mooring system, yaw limiter and tethered hydrobuoy.

Figure 4.1 - CoRMaT specification for the Argyll Tidal demonstrator project



10. The CoRMaT device comprises a neutrally buoyant cylindrical nacelle with contra-rotating rotors (upstream – 3 blades, downstream – 4 blades) in close proximity around a common axis of rotation. This novel arrangement, unique to the Nautricity tidal technology, encourages stability during operation and eliminates the requirement for a rigid support structure to transmit operational loads to the seabed, thus offering a significant weight saving relative to fixed technologies.

11. A further benefit of a moored device is the flexibility to deploy in deeper water than practical for devices with fixed foundations. Additionally, the optimum operational position within the water column can be more readily and economically attained using a moored approach.

12. CoRMaT generates at variable speed via a submersible, contra-rotating permanent magnet generator with the rotor and stator driven directly by the upstream and downstream rotors respectively.

13. For the demonstration deployment at the Mull of Kintyre, a minimum clearance of 10m below Chart Datum will be maintained above the hydrobuoy to allow safe passage of vessels above and to distance the buoy from wave action, the loading from which is most severe close to the surface. The lower tips of the rotors will be at least 7m from the seabed in order to operate above the highly sheared, lower resource region of the turbulent bottom boundary layer.

14. A rigid 'stinger' with float surround connects the nacelle to the yaw limiter. The nacelle is approximately 2.5m in diameter and 9.5m in length. Initially, 10m diameter rotor blades will be fitted with scope for future upgrade to a maximum of 14m diameter. A photograph of the CoRMaT device currently undergoing testing at EMEC is shown below in Figure 4.2.

Figure 4.2 - CoRMaT at the Port of Montrose

15. The overall system design will allow the nacelle to self-align with the predominant flow direction following periods of slack water. Power generation will be governed by site-specific flow conditions (site ADCP data assessment will guide definition) – approximately:

    - the electrical cut-in speed will be 1 m/s and the device will generate at rated output in flows greater than 2.5m/s,
    - the maximum rotational speed of each rotor will be 12 rpm.

ii. Drilled and Grouted Pin Foundations

16. The device and mooring system will be attached to 3 cylindrical can foundations anchored to the seabed via drilled and grouted pins. The can dimensions are not expected to exceed 1.4m in height and 0.8m in diameter.

17. The spread and relative orientation of the foundation locations to the tidal flow will be determined by a number of design factors including deployment depth, the morphology and bathymetry at the deployment location and local resource variations.

18. Drilling depths are not expected to be greater than 12m and the diameter of holes is likely to be in the 140 – 250mm range. Cuttings - rock fragments - will be flushed away.

19. The anchors will be solid cylindrical steel pins of diameter in the range 75 – 150mm. A non-shrink, high strength grout will secure the anchor pins. All grouting operations will be sealed to prevent loss of grout to the environment.

20. A data sheet for grout widely used in similar offshore applications is provided in the appendix for this chapter.

iii. Mooring System, Yaw Limiter and Tethered Hydrobuoy

21. The mooring system will be comprised of a 'platform' of 3 steel wire lines. A single line will be connected to each of the foundation cans and these will meet approximately mid-water column and connect to the yaw limiter. The 'platform' mooring line inclinations will be dependent on design factors including deployment depth, foundation specification and local resource level. Operational tilt resulting from thrust and drag loading will be up to 30 degrees from the upright position.

22. The mechanical yaw limiter acts as the connection point for the CoRMaT system via a rigid 'stinger'. Its operational function is 2-fold:

    i. to allow alignment with prevailing tidal flow direction and

    ii. to prevent coiling of the electrical and control cable passing through its centre

23. The hydrobuoy will be foam-filled, constructed from steel with suitable corrosion and anti-fouling protection and be tethered to the upper plate of the yaw limiter using steel mooring lines. To avoid disturbance to the flow upstream of the rotor swept area, the lower surface of the hydrobuoy will be located above rotor tip height in the water column. The hydrofoil profile has been selected to offer stable performance through a wide range of angles of attack.

24. It is expected that the maximum dimensions of the hydrobuoy will be a 6.5m chord length and an 8m span. As with the final specification of the mooring system and foundations, the design of this element will be determined in light of detailed information on the local flow environment.

iv. Subsea Electrical Cable in Protective Drill Pipe

25. Power will be delivered to shore via an electrical export cable (3 phase, 3.3kV) protected in a single 4" to 6" diameter drill pipe run.

26. Also enclosed within the drill pipe will be a 230V electrical supply cable and fibre bundle for the CoRMaT control and braking systems. A motor driving a hydraulic piston requires electrical supply to release the brakes from the default ON position, thus allowing the device to generate. In the event of loss of supply current or communications, hydraulic pressure is lost and the device brakes are applied.

27. A high density gel, 'LiquDense' developed by Aubin, will be used to ballast the drill pipe, helping to maintain grounding with the seabed and providing stability and support for the cables within. A data sheet for LiquDense is provided in the appendix for this chapter. LiquDense contains only natural compounds (iron filings in a viscous gel). As the pipeline is not pressurised, only minor seepage will occur in the unlikely event of a fracture.

28. The connection for electrical export, electrical supply and communications cabling will most likely be dry-mate – the final configuration and location of this connection is still to be determined. A provisional connection methodology is presented in Chapter 5, Section 5.4.2.

29. Detailed design activity may conclude that additional means of securing the pipeline to the seabed are required at exposed sections of the route e.g. use of subsea cable mattress.

v. Protective Surf-Zone and Landing J-Tube

30. At the subsea export cable landing and along the surf-zone approach, a secondary 12" diameter pipe will be used to provide additional protection to the export cable-in-pipe run. The offshore length requirement for the j-tube section will be determined following analysis of data captured during the recent near-shore bathymetric survey (late Nov 2013). At the landing, the larger diameter pipe will be secured to a crevice feature in the inter-tidal rock. The crevice feature is shown below in Figure 4.3.

Figure 4.3 - Crevice feature in inter-tidal rock at export cable landing location

4.3 ARGYLL TIDAL DEMONSTRATION PROJECT DESCRIPTION – ONSHORE ELEMENTS

31. Figure 4.4 shows the onshore infrastructure layout for the project. Figure 4.5 shows the same infrastructure overlaid on the aerial photograph of the region.

Figure 4.4 - Onshore Infrastructure Detail Plan

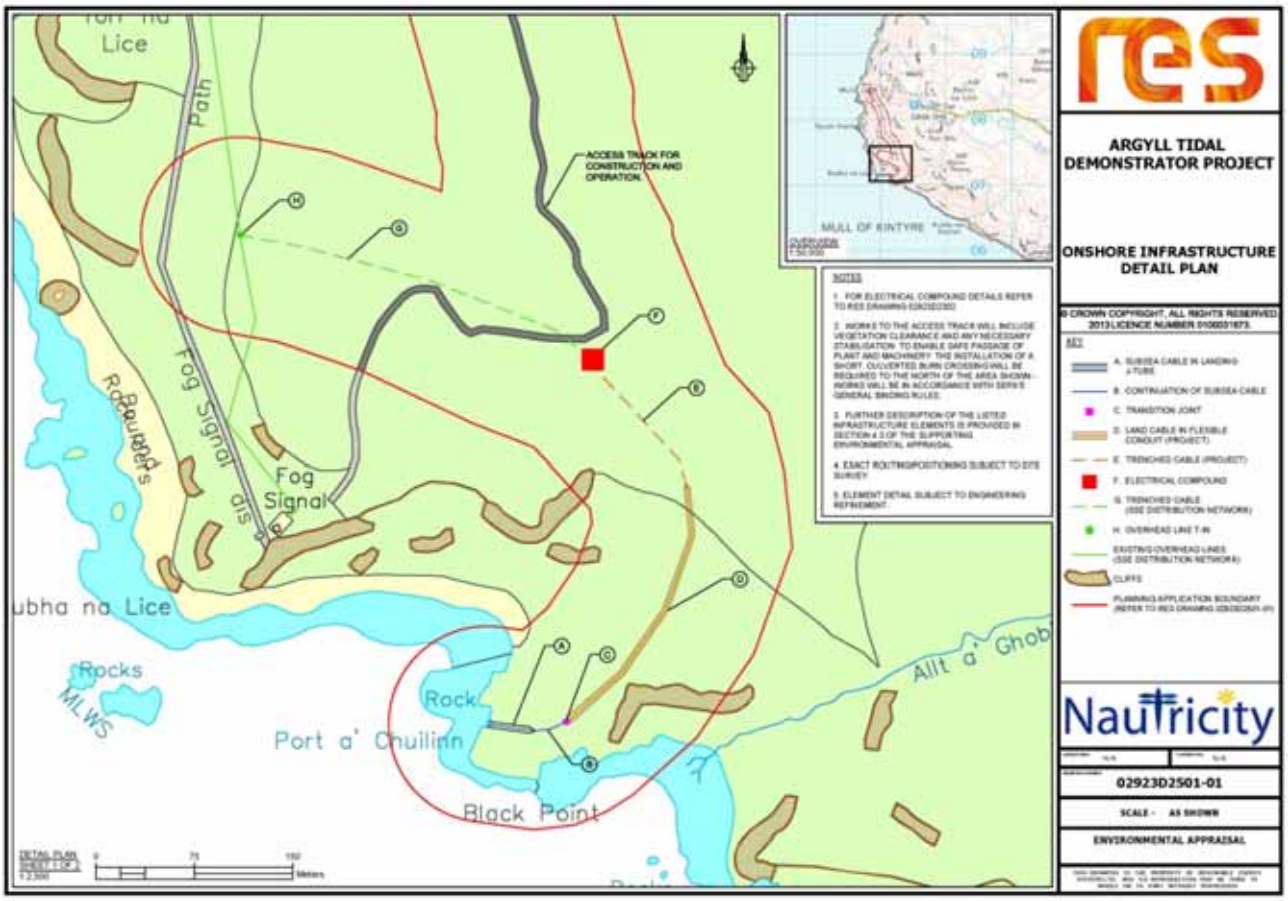
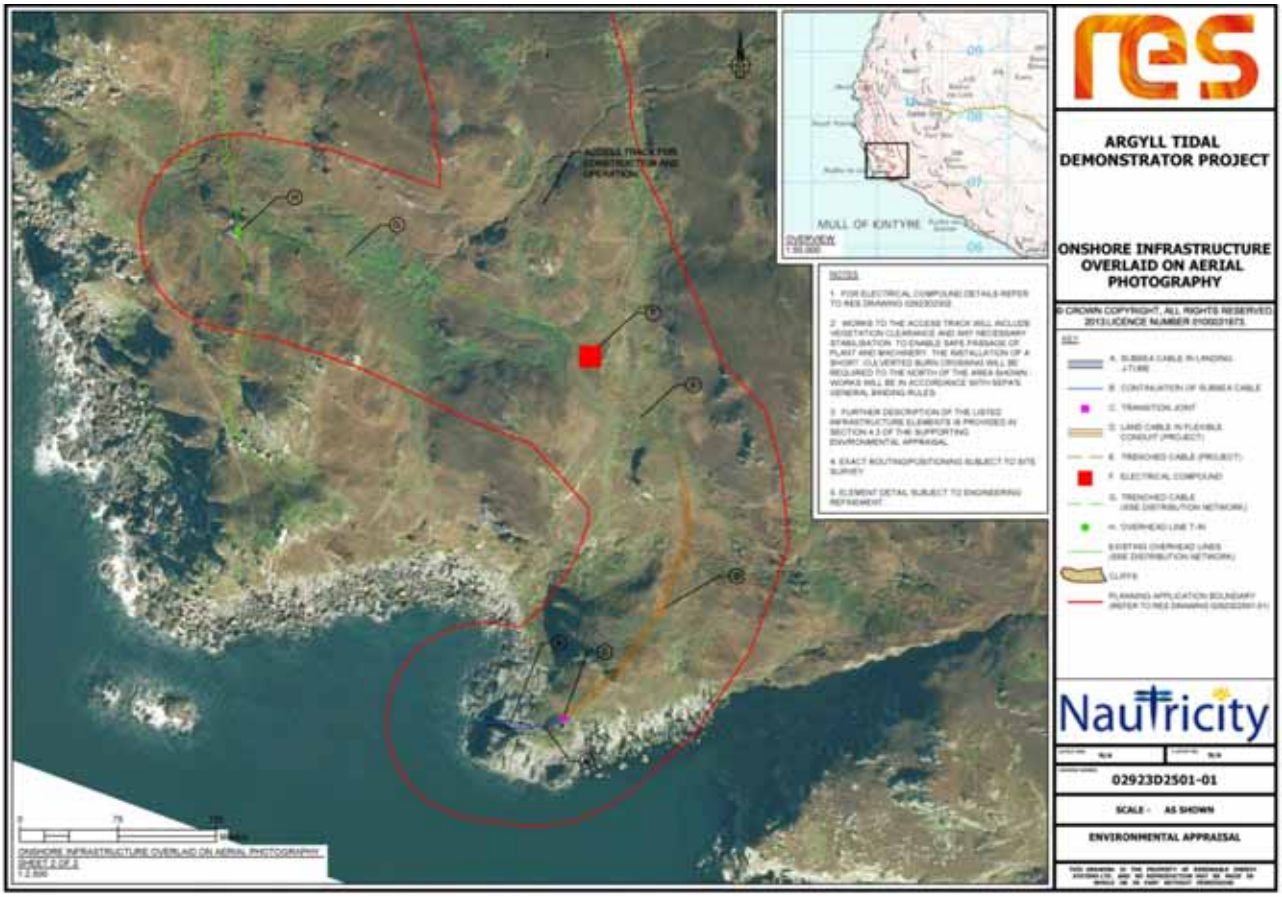


Figure 4.5 - Detail Plan overlaid on aerial photography



32. An offshore photograph of the landing area is shown in Figure 4.6 to further assist with understanding of the layout and context of the onshore elements. The white line mark-up traces a very approximate route for the onshore cabling from the inter-tidal crevice feature at the landing location up the steep terrain behind towards the container compound location. There is a large, grassy and flat area (approximately 50m^2) landward of the crevice – winching operations will make use of this working space and the area will host an offshore to onshore cable joint bay before the power export route kicks up steeply over a rocky outcrop.

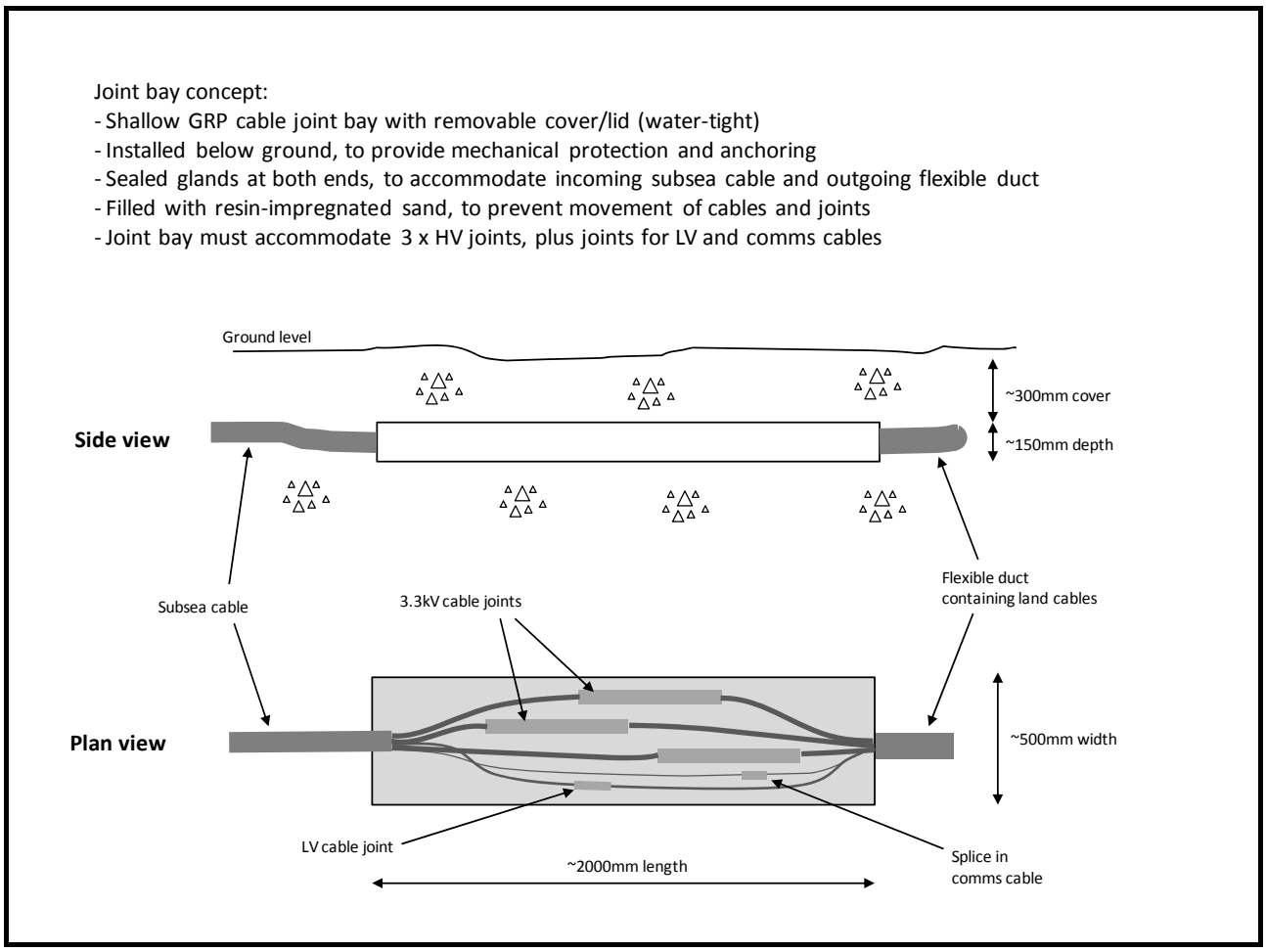
Figure 4.6 – Offshore photograph of fog signal and landing location

33. Working from landing to grid, the various projects elements shown in Figure 4.4 are detailed below.

34. The subsea export cable landing j-tube bounds the offshore and onshore elements of the project. Landward of this point, a short tail of the subsea cable-in-pipe (approximately 25-50m in length) will protrude from the wider diameter j-tube following a winched installation. The protruding section of drill pipe will be secured along its length by appropriate means; potentially shallow burial.

35. At the end of the tail, an offshore to onshore electrical joint will be made and installed within a compact, buried joint bay. A conceptual sketch of the bay is shown in Figure 4.7.

Figure 4.7 – Joint bay concept sketch



36. Exiting landward of the joint bay, the terrain is steep, rocky and uneven, rising approximately 100m over a lateral distance of 250m. Gradients are too severe for machine access and, following site survey by Scottish and Southern Energy (SSE), it was established that neither cable burial nor overhead line offers a feasible means of electrical power transfer over this section.

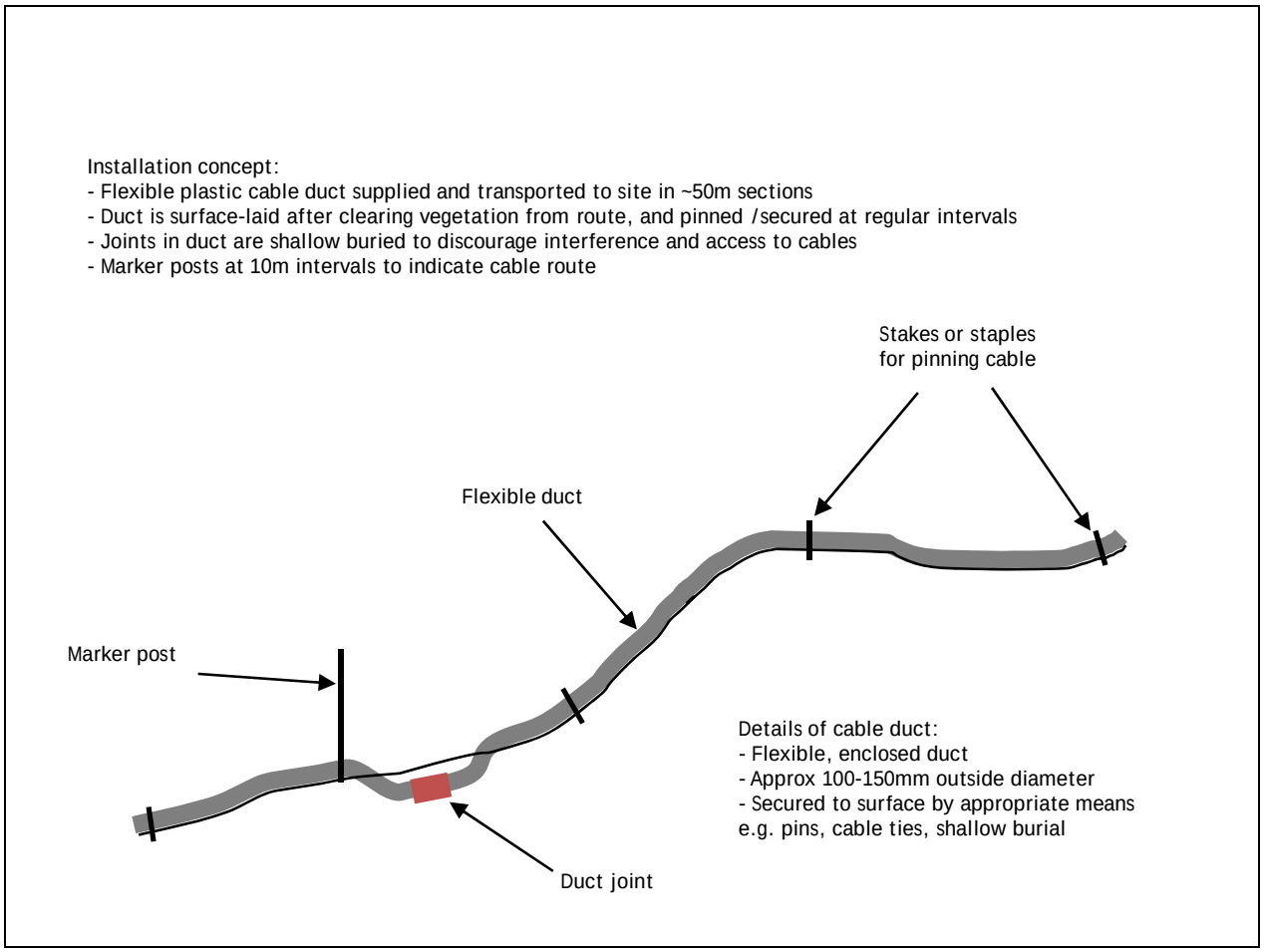
37. A surface-lay / low-level installation is the only realistic approach for power transfer from the joint bay up the steep slopes towards the compound location; cables will therefore require a level of mechanical protection to prevent damage and inhibit direct access.

38. A number of installation concepts were considered and a Design Risk Assessment process identified routing cables within a pre-installed flexible conduit as the most suitable in terms of ease of installation, and operational safety and robustness. The installation of 2 conduits is proposed, the first will host bundled 3-phase 3.3kV export cables and the second, the 230V low voltage supply cables and fibre bundle.

39. A sketch of the concept is shown in Figure 4.8. The specification for securing the duct to the hillside and the choice of product for the flexible conduit are to be finalised. Marker posts will be installed to identify the route and appropriate signage will warn of the presence of high voltage and low voltage electrical cables.

40. There is a distance of approximately 100m between the top of the steep rise and the container compound location. It is anticipated that conduits will be buried in a trench of up to 1m depth along this section.

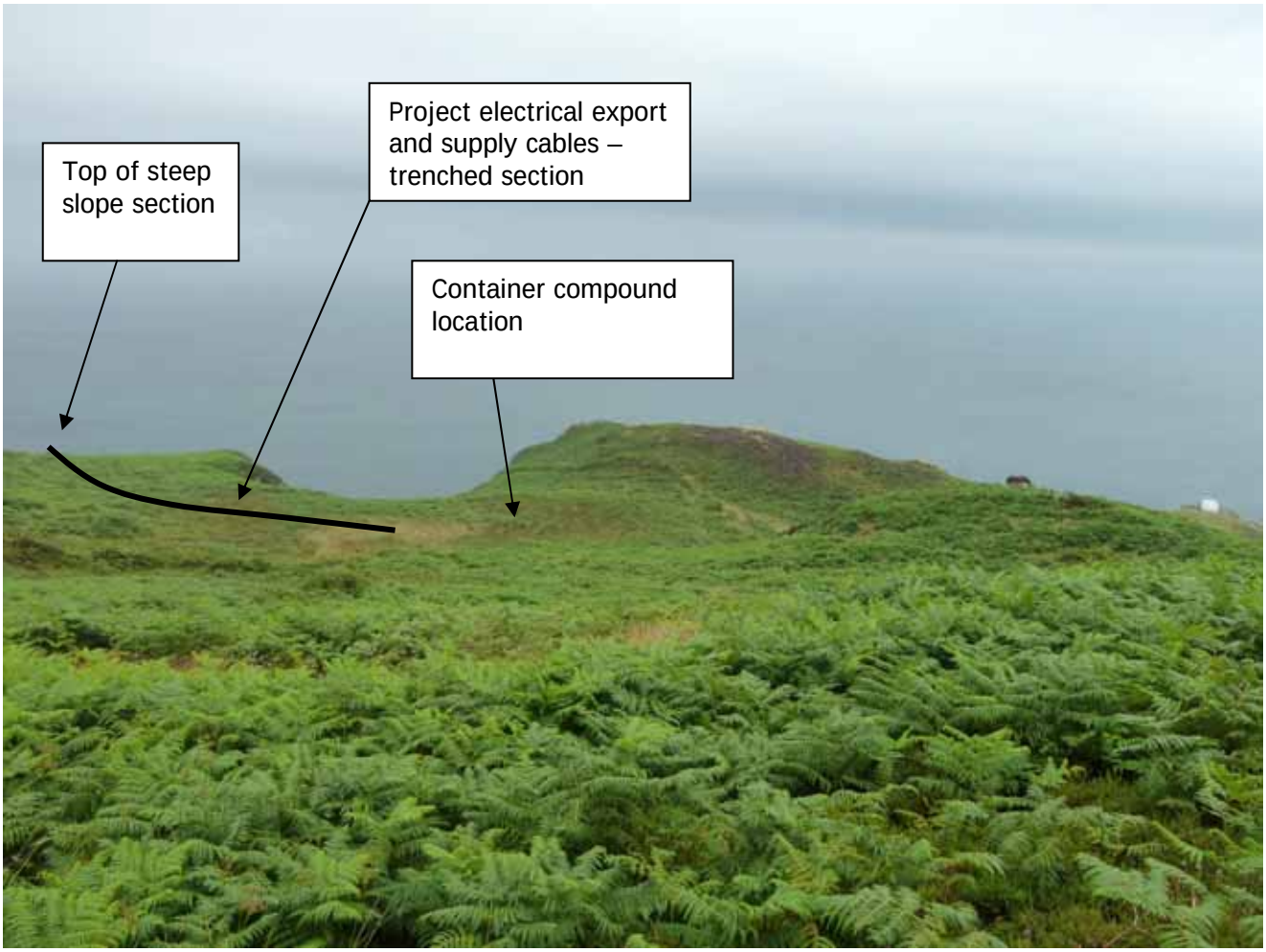
Figure 4.8 – Onshore cabling installation concept for steep slope section



41. An isolator / earth switch will interface the onshore electrical equipment within the container compound from the generator. It is expected that the isolator will be containerised and located within the compound.

42. The location of the container compound is indicated on the photograph below, Figure 4.9.

Figure 4.9 – Electrical container compound location



43. The container compound will house both project and Distribution Network Operator (Scottish Hydro Electric Power Distribution) equipment.

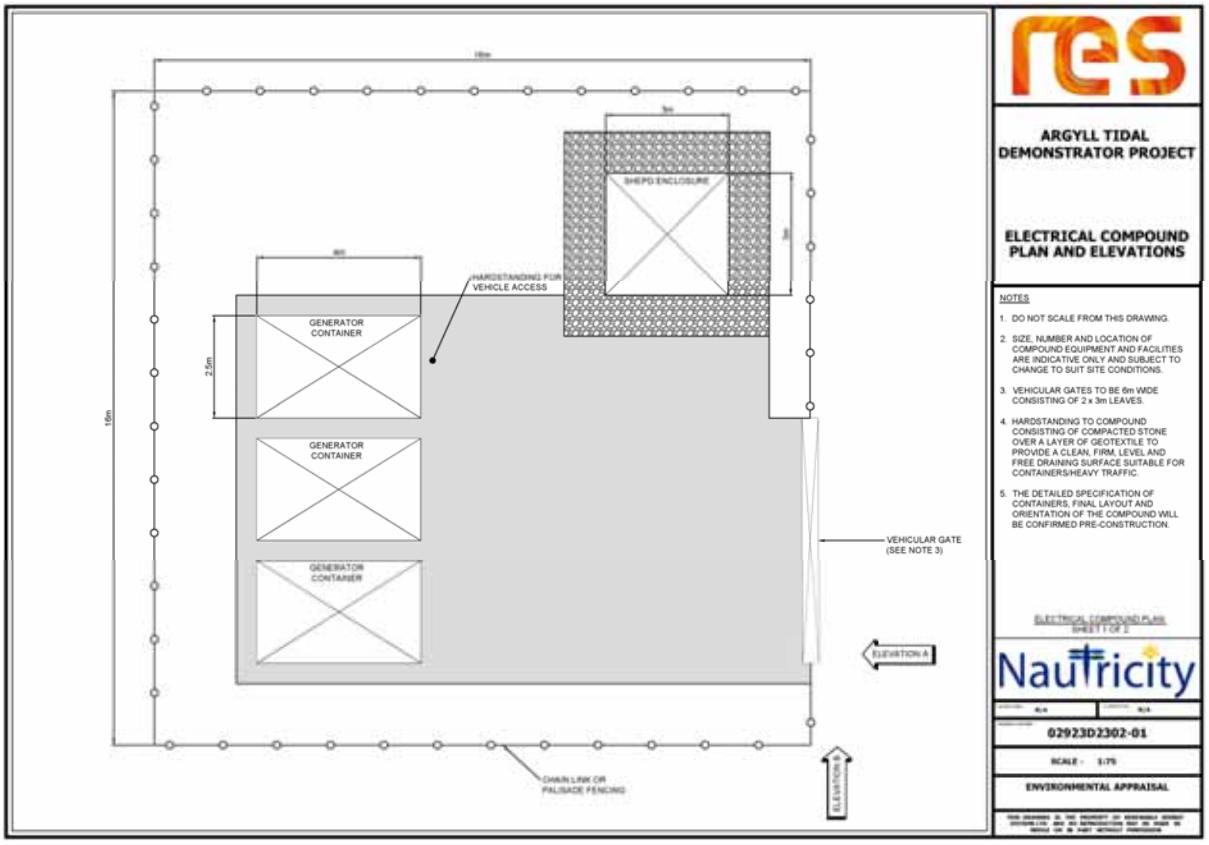
44. Project-side equipment will include:

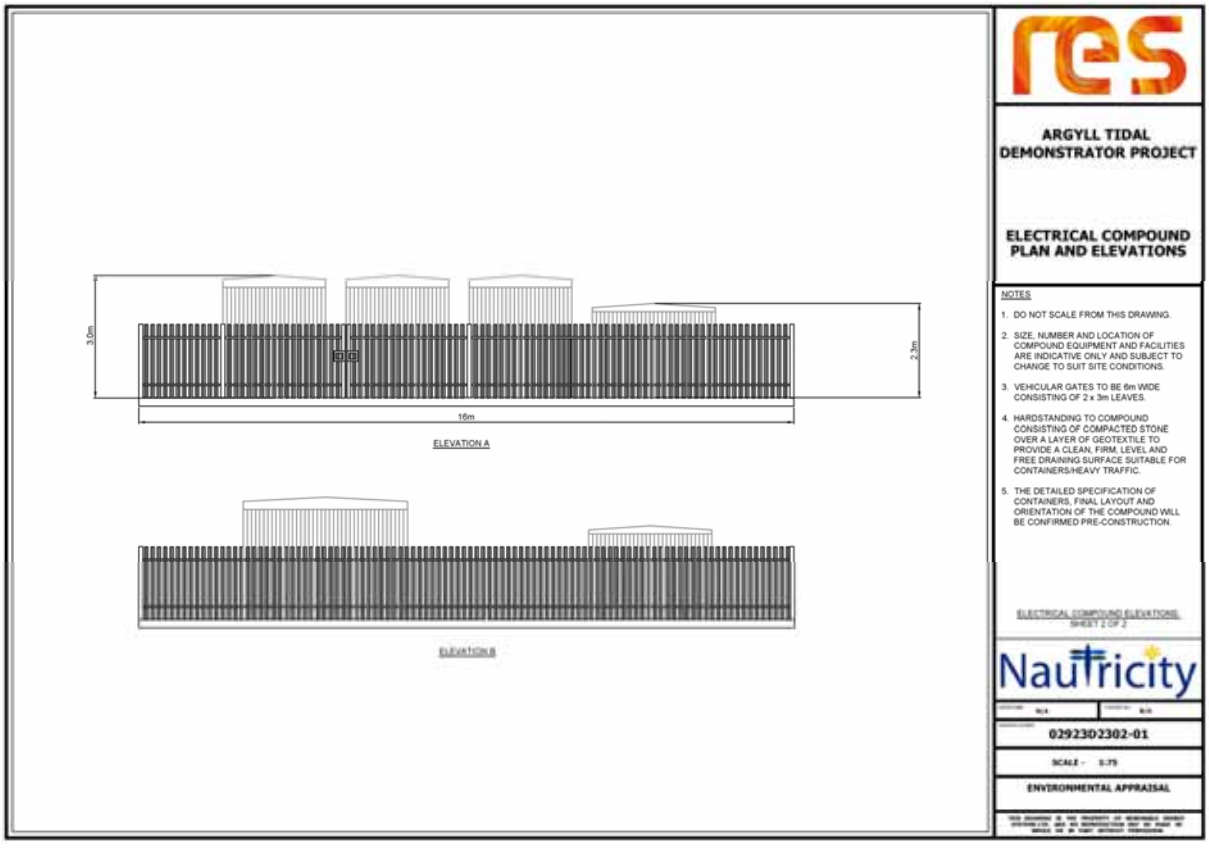
    - An isolator / earth switch bridging onshore electrical equipment and the generator
    - Converters, transformers and switchgear housed in a number (provisionally 3) of compact containers

45. The DNO equipment comprises switchgear on a concrete plinth housed within a GRP enclosure.

46. Indicative plan and elevation drawings of the container compound are shown in Figure 4.10. The detailed specification of the containers, final layout and orientation of the compound will be confirmed pre-construction.

Figure 4.10 – Provisional electrical compound layout

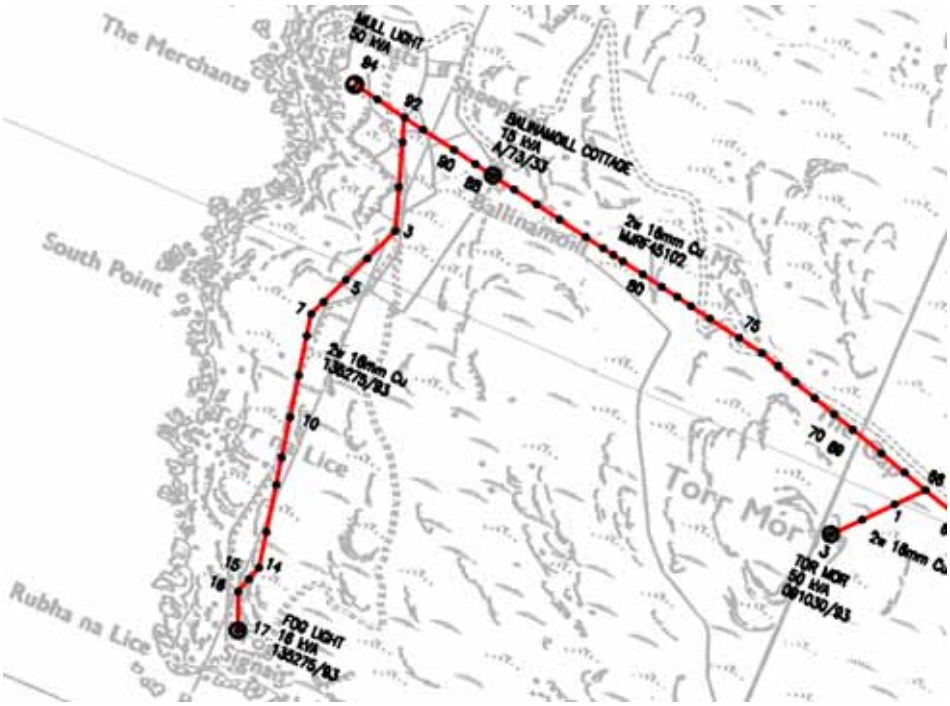




47. A grid-side underground cable link (narrow trench, approximately 1m depth) will be installed between the container compound and the 11kV overhead line spur supplying the fog signal. Tee-in to the existing overhead line will be north of the fog signal, at pole 13 as marked below in

Figure 4.11. Trench routing will be direct where ground conditions allow and will be subject to the findings of a survey to define the exact location and extent of known interlying archaeological features (see Chapter 12 for further details).

Figure 4.11 – SHEPD 11kV Distribution Network diagram – fog signal spur



5 INSTALLATION, OPERATION AND DECOMMISSIONING

5.1 INTRODUCTION

1. This chapter presents a summary of the installation, operation and decommissioning plans for the Argyll Tidal demonstrator project.

2. The information presented is intended to guide the reader on likely approach, exact details will be finalised post-consent. Detailed Construction Method Statements and Health and Safety Plans will be prepared and submitted to MS-LOT and Argyll and Bute Council for approval prior to commencement of works.

5.2 SUMMARY OF KEY CONTRACTORS

3. SmartMotor is the overall Electrical System Designer for the project and is responsible for the generator and on-board electrical system design and build as well as the design and supply of all generator-side equipment within the container compound.

4. RES are managing the consenting and construction phase of the Development and are responsible for the onshore infrastructure layout, access assessment and the design of the electrical cable installation solution between the onshore subsea cable termination and the electrical compound.

5. Ecosse Subsea Systems Ltd has been identified as the installation contractor for the landing j-tube caisson and the subsea cable in protective drill pipe.

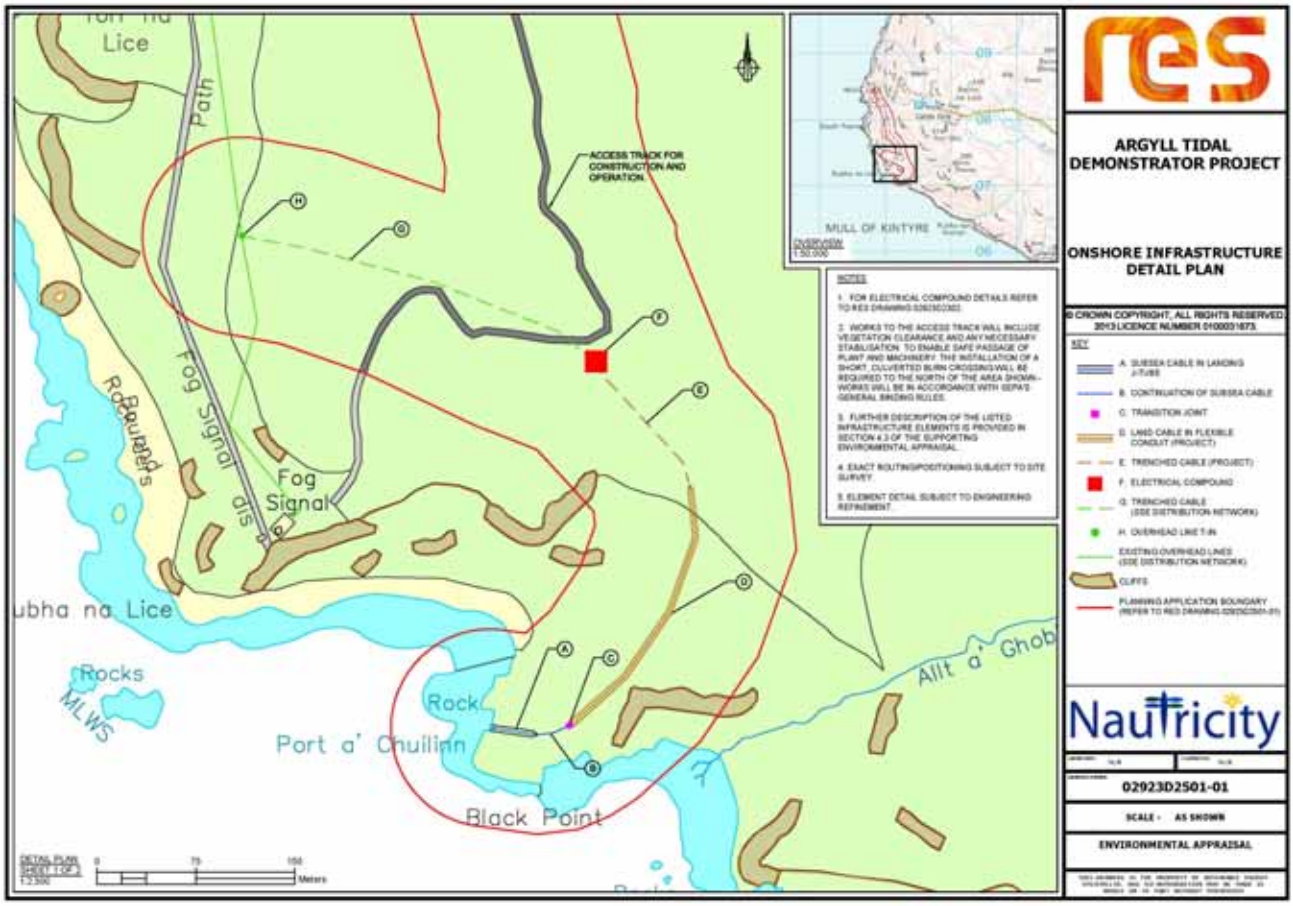
6. McLaughlin & Harvey has been identified as the offshore drilling contractor for the installation of the pin foundations.

5.3 ONSHORE WORKS

5.3.1 Overview of planned works

7. The Onshore Infrastructure Detail Plan for the demonstrator project is shown below in Figure 5.1.

Figure 5.1 - Onshore Infrastructure Detail Plan



5.3.2 Access works

8. Site works will begin with preparatory work on the access track to the fog signal to enable safe passage of construction vehicles and 4x4 access to the electrical compound location during the operational period. The southern end of this track is identified in Figure 5.1.

9. In its present condition, the track is overgrown and difficult to identify in sections, but generally firm underfoot. An existing watercourse crossing on the northern third of the route, consisting of a few railway sleepers spanning a narrow burn, is shown below in Figure 5.2.

Figure 5.2 – Watercourse crossing on access track to fog signal

10. Works to the access track will be kept to a minimum where possible but are likely to include vegetation clearance and limited stabilisation works, potentially including the installation of geotextile membranes or proprietary ground reinforcement mesh, infill of ruts and depressions, minor contouring etc. Low ground bearing pressure machinery shall be used during the construction phase to minimise disturbance to upper layers of soils.

11. An in-depth assessment of the access track will be carried out post-consent to determine the scope of the required remedial works prior to the construction phase.

12. A bespoke design will also be carried out post-consent to specify the most appropriate method of crossing the watercourse, keeping in mind channel width and flow depth, and the loadings imposed on any new crossing by construction plant. These works are likely to fall under SEPA's General Binding Rules; however, verification of this will be made at the design stage and any necessary approval processes will be adhered to.

5.3.3 Container delivery and onshore construction

13. The project electrical containers (provisionally 3 units) housing power conditioning equipment and transformers are being fabricated and commissioned in Norway by SmartMotor. Sea delivery will be to the Port of Montrose or to another major port on the east coast of Scotland. From here, units will be loaded onto standard road-going low loader vehicles for transport to Campbeltown, Argyll & Bute.

14. On arrival in Campbeltown, the containers will be transferred onto a trailer unit towed by a JCB FasTrac or similar tractor unit for transportation to 'The Gap' car park at the publically accessible end of the Mull of Kintyre tourist route.

15. The containers will then be transferred to a Morooka (or similar) tracked dumper unit with a flat bed for single unit delivery to the compound location. Discussions have taken place with the

major UK importer of Morooka tracked dumpers to confirm the vehicle type best suited to the requirement.

16. Arrangements will be made with Argyll & Bute Council for temporary and partial use of the public parking area at 'The Gap' for load transfer operations. Transfer of the container units will be made by lifting from and suspension above the trailer bed to enable the trailer to be driven clear. A Marooka would then be reversed into position under the raised container, which will be lowered onto the rear bad and secured for onward transit to the compound location.

17. The differential caterpillar track steering of the Marooka will allow safe negotiation of the tight switchbacks on the private road between 'The Gap' and the Mull of Kintyre lighthouse.

18. Delivery of the project containers will be carefully programmed to minimise the effect on public enjoyment of the local access roads and parking area. While slow moving traffic associated with the container movements may cause minor delay to other vehicle movements, escorts will be put in place to warn other road users of the presence of slow-moving vehicles and to co-ordinate safe passage through the use of existing passing bays where these are available.

19. Argyll & Bute Council will be notified in advance of the intended programme of deliveries. Should there be a requirement to notify the general public, a means of doing this will be agreed with Argyll & Bute Council.

20. Construction materials; including stone for hardstanding construction, fencing materials, cable drums, etc.; shall be transported from The Gap to the project compound location by Morooka tracked dumper.

21. The electrical compound as shown on Figure 4.9 will be formed with compacted stone over a layer of geotextile membrane to form a clean, firm and level free draining surface. For security and safety reasons the compound will be fenced.

22. A suitable access and flexible conduit lay down route will be assessed and cleared of vegetation down the steep slope section linking the subsea export cable landing location and the electrical compound.

23. Materials for the installation of the joint bay, housing the offshore to onshore cable joints, will be delivered to the landing location either by manual handling or the use of a sled system.

24. The flexible conduit will be delivered to the compound location in coiled sections of approximately 50m length. These will laid out on the flat at the top of the rise and managed down the steep slope section to line the chosen export route, potentially making use of a winch and route guides to allow controlled and safe installation.

25. When in place, the conduit will be secured to the hillside by suitable means and joints between sections will be made and buried to prevent tampering. Again, materials and tools required will be managed down the slope either by manual handling or the use of a sled system. Pull-through cables will be installed within the conduits.

26. It is possible that the conduits will be buried over exposed sections where pinning is challenging due to a shallow underlying soil layer.

27. The 3 phase conductors comprising the MV export cables will be bundled and set up on a spool near to the container compound location. A second spool will be used for the LV supply cables

and fibre bundle. A winch system will be positioned at a suitable location to pull the cable bundles through their respective conduits.

28. When installed, a jointing operation will connect the land and subsea cables within the buried joint bay. Testing and commissioning checks will then be carried out and additional protection or burial applied as necessary in the exposed regions adjacent to the shoreline.

29. The duration of the onshore installation works is expected to be approximately 1 month. Arrangements will be made for the provision of temporary welfare facilities during the construction phase.

5.3.4 Operational access and decommissioning

30. CoRMaT will be remotely operated and, following commissioning and the initial phase of operation, vehicular (4x4) access to the electrical compound location by the generator operator is likely to be only an occasional requirement, perhaps monthly. Access to the compound location by the Distribution Network Operator will be a less frequent requirement, perhaps annually for equipment inspection.

31. In the event of a major servicing or repair requirement for an element of the project infrastructure, vehicles similar to those used during the installation works will be used for delivery and removal of materials and equipment.

32. At the decommissioning stage, the major components of the project will be removed from site including compound fencing, containers, above-surface electrical cabling and protective conduits. Again, similar vehicles to those intended for the installation will likely be used for decommissioning. The applicant will discuss and agree requirements with the landowner and local authority.

33. The Argyll Tidal demonstration lease with The Crown Estate will endure for a maximum of 7 years. An extension to this lease may be sought. Decommissioning of the onshore elements of the project will mirror the offshore decommissioning works.

5.4 OFFSHORE WORKS

5.4.1 Subsea cable and landing j-tube installation

34. The installation of the subsea cable in protective drill pipe and the landing j-tube will be a 2-stage operation.

    i. Stage 1 will consist of the installation of the landing j-tube

    ii. Stage 2 will consist of the deployment of the subsea export cable and protective drill pipe bundle

35. Preparatory works will begin with offshore export cable route planning and the finalisation of the j-tube landing design. Data captured during the recent near-shore bathymetric survey (late Nov 2013) will allow these activities to conclude, thus determining the final length requirement for both the export cable and the protective surf-zone and landing j-tube section and enabling the procurement process to progress.

36. The assembly of the export cable within protective 4” to 6” outer diameter drill pipe requires a suitable onshore assembly area. The installation process makes use of rollers to support the pipeline in sections of approximately 500m length through which the cable is then pulled.

Additional sections are then joined sequentially – the fully assembled cable-in-pipe will be 1000m to 1500m in length depending on the offshore deployment route selected.

37. Use of the facilities at Machrihanish Airbase for the cable-in-pipe assembly works has been discussed and agreed in principal with Machrihanish Airbase Community Company. Works will take place at the west end of the runway. From here, rollers will be set up to transit the cable-in-pipe assembly through a narrow section between the golf courses of Machrihanish Dunes and Machrihanish Old and out to sea. A picture of the route is shown below in Figure 5.3.

Figure 5.3 - Machrihanish Dunes crossing route

Stage 1

38. At the landing location, the crevice feature in the inter-tidal rock to which the j-tube will be secured may require minor augmentation (drilling works) as part of the preparatory installation works. This requirement will be determined during a further site visit before detailed construction planning is concluded. Preparatory works will also include the installation of supports to secure the j-tube to the crevice feature.

39. Land access to the subsea cable landing site for the preparatory and installation works will share common route with that outlined for the onshore construction works detailed above.

40. The landing j-tube will be delivered in 12m sections to Campbeltown harbour and assembled to the required length for testing.

41. On satisfactory test completion, the j-tube caisson will be floated to the tie-in location and work will take place to secure onshore and subsea. The caisson will feature adequate corrosion protection.

Stage 2

42. Upon completion of the export cable in protective pipe assembly works, glanded end caps are added to secure and allow cable protrusion for onshore / offshore tie-in. The end caps feature a 2-way valve allowing fluid flow upon attachment of a delivery / recovery hose.

43. The installation sequence proceeds as follows:

    i. In suitable tidal conditions, the pipe assembly will be transported through the dunes along pre-set rollers and mated at the beach end with a piggyback pipe. The piggyback will be filled with compressed air to provide buoyancy for the pipeline assembly, which will be free-flooded on float out.

    ii. As the pipeline and piggyback assembly reaches the waterline, a shallow draught Multicat will take up the tow of the bundle. A rigid hulled inshore craft may be used at this point to monitor the float out until the rear of the assembly is at a depth where a second Multicat can pick up the tail end.

    iii. Working in tandem, the Multicats will tow the pipeline assembly to the landing location – given the length of the pipeline in tow, a guard vessel may be used for this operation to ensure safe transit. A messenger wire will be used to pull a winch cable through the landing j-tube and the landward end of the pipeline will be secured to this cable at the subsea opening of the j-tube.

    iv. The seaward end of the pipeline will then be positioned at the device deployment location and the piggyback line will be gradually filled with LiquDense to sink the assembly to the seabed. A Multicat will be used to assist lay down on the correct route.

    v. At a point when the pipeline is close to being fully deployed, a Multicat will position at the subsea end of the j-tube opening and the second vessel will locate at the opposite side of the crevice location.

    vi. The vessel winch, through a sheave system if required, will be used to pull the pipeline assembly through the landing j-tube. Alternatively, a self-anchoring winch may be used from land.

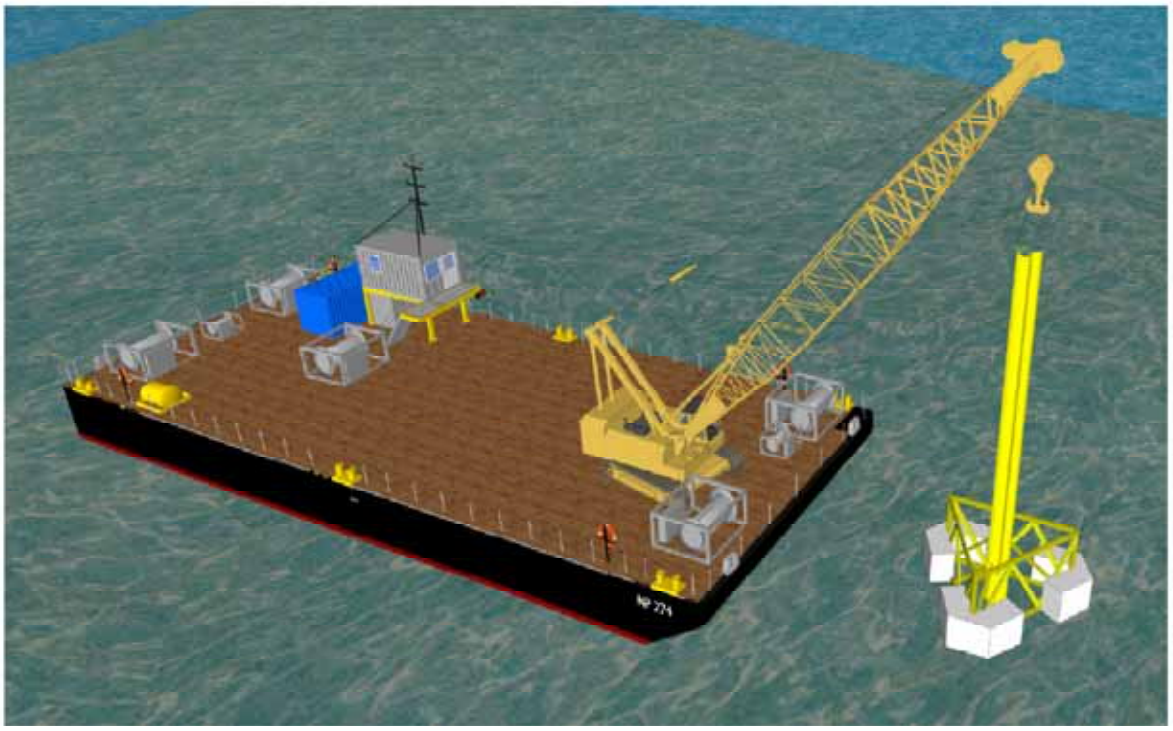
    vii. On completion of the winching operation, the pipeline will be secured to the landward opening of the j-tube and ready-mixed LiquDense will be pumped through; flushing water out and providing the ballast required to maintain grounding during the operational period.

5.4.2 Mooring foundations and CoRMaT system installation

44. During the preparatory works at Machrihanish, sufficient cable to reach the water surface will be left protruding from the device end of the pipeline assembly. This cable will be stored (likely coiled) and temporarily secured on the seabed by an appropriate means between times of pipeline and device installation works.

45. The system mooring pins will be installed by McLaughlin and Harvey, potentially making use of a temporary framework for drilling, pinning and grouting the foundations. This operation will require a barge of approximately 30m in length and a workboat of approximately 20m in length. An example of the type of equipment that may be used is shown in Figure 5.4.

Figure 5.4 - Concept drilling rig and barge



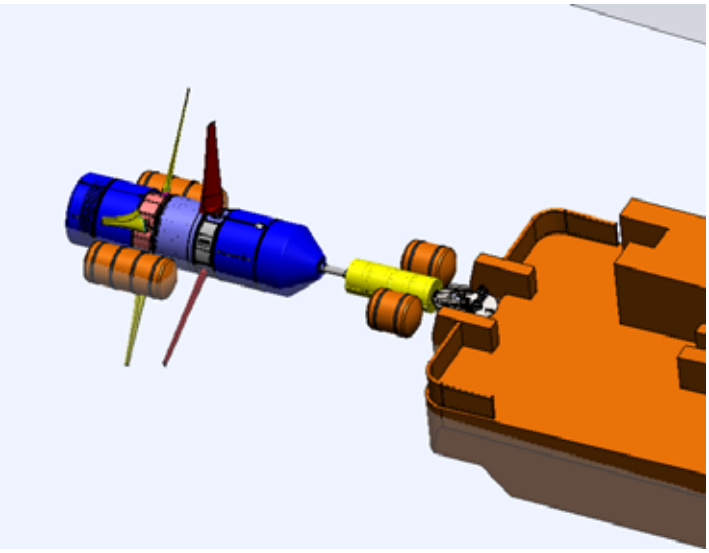
46. With the foundations and pipeline assembly installed, the device mooring is then deployed.

47. The mooring system and hydrobuoy will be assembled on the quayside at Campbeltown harbour and then floated to site behind a workboat. At the deployment location, a pull down wire will pass round a pulley system installed close to the seabed. One end of this wire will attach to the underside of the yaw limiter and the free end will be tensioned using the vessel winch to locate the mooring system above the foundations.

48. From this position, the mooring legs will be connected to the foundation pins using the either a dive team or an ROV. Tension will then be transferred from the pull down wire to the mooring lines to complete this element of the deployment. The mooring system will be tested for a number of tidal cycles before the CoRMaT device is attached.

49. CoRMaT will be towed to the deployment site (Figure 5.5) from Campbeltown harbour and then submerged to deployment depth. Mechanical connection to the yaw limiter will be made using either a dive team or an ROV.

Figure 5.5 - Visualisation of CoRMaT towing arrangement



50. The electrical cable from CoRMaT will be pre-installed with sufficient slack to reach the water surface. The stored cable protruding from the pipeline will also be brought to the water surface and a splice or dry-mate connection will be made. Loose cable will then be managed through the yaw limiter and secured on the seabed by suitable means, potentially using a cable mattress.

51. Given suitable tidal and weather conditions it is expected that the installation of the subsea foundations will take approximately 4 days, and the subsequent hook-up of the mooring system and connection of CoRMaT a further 3 days.

5.4.3 Operation and decommissioning

52. During operation, CoRMaT will be monitored and controlled using a SCADA system. The system will monitor tidal flow rates and the rotational speed of the rotor and stator amongst other aspects of device performance. Generation will be tuned to the site conditions and safe working limits will be set.

53. CoRMaT will be shut down if these limits are exceeded through application of the braking system. A motor driving a hydraulic piston requires electrical supply to release the brakes from the default ON position, thus allowing the device to generate. In the event of loss of supply current or communications, hydraulic pressure is lost and the device brakes are applied. The SCADA system will also function as a drift alarm and will provide immediate notification if station is lost.

54. Periodic maintenance will take place during the operation life of the demonstration project. Works may include visual inspections using drop-down cameras or divers and recovery to shore for maintenance. It is anticipated that Campbeltown harbour will be used as the maintenance port.

55. CoRMaT has been designed for a 20 year operational life however the Argyll Tidal demonstration lease with The Crown Estate will endure for a maximum of 7 years. Decommissioning will see the removal or upgrade of the device, potentially under a new lease agreement. Upon final decommissioning, all system elements above the seabed will be removed and only the embedded mooring pins will remain.

56. The subsea pipeline assembly will be recovered through a reverse of the installation process and the landing j-tube will also be removed from site at the decommissioning stage.

6 PHYSICAL ENVIRONMENT

1. This chapter describes the offshore physical environment local to the Argyll Tidal Development Site.

2. Data sources consulted are noted and, where investigative activity goes beyond desktop-based information gathering, the surveys and other methods used are briefly described. An evaluation of the likely effects of the Development is given.

3. The physical environment local to the Argyll Tidal Development Site is characterised and assessed for 'Tidal Conditions', 'Waves', 'Geology and Bathymetry' and 'Water and Air Quality'.

6.1 BASELINE CONDITIONS

6.1.1 Tidal Conditions

4. A sound understanding of the tidal conditions of the site is required for both technical and environmental reasons. Technically, the nature of the tidal flows will determine the power production of the tidal device as well as its loading regime. Environmentally, tidal flows play a key part in the coastal processes of sediment and nutrient transport.

5. Tidal heights and flows have been characterised in the area of interest using a variety of publically accessible data sources. Given the importance to the project of a sound understanding of the resource, further investigation of the tidal environment has been conducted through dedicated modelling and survey activity.

6.1.1.1 Tidal heights

6. Admiralty tide tables indicate that there is an amphidromic point in the Port Ellen area where the tidal range is nearly zero (M2 tidal amplitude 0.15m). Tidal range generally increases with distance from an amphidromic point. The data presented in the Admiralty tide tables aligns with this rule-of-thumb; the M2 tidal amplitude is 0.18 m at Machrihanish, 0.71 m at Southend and 0.96 m at Campbeltown.

7. UK Class 'A' tidal gauges are located at Port Ellen, Millport, Portpatrick and Bangor. (These have been used as calibration sources for the tidal flow modelling activity described below.)

6.1.1.2 Tidal flows

8. The North Channel experiences strong flows, with the flood (into the Irish Sea) coinciding approximately with rising tide at Liverpool (or Dover). Close to the Mull coastline, the tide changes earlier than further offshore due to the formation of downtide eddies; flows at the coast within these eddies are towards the Mull, i.e. counter to the flow in the main channel. This is suggested by RES's in-house modelling and confirmed by surface observation.

9. Tidal flows of 6 knots are reported about 3 km southeast of the Mull, with 2 knots to the north of Machrihanish (Admiralty Chart 2798-0_w).

10. The Admiralty Pilot and Reeds Almanac indicate that areas near headlands (e.g. within the North Channel off Fair Head and Torr Head in Northern Ireland and off Mull of Kintyre in Scotland) experience particularly fast flows. The channels connecting the Sound of Jura with the Linnhe system such as the Sound of Islay and the Gulf of Corryvrechan, also experience strong tidal flows.

11. Limited current meter data are available in the open North Channel.

12. As part of the preliminary resource assessment work stream for the project, RES Offshore constructed a regional numerical flow model of the North Channel area. The model is a 2D formulation of the Princeton Ocean Model (POM).

13. The model domain includes the whole North Channel and Clyde Sea and associated sea lochs; horizontal model resolution varies between about 1 km at the open boundaries to 60 m local to the Mull of Kintyre.

14. To drive the regional model, tidal elevations, taken from a calibrated shelf model, have been specified at the model boundaries. The regional model has been calibrated against available tide gauge and current meter data and shows an error of less than 15 cm in tidal elevation and less than 0.2 m/s at current meter locations. No calibration data were available within in the Development Site. The model has been run for 29 days.

15. The regional model results are presented below in Figure 6.1 (mean flow speed) and Figure 6.2 (maximum flow speed). These should be taken as indicative only due to the coarse nature of the model input data and the uncertainties inherent in the modelling process. Relative variations are generally well represented by such models.

16. Modelling activity suggests that the south-eastern corner of the Development Site is the region of highest tidal resource with much of the northern and western areas being too benign for development. Maximum flow speeds are approaching 4 m/s in the highest resource areas with corresponding mean speeds of 1.8 m/s.

17. To further understand the resource variations at the preferred device deployment site, an ADCP was deployed in October 2013 at a location close to the device deployment area defined in Chapter 3. The instrument awaits a suitable weather window for recovery (Dec 2013).

Figure 6.1 - Mean depth-averaged flow speed (m/s) map from POM regional flow model

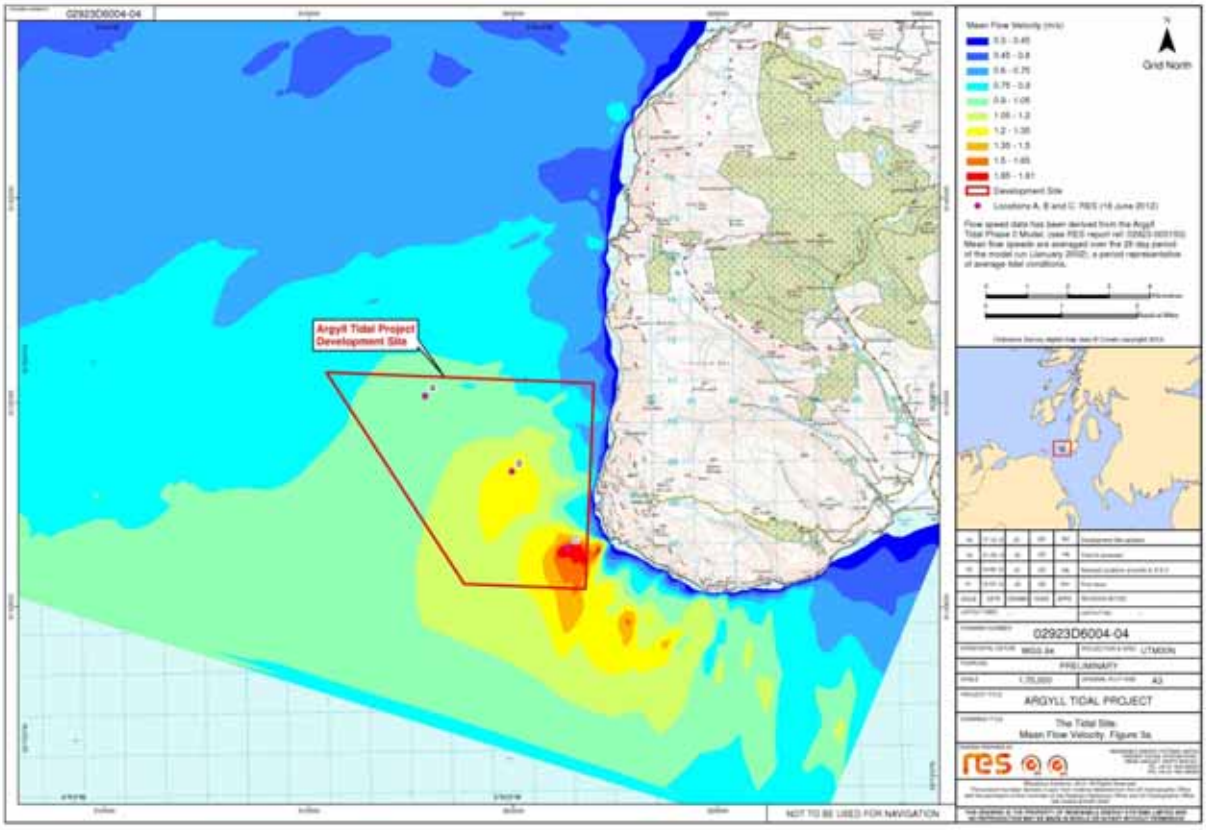
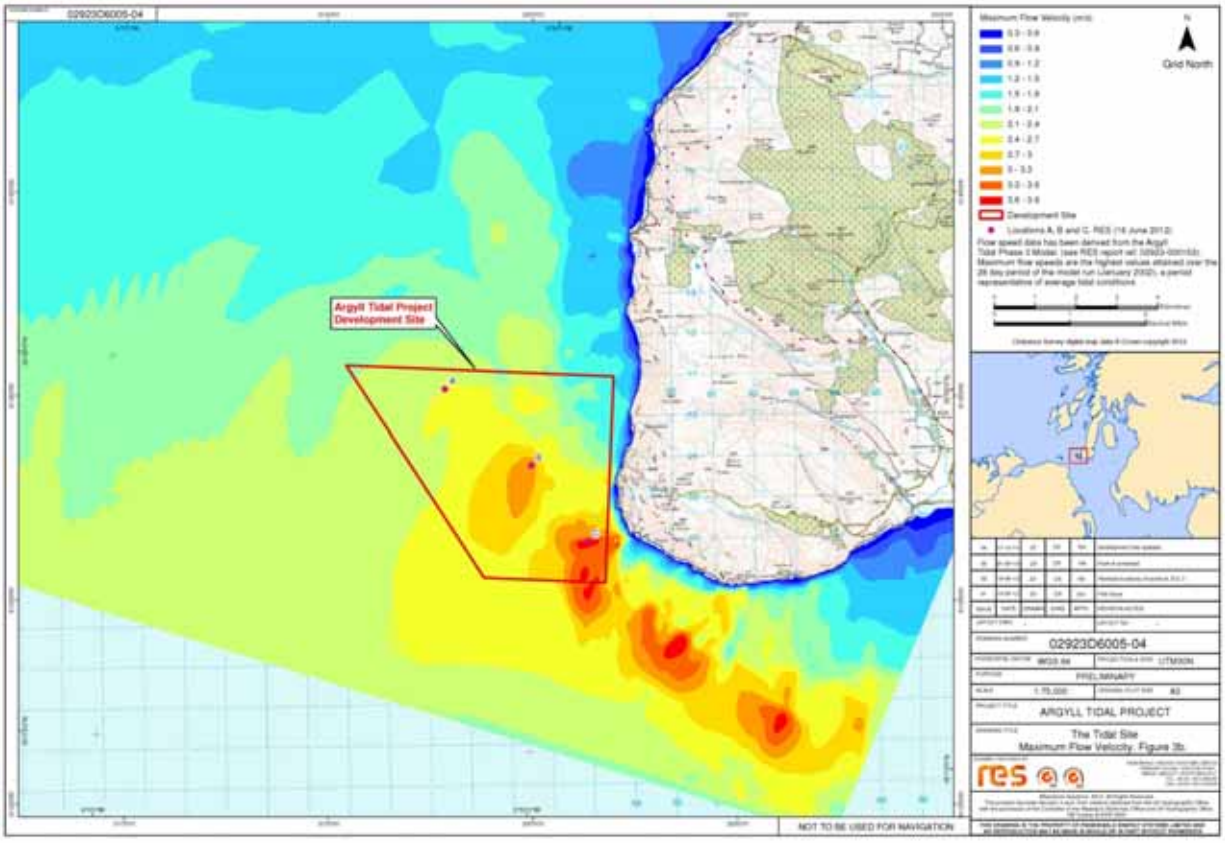


Figure 6.2 - Maximum depth-averaged flow speed map from POM regional flow model



6.1.2 Waves

18. Knowledge of the wave regime is mainly required for technical reasons since extreme wave conditions represent design loading cases for the device and its attachment systems. The wave regime also has a major influence on windows for deployment and maintenance. Environmentally, waves are important for pollution dispersion.

19. The wave regime of the Development Site has been assessed using various data sources. Although not reported here, a wave model of the region is under construction to assist with the characterisation of extreme conditions for the design envelope.

20. The following data sources have been consulted:

    - 1 year of wave data from a sheltered location at Ballycastle for 1975-6;
    - HSE Offshore Technology Report (2001);
    - Low resolution global wave models (FNMOC and ECMWF);
    - Satellite data (globwave).

21. These sources can only give a very approximate indication of the wave regime of the development area, hence the ongoing development of a project specific model.

22. The FNMOC and ECMWF models are limited in usefulness by resolution and also by their lack of consideration of interaction effects caused by tidal currents. Satellite data resolution is also of limited use in terms of accuracy near the coast due to resolution issues.

23. No wave measurements are available at the site. The 1 year of wave data, reduced to a time series of significant wave height and zero crossing period, from Ballycastle are shown in Figure 6.3 and Figure 6.4. 50 year return heights for UK waters are presented in the HSE offshore technology report, and are shown in Figure 6.5.

24. The wave heights at the Ballycastle site, which is sheltered and in an area of weak tides, can only be regarded as a very rough, understated, indication of conditions off the Mull of Kintyre. The wave heights in the HSE report are based on measurements at points indicated in Figure 6.5.

25. ECMWF ERA interim reanalysis (http://data-portal.ecmwf.int/data/d/interim_full_daily/) includes a wave model at 0.75 degree horizontal resolution and 6 hour temporal resolution for the period since 1979. Examination of significant wave height data for 1989-2011 from this source indicates the following extreme values on the Malin Shelf: (12-Jan-2005) 12m; (22-Jan-1993) 11m; (17-Jan-1990) 10m. While the site is partially sheltered by Islay and Jura, strong wave current interaction is expected both at Mull-of-Kintyre and indeed across the wider North Channel.

26. Local fishermen and the local lifeboat coxswain report waves off the Mull-of-Kintyre in excess of 12m in westerly gales (stakeholder consultations for the Navigational Risk Assessment process conducted by Marico Marine). This seems plausible.

Figure 6.3 - Location of Ballycastle wave measurements

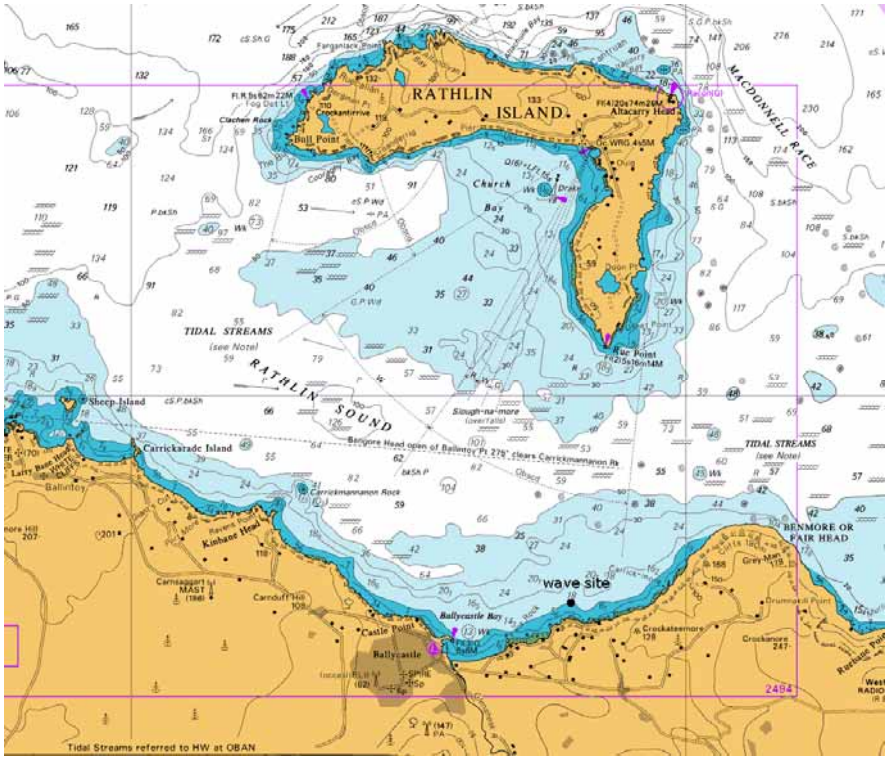


Figure 6.4 - Ballycastle wave data

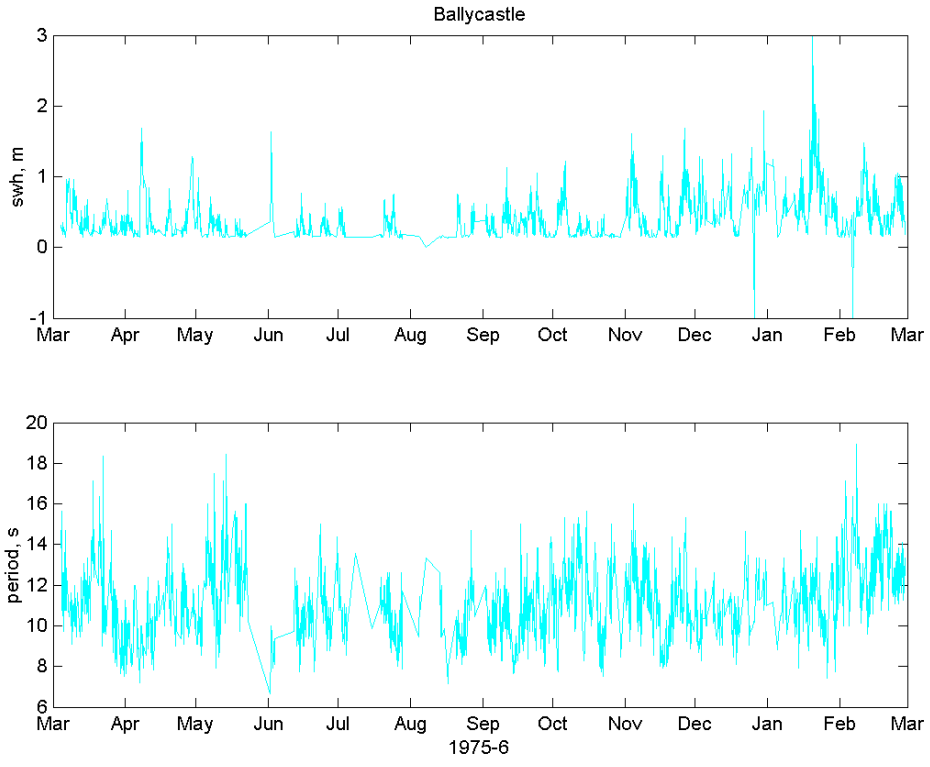
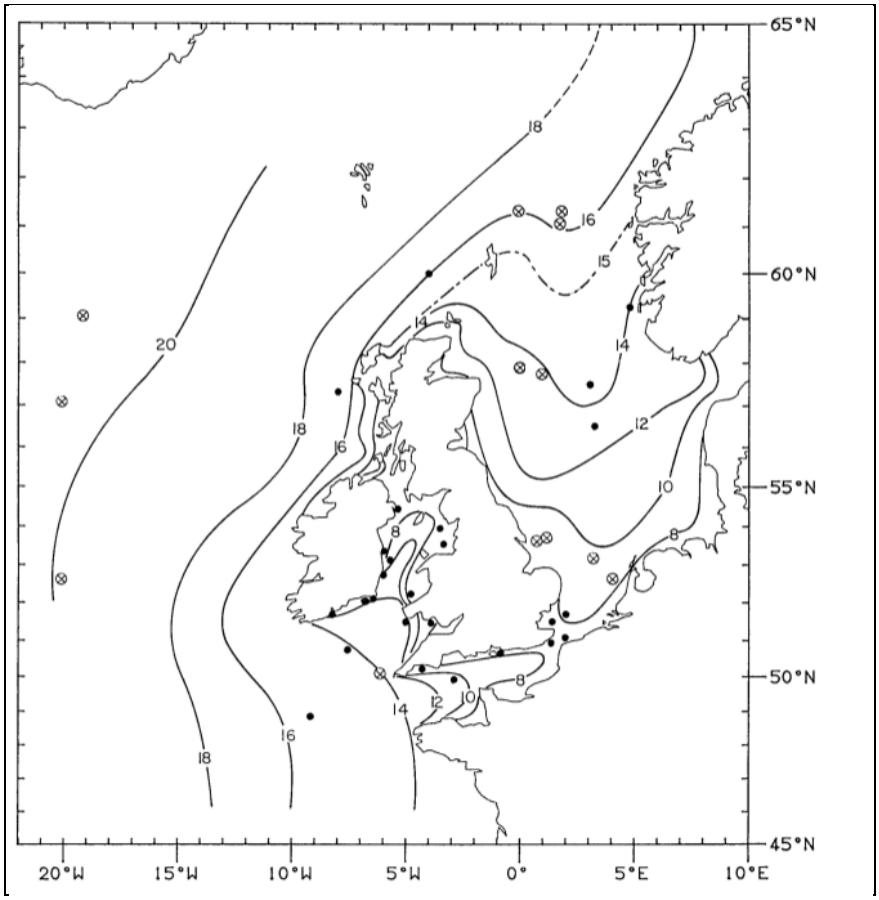


Figure 6.5 - 50 year return heights from HSE 2001 report



6.1.3 Geology and bathymetry

6.1.3.1 Data sources

27. Bathymetry data are available from Seazone Ltd. As of 2012, these data have been based on spot measurements (e.g. single beam echo soundings) with point spacing of 100-200m. The Seazone data provides a good overview of the wider bathymetry of the North Channel region.

28. A multi-beam (MBES) survey with a resolution a few metres was undertaken during 2012 as part of the INIS Hydro project (see www.inis-hydro.eu) and data were released to the public during 2013. This survey has provided an excellent definition of the region off the coast around the Mull-of-Kintyre beyond a depth of 20 metres.

29. An additional dedicated MBES survey of the development site in the region inshore of the 20 metre contour was conducted for the development on 24th November 2013.

30. A dedicated drop-down video survey was also carried out in selected locations on 14th October 2013.

31. Some sediment sampling was done as part of the INIS Hydro survey, fifteen samples being taken.

6.1.3.2 Bathymetry

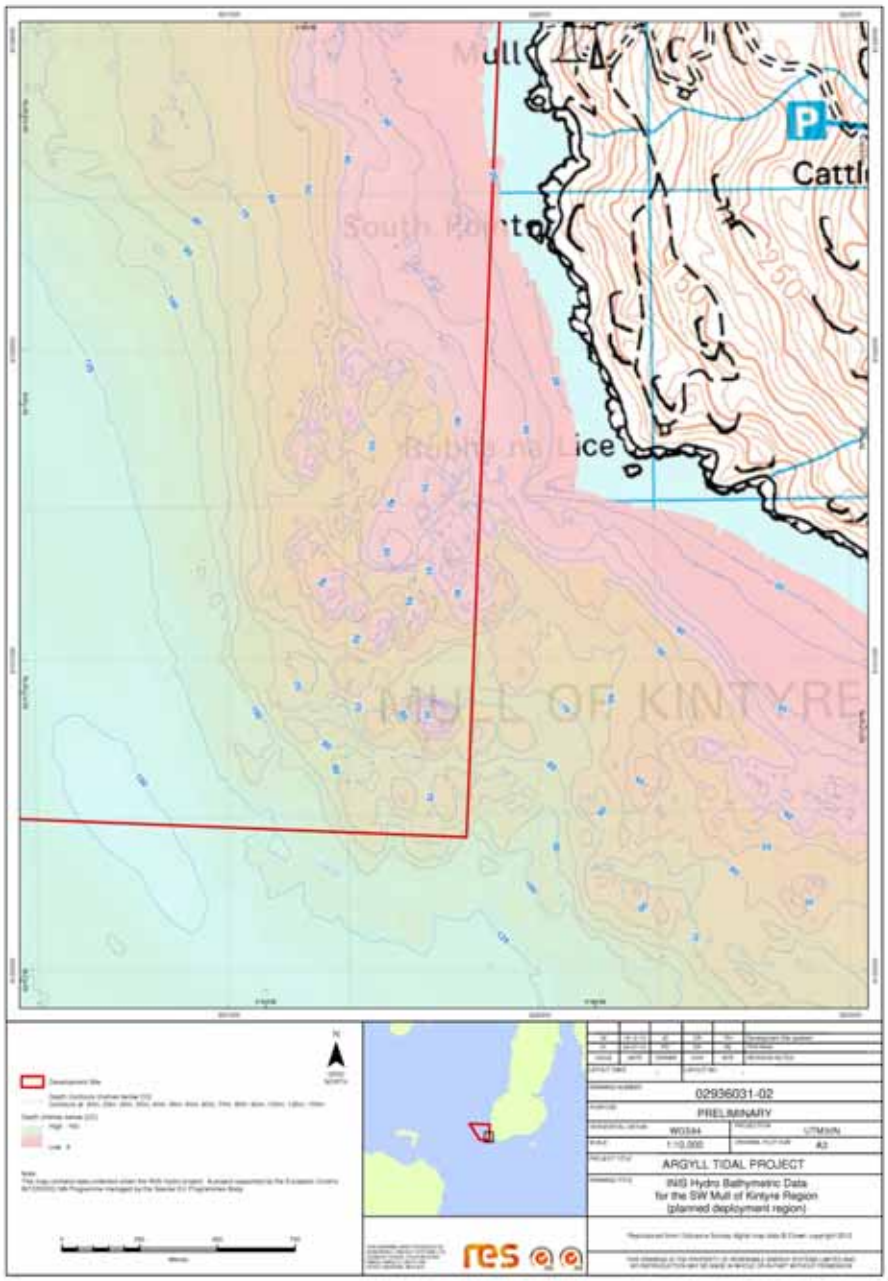
32. In the North Channel, Seazone data show that depths exceed 200 m to the North of Rathlin Island and in the Beaufort deep.

33. Local to the Mull-of-Kintyre, the Seazone data show that the 50 m isobath is within 1 km of the coast but its distance from shore increases to the north and east. A small sill of 8 m depth is identified to the southwest of the Mull.

34. A bathymetry map based upon the INIS Hydro data in the vicinity of the proposed area of deployment is shown in Figure 6.6.

35. Taken together with Figure 6.2, it is clear that the tidal flows are influenced heavily by both the plan of the coastline and also by the bathymetry with flow being accelerated by the headland and by ledges of shallower bathymetry.

Figure 6.6 - Bathymetry in the vicinity of the deployment location based on INIS Hydro data

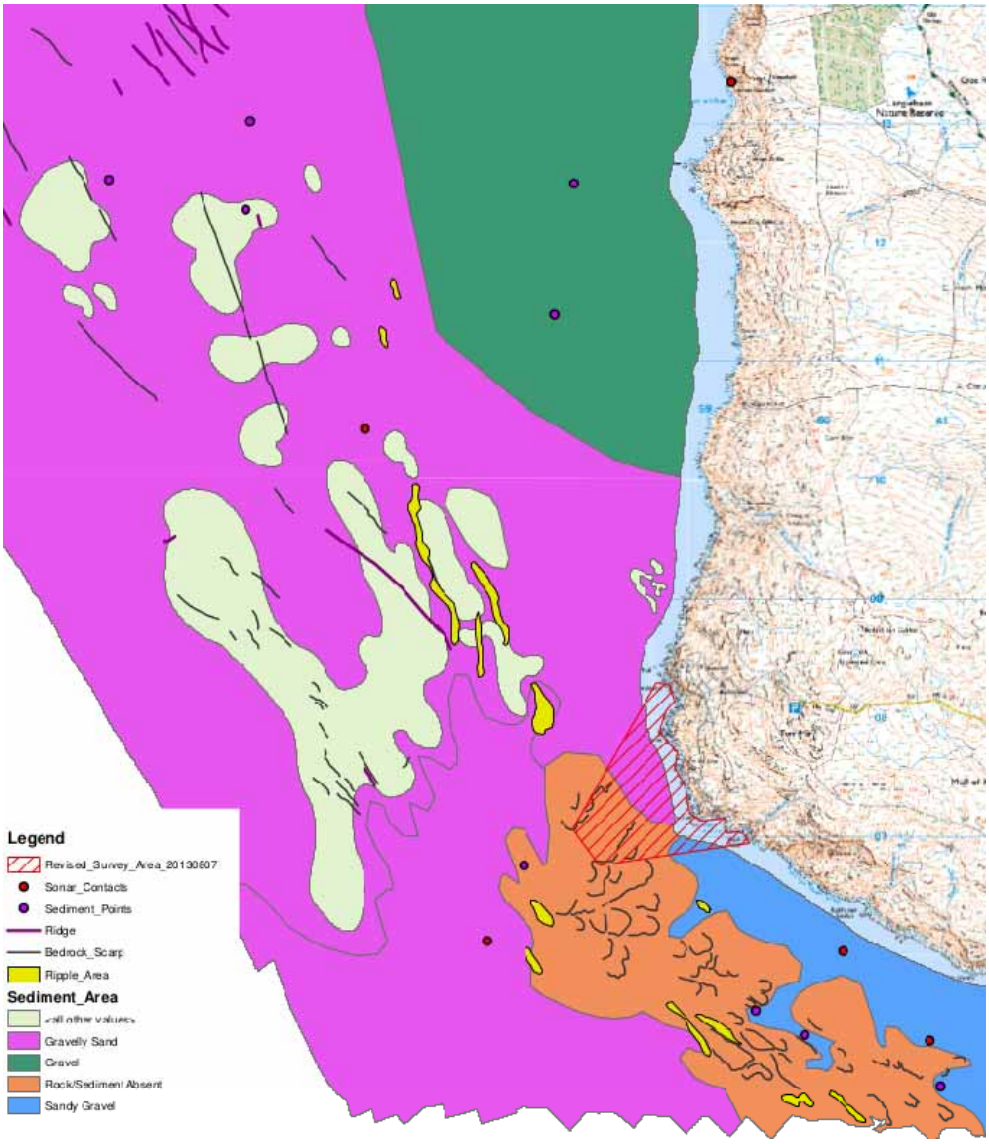


6.1.3.3 Sediments

36. Off the Mull, rock, gravelly sand and sandy gravel predominate, with rock in areas of high tidal scour. Throughout the defined device deployment area (see Chapter 3), the bed is rocky, very uneven in patches, with occasional boulders/rocks. Scarps are present at the site and offshore to the north and west. Areas of ripples exist in the zone, possibly consisting of gravel and shell. Away from the site, in less tidally active areas, and towards the shore, cobbles and gravel are present, and closer in, areas of gravel and sand exist. As expected, the areas that are most exposed to the stronger tidal flows are largely bare rock.

37. A sediment classification map is shown in Figure 6.7. There is no evidence of any significant sediment settling across the proposed deployment site.

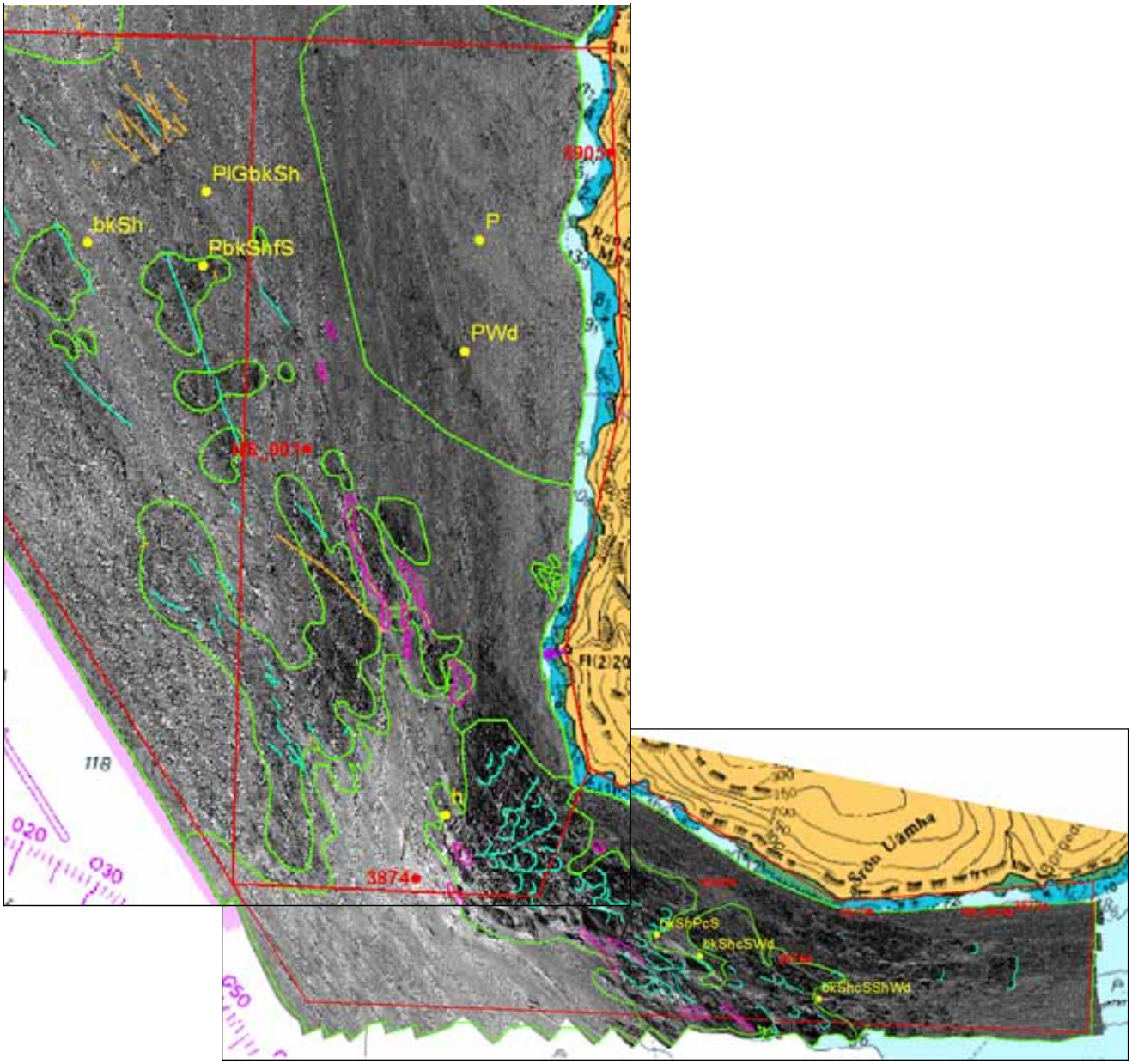
Figure 6.7 - Sediment classification map based on INIS Hydro data



6.1.3.4 Bottom texture and type

38. A bottom texture map, shown in Figure 6.8 and based on the characteristics of the sonar reflection from the bottom, has been derived from the INIS Hydro MBES survey. The dedicated drop-down video survey provided a confirmatory source of information along a cruise path which ran just offshore from the lighthouse to the proposed cable landing site and offshore to the proposed device location.

Figure 6.8 – Bottom texture map



6.1.4 Water quality

39. The waters off the Mull of Kintyre are covered by the Scottish Environmental Protection Agency's (SEPA) 'Argyll and Lochaber area management plan' which aims to maintain and improve the quality of the rivers, lochs, estuaries, coastal waters and groundwaters in the area. This helps to deliver the Water Framework Directive requirements of improving all water bodies to good ecological status and preventing any deterioration.

40. North of the Development Site lies the Machrihanish bathing water, designated under the EC Bathing Water Directive.

41. There are no designated fish or shellfish farm leases in the area of the Development Site.

6.2 ASSESSMENT OF POTENTIAL EFFECTS

6.2.1 Tidal regime

42. Alterations to the flow as a result of blockage and energy extraction will occur in the immediate near-field of the device. A turbulent wake structure will form in the energy deficit region downstream of each rotor and small levels of flow enhancement are expected to occur in the regions around the rotor swept areas of the device. Tank tests and existing model simulations indicate that flow will return to 95% of the undisturbed level not more than 20 device diameters downstream of the device.

43. Outwith the near-field there will be no significant alteration to the nature or strength of the flow.

44. At a flow speed of 2.5 m/s (the typical rated speed of tidal devices), the full depth water column across the device width (14 m) will see a kinetic energy flux of circa 3,500 kW. The device will extract approximately 500 kW (or 15%) of this. Due to the lack of a substantial support structure, there will be little additional energy dissipation from structural eddies. Given that the main tidal race extends offshore for roughly 1 kilometre, or 70 times the device width, the total additional energy that will be extracted by the deployment of the device will be less than 1% of the total flux.

45. Lowest percentage impacts will be experienced at low flows around slack, when the turbine will not be operating and at high spring peak flows when the turbine is beyond its rated speed.

46. More detailed analysis of the effects on the flow field would be necessary for commercial scale deployments of say 50-100 MW.

47. Given the negligible impact on the flow field, no mitigation is required.

6.2.2 Wave regime

48. In theory, significant changes to a tidal regime can alter tide-wave interaction effects such as enhanced or retarded wave breaking.

49. Given the negligible impact that the device will have on the tidal regime, there will correspondingly negligible coupling effects and thus no significant alteration to the wave regime through this mechanism.

50. The device will be hydrodynamically active in much the same manner as a moored vessel. It will have a similar level of wave scattering and wave radiation potential as a small fishing boat i.e. insignificant in scale relative to the surrounding regime.

6.2.3 Geophysical integrity

51. The deployment of the device will require the drilling for a small number of grouted piles. The scale and penetration of these will have no significant impact on the integrity of the local rock structures.

6.2.4 Sediment transport and pollution dispersion

52. A single device will have little effect on the sediment transport regime; wake effects downstream of the device will be confined to the middle of the water column and the wake

direction will vary by up to 20 degrees during each phase of the tidal cycle, so it is extremely unlikely that deposition will be increased.

6.2.5 Pollution, water quality and air quality

53. The vigour of the tidal and wave regimes is an advantage in the event of any pollution event that might occur either directly or indirectly as a result of the project.

54. During construction, drilling for grouted piles will be carried out. Even with the generation of spoil for this one-off event, the small quantities and the vigour of the tidal regime will cause rapid dispersal.

55. As outlined in the project description (Chapter 4), the device has a flooded gearbox i.e. with no hydrocarbon or synthetic contained coolant. No pollution scenario is seen to exist in relation to the device.

56. In terms of the cable/pipe system to shore, high density gel may be used to sink the pipe and to help retain it on the seabed. In the event of any escape of unpressurised gel caused for instance by a catastrophic fracture, the environmentally benign nature of the gels, coupled with the low seepage rate are unlikely to pose a threat of any significance, especially when coupled with the high wave and tidal dispersion characteristics of the site.

57. No fuel, other than by plant and vessels during construction and during operational recovery, will be burnt on site. No significant impact on local air quality will occur.

6.3 MITIGATION MEASURES

58. An environmental management plan will be included as part of the agreed Construction and Operation Method Statement for the development.

6.4 SUMMARY OF EFFECTS

59. Any effects on the wave and tidal resource will be negligible and not significant. Adherence to the environmental management plan will ensures any effects on water and air quality will be negligible.

7 BENTHIC ECOLOGY

7.1 INTRODUCTION

1. This chapter of the Environmental Appraisal (EA) evaluates the effects of the proposed Argyll Tidal Demonstrator Project (hereafter referred to as "the Development") on the benthic ecology resource.

7.2 ASSESSMENT METHODOLOGY

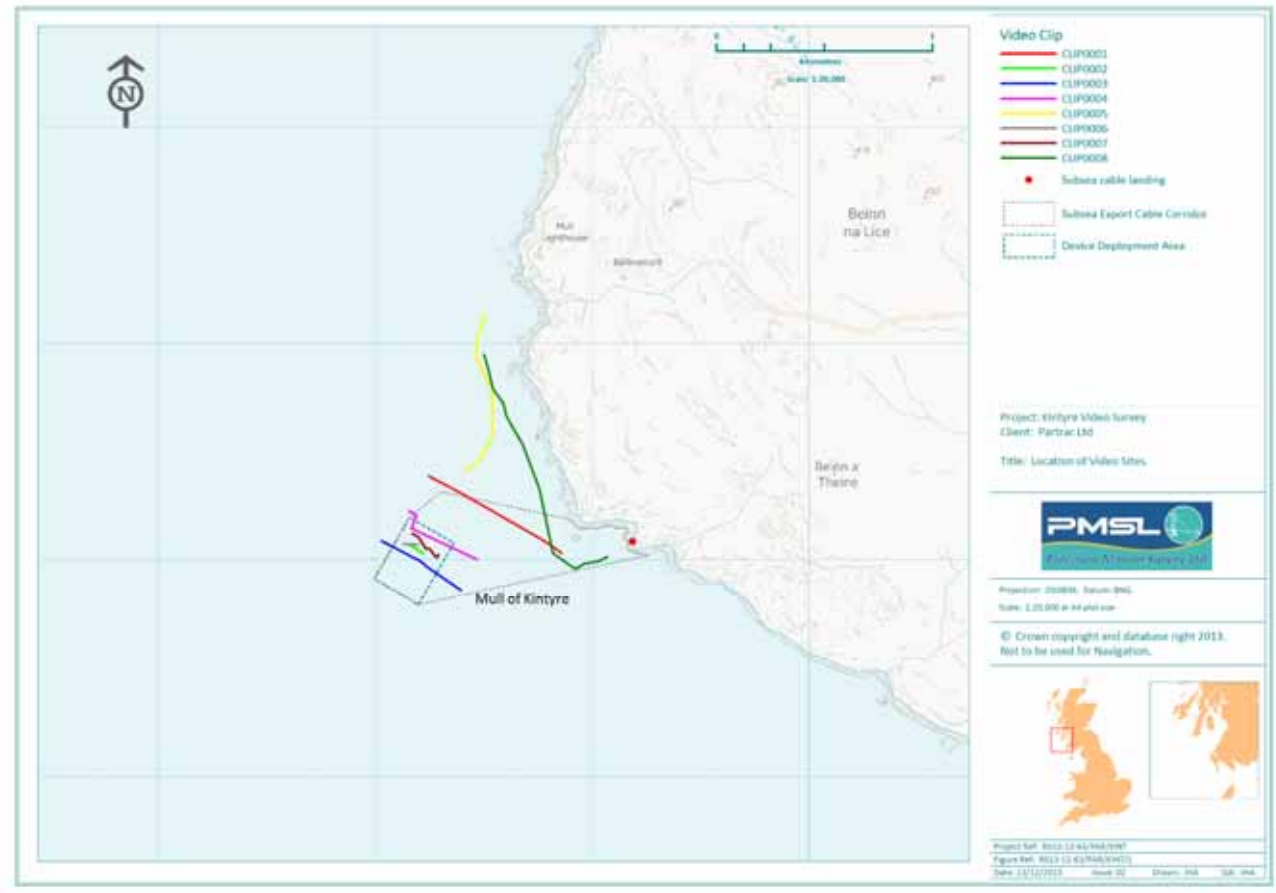
2. The benthic ecology assessment has been based on a drop-down video survey undertaken on the 14th October 2013. The video survey scope was agreed with MS-LOT and can be found in Appendix 7.1.

3. The aim of the video survey was to establish the habitats types and species present in the device deployed region and along the potential subsea export cable corridors in order to enable the assessment of the potential impacts of the proposed development on identified communities.

4. Precision Marine Survey Ltd was commissioned to undertake an assessment of the video data obtained from the drop-down video survey.

5. Eight video transects/drifts were undertaken and twenty two video clips analysed. The location of the video clips recorded during the survey in relation to the proposed offshore development areas is shown in Figure 7.1.

Figure 7.1- Location of survey sites



6. Video data was provided to Precision Marine Survey Ltd in MOV format on a hard drive for subsequent analysis. Each video clip was reviewed and the main habitats defined. Positional data and times for the start and end of each clip and the separate areas (habitats) within each clip were derived from data encoded within the video. A summary of sedimentary features and characteristic taxa for each area was recorded and a representative series of still photographs taken from each video.

7. The results of the analysis were then tabulated and used to derive biotopes as per the Marine Habitat Classification for Britain & Ireland (Connor et al., 2004). This information along with coordinates for each video clip and habitats/biotopes derived from the video were then input into GIS to derive maps of the survey area.

7.3 SITE CHARACTERISATION

8. The review of the video data indicated that the survey area was characterised primarily by hard or coarse mixed substrata in an area with strong tidal currents primarily in depths between 20 to 50m CD with the shallowest inshore site in depths between 10 to 20m CD. For much of the survey visibility was reduced due to strong tidal currents in conjunction with rough seabed topography which necessitated lifting the drop down video off the seabed to avoid damage. As such detailed quantitative analysis of seabed species was hampered during periods of strong tidal flows although the footage was sufficient to give an indication of habitat type and the main (characteristic) taxa from which indicative biotopes have been derived.

9. The video camera was periodically dropped to the seabed which allowed a more detailed assessment of substrata and species which could be extrapolated over the adjacent seabed for each habitat. Indicative distributions of biotopes along routes surveyed by video are provided in Figure 7.2.

Figure 7.2 - Distribution of biotopes in the survey area

10. A summary of each area (habitat) recorded along the video clips is provided in Appendix 7.2 which includes a summary of substrata, key taxa and biotope(s). The summary for transect 4 which traverses the device deployment region is provided in Table 7.1 below.

Table 7.1 - Summary of habitats in device deployment region

Video	Area	Summary	Biotope(s)	Example seabed photograph
CLIP0004_00009	1	Barnacles on bedrock and boulders, *Asterias rubens*, sponges, *Tubularia*, *Urticina felina* & *Echinus esculentus*.	**CR.HCR.FaT.BalTub / CR.MCR.EcCr.UrtScr**	
	2	Coarse sand patches with cobbles & occasional patch of bedrock and boulders with *Urticina felina*, barnacles, *Spirobranchus*, *Flustra foliacea*, hydroids.	**SS.SMx.CMx.FluHyd**	

Video	Area	Summary	Biotope(s)	Example seabed photograph
				
CLIP0004_00010	1	Coarse sand, cobbles, on bedrock and boulders, with barnacles, *Echinus esculentus, Flustra foliacea*, hydroids, *Spirobranchus, Urticina felina Nemertesia*, *Calliostoma zizyphinum*.	**SS.SMx.CMx.FluHyd**	

Video	Area	Summary	Biotope(s)	Example seabed photograph
				

11. The estimated abundance of species and substratum components for each area is provided in Appendix 7.3.

12. The results of the video analysis highlighted that the survey area was broadly consistent in terms of general habitat types and biotopes. Inshore areas tended to have a greater proportion of mixed coarse substratum albeit with areas of bedrock or boulder (e.g. in the vicinity of video clips 5 and 8) whilst further offshore there was a combination of bedrock and boulder which was often influenced by adjacent coarse sandy/gravelly sediments. Within the limitations of the survey video a number of biotopes were defined and it was noted that these often included rather transitional habitats or those which appeared to include variable mosaics of different seabed features. As such the biotopes defined are indicative and include areas where several biotopes may be present.

13. Along the inshore region (video clips 5 and 8) the seabed appears to be characterised by variable mixed (coarse) sediments with boulder and/or bedrock interspersed with wide areas of coarse gravelly sandy with variable cobble content. These include areas with larger cobbles and boulder characterised by red seaweeds including foliose and encrusting red algae such as Corallinaceae along with moderate coverage by barnacles and frequent echinoderms such as *Echinus esculentus* and *Asterias rubens*. Such areas appear to be somewhat impoverished and are likely to comprise of a variable (or transitional form) of biotopes such as IR.HIR.KFaR.FoR (Foliose red seaweeds on exposed lower infralittoral rock) and this habitat was often interspersed with areas of rather barren coarse or mixed substrata (CCS/CMx). A similar habitat is also present in this inshore area which also included areas of boulder or bedrock with patchy kelp (low to moderate densities) with red seaweeds and *Dictyota dichotoma* which appears to be somewhat scoured and influenced by adjacent sands and gravels. This habitat been classified as IR.HIR.KSed (Sand or gravel-affected or disturbed kelp and seaweed communities) and may include biotopes such as IR.HIR.KSed.XKScrR (Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock.

14. Just offshore to the north of the survey area video clip 5 also includes a broad area of mixed coarse sediment of cobbles, pebbles and gravelly sand with variable coverage by epifauna including a variety of bryozoans and hydroids and occasional red algae with variable but often high densities of brittlestars such as *Ophiothrix fragilis* and *Ophiocomina nigra* (SS.SMX.CMx.OphMx - *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment) interspersed with mixed sediment with lower abundances of brittlestars (CMx). In slightly deeper water further offshore (e.g. clip 1 and various sections of clips 3, 4 and 6) are areas of variable coarse mixed sediment (pebbles, cobbles, gravel and sand) with a variable and moderately diverse hydroid/bryozoan turf including *Flustra foliacea*, echinoderms (*Asterias rubens*) and variable populations of other epibiota (sponges, ascidians). Whilst variable this

habitat generally corresponds to SS.SMx.CMx.FluHyd (*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment). Adjacent to such habitats and notably to the south of the area (clips 3, 4, 6, 7 and 8) are areas of tideswept hard substrata (boulder and bedrock) interspersed with gullies containing coarse mixed sediment or areas of flatter rock characterised by areas of surficial sandy gravel. These areas were difficult to assess in detail but appear to be subject to strong tides and were often influenced by scour or adjacent areas of softer sediments. In such areas exposed rock was usually characterised by a high coverage by barnacles or other encrusting taxa along with a patchy/variable hydroid turf including *Tubularia* sp. A variety of other epibiota were also present including a moderate numbers of anemones such as *Urticina felina* and occasional sponges or colonial ascidians.

15. These habitats appear to include somewhat variable or transitional forms of tideswept circalittoral rock biotopes (CR.HCR or CR.MCR) characterised by tideswept faunal turfs or crustose communities and whilst visibility in these areas was often poor they have been tentatively ascribed as somewhat impoverished variants of the biotopes CR.HCR.FaT.BalTub - *Balanus crenatus* and *Tubularia indivisa* on extremely tide-swept circalittoral rock (albeit with modest densities of *Tubularia*) and/or CR.MCR.EcCr.UrtScr - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock and these areas may include mosaics or transitional forms of these biotopes. Interspersed with these areas are rocky habitats which are more influenced by sandy/gravel substrata and whilst these tended to have restricted visibility they have been assigned the biotope CR.MCR.EcCr.UrtScr but also contain elements of more mixed sediment communities such as SS.SMx.CMx.FluHyd and again are likely to include transitional forms or mosaics of these biotopes. At several locations within this area are also areas of rock with similar communities to those listed above but which are characterised by variable (but often dense) patches of mussels which are likely to include the biotope CR.MCR.CMus.CMyt (*Mytilus edulis* beds with hydroids and ascidians on tide-swept exposed to moderately wave-exposed circalittoral rock).

7.4 DEVELOPMENT DESIGN MITIGATION

16. The offshore deployment areas chosen have been shown by the benthic assessment work carried out to be in an area with:

    i. limited likelihood of being host to significant areas of seabed habitat with features of conservation importance and

    ii. no evidence of Priority Marine Features.

17. The potential for the Development to have significant effect on the benthic environment has been minimised through choice of a suitable deployment location.

7.5 ASSESSMENT OF POTENTIAL EFFECTS

18. The area is characterised by variable, tideswept rocky substrata interspersed with, or influenced by, coarse mixed sediments. These include biotopes such as CR.HCR.FaT.BalTub, CR.MCR.EcCr.UrtScr, CR.MCR.CMus.CMyt, IR.HIR.KFaR.FoR, SS.CCS, SS.SMx.CMX, IR.HIR.KSed, SS.SMx.CMx.FluHyd and SS.SMX.CMx.OphMx often with areas of transitional habitats or those containing mosaics of several biotopes. Whilst the nature of the seabed terrain and strong tidal currents hampered a detailed assessment of the biotopes and species in some areas, the communities recorded appear to be relatively robust forms which are typically found in rocky coastal environments subject to strong currents and/or wave action.

19. In terms of the proposed development the offshore device is a relatively small structure held in place with 3 drilled and grouted pin foundations for hook-up of the mooring system. The location of this structure will be in the vicinity of tideswept, circalittoral rock or sediment influenced rock habitats (CR.HCR and CR.MCR) and coarse mixed sediment communities as listed above which are likely to include biotopes such as CR.HCR.FaT.BalTub, CR.MCR.EcCr.UrtScr and SS.SMx.CMx.FluHyd along with small areas of mussel bed on rock. These communities and other similar CR.HCR or CR.MCR biotopes in exposed tideswept areas are usually characterised by robust taxa and aside from very localised direct impacts (habitat loss) at the mooring foundations are unlikely to be subject to significant disturbance. Given the highly dynamic nature of the environment to which such communities are accustomed any direct or indirect impacts during construction in terms of smothering or increased turbidity are likely to be small and of limited extent/duration.

20. Along the export route the export cable will be housed in a 4" drill pipe (or 12"j-tube through the surf zone) so the extent of potential disturbance or direct habitat loss beneath the pipe will be relatively small. This area is characterised by tideswept mixed substrata (SS.SMx.CMx.FluHyd) further offshore or relatively impoverished red algae encrusted coarse mixed sediment and cobble/boulder (e.g. IR.HIR.KFaR.FoR) along with patchy areas of kelp and red algae (e.g. IR.HIR.KSed) along the nearshore margin. These communities appear to be adapted to a dynamic environment with epifaunal or algal communities influenced by coarse soft sediments (sand/gravel). Whilst variable, the populations of epibiota/algae in this area are often either somewhat impoverished or exhibit a patchy distribution often interspersed with areas of relatively barren coarse mixed sediment (pebbles, cobbles and gravel). As such it is unlikely that the limited disturbance from installation of the export cable would cause significant impacts to these communities and in such a dynamic area potential changes to the current regime (or sediment transport) which could influence near shore communities are likely to be minor.

21. Based on the video data and analysis undertaken for this project, there appears to be limited likelihood for significant areas of seabed habitat with features of conservation importance and no Priority Marine Features were evident. The communities which have been recorded are somewhat variable and often transitional (or with patchy distribution of key species). These communities are presumably influenced by strong tidal currents/wave action and sediment movement and as such are likely to be relativity resistant to moderate to low levels of disturbance resulting from the installation of an offshore tidal device.

22. As described in Chapter 6 – Physical Processes, any reduction in flow velocities resulting from the extraction of tidal energy at the device will be restricted to a small region close to the device and impacts on the seabed negligible so no impacts are predicted on habitats and species which are sensitive to changes in tidal flows.

7.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

23. No further mitigation measures are proposed with regard to the benthic ecology resource.

7.7 ASSESSMENT OF CUMULATIVE EFFECTS

24. As the effects of the Development alone are considered to be negligible, no cumulative effects are predicted when the Development is combined with any other projects or activities.

7.8 SUMMARY OF EFFECTS (RESIDUAL EFFECTS)

25. Residual impacts on the benthic ecology are all considered to be negligible and not significant.

7.9 REFERENCES

Connor, D.W., Allen, J. H., Golding, N., Howell, K. L., Lieberknecht, L. M., Northen, K. O. and Reker, J. B. 2004. *The National Marine Habitat Classification for Britain and Ireland. Version 04.05.* Joint Nature Conservation Committee, Peterborough. ISBN: 1 861 07561 8 (internet version).

8 MARINE MAMMALS

8.1 INTRODUCTION

1. This chapter of the Environmental Appraisal (EA) evaluates the effects of the proposed Argyll Tidal Demonstrator Project (hereafter referred to as "the Development") on the marine mammal resource.

2. This assessment is supported by the following Appendices: a) MacArthur Green (2012) Argyll Tidal Array Seabird Survey Methodology. Report to Marine Scotland and Scottish Natural Heritage; b) Excel spreadsheet of marine mammal survey data.

3. The chapter provides information on the likely presence, relative abundance and distribution of marine mammals, and how they vary spatially and temporally, within the vicinity of the Development.

4. The potential impacts to marine mammals during construction, operation and maintenance, and decommissioning are also considered and possible mitigation measures to reduce these impacts are discussed. Cumulative impacts with other developments are considered.

5. Twenty-eight species of whales, dolphins and porpoises (cetaceans) are known to occur in north-west European waters, while in UK waters, eleven species may be seen regularly, the most frequent including minke whale *Balaenoptera acutorostrata*, fin whale *B. physalus* and sperm whale *Physeter macrocephalus*, common bottlenose dolphin *Tursiops truncatus*, short-beaked common dolphin *Delphinus delphis*, Atlantic white-sided dolphin *Lagenorhynchus acutus*, and harbour porpoise *Phocoena phocoena* (Reid et al. 2003).

6. All these species are listed on Annex IV of Directive (92/43/EEC) on Conservation of Natural Habitats and of Wild Fauna and Flora (as amended) (the Habitats Directive) and are European Protected Species. This requires regular assessments of their conservation status in UK waters.

7. In addition, common bottlenose dolphin *Tursiops truncatus* and harbour porpoise *Phocoena phocoena* are listed on the Habitats Directive Annex II which requires the designation of Special Areas of Conservation where suitable areas can be identified (JNCC web ref 1).

8. Two species of seal occur in large numbers in the west of Scotland, harbour seal *Phoca vitulina* (also known as common seal) and grey seal *Halichoerus grypus*.

9. Harbour seal and grey seal are listed as Annex II species under the Habitats Directive and are protected by a suite of Natura sites (Special Areas of Conservation (SACs)).

10. The Marine (Scotland) Act 2010 introduced increased protection for seals in Scottish waters, including making it an offence to deliberately harass seals at haul-out sites which have been listed under Section 117 of the Act. Seven ‘Seal Management Areas’ were established, with the Development being at the southern edge within the ‘West Highland Management Area’ extending from Cape Wrath to Mull of Kintyre. Within this management area, a Potential Biological Removal (PBR) analysis concluded that up to 442 harbour seals and 297 grey seals could be killed by human activities in addition to natural mortality without significant impact on the size of the population (Scottish Government 2012). These totals include numbers that might be killed by marine renewable developments.

11. European Union Member States are required to maintain or restore European protected habitats and species that are listed in Annexes to ‘Favourable Conservation Status’ (FCS). FCS is defined as

population maintaining itself on a long term basis as a viable component of its natural habitats; the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and there is and will probably continue to be a sufficient area of habitat to maintain population on a long-term basis.

8.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

8.2.1 Data sources and guidance

12. The assessment has been undertaken in line with the following international conventions:

- The Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention);
- The Convention on Migratory Species (the Bonn Convention); and
- The OSPAR Convention.

13. The assessment has been undertaken in line with the following European legislation, policy, and guidance:

- Directive 92/43/EEC on Conservation of Natural Habitats and of Wild Fauna and Flora (as amended) (Habitats Directive);
- The Environmental Impact Assessment Directive 85/337/EEC (as amended);
- The Marine Strategy Framework Directive 2008/50/EC.

14. The following national legislation, policy and guidance are considered as part of the assessment:

- The Wildlife and Countryside Act 1981 (as amended);
- The Nature Conservation (Scotland) Act 2004 (as amended);
- The Marine (Scotland) Act 2010;
- The Marine and Coastal Access Act 2009;
- The Wildlife and Natural Environment (Scotland) Act 2011;
- Electricity Act 1989;
- The Town and Country Planning (Scotland) Act 1997 as amended by the Planning (Scotland) Act 2006;
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011;
- The Conservation (Natural Habitats &c.) Regulations 1994 (as amended);
- The Conservation (Natural Habitats &c.) Regulations 1994 (as amended);
- The Conservation of Habitats and Species Regulations 2010;

- The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended);
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011;
- The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2004;
- The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2007;
- Environmental Impact Assessment (Scotland) Regulations 1999 (as amended);
- Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 (as amended);
- Environmental Impact Assessment (Scotland) Regulations 2011 (as amended);
- Marine Works (Environmental Impact Assessment) Regulations 2007;
- Electricity Works (Environmental Impact Assessment) (Scotland) Amendment Regulations 2008;
- Guidance on the Electricity (Environmental Impact Assessment) (Scotland) Amendment Regulations 2008;
- SERAD (Scottish Executive Rural Affairs Department) 2000. Habitats and Birds Directives, Nature Conservation; Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('the Habitats and Birds Directives'). Revised Guidance Updating Scottish Office Circular No 6/1995[i];
- The UK Biodiversity Action Plan (BAP);
- Marine Scotland Licensing and Consents Manual: Covering Marine Renewables and Offshore Wind Energy Development (Draft) (Marine Scotland 2012);
- Scottish Natural Heritage (March 2012). Assessing the Cumulative Impact of Onshore Wind Energy Developments. SNH;
- Scottish Natural Heritage (July 2013) Assessing connectivity with Special Protection Areas. SNH.
- Scottish Planning Policy, Scottish Government 2010;
- Planning Advice Note 1/2013: Environmental Impact Assessment; and
- Planning Circular 3 2011; Guidance on the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011.

15. The following data sources were considered as part of the assessment:

- SNH Site Link (www.snh.gov.uk/sitelink);
- NBN Gateway (www.searchnbn.net).

8.2.2 Methodology for assessing wider-countryside interests:

16. The evaluation for wider-countryside interests (interests unrelated to an SAC) involves the following process:

- Identification of the potential effect of the Development;
- Consideration of the likelihood of occurrence of potential effects where appropriate;
- Defining the Nature Conservation Importance of the marine mammal populations present;
- Establishing the population's Conservation Status;
- Establishing the magnitude of the Likely Effect (both spatial and temporal);
- Based on the above information, a judgement is made as to whether or not the identified effect is significant with respect to the EIA Regulations;
- If a potential effect is determined to be significant, measures to mitigate or compensate the effect are suggested where required;
- Opportunities for enhancement are considered where appropriate;
- Residual effects after mitigation, compensation or enhancement are considered.

8.2.3 Habitats Regulations appraisal methodology

17. The Habitats Directive is transposed into domestic legislation by the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (the Habitats Regulations). Regulation 48 indicates a number of steps to be taken by the competent authority (in this case Marine Scotland) before granting planning permission (the 'Habitats Regulation Appraisal'). In order of application, these steps are noted below:

- Step 1: Consider whether the proposal is directly connected to or necessary for the management of the site (Regulation 48 (1b)). If not:
- Step 2: Consider whether the proposal, alone or in combination, is likely to have a significant effect ("LSE") on the site (Regulation 48 (1a)). If so:
- Step 3: Make an appropriate assessment of the implications for the site in view of that site's conservation objectives (Regulation 48 (1)).
- Step 4: Consider whether it can be ascertained that the proposal will not adversely affect the integrity of the site ("Integrity Test") having regard to the manner in which it is proposed to be carried out or to any conditions or restrictions subject to which they propose that the consent, permission or other authorisation should be given (Regulation 48 (5 & 6)).

18. Following on from these first four steps set out in Regulation 48 there are a further four steps set out by the Habitats Regulations, detailed below:

- Step 5: Refuse planning permission, subject to Regulation 49, unless it has been ascertained that site integrity is not adversely affected (Regulation 48 (5)).

- Step 6: If the proposal fails the Integrity Test, consider if alternative solutions exist (Regulation 49 (1)). If there are alternative solutions then the competent authority should refuse planning permission. If no alternative solutions exist then proceed to next step.

- Step 7: Consider whether the proposal must be carried out for imperative reasons of overriding public interest ("IROPI"). (Regulation 49 (1).

- Step 8: If IROPI is considered to exist, consider whether one can secure any compensatory measures considered necessary to ensure the protection of the overall coherence of Natura 2000 (Regulation 53).

19. The information provided within this assessment will be sufficient to inform the Habitat Regulations Appraisal and the appropriate assessment (should SNH advise Marine Scotland that this is required) which falls within this (Step 3 above).

20. First we consider the value of the receptor (Table 8.1).

Table 8.1 - Value of marine mammals

Receptor value	Importance value of Marine flora and fauna	Site designations
High	International/National	Species listed under National or International legislation and policies e.g. listed in Habitats Directive, or Bonn Convention, or UK Biodiversity Action Plan (BAP) priority species.
Medium	Regional	Species that have been designated for their regional importance (Local BAP species). Impact on a known area inhabited by a marine mammal species that is nationally rare or scarce which has a high to very high sensitivity to the impact in question.
Low	Local	Impact on a marine mammal species that is not designated under national or international legislation and that has a low to moderate sensitivity to the impact in question.
Negligible	Lesser	Other species with little or no local importance or sensitivity to the impact in question.

21. All marine mammals within the study area are of national or international importance and therefore are of high receptor value.

22. The significance of the impact is assessed in relation to the sensitivity of the receptor (Table 8.2) and the magnitude of the impact (Table 8.3).

Table 8.2 - Sensitivity of marine mammals

Receptor value	Definition
Very High	Lethal consequences anticipated (i.e. no ability to avoid or recover from the identified impact)
High	Potentially lethal consequences anticipated (i.e. very little ability to avoid or recover from the identified impact)
Medium	Non-lethal consequences anticipated (limited ability to avoid, accommodate to, or recover from the identified impact)
Low	No major consequences identified
Negligible	Species considered tolerant to potential impacts

23. Table 8.3 lists the definition of the Magnitude of the Impact (based on the Scottish Executive (2007) Significance Assessment Criteria).

Table 8.3 - Defining magnitude of the impact

Magnitude	Description
Major	An impact affecting the entire population/habitat causing a decline in abundance and/or change in distribution beyond which natural recruitment would not return that population/habitat, or any population/habitat dependent on it, to its former level within several generations of the species being affected.
Moderate	Damage or disturbance to habitats or populations above those experienced under natural conditions, over one or more generations, but which does not threaten the integrity of that population or any population dependent on it.
Minor	Small-scale or short-term disturbance to habitats or species, with rapid recovery rates, and no long-term noticeable effects above the levels of natural variation experienced in the area. The impacts are not sufficient to be observed at the population level.
Negligible	An imperceptible impact in relation to the baseline condition of the receptor population.

24. Table 8.4 outlines the matrix used in assessing the significance of each impact to marine mammals using both the Value of the Receptor (marine mammal populations) and the Magnitude of the Impact. This provides a 'Worst Case scenario' and does not take into consideration the likelihood of occurrence. The magnitude of the Impact may be influenced by the sensitivity of the receptor to the potential impacts (Table 8.5).

Table 8.4 - Significance prediction matrix

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

25. Table 8.5 outlines the sensitivities of marine mammal species to specific impacts as discussed by Scottish Executive (2007).

Table 8.5 - Sensitivities of marine mammals to specific impacts

Species	noise	collision	Increased sediments	Release of contaminants	Barrier effect	Habitat exclusion
Harbour seal	High	High	High	Low-medium	Medium	Medium
Grey seal	High	High	High	Low-medium	Medium	Medium
Harbour porpoise	High	High	Medium	Low	High	High
Short-beaked common dolphin	High	High	Medium	Low	Medium-high	Medium-high

26. It should be noted that any residual effect (the effect after the implementation of mitigation) which remains at the level of 'Moderate' or 'Major' is regarded by the EIA Regulations as being of significant effect.

27. Residual Impact Significance is assessed after any mitigation measures are applied. A conclusion on the significance of residual impacts is then drawn, relating this to the description given in the EIA Regulations (as shown in Table 8.6).

Table 8.6 - Residual Impact Significance

Significance	Description	Interpretation under the EIA Regulations
Major	Highly significant and requires immediate action	Significant Impact
Moderate	Significant and requires additional management	Significant Impact
Minor	Not significant but monitoring may be desirable	Insignificant
Negligible	Not significant	Insignificant

28. Cumulative Impact Assessment (CIA) in the context of EIA is the assessment of the impacts of multiple independent projects on the baseline status of a particular Receptor. Projects to consider in CIA are Sound of Sanda tidal turbine, Sound of Islay tidal array, and West Islay tidal array.

8.3 BASELINE CONDITIONS

29. Consultation with statutory bodies resulted in advice from Marine Scotland that literature review and assessment of tracking studies should be carried out in addition to Vantage Point (VP) surveys.

30. Important sources of information reviewed can be found in Table 8.7.

Table 8.7 - Baseline information on marine mammals

Data source	Coverage	Reference
Scottish Marine Renewables Strategic Environmental Assessment (SEA)	Scotland	Scottish Executive 2007. Scottish Marine Renewables Strategic Environmental Assessment http://www.seaenergyscotland.net/SEA_Public_Environmental_Report.htm
SNH Sitelink	Scotland	http://gateway.snh.gov.uk/sitelink/
JNCC SAC database	UK	http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=S1365 http://jncc.defra.gov.uk/protectedsites/sacselection/species.asp?FeatureIntCode=S1364 http://jncc.defra.gov.uk/default.aspx?page=1554
Scottish Committee on Seals	Scotland	SCOS 2012. Scientific advice on matters related to the management of seal populations: 2012. http://www.smru.st-andrews.ac.uk/documents/1199.pdf
Sea Mammal research Unit	Scotland	SMRU 2001. Interactions between grey seals and fisheries: towards a predictive model for evaluating management options. MAFF Research and development Final Project Report, MF0311. http://randd.defra.gov.uk/Document.aspx?Document=MF0311_155_FRP
JNCC Atlas of Cetacean distribution	NW Europe	Reid, J.B., Evans, P.G.H. and Northridge, S.P. 2003. Atlas of Cetacean distribution in northwest European waters. Joint Nature Conservation Committee, Peterborough. http://jncc.defra.gov.uk/PDF/CetaceansAtlas_web.pdf
Goodwin & Speedie	West coast of the UK	Goodwin, L. and Speedie, C. 2008. Relative abundance, density and distribution of the harbour porpoise (*Phocoena phocoena*) along the west coast of the UK. Journal of the Marine Biological Association of the United Kingdom 88: 1221-1228.
Hammond et al.	North Sea and adjacent waters	Hammond, P.S., Berggren, P., Benke, H., Borchers, D.L., Collet, A., Heide-Jørgensen, M.P., Heimlich, S., Hiby, A.R., Leopold, M.F. and Øien, N. 2002. Abundance of harbour porpoise and other cetaceans in the North Sea and adjacent waters. Journal of Applied Ecology 39: 361-376.

8.3.1 Seals

31. Two phocid species occur in the area; the harbour seal and the grey seal.

8.3.1.1 Harbour seal

32. The harbour seal population of the UK is estimated at 33,400 seals surveyed at haul-outs in August (thought to be equivalent to around 48,000 to 56,000 animals in total; JNCC web ref 1). Harbour seal numbers have decreased in recent years for a variety of reasons (Cordes and Thompson 2013). However, changes in distribution of 'traditional' haul-out sites can occur that make assessment of population trends complex (Cordes et al. 2011).

33. The nearest European designated sites for harbour seals to Mull of Kintyre are South-east Islay Skerries SAC (40 km to the north; shown pink in Figure 8.1). Strangford Lough SAC in Northern Ireland (more than 110 km to the south by the shortest sea route, off the southern edge of Figure X.1), Murlough SAC in Northern Ireland (more than 150 km to the south by the shortest sea route) (JNCC web ref 1), and Eileanan agus Sgeiran Lios mor SAC in Argyll (140 km to the north by the shortest sea route).

34. Harbour seals normally feed within 40-50 km around their haul out sites (SCOS 2012), so the only European designated site that might show connectivity with Mull of Kintyre is South-East Islay Skerries SAC. The distance between South-East Islay Skerries SAC and Mull of Kintyre is close to the ranging limit for harbour seals. Given that it involves an open sea crossing with no direct coastal connecting route, and harbour seals tend to remain in coastal waters (SCOS 2012) where they prefer areas with sea depth of 10 to 50 m (Bailey and Thompson 2009), it seems likely that harbour seals from South-East Islay Skerries SAC will only be likely to visit the Mull of Kintyre when moving from the Islay haul-out sites to haul-outs elsewhere, as that would involve long commuting trips across deeper water.

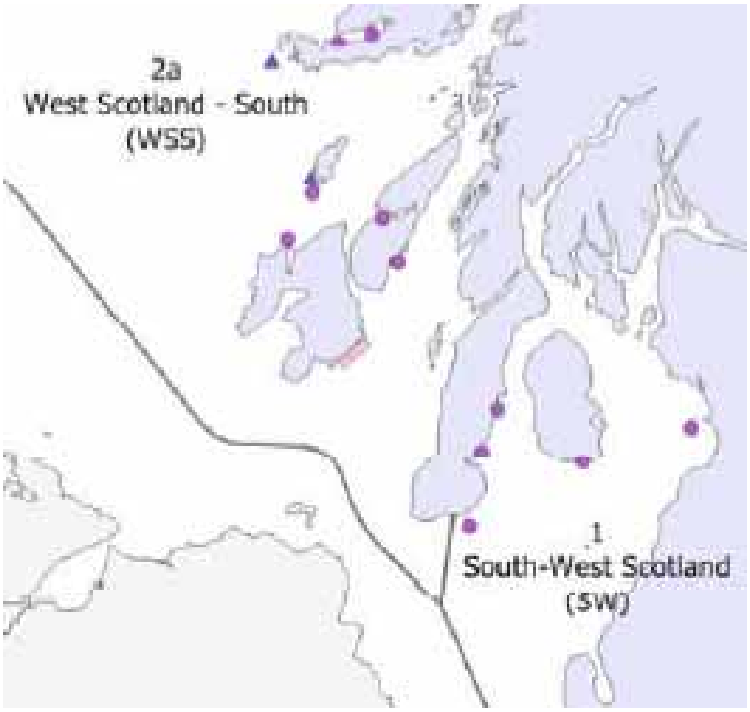
35. Sparling (2013) presents tracking data from harbour seals tagged at Islay, and these tracking data confirm that few seals from Islay visit the Mull of Kintyre, and that the tracks of these animals indicate that they were moving directly past the Mull of Kintyre to haul-out sites such as Sanda Islands. Of 17 animals tagged in 2011 and 2012, two individuals spent time near Machrihanish and around Sanda, and another two spent time in the Clyde, but all four appear to have passed Mull of Kintyre tidal site without remaining in the area for any length of time (Figure 13a in Sparling (2013) shows these tracks).

36. Tracking in 2004 also showed that some harbour seals from Islay moved to haul-out sites at Machrihanish and in the Clyde after tagging, but did not spend time in the area around Mull of Kintyre tidal site but rather transited directly past that site (e.g. Figure 4 in Cunningham et al. 2009).

37. South-East Islay Skerries SAC was designated on 17 March 2005, and is considered to hold about 1.5 to 2% of the UK population of harbour seals (i.e. around 500 to 670 animals on haul-outs). Conservation Status of the SAC was defined as 'Favourable Maintained' on 12/08/2009 (SNH Sitelink web ref).

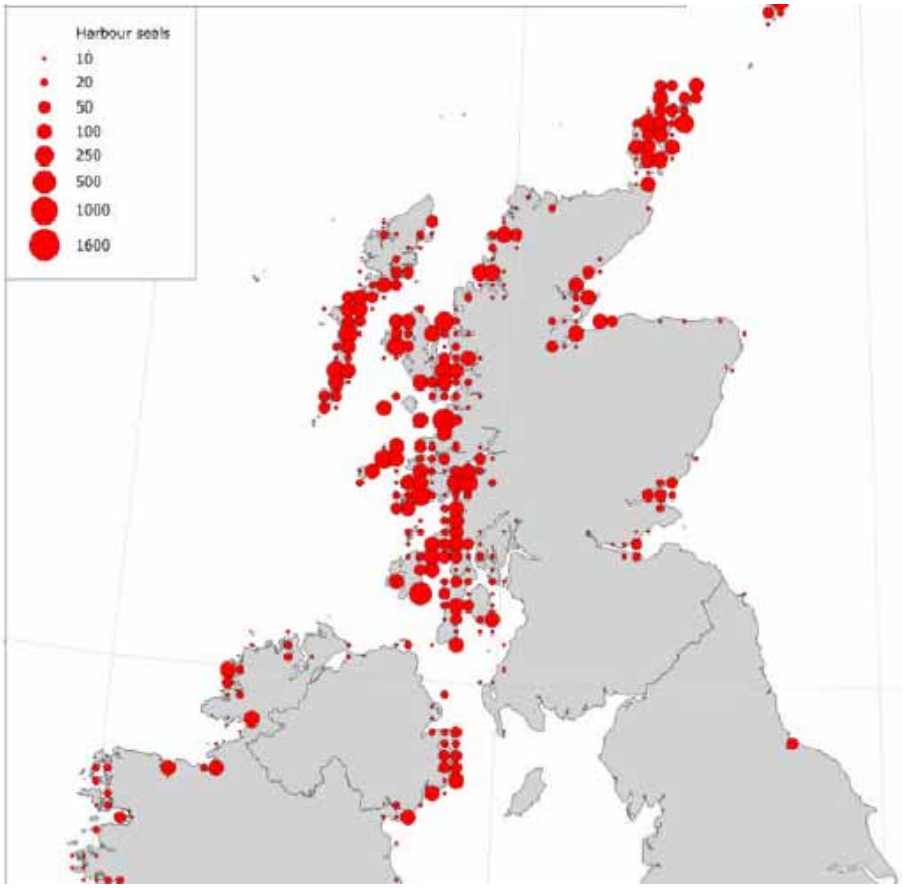
38. There are several traditional haul-out sites used by harbour seals in West Scotland South and South-West Scotland (Figure 8.1).

Figure 8.1 - Regular seal haul-out sites in parts of West Scotland (South) and South-West Scotland. The 11 year round sites in the area are marked by purple circles; the two seasonal sites (grey seal breeding colonies) are marked by blue triangles. Pink shading indicates SAC for harbour seals. From SCOS (2012).



39. The closest to Mull of Kintyre are haul-outs at Sanda and Sheep Islands (about 15 km from Mull of Kintyre by the shortest sea route), Rubha nan Sgarbh, East Kintyre (about 35 km from Mull of Kintyre by the shortest sea route), Yellow Rock East Kintyre (about 45 km from Mull of Kintyre by the shortest sea route), Sound of Pladda Skerries Arran (about 52 km from Mull of Kintyre by the shortest sea route), and Craighouse Small Isles Jura (about 60 km from Mull of Kintyre by the shortest sea route). Most of these hold only small numbers of seals, the largest numbers being found at Sanda and Sheep Islands (31% of the regional haul-out population of harbour seals; SCOS 2012). The distribution of harbour seals surveyed by the Sea Mammal Research Unit using thermal cameras in August is shown in Figure 8.2

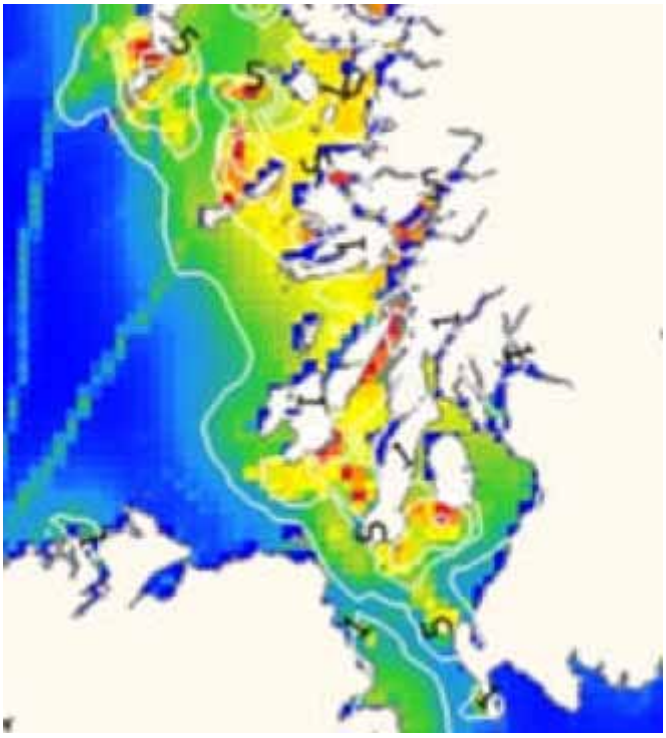
Figure 8.2 - Harbour seals surveyed by Sea Mammal Research Unit in August (2007-2011 in Great Britain; 2002-2003 in Ireland). From SCOS 2012).



40. It is evident from this map that Mull of Kintyre lies in an area that is of relatively low use by harbour seals, concentrations tending to occur further north, and to a small extent to the south in Northern Ireland, and to an even smaller extent in the Firth of Clyde.

41. The relatively low importance of Mull of Kintyre, and the North Channel in general, for harbour seals is further emphasised by the estimated harbour seal total (at-sea & hauled-out) usage of the local marine area shown in Figure 8.3 which indicates that harbour seals occur at low density at Mull of Kintyre, with higher densities occurring nearby in more sheltered water to the east and north of the Mull of Kintyre.

Figure 8.3 - Estimated harbour seal total (at-sea & hauled-out) usage of marine areas near to Mull of Kintyre. From SCOS (2012).



42. Seals are difficult to detect at sea. Although a very small number of harbour seals were occasionally seen in summer hauled out on rocks below the Mull of Kintyre fog horn (immediately below the Vantage Point), no seals seen in the water during VP surveys were positively identified as harbour seals.

8.3.1.2 Grey seal

43. The grey seal population of Great Britain is estimated at 124,000 animals, with another 300-400 around Northern Ireland and the Isle of Man (SCOS 2012).

44. The nearest European designated sites for grey seals to Mull of Kintyre are The Maidens SAC in Northern Ireland (30 km to the SSW), and Treshnish Isles SAC (more than 150 km to the north by the shortest sea route) (JNCC web ref 2).The grey seal is also a notified feature of Oronsay and South Colonsay SSSI, which lies approximately 85 km north-west of the Development. The numbers of grey seals breeding on that SSSI remain stable, and the site continues to be one of the best sites for pup production in the west of Scotland (SCOS 2012).

45. Grey seals may range widely to forage and frequently travel over 100km between haulout sites (SCOS 2012), so connectivity between Mull of Kintyre and the SACs at The Maidens and Treshnish Isles is certainly theoretically possible. Indeed, grey seals have even been found to occasionally travel from the Firth of Forth, North Sea to west of Ireland and foraging range can be up to 2100 km from the home haul-out (McConnell et al. 1999) so there could be connectivity between all populations of grey seals in waters around the British Isles.

46. However, McConnell et al. (1999) also found that 88% of foraging trips resulted in animals returning to the same haul-out site after an average of only 2.3 days at sea, so in most cases grey seals remain close to their normal haul-out site.

47. The Maidens SAC (54.94N 5.75W) includes grey seal as a qualifying species but not as a primary reason for site selection. About 50 to 100 animals occur at the site (JNCC web ref 2). Treshnish Isles SAC produces just under 3% of UK grey seal pup production (JNCC web ref 2), equivalent to a population of around 3,700 animals, so although further from Mull of Kintyre, holds a much larger population.

48. There are several traditional haul-out sites used by grey seals in West Scotland South and South-West Scotland (Figure 8.1).

49. The closest to Mull of Kintyre are haul-outs at Sanda and Sheep Islands (about 15 km from Mull of Kintyre by the shortest sea route), Rubha nan Sgarbh, East Kintyre (about 35 km from Mull of Kintyre by the shortest sea route), Yellow Rock East Kintyre (about 45 km from Mull of Kintyre by the shortest sea route), Sound of Pladda Skerries Arran (about 52 km from Mull of Kintyre by the shortest sea route), and Craighouse Small Isles Jura (about 60 km from Mull of Kintyre by the shortest sea route). Most of these hold only small numbers of seals, the largest numbers being found at Sanda and Sheep Islands (20% of the regional haul-out population of grey seals; SCOS 2012).

50. Sea Mammal Research Unit estimation of grey seal usage of marine areas suggests that Mull of Kintyre Tidal Development is one of the least used areas of sea in Scottish west coast waters (Figure 8.4). This is also indicated by the data on grey seal numbers obtained from thermal camera survey (Figure 8.5)

Figure 8.4- Estimated grey seal total (at-sea & hauled-out) usage of marine areas near to Mull of Kintyre. From SCOS (2012).

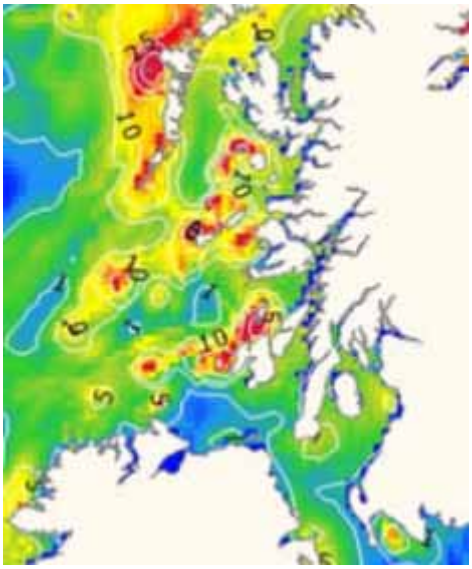
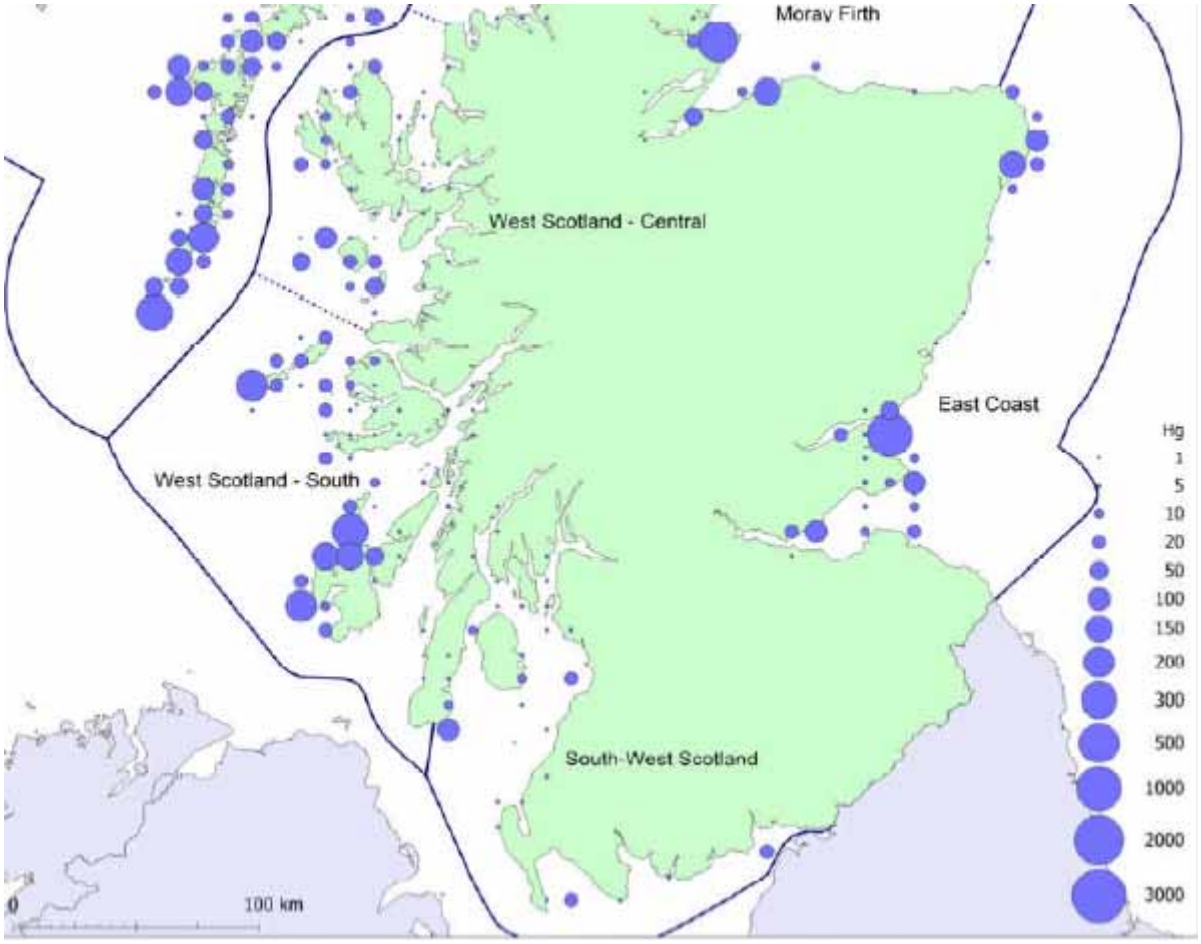


Figure 8.5 - The number and distribution of grey seals in Management Areas around the coast of Scotland, from surveys carried out between August 2007 and 2011. All areas were surveyed by helicopter using a thermal imaging camera. From SCOS (2012).



51. Further (independent) support for this is provided by data from tracking grey seals equipped with satellite transmitters. None of the tracks of 108 animals equipped with satellite transmitters came closer than 90 km from Mull of Kintyre, indicating this to be one of the marine areas around the British Isles with the least usage by grey seals (Figure 8.6 and Figure 8.7).

Figure 8.6 - Tracks of 108 grey seals equipped with satellite tracking devices by Sea Mammal Research Unit at sites around the UK. Individuals are coded by colours, cycling through 12 different colours. From SMRU (2001).

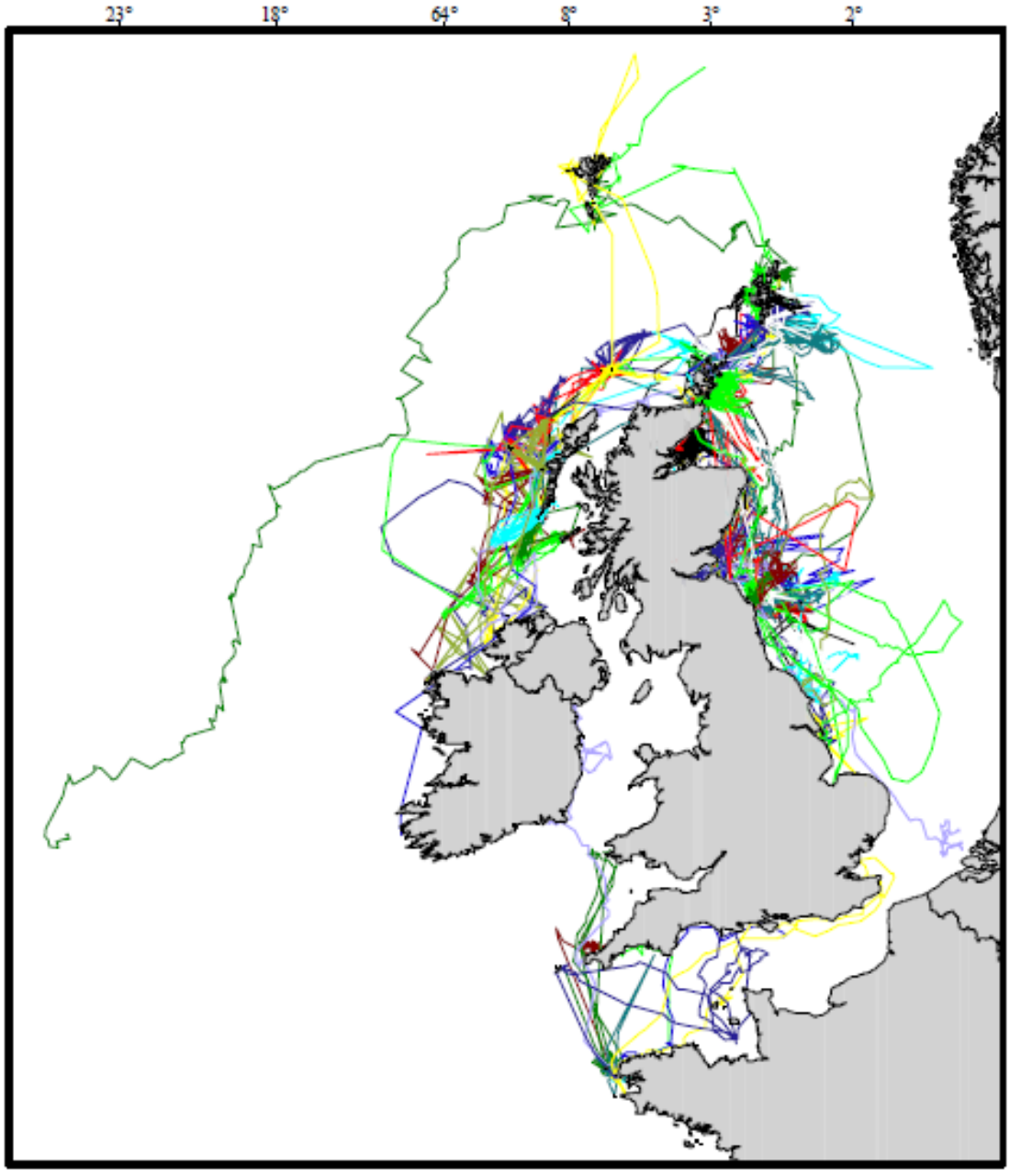
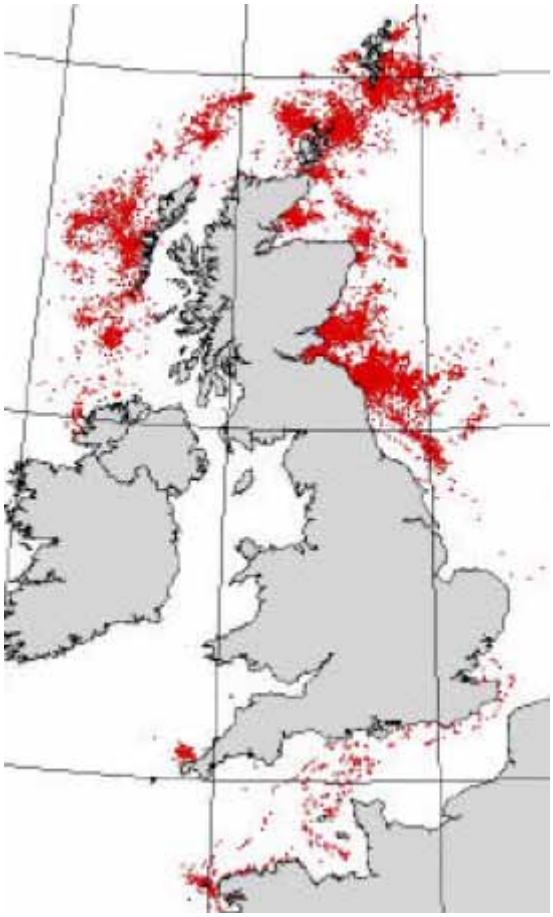
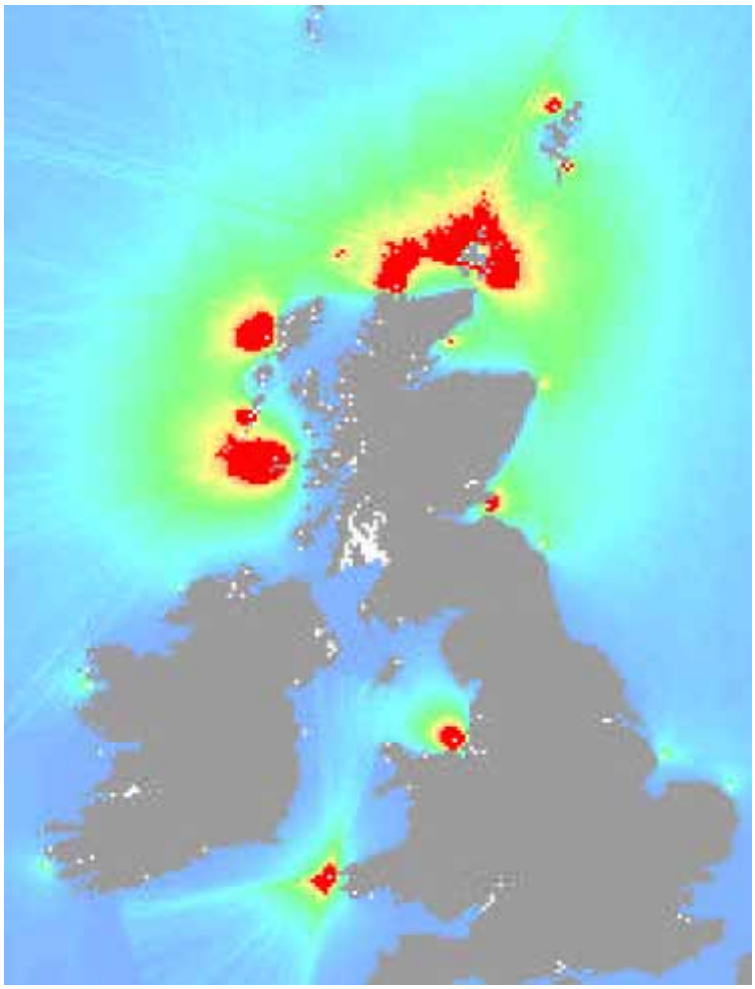


Figure 8.7 - Plot of the 14,279 grey seal Argos locations fixes deemed to be within return trips from the tracks of 108 animals equipped with satellite transmitters. From SMRU (2001).



52. Sea Mammal Research Unit modelling of usage of marine areas around the British Isles by grey seals further emphasises the low usage of the area close to Mull of Kintyre and the North Channel in general (Figure 8.8).

Figure 8.8 - Modelled prediction of grey seal distribution around the British Isles (model based on the locations of haul-out sites, numbers of seals associated with these, and foraging ranges and habitat [preferences of grey seals). From SMRU (2001).



53. Small numbers of grey seals were present at sea within the viewshed during most VP surveys, although many seals were only tentatively identified as grey seals and sightings could possibly have included some harbour seals. The mean count in 166 30-minute surveys through the year was 7.2 seals within the viewshed.

54. There was evidence of seasonal variation with lower numbers in autumn (spring n=30 counts, mean 8.9 seals; summer n=53 counts, mean 9.7 seals, autumn n=36 counts, mean 0.0 seals, winter n=47 counts, mean 8.7 seals). This variation could possibly indicate larger numbers of grey seals in the area during their non-breeding season (roughly January to July), when grey seals from colonies in NW Scotland may be more widely dispersed (SCOS 2012).

55. Although seals were seen up to 1700 m from the VP, the highest numbers of records were from 200 to 600 m from the VP. This may suggest a tendency for seals to avoid the higher water flow rates occurring further offshore, or to move along the coast within a band some 200 to 600 m from the shore.

56. It would be inappropriate to use Distance Sampling methods to correct seal numbers given the obvious ecological gradient present from the VP, but it is highly likely that observed numbers will underestimate true numbers present.

57. The VP observations suggest that the Development site is only used by very small numbers of grey seals. These conclusions are consistent with the data available from the Sea Mammal Research Unit mapping and tracking (summarised earlier).

8.3.2 Cetaceans

58. Cetaceans recorded in the Mull of Kintyre area include harbour porpoise and short-beaked common dolphin. Although other species may occasionally visit the area, no other species was seen during VP watches. Common bottlenose dolphins have occasionally been recorded in Argyll waters so may pass through the area.

8.3.2.1 Harbour porpoise

59. The harbour porpoise, also known as common porpoise, is the smallest, but also by far the most numerous of the cetaceans found in north-western European continental shelf waters (Hammond et al. 2002), and also occurs widely across temperate waters of the North Atlantic and North Pacific, ranging from as far as 15°S to 72°N (Reid et al. 2003). Typically, harbour porpoises occur in small groups of one to three animals, but these may amalgamate to form large aggregations, for example to exploit schools of fish (Reid et al. 2003, Pusineri et al. 2007).

60. There may be around 300,000 harbour porpoises in the seas around the British Isles, especially numerous in the North Sea (Reid et al. 2003). Seasonal movements of these animals are unclear but they are present throughout the year; highest sighting rates occur in winter in Strangford Lough (Royal Haskoning 2011), in winter in the southern North Sea but in summer in the Western Isles (Reid et al. 2003).

61. The 2005 SCANS-II aerial survey indicated a population of 12,000 harbour porpoises in Survey Block N (inshore waters of Western Scotland) in summer (with 95% confidence limits 4,685 and 27,239 animals) (SCANS-II 2008). Most of these animals tend to occur in the Sound of Jura, Firth of Lorne, waters between Mull and the Treshnish Isles, and the Sound of Sleat (Embling et al. 2010).

62. Despite relatively high survey effort around the Mull of Kintyre and North Channel (Figure 2), the relative abundance of harbour porpoises in these areas is low, with higher abundances occurring further north (east of Mull for example) and further south (in the northern Irish Sea for example) (Figure 2)

63. Harbour porpoise is listed on Habitats Directive Annex II which requires the designation of Special Areas of Conservation where suitable areas can be identified (JNCC web ref 1).

64. For harbour porpoise, JNCC and the country agencies are currently analysing distribution data for the species in UK waters to determine whether any suitable sites for SAC designation can be found (JNCC web ref 1); no sites have yet been designated specifically for harbour porpoise, but Skerries and Causeway SAC in Northern Ireland (55.24N 6.60W), a 10,862 ha area of sheltered sea inlets featuring three Annex 1 habitats (sandbanks, reefs and sea caves), includes harbour porpoise as a qualifying feature but not a primary reason for site selection (JNCC web ref 1).

65. Based on distribution data shown (Figure 2) it seems clear that areas close to the Mull of Kintyre would not be appropriate for future designations of SACs for harbour porpoises in UK waters. However, Pierpoint (2008) showed that harbour porpoises can choose to feed within areas of high

tidal flow, especially using undersea canyons as feeding sites where currents can concentrate fish, and also feeding on peripheral areas adjacent to high tidal flow streams where catching fish being carried along in the current may be more efficient, so there appears to be an association between harbour porpoises and high energy tidal environments that could potentially make them more vulnerable to impacts from tidal stream energy development.

66. However, Embling et al. (2010) concluded that harbour porpoise distribution in the West of Scotland was predominantly in areas of low current flow, while Booth (2010) found that water depth, seabed slope, and distance from shore influenced harbour porpoise distribution in the west of Scotland but that relationships with tidal flow were weak.

67. Harbour porpoises were seen on 7 of the 9 winter VP surveys, 4 of the 5 spring surveys, 3 of the 12 summer surveys and 2 of the 12 autumn surveys, suggesting that these animals were present more often in winter and spring than in summer and autumn. Harbour porpoise numbers varied between 0 and 10 animals at any one time, with the median peak number on days when they were present (16 out of 38 survey days) being 4 animals.

68. Harbour porpoise is considered to be at 'Favourable' Conservation Status based on the species' range, and population size and trend (JNCC 2007).

8.3.2.2 Short-beaked common dolphin

69. The short-beaked common dolphin *Delphinus delphis* is the most abundant cetacean throughout the world's warm-temperate and tropical waters (Reid et al. 2003). It is widely distributed in continental shelf waters west of the British Isles, though more abundant in warmer water to the south-west than in the north-west (Reid et al. 2003).

70. MacLeod et al. (2005) suggested that short-beaked common dolphins may be increasing in the west of Scotland as climate change results in warmer waters which they prefer. Surveys in the Celtic Sea suggest a population of at least 120,000 short-beaked common dolphins in that area alone (Reid et al. 2003). Distributional survey data from waters around the British Isles indicate an average group size of 14 animals (Reid et al. 2003).

71. Despite relatively high survey effort for the Atlas of Cetacean Distribution around the Mull of Kintyre and North Channel (Figure 1), the relative abundance of short-beaked common dolphins in these areas is low, with much higher abundances occurring to the west of Ireland and especially to the SW of Ireland (Figure 1).

72. Short-beaked common dolphin is considered to be at 'Favourable' Conservation Status based on the species' range, and population size and trend (JNCC 2007).

73. Short-beaked common dolphins were seen on only one date, 7 May 2013, when up to 12 animals were present within the viewshed.

8.3.2.3 Common bottlenose dolphin

74. Common bottlenose dolphin is listed on Habitats Directive Annex II which requires the designation of Special Areas of Conservation where suitable areas can be identified (JNCC web ref 1).

75. The only two areas in UK waters that have been identified as having the physical and biological factors essential to the life and reproduction of a population of common bottlenose dolphins are Cardigan Bay (between 125 and 300 individuals) and the Moray Firth (130 individuals). Both have been selected as SACs.

76. These sites hold the only two substantial semi-resident populations of the species in UK waters (Bailey and Thompson 2009). While the individuals using the two sites may range further afield during certain times of the year, common bottlenose dolphins are present at these two sites throughout the year and individuals spend most of their time within the sites (JNCC web ref 1).

77. Common bottlenose dolphin is also a qualifying feature at Lleyn Peninsula and the Sarnau SAC in Wales, but is not the primary reason for designation of that site.

78. No common bottlenose dolphins were seen during VP surveys. However, they may occasionally pass through the area, as the species was seen at West Islay Tidal Park, and there is a small population in the Inner Hebrides.

79. Common bottlenose dolphin conservation status was assessed by JNCC as 'Unknown' (JNCC 2007).

8.3.2.4 Other cetaceans likely to occur in the area

80. Risso's dolphin *Grampus griseus* occurs in small numbers off western Scotland. It has a preference for waters more than 50 m deep (Reid et al. 2003) and most sightings have been reported from the Minch and Outer Hebrides during summer. Several were seen off Islay during surveys at West Islay Tidal Park, but the species was not seen during VP watches at Mull of Kintyre. Minke whale *Balaenoptera acutorostrata* is the only baleen whale regularly seen in Scottish inshore waters (Reid et al. 2003), and usually occurs in summer. Minke whales occur regularly at particular sites in the Inner Hebrides where feeding conditions are favourable (Macleod et al. 2007). However, no minke whales were seen during VP surveys at Mull of Kintyre.

8.4 DEVELOPMENT DESIGN MITIGATION

81. Mitigation against potential harmful impacts on marine mammal populations has been taken by siting the Development in an area with low abundance and activity of marine mammals.

8.5 ASSESSMENT OF POTENTIAL EFFECTS

82. Potential impacts on marine mammal populations are listed in Table 8.8 and considered individually in the subsequent sections.

Table 8.8 - Potential impacts on marine mammals

CONSTRUCTION (temporary)		
Section	**Impact**	**Effect**
8.5.1.1	Presence of construction vessels and activity	Potential for injury or death by collision, and disturbance by vessel presence and noise which could affect body condition and/or lead to displacement from the Development
8.5.1.2	Disturbance of seal haul-out sites	Potential for seals to be disturbed and/or displaced
8.5.1.3	Increased turbidity	Potential impact on marine mammal behaviour
8.5.1.4	Contaminant spills	Potential impact of toxins
8.5.1.5	Changes to prey abundance	Potential impact on food availability
OPERATION (permanent over lifetime of project)		
Section	Impact	Effect

8.5.2.1	Operational noise	Disturbance and/or displacement
8.5.2.2	Collision	Injury or death
8.5.2.3	Displacement	Loss of habitat and/or increased energy costs
8.5.2.4	Electromagnetic fields	Possible impact on behaviour
8.5.2.5	Contaminant spills	Potential impact of toxins
8.5.2.6	Changes to prey abundance	Potential impact on food availability
DECOMMISSIONING (temporary)		
Comparable to list presented in CONSTRUCTION phase.		

8.5.1 Construction

8.5.1.1 Presence of construction vessels and activity

83. VP watches recorded the presence of a variety of boats on most dates when watches were made; this variety included small fishing vessels, leisure craft (sail powered yachts and motor cruisers), cargo vessels, ferries. In view of the regular presence of boats in the area, additional boat traffic during construction activities is considered to represent both a temporary and a quantitatively small increase in boat activity in the area. Seals in the water were seen on several occasions to show considerable interest in the presence of crab and lobster fishing boats close to shore, following these for scraps from their lobster pots, indicating that they are accustomed to the presence of boats in the area. Collision between boats and marine mammals tends to arise when boats are moving fast; risk is low when vessels are moving at speeds below 7 m/sec (Laist et al. 2001). Construction vessels are likely to be moving more slowly than this, so represent a lower collision risk than presented by ships such as cargo boats or ferries transiting past the area. Construction vessels using dynamic positioning systems that depend on propellers housed in cylindrical nozzles are thought to have been responsible for 'corkscrew' injuries to harbour seals and juvenile grey seals that have been drawn into the propeller housing (Bexton et al. 2012). However, risk of such injuries would be low at the Development site as seal numbers in the area are low, and construction activities for a single turbine device and moorings would be expected to require only a short period of activity, if any, by such vessels.

84. There is potential for construction work associated with installation of the tidal turbine, and cabling to landfall, to cause disturbance to marine mammals. Disturbance would primarily be caused by vibration and noise generated by boat traffic and by drilling (if required) to secure foundations to the seabed. Noise may mask echolocation so disrupt navigation and feeding by cetaceans, and may mask communication. The strength of these impacts would depend on distance of marine mammals from the source of noise, and the duration of the noise. Hearing loss can occur when noise is at high levels close to marine mammals. However, drilling activities required to install foundations for turbine devices generate noise levels which are below those predicted to cause hearing damage to marine mammals (Nedwell and Brooker 2008, Kongsberg Maritime Ltd 2010), but may cause avoidance behaviour if animals are within a few metres of the drilling activity.

85. During drilling operations, some avoidance of the immediate area of drilling activity is likely. However, since marine mammal numbers in the general vicinity are low and the site appears mainly to be used for transit rather than for residency or foraging, and is apparently not used for breeding, the overall impact of disturbance due to construction activity is likely to be Negligible or Minor, and so is not considered to be significant under the terms of the EIA Regulations.

8.5.1.2 *Disturbance of seal haul-out sites*

86. Activity during construction can displace seals from coastal haul-out sites. Seals have been found to be largely unaffected by construction or operation of offshore wind farms, with only minor disturbance affecting numbers at a haul-out on one occasion due to pile-driving (Danish Energy Authority 2006, Danish Energy Agency 2013). Seals do tend to avoid areas with high levels of human activity (SCOS 2012) and so short-term disturbance of the small numbers of seals in the area may arise during deployment of a tidal turbine. Scottish Executive (2007) suggest that boats more than 1500 m from haul-out sites are unlikely to cause disturbance to seals, that boats between 900 and 1500 m from haul-outs may cause seals to watch but not to move, while boats less than 900 m from haul-outs might cause seals to flush into the water. There are no important haul-out sites regularly used by seals in the west of Scotland that are within 5 km of the Development (SCOS 2012). The nearest significant haul-out of seals to the Development is 15 km away at Sanda Islands, which is around the Mull of Kintyre peninsula and so not in direct line of sight of the Development. However, small numbers of harbour seals occasionally haul out on the rocks close to the Mull of Kintyre lighthouse and fog horn. Harbour seals tend to haul out most frequently in late summer when they undergo moult. These animals might be displaced by construction activities, including some onshore activities. However, disturbance would be over a short timescale and would involve small numbers of animals so the population level impact is considered to be Negligible and so Not Significant under the terms of the EIA Regulations.

8.5.1.3 *Increased turbidity*

87. Construction work may disturb seabed sediments or create sediment through drilling activity. Because there is a strong tidal flow through the area, such sediment is likely to be transported and diluted, and seabed mud amounts are likely to be low so that potential to cause turbidity will be small. Furthermore, seals and cetaceans can feed in turbid water, so impacts of construction work increasing turbidity locally for a short period are likely to be Negligible and Not Significant under the terms of the EIA Regulations.

8.5.1.4 *Contaminant spills*

88. There is a small risk of accidental spillage of contaminants during construction, such as diesel fuel or hydraulic fluid. A spillage would be dispersed by tidal mixing and marine mammals have the ability to avoid small contaminated areas. Dilution of contaminants makes risk extremely small for marine mammal populations in the area. The risk is considered to be Negligible and so Not Significant under the terms of the EIA Regulations.

8.5.1.5 *Changes to prey abundance*

89. Construction impacts on lower trophic levels (phytoplankton to fish) will be short-term and are likely to be Negligible temporally and spatially. Furthermore, numbers of marine mammals occurring at the Development site are small, and they tend to pass through the area rather than forage. Therefore indirect effects on marine mammals through the food chain can be assessed as Negligible and Not Significant under the terms of the EIA Regulations.

8.5.2 Operation

8.5.2.1 *Operational noise*

90. Tidal stream turbines produce noise within the audible range of marine mammals, caused by vibrations of components and rotation of blades. The noise will increase during high flow periods and decrease at slack water. Noise output from the tidal turbine at Strangford Lough narrows has been found to have little or no impact on marine mammals there (Royal Haskoning 2011). Noise from the tidal array at West Islay Tidal Energy Park (an array of 30 MW of turbines) was considered to present a Minor impact to marine mammal populations (DP Marine Energy 2013).

Considering that marine mammals have capacity to avoid, adapt to, accommodate and recover from the impact of noise, sensitivity was assessed as Low (DP Marine Energy 2013). The indications from the monitoring at Strangford Lough tidal turbine and the assessment for West Islay Tidal Energy Park indicate that for a single device at Mull of Kintyre the impact can be assessed as Negligible, and therefore Not Significant under the terms of the EIA Regulations.

8.5.2.2 Collision

91. Collision between marine mammals and rotating turbine blades might result in injury or death. The speed of tidal stream turbine rotors is low compared with the speed of ships' propellers. Collision of marine mammals with tidal stream turbine blades therefore seems less likely than collision with ship propellers. The collision risk can be estimated from the numbers of marine mammals in the area (population density) modified by the depth distribution of the animals in relation to the depth of the tidal turbine, and the avoidance behaviour of marine mammals in response to sound or visual stimuli from the device. Avoidance rates of marine mammals are unknown, although the evidence from the tidal turbine at Strangford Lough is that seals and porpoises easily avoid the device and no collisions have been reported at that site despite a high population density of seals (Royal Haskoning 2011). the evidence from deployment of a tidal turbine in the Narrows at Strangford Lough (within an area which is an SAC for seals) is that seals are able to avoid the turbine, are not harmed, and that there have been no adverse effects of the development at Strangford on seals. The Final Report on post-construction monitoring (Royal Haskoning 2011) concluded *'Seals and porpoises regularly transit past the operating turbine, clearly demonstrating a lack of any barrier effect. The only changes observed after three years of operation of the device have been relatively small scale changes in the behaviour and distribution of seals and harbour porpoises, suggestive of a degree of local avoidance of the device. This avoidance reduces the risk of any direct interactions with the moving rotors and suggests that both seals and porpoises have the capacity to adjust their distributions at local scales in response to a potential hazard'* and '*No major impacts of SeaGen have been detected on harbour seals, grey seals or harbour porpoises. Relative abundance of seals as measured by shore based visual surveys, or annual counts of seals at haul out and breeding sites have not undergone any detectable changes which can be attributable to SeaGen'*. In view of this evidence, and since numbers of seals at the Development site are small in a regional or national context or in relation to the size of the population at South-East Islay Skerries SAC, it is concluded that the Development will have no significant impact on seal populations under the terms of the EIA Regulations, and no significant impact under the Habitats Regulations with regard to the South-East Islay Skerries SAC.

92. Based on a modelling approach, DP Marine Energy (2013) assessed the impact of collision risk of marine mammals at West Islay Tidal Energy Park to be Minor for seals and Negligible for cetaceans. By analogy, the impact of collision on marine mammal populations at Mull of Kintyre can be assessed as Negligible for a single turbine, and hence Not Significant under the terms of the EIA Regulations.

8.5.2.3 Displacement

93. Avoidance of noise or disturbance could lead to marine mammals being displaced from the turbine. However, studies at Strangford Lough indicate only a negligible displacement effect for seals and no impact on seal activity in the area (Royal Haskoning 2011). For a single turbine a barrier effect can be ruled out and any displacement can be assessed as Negligible and therefore Not Significant under the terms of the EIA Regulations.

8.5.2.4 *Electromagnetic fields*

94. Electromagnetic fields produced by electricity in cables could possibly affect cetaceans. However, harbour porpoises regularly pass over cables carrying electricity from Danish offshore wind farms. The field strength decreases over short distance from cables, so that any effect on cetaceans would be limited to very short distances from cables. Any impact is therefore considered to be Negligible, and so Not Significant under the terms of the EIA Regulations.

8.5.2.5 *Changes to prey abundance*

95. Operation of a single tidal turbine is unlikely to have any detectable impact on the lower trophic levels of the marine food web on which marine mammals depend, even at a small spatial scale, and certainly not at the large scale over which marine mammals operate. Furthermore, numbers of marine mammals occurring at the Development site are small, and they tend to pass through the area rather than forage. Therefore indirect effects on marine mammals through the food chain can be assessed as Negligible and Not Significant under the terms of the EIA Regulations.

8.5.3 Decommissioning

96. It is likely that impacts of Decommissioning will be comparable to those of Construction.

8.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

97. No mitigation is considered necessary.

98. Residual impacts on marine mammal populations are all considered to be Negligible and Not Significant under the terms of the EIA Regulations.

8.7 ASSESSMENT OF CUMULATIVE EFFECTS

99. Cumulative Impact Assessment (CIA) in the context of EIA is the assessment of the impacts of multiple independent projects on the Baseline status of a particular Receptor. Projects to consider in CIA are Sound of Sanda tidal turbine, Sound of Islay tidal array, and West Islay tidal array.

100. The West Islay Tidal Energy Park assessed all impacts on marine mammals as Negligible except possibly mortality through collision, cumulative effects of noise, and cumulative hazard of corkscrew injuries caused by propellers of vessels equipped with propeller pods. The ES for West Islay Tidal Energy Park assessed that the additional impact of the Sound of Sanda and Mull of Kintyre Developments present a negligible addition to those impacts. It was concluded that cumulative impact of collision mortality of seals in combination with the take under shooting licences, was well below the PBR thresholds for harbour seal and grey seal, with the take by shooting considerably exceeding the estimated mortality caused by collision. Cumulative impacts from noise and from corkscrew injuries were considered to be Minor, with the small Developments at Mull of Kintyre and Sound of Sanda contributing a Negligible amount to these (DP Marine Energy 2013). DP Marine Energy (2013) concluded that there are no likely significant effects arising from the West Islay Tidal Energy Park alone or in combination for the South-east Islay Skerries SAC. This same conclusion applies for the Mull of Kintyre Development (which was considered in the DP Marine assessment).

8.8 SUMMARY OF EFFECTS (RESIDUAL EFFECTS)

101. Residual impacts on marine mammal populations are all considered to be Negligible.

8.9 STATEMENT OF SIGNIFICANCE

102. Impacts on marine mammals are assessed as Not Significant under the terms of the EIA Regulations and under the terms of the Habitats Regulations.

8.10 REFERENCES

Bailey, H. and Thompson, P.M. 2009. Using marine mammal habitat modelling to identify priority conservation zones within a marine protected area. Marine Ecology Progress Series 378: 279-287.

Bexton, S., Thompson, D., Brownlow, A., Barley, J., Milne, R. and Bidewell, C. 2012. Unusual mortality of pinnipeds in the United Kingdom associated with helical (corkscrew) injuries of anthropogenic origin. Aquatic Mammals 38: 229-240.

Booth, C.G. 2010. Variation in habitat preference and distribution of harbour porpoises west of Scotland. PhD thesis, University of St Andrews.

Cordes, L.S. and Thompson, P.M. 2013. Variation in breeding phenology provides insights into drivers of long-term population change in harbour seals. Proceedings of the Royal Society B – Biological Sciences 280: 20130847.

Cordes, L.S., Duck, C.D., Mackey, B.L., Hall, A.J. and Thompson, P.M. 2011. Long-term patterns in harbour seal site-use and the consequences for managing protected areas. Animal Conservation 14: 430-438.

Cunningham, L., Baxter, J.M., Boyd, I.L., Duck, C.D., Lonergan, M., Moss, S.E. and McConnell, B. 2009. Harbour seal movements and haul-out patterns: implications for monitoring and management. Aquatic Conservation: Marine and Freshwater Ecosystems 19: 398-407.

Danish Energy Authority 2006. Danish Offshore Wind. Key Environmental Issues. Danish Energy Agency, Danish Nature Agency, DONG Energy and Vattenfall; Copenhagen.

Danish Energy Agency 2013. Danish Offshore Wind. Key Environmental Issues – a Follow-up. The Environment Group: The Danish Energy Agency, The Danish Nature Agency, DONG Energy and Vattenfall; Copenhagen.

DP Marine Energy 2013. West Islay Tidal Energy Park Volume 2 Environmental Statement.

Embling, C.B., Gillibrand, P.A., Gordon, J., Shrimpton, J., Stevick, P.T. and Hammond, P.S. 2010. Using habitat models to identify suitable sites for marine protected areas for harbour porpoises (*Phocoena phocoena*). Biological Conservation 143: 267-279.

Goodwin, L. and Speedie, C. 2008. Relative abundance, density and distribution of the harbour porpoise (*Phocoena phocoena*) along the west coast of the UK. Journal of the Marine Biological Association of the United Kingdom 88: 1221-1228.

Hammond, P.S., Berggren, P., Benke, H., Borchers, D.L., Collet, A., Heide-Jørgensen, M.P., Heimlich, S., Hiby, A.R., Leopold, M.F. and Øien, N. 2002. Abundance of harbour porpoise and other cetaceans in the North Sea and adjacent waters. Journal of Applied Ecology 39: 361-376.

JNCC 2007 Second Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2001 to December 2006. www.jncc.gov.uk/article17

JNCC web ref 1
http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=S1365

JNCC web ref 2
http://jncc.defra.gov.uk/protectedsites/sacselection/species.asp?FeatureIntCode=S1364

Kongsberg Maritime Ltd 2010. Operational underwater noise. SeaGen Unit for Marine Current Turbines Ltd: Technical Report – Measurement.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and whales. Marine Mammal Science 17: 35-75.

Macleod, C.D., Bannon, S.M., Pierce, G.J., Schweder, C., Learmonth, J.A., Herman, J.S. and Reid, R.J. 2005. Climate change and the cetacean community of north-west Scotland. Biological Conservation 124: 477-483.

MacLeod, C.D., Weir, C.R., Pierpoint, C. and Harland, E.J. 2007. The habitat preferences of marine mammals west of Scotland (UK). Journal of the Marine Biological Association of the United Kingdom 87: 157-164.

Macleod, K., Lacey, C., Quick, N., Hastie, G. and Wilson, J. 2011. Guidance on survey and monitoring in relation to marine renewables deployments in Scotland. Vol. 2 Cetaceans and Basking Sharks. Report to SNH and Marine Scotland.

McConnell, B.J., Fedak, M.A., Lovell, P. and Hammond, P.S. 1999. Movements and foraging areas of grey seals in the North Sea. Journal of Applied Ecology 36: 573-590.

Nedwell, J.R. and Brooker, A.G. 2008. Measurement and assessment of background underwater noise and its comparison with noise from pin pile drilling operations during installation of the SeaGen tidal turbine device, Strangford Lough. Subacoustech Report No. 724R0120. Report to COWRIE.

Pierpoint, C. 2008. Harbour porpoise (*Phocoena phocoena*) foraging strategy at a high energy, near-shore site in south-west Wales, UK. Journal of the Marine Biological Association of the United Kingdom 88: 1167-1173.

Pusineri, C., Magnin, V., Meynier, L., Spitz, J., Hassani, S. and Ridoux, V. 2007. Food and feeding ecology of the common dolphin (*Delphinus delphis*) in the oceanic northeast Atlantic and comparison with its diet in neritic areas. Marine Mammal Science 23: 30-47

Reid, J.B., Evans, P.G.H. and Northridge, S.P. 2003. Atlas of Cetacean Distribution in North-West European Waters. Joint Nature Conservation Committee, Peterborough.

Royal Haskoning 2011. SeaGen Environmental Monitoring Programme Final Report. Royal Haskoning, Leith. http://seageneration.co.uk/files/SeaGen-Environmental-Monitoring-Programme-Final-Report.pdf

SCANS-II. 2008. Small Cetaceans in the European Atlantic and North Sea (SCANS-II). Final Report to the European Commission LIFE Nature programme on project LIFE04NAT/GB/000245. http://biology.standrews.ac.uk/scans2/

SCOS. 2012. Scientific advice on matters related to the management of seal populations: 2012. http://www.smru.st-andrews.ac.uk/documents/1199.pdf

Scottish Executive. 2007. Scottish Marine SEA: Environmental Report Section C SEA Assessment: Chapter C6.

Scottish Government 2012. Provisional Regional PBR for Scottish seals: Updated March 2012. http://scotland.gov.uk/Topics/marine/Licensing/SealLicensing/PBR

SMRU. 2001. Interactions between grey seals and fisheries: towards a predictive model for evaluating management options. MAFF Research and development Final Project Report, MF0311. http://randd.defra.gov.uk/Document.aspx?Document=MF0311_155_FRP

SNH Sitelink http://gateway.snh.gov.uk/sitelink/

Sparling, C.E. 2013. Sound of Islay Marine Mammal Baseline Data – Year 2 Update. SMRUL-SPR-2013-004 Report to Scottish Power Renewables

Wilson, B., Batty, R.S., Daunt, F. and Carter, C. 2007. Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science, Oban.

[i] SERAD (Scottish Executive Rural Affairs Department) 2000. Habitats and Birds Directives, Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('The Habitats and Birds Directives'), Revised Guidance Updating Scottish Office Circular No 6/1995.

9 BASKING SHARKS

9.1 INTRODUCTION

1. This chapter of the Environmental Appraisal (EA) evaluates the effects of the proposed Argyll Tidal Demonstrator Project (hereafter referred to as "the Development") on the basking shark resource.

2. The chapter provides information on the likely presence, relative abundance and distribution of basking sharks, and how they vary spatially and temporally, within the vicinity of the proposed development and export cable routes.

3. It also considers potential effects on basking sharks of the Development during construction, operation and maintenance, and decommissioning. Possible mitigation measures to reduce these impacts are discussed. Cumulative impacts with other developments are considered.

4. The basking shark *Cetorhinus maximus* is the world's second largest species of fish. It is an obligate ram-feeding zooplanktivore, so in summer it tends to aggregate in areas with high biomass of zooplankton.

5. It has a circumglobal distribution and can undertake extensive trans-ocean basin migrations (Gore et al. 2008), although the relative frequency and function of these migrations is unknown.

6. Areas south of Tiree, in Gunna Sound (between Coll and Tiree) and at Hyskeir are known basking shark “hotspots” within the UK (Witt et al. 2012).

7. Basking sharks arrive in these Scottish hot spots in late spring, and remain there feeding on zooplankton until late summer. In autumn they move south or west, seeking warmer waters to overwinter. Thus basking sharks are unlikely to be in the area near to the Development in winter, but could pass the Development in spring and autumn, and possibly during their summer feeding activity.

8. The basking shark has had full legal protection since 1998 (listed in Schedule 5) under the Wildlife & Countryside Act 1981 (as amended by the Nature Conservation (Scotland) Act 2004). This legislation protects basking sharks from intentional killing, capture or disturbance in waters out to 12 nm from the Scottish coast, and from ‘intentional and reckless’ disturbance. It is also featured in the Bonn Convention (listed in Appendices I and II), in CITES (Appendix II), OSPAR list of Threatened and/or Declining Species. The IUCN included basking shark in the Red List of vulnerable species in the north-east Atlantic.

9. No sites around the UK have been designated for protection of basking sharks, but it is planned to designate Marine Protected Areas (MPAs) within Scottish waters that will include sites selected for their high importance for basking sharks. In preparation for selecting such MPAs, a programme of tagging and tracking basking sharks was established in 2012 and continued in 2013, funded by SNH and carried out by researchers from the University of Exeter.

10. In 2012, satellite tags were attached to 21 basking sharks in the vicinity of Tiree, Gunna Sound and Hyskeir (Witt et al. 2013). In 2013 a further 27 basking sharks were tagged in the same general area (web ref 1), providing insights into their summer feeding and autumn migration.

9.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

9.2.1 Data sources and guidance

11. The following international, European and national legislation, policy and guidance are considered as part of the assessment:

- The Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention);
- The Convention on Migratory Species (the Bonn Convention);
- The OSPAR Convention;
- The Wildlife and Countryside Act 1981 (as amended);
- The Nature Conservation (Scotland) Act 2004 (as amended);
- The Marine (Scotland) Act 2010;
- The Marine and Coastal Access Act 2009;
- The Wildlife and Natural Environment (Scotland) Act 2011;
- The Electricity Act 1989;
- The Town and Country Planning (Scotland) Act 1998 as amended by the Planning (Scotland) Act 2006;
- The Conservation (Natural Habitats &c.) Regulations 1994 (as amended);
- The Conservation of Habitats and Species Regulations 2010;
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011;
- The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended);
- The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2004;
- The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2007;
- Environmental Impact Assessment (Scotland) Regulations 1999 (as amended);
- Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 (as amended);
- Environmental Impact Assessment (Scotland) Regulations 2011 (as amended);
- Marine Works (Environmental Impact Assessment) Regulations 2007;
- Electricity Works (Environmental Impact Assessment) (Scotland) Amendment Regulations 2008;

- SERAD (Scottish Executive Rural Affairs Department) 2000. Habitats and Birds Directives, Nature Conservation; Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('the Habitats and Birds Directives'). Revised Guidance Updating Scottish Office Circular No 6/1995[i];
- The UK Biodiversity Action Plan (BAP)[ii];
- Marine Scotland Licensing and Consents Manual: Covering Marine Renewables and Offshore Wind Energy Development (Draft)(Marine Scotland 2012);
- Scottish Natural Heritage (March 2012). Assessing the Cumulative Impact of Onshore Wind Energy Developments. SNH;
- Scottish Natural Heritage (July 2013) Assessing connectivity with Special Protection Areas. SNH;
- Planning Advice Note 1/2013: Environmental Impact Assessment;
- Planning Circular 3 2011; Guidance on the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011; and
- Scottish Planning Policy, Scottish Government, 2010.

12. The following data sources were considered as part of the assessment:

- SNH Site Link (www.snh.gov.uk/sitelink);
- NBN Gateway (www.searchnbn.net).

9.2.2 Methodology for assessing wider-countryside interests:

13. The evaluation for wider-countryside interests (interests unrelated to an MPA) involves the following process:

- Identification of the potential effect of the Development;
- Consideration of the likelihood of occurrence of potential effects where appropriate;
- Defining the Nature Conservation Importance of the marine mammal populations present;
- Establishing the population's Conservation Status;
- Establishing the magnitude of the Likely Effect (both spatial and temporal);
- Based on the above information, a judgement is made as to whether or not the identified effect is significant with respect to the EIA Regulations;
- If a potential effect is determined to be significant, measures to mitigate or compensate thev effect are suggested where required;
- Opportunities for enhancement are considered where appropriate;

- Residual effects after mitigation, compensation or enhancement are considered.

14. Basking sharks are of national and international importance, protected by UK legislation and soon to be included as features of MPAs that are likely to be designated in Scottish waters in the near future, and therefore are of high receptor value.

15. The significance of the impact is assessed in relation to the sensitivity of the receptor (Table 9.1) and the magnitude of the impact (Table 9.2).

Table 9.1 - Sensitivity of animals

Receptor value	Definition
Very High	Lethal consequences anticipated (i.e. no ability to avoid or recover from the identified impact)
High	Potentially lethal consequences anticipated (i.e. very little ability to avoid or recover from the identified impact)
Medium	Non-lethal consequences anticipated (limited ability to avoid, accommodate to, or recover from the identified impact)
Low	No major consequences identified
Negligible	Species considered tolerant to potential impacts

16. Table 9.2 lists the definition of the Magnitude of the Impact (based on the Scottish Executive (2007) Significance Assessment Criteria).

Table 9.2 - Defining magnitude of the impact

Magnitude	Description
Major	An impact affecting the entire population/habitat causing a decline in abundance and/or change in distribution beyond which natural recruitment would not return that population/habitat, or any population/habitat dependent on it, to its former level within several generations of the species being affected.
Moderate	Damage or disturbance to habitats or populations above those experienced under natural conditions, over one or more generations, but which does not threaten the integrity of that population or any population dependent on it.
Minor	Small-scale or short-term disturbance to habitats or species, with rapid recovery rates, and no long-term noticeable effects above the levels of natural variation experienced in the area. The impacts are not sufficient to be observed at the population level.
Negligible	An imperceptible impact in relation to the baseline condition of the receptor population.

17. Table 9.3 outlines the matrix used in assessing the significance of each impact to basking sharks using both the Sensitivity of the Receptor (basking shark populations) and the Magnitude of the Impact. This provides a 'Worst Case scenario' and does not take into consideration the likelihood of occurrence.

Table 9.3 - Significance prediction matrix

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

18. It should be noted that any residual effect (the effect after the implementation of mitigation) which remains at the level of 'Moderate' or 'Major' is regarded by the EIA Regulations as being of significant effect.

19. Residual Impact Significance is assessed after any mitigation measures are applied. A conclusion on the significance of residual impacts is then drawn, relating this to the description given in the EIA Regulations (as shown in Table 9.4).

Table 9.4 - Residual impact significance

Significance	Description	Interpretation under the EIA Regulations
Major	Highly significant and requires immediate action	Significant Impact
Moderate	Significant and requires additional management	Significant Impact
Minor	Not significant but monitoring may be desirable	Insignificant
Negligible	Not significant	Insignificant

20. Cumulative Impact Assessment (CIA) in the context of EIA is the assessment of the impacts of multiple independent projects on the baseline status of a particular Receptor. Projects to consider in CIA are Sound of Sanda tidal turbine, Sound of Islay tidal array, and West Islay tidal array.

9.3 BASELINE CONDITIONS

9.3.1 Evidence from observations from the Vantage Point

21. No basking sharks were seen within the viewshed during any of the surveys from the Vantage Point (VP).

22. No basking sharks were seen beyond the viewshed during any of the surveys from the VP.

23. No basking sharks were seen during incidental observations from the VP or during time spent in the general area away from the VP.

24. The lack of sightings within the viewshed suggests that the Mull of Kintyre, and North Channel in general, are areas that are not favoured by basking sharks as feeding grounds.

9.3.2 Evidence from observations in the region

25. Sightings of basking sharks are not uncommon in May to September off the west of Scotland (Witt et al. 2012), especially around the Inner Hebrides, but also in the Clyde Sea area. Aggregations are known particularly around Coll and Tiree, and are thought to relate to eddies or frontal systems where zooplankton aggregate. Areas of high tidal flow are therefore thought to be unlikely to attract feeding basking sharks, but areas adjacent to the ends of high tidal flows where 'backwaters' may occur where plankton carried by flowing water may aggregate might be suitable areas for basking sharks to feed.

9.3.3 Evidence from tracking

26. Tracking of basking sharks equipped with satellite transmitters in 2012 and 2013 suggests that these animals aggregate at a feeding hopspot off Tiree, but do not spend time close to Mull of Kintyre tidal energy site (Witt et al. 2013, web ref 1). These data are therefore consistent with the lack of sightings from the VP.

27. None of the tagged basking sharks transmitted from a position within 10 km of Mull of Kintyre. Transmitted locations of the 2012-tagged animals suggest that while several animals that left the west of Scotland 'hotspot' moved into the open North Atlantic and down the west of Ireland, at least three of the animals moved from the hot spots around Tiree, Gunna Sound and Hyskeir to southern Britain through the North Channel and down the Irish Sea (Witt et al. 2013, web ref 1).

28. This would suggest that if basking sharks do pass near to the Mull of Kintyre tidal energy site, they probably do so while on passage moving directly through the area, and do not remain in the area close to the Mull of Kintyre for any prolonged period of time.

9.4 DEVELOPMENT DESIGN MITIGATION

29. In view of the lack of basking shark activity at the site, there is no requirement for mitigation specifically in relation to basking sharks.

9.5 ASSESSMENT OF POTENTIAL EFFECTS

30. A tidal turbine could displace feeding basking sharks through impacts of noise, especially during construction activities on the site. However, there is no evidence to suggest that basking sharks feed at the site.

31. Increased turbidity during construction could occur, but is unlikely to affect basking sharks.

32. Accidental release of contaminants could occur, particularly during construction activities, but amounts are unlikely to have any impact on basking sharks.

33. A tidal turbine could cause injury, or death, as a result of collision. However, there is no evidence to suggest that basking sharks feed at the site. Animals transiting through the area might be at risk of collision impacts, but the numbers of basking sharks thought to transit through the area close to the Development appear to be only a small fraction of the regional population (since tracking data suggest that most transit south in autumn to the west of Ireland rather than through the Irish Sea (Witt et al. 2013, web ref 1).

34. There is a risk of collision between basking sharks and boats used during construction and during maintenance operations. However, the additional boat activity in the area is likely to be small in the context of regular fishing boat, ferry boat, cargo boat and pleasure boat activity in the area.

35. Power cables will generate electromagnetic fields (EMFs) close to the cables. Sharks are sensitive to EMFs. However, the sensitivity of the basking shark, which is a pelagic species that apparently does not use EMFs to locate prey, is thought to be low. Given that basking sharks rarely occur in the area and apparently do not feed at the site, this impact appears to be negligible.

9.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

36. No mitigation is proposed.

37. Residual effects on basking sharks will represent a Negligible impact, given that no basking sharks are normally to be found at the site, and hence the predicted Significance for the population is classified as Negligible, and Not Significant under the terms of the EIA Regulations.

9.7 ASSESSMENT OF CUMULATIVE EFFECTS

38. Regulated developments that could also affect basking sharks include the Sound of Islay Tidal Array, the West Islay Tidal Energy Park, and the Evopod floating tidal turbine test module at Sound of Sanda. Small numbers of basking sharks were recorded in the vicinity of the Sound of Islay Tidal Array, but the impact of that development was considered to be Negligible. No basking sharks were seen at the West Islay Tidal Energy Park but one was seen nearby. The ES for West Islay Tidal Energy Park concluded that the impact of that development on basking sharks would be Negligible. Given the distances between these sites and the very low presence of basking sharks at these sites, cumulative impacts of these developments can be assessed as Negligible overall, and therefore Not Significant.

9.8 SUMMARY OF EFFECTS (RESIDUAL EFFECTS)

39. Impacts on basking sharks are classified as Negligible.

9.9 STATEMENT OF SIGNIFICANCE

40. The predicted Significance for the population is classified as 'Not Significant'.

9.10 REFERENCES

Gore, M.A., Rowat, D., Hall, J., Gell, F.R. and Ormond, R.F. 2008. Transatlantic migration and deep mid-ocean diving by basking shark. Biology Letters 4: 395-398.

Scottish Executive 2007.

Witt, M.J., Hardy, T., Johnson, L., McCleellan, C.M., Pikesley, S.K., Ranger, S., Richardson, P.B., Solandt, J.-L., Speedie, C., Williams, R. & Godley, B.J. 2012. Basking sharks in the northeast Atlantic: spatio-temporal trends from sightings in UK waters. Marine Ecology Progress Series 459: 121-134.

Witt, M.J., Doherty, P.D., Hawkes, L.A., Godley, B.J., Graham, R.T. and Henderson, S.M. 2013. Basking shark satellite tagging project: post-fieldwork report. SNH Commissioned Report No. 555.

Web ref 1. http://wildlifetracking.org/index.shtml?project_id=839

[i] SERAD (Scottish Executive Rural Affairs Department) 2000. Habitats and Birds Directives, Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('The Habitats and Birds Directives'), Revised Guidance Updating Scottish Office Circular No 6/1995.
[ii] UK Biodiversity Action Plan.

10 FISH AND SHELLFISH ECOLOGY

10.1 INTRODUCTION

1. This chapter of the Environmental Appraisal (EA) evaluates the effects of the proposed Argyll Tidal Demonstrator Project (hereafter referred to as "the Development") on the fish and shellfish ecology resource.

2. Fish and shellfish ecology, benthic habitats, commercial fisheries and ornithology are intrinsically linked and as such, this Chapter should be read in conjunction with Chapter 11 Marine Birds, Chapter 7: Benthic Ecology and Chapter 13: Commercial Fisheries in order to gain a full overview of baseline conditions and potential effects.

10.2 ASSESSMENT METHODOLOGY

10.2.1 Guidance

3. The European Marine Energy Centre (EMEC) has developed Environmental Appraisal guidance for wave and tidal energy developers seeking to connect to sites within the EMEC grid at Orkney[1]. Whilst these guidelines have been developed for the EMEC site, they are relevant and transferrable for developments <1MW elsewhere in Scottish Waters. These EMEC guidelines provide details on the EA process and outline what should be included in the Environmental Report. In addition the guidelines provide criteria to assess and categorise potential impacts, including definitions for negligible, minor, moderate and major impacts in relation to ecological effects, socio-economic effects and stakeholder concerns.

4. Other guidance relevant to tidal devices focuses on Environmental Impact Assessment (EIA), including the Marine Scotland Licensing and Consents Manual[2] and EMEC EIA guidance for wave and tidal energy developers[3], but neither of these detail impact assessment requirements in relation to fish and shellfish resources.

5. There are no other specific guidelines developed for tidal turbines, however the EIA guidelines developed in support of licensing offshore wind farms under the Food and Environmental Protection Act 1985 (FEPA) and the Coast Protection Act 1949 (CPA) by Cefas (2004)[4] and guidelines developed to inform data acquisition to support marine environmental assessments of offshore renewable energy projects, also by Cefas (2012)[5] are both largely applicable.

6. The Cefas (2004) guidance details what an EIA should take into account when assessing impacts on fish and shellfish resources, including the presentation of information that describes fish and shellfish resources within the development site and in the context of the wider area. Based on Cefas 2004 and 2012 guidance, important fish and shellfish resources are considered to be those that are:

    - Of significant importance to commercial and recreational fisheries;

[1] EMEC (2013). Guidance For Developers At EMEC Grid-Connected Sites: Supporting Environmental Documentation
[2] ABP Marine Environmental Research Ltd. (2012). Marine Scotland Licensing and Consents Manual, covering Marine Renewables and Offshore Wind Energy Development
[3] EMEC (2005). Environmental Impact Assessment Guidance for Developers at the European Marine Energy Centre.
[4] Centre for Environment, Fisheries and Aquaculture Science. (2004). Offshore Wind Farms: Guidance note for Environmental Impact Assessment In respect of FEPA and CPA requirements. Version 2 - June 2004.
[5] Judd, A. (2012). Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects. Cefas contract report: ME5403 – Module 15

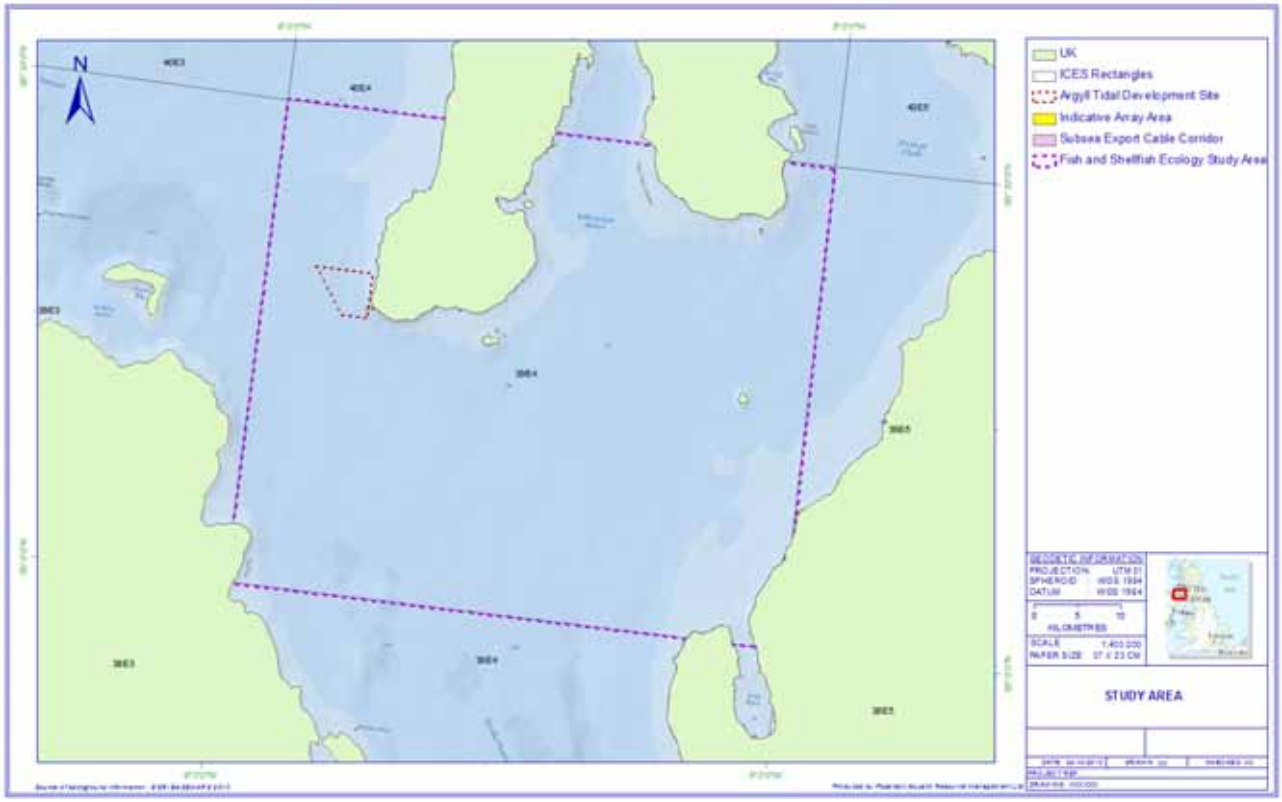
- Of conservation importance e.g. European Protected Species, United Kingdom Biodiversity Action Plan (UKBAP) species;
- Sensitive to the potential effects of electromagnetic fields (EMF); and
- Of restricted geographical distribution and are locally abundant in the area.

7. For those resources identified as important, the following ecological aspects need to be considered: spawning grounds; nursery grounds; migration routes; and over wintering areas for crustaceans. Section 10.4.3 describes spawning and nursery grounds in detail, including intensity maps; migration routes and over wintering areas are discussed within the text where relevant.

10.2.2 Study area

8. For the purpose of the fish and shellfish ecology assessment, the study area has been defined as the area within ICES statistical rectangle 39E4, which overlaps the Argyll Tidal Development Site, as indicated in Figure 10.1**Error! Reference source not found.**. The Argyll Tidal Development Site is approximately 0.7% of this study area, and the Indicative Array Area is 0.003%. The study area has been chosen to allow consistency with the landing statistics reported by ICES rectangle (and presented in Section 10.4).

Figure 10.1 - Study area of fish and shellfish ecology assessment



10.3 DATA SOURCES

9. The main sources of information used to establish baseline conditions are as follows:

- Marine Management Organisation (MMO) landings statistics by species and ICES rectangle for period 2008-2012;
- Habitat mapping using the European Nature Information System (EUNIS) Mapping European Seabed Habitats (MESH);

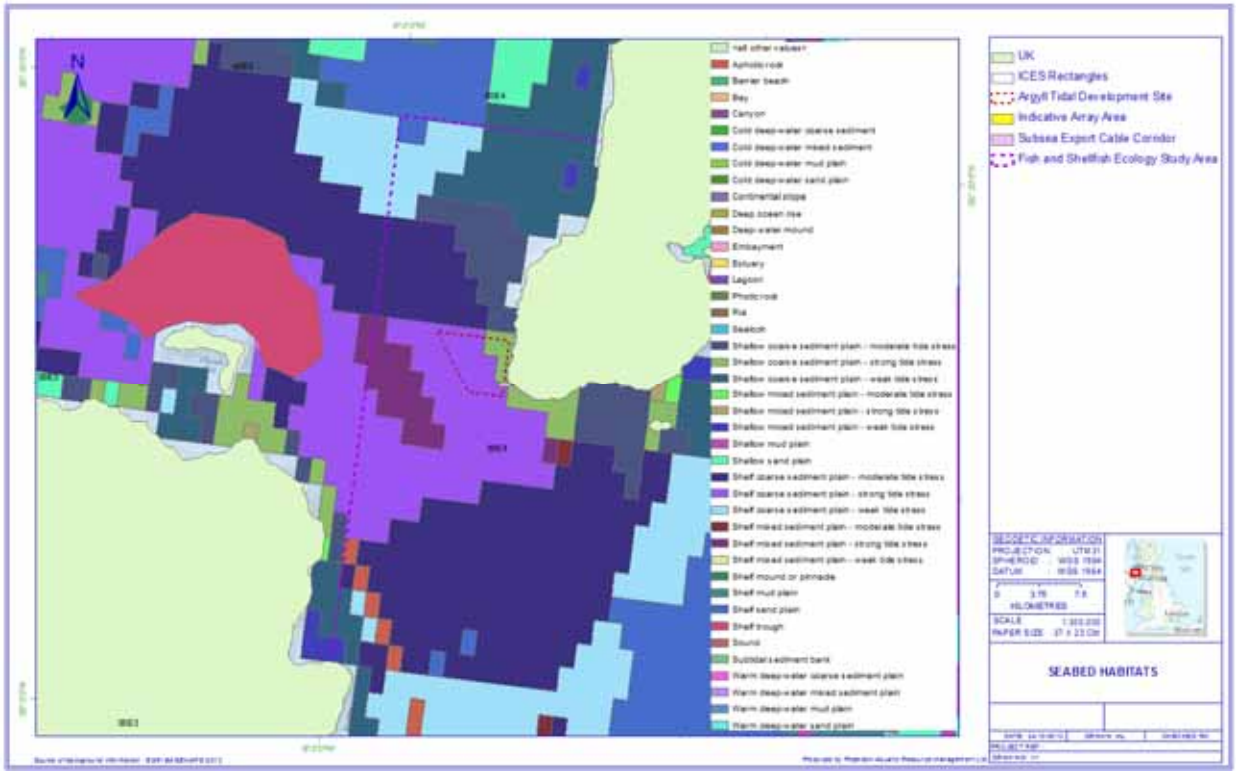
- Spawning and nursery grounds of selected fish species in UK waters[67];
- Technical reports and reviews produced in support of Strategic Environmental Assessments for offshore renewable energy and oil and gas development in UK waters; and
- Broad-scale and species specific information from other sources including FishBase[8], MarLin[9], CEFAS[10] and ICES[11].

10.4 SITE CHARACTERISATION

10.4.1 Seabed habitats

10. The seabed environment is presented in Figure 10.2 based on European Nature Information System (EUNIS) habitat classification. The seabed habitats across the Argyll Tidal Development Site are characterised by coarse sediment plains that are exposed to strong tidal stress.

Figure 10.2 - Seabed habitat EUNIS classification



[6] Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J. (2012) Spawning and Nursery Grounds of Selected Fish Species in UK Waters. Sci. Ser. Tech. Rep., CEFAS Lowestoft, 147: 56 pp
[7] Coull, K. A., Johnstone, R and Rogers, S. I. (1998) Fishery Sensitivity Maps in British Waters. Published and distributed by UKOOA Ltd.
[8] FishBase, accessed on 30/10/2013. www.fishbase.org/
[9] The Marine Life Information Network: MarLIN, accessed on 30/10/2013. www.marlin.ac.uk
[10] Cefas, accessed on 30/10/2013. cefas.defra.gov.uk/
[11] International Council for the Exploration of the Sea, accessed on 30/10/2013. www.ices.dk/

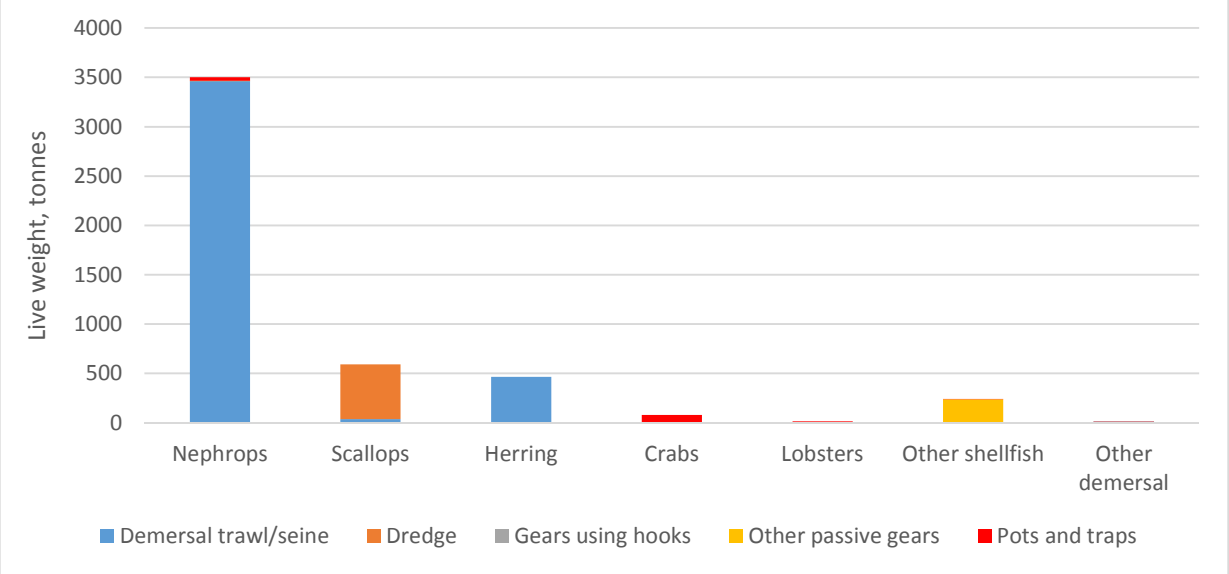
11. Coarse sediments typically include coarse sand, gravel, pebbles, shingle and cobbles, and in this area are likely to be somewhat unstable due to the tidal currents present. Coarse sediments typically have a low silt content and a lack of a significant seaweed component, as such they are characterised by a robust fauna including venerid bivalves.[12]. Further details on seabed habitats and potential benthic impacts are described in Chapter 7 Benthic Ecology.

10.4.2 Landings by commercial fisheries

12. Landing statistics for ICES rectangle 39E4 in 2012 (see Figure 10.3) indicate commercial fisheries targeting Nephrops *Nephrops norvegicus* with demersal trawl, scallops *Pecten maximus* with dredges, herring *Clupea harengus* with seine nets and brown crab *Cancer pagurus*, lobster *Homarus gammarus* and Nephrops with pots. Nephrops and scallops are unlikely to be present across the Argyll Tidal Development Site, given the presence of coarse gravel sediment, but will be caught from elsewhere in ICES rectangle 39E4, across more sandy substrates.

13. Based on landing statistics it is likely that crabs, lobsters and herring may be present across the Argyll Development Site.

Figure 10.3 - Live weight of landings by UK vessels from ICES rectangle 39E4, 2012[13]



10.4.3 Spawning and nursery areas

14. Coull *et al* and Ellis *et al* have mapped spawning and nursery grounds for a range of species around the UK. All of these species are presented in Table 10.1 indicating which have spawning and/or nursery grounds that overlap with the Argyll Tidal Development Site. The relative size of the development site in relation to the area of the spawning and nursery grounds and the minimum distance from the spawning and nursery grounds to the site are also provided.

15. The Argyll Tidal Development site overlaps with low intensity nursery grounds for the following species: anglerfish *Lophius piscatorius*, cod *Gadus morhua*, common skate *Rajo batis*, European hake *Merluccius merluccius*, mackerel *Scomber scombrus* and whiting *Merlangius merlangus*; and high intensity nursery grounds for spurdog *Squalus acanthias* (Figure 10.4 and Figure 10.5). It also overlaps with nursery grounds for Nephrops and saithe *Pollachius virens* (noting that the

[12] Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. & Reker, J.B. [edited ETC/BD] (2004). The Marine Habitat Classification for Britain and Ireland, Version 04.05
[13] MMO (2013). Annual fisheries statistics. Available at: http://www.marinemanagement.org.uk/fisheries/statistics/annual.htm Accessed on 01 November 2013

intensity of this is unknown). Herring nursery grounds occur to the east and west of the Kintyre peninsula, but do not overlap the Development Site (Figure 10.6). Spawning grounds for Nephrops and saithe are also recorded to overlap the Development Site (Figure 10.6).

16. All of the nursery and spawning grounds that are overlapped by the Argyll Tidal Development Site are part of wider grounds located across a large area. As such, the Development Site covers a very small (<0.05%) area of each nursery or spawning area.

Table 10.1 - Distance to spawning and nursery areas and relative area covered by the Argyll Tidal Development Site

Species	Distance to nearest nursery area (km)	% of nursery area covered by site	Distance to nearest spawning area (km)	% of spawning area covered by site
Spawning and/or nursery areas for species that do overlap the site				
Anglerfish *Lophius piscatorius*	0	0.005%	No data	
Cod *Gadus morhua*	0	0.003%	32	
Common skate *Rajo batis*	0	0.005%	No data	
European hake *Merluccius merluccius*	0	0.005%	No data	
Mackerel *Scomber scombrus*	0	0.005%	32	
Nephrops *Nephrops norvegicus*	0	0.04%	0	0.04%
Saithe *Pollachius virens*	0	0.05%	>200	
Spurdog *Squalus acanthias*	0	0.005%	No data	
Sprat *Sprattus sprattus*	164		0	0.005%
Whiting *Merlangius merlangus*	0	0.003%	32	
Spawning and/or nursery areas for species that do not overlap the site				
Blue whiting *Micromesistius poutassou*	44		>200	
Haddock *Melanogrammus aeglefinus*	94		186	
Hake *Merluccius merluccius*	No data		91	
Herring *Clupea harengus*	4.7		35	
Horse mackerel *Trachurus trachurus*	No data		147	
Lemon sole *Microstomus kitt*	98		126	
Ling *Molva molva*	37		32	
Norway pout *Molva molva*	99		99	
Plaice *Pleuronectes platessa*	66		89	
Sandeel *Ammodytes spp.*	20		82	
Sole *Solea solea*	121		91	
Spotted ray *Raja montagui*	79		No data	
Thornback ray *Raja clavata*	79		No data	
Tope *Galeorhinus galeus*	79		No data	
Undulate ray *Raja undulata*	>200		No data	

Figure 10.4 -Nursery areas for anglerfish, cod, common skate and european hake

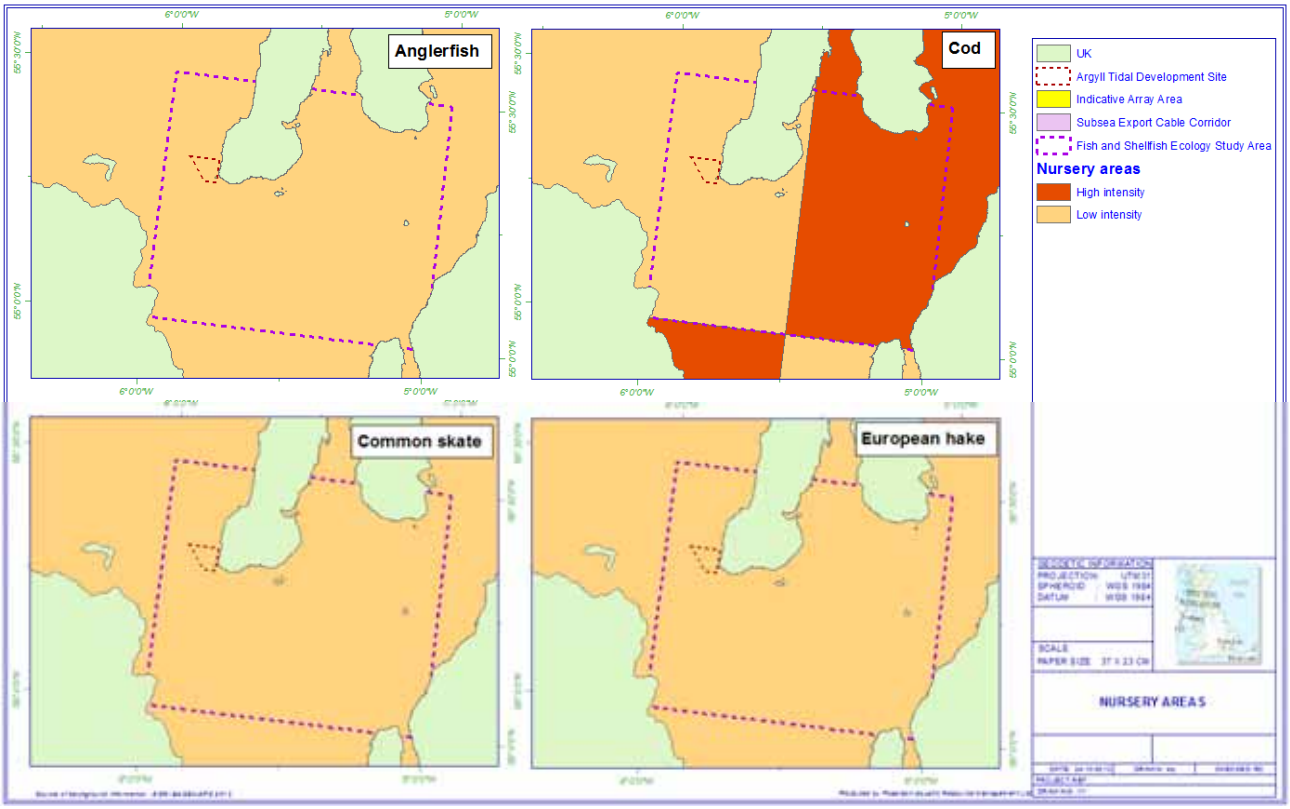


Figure 10.5 - Nursery areas for mackerel, saithe, spurdog and whiting

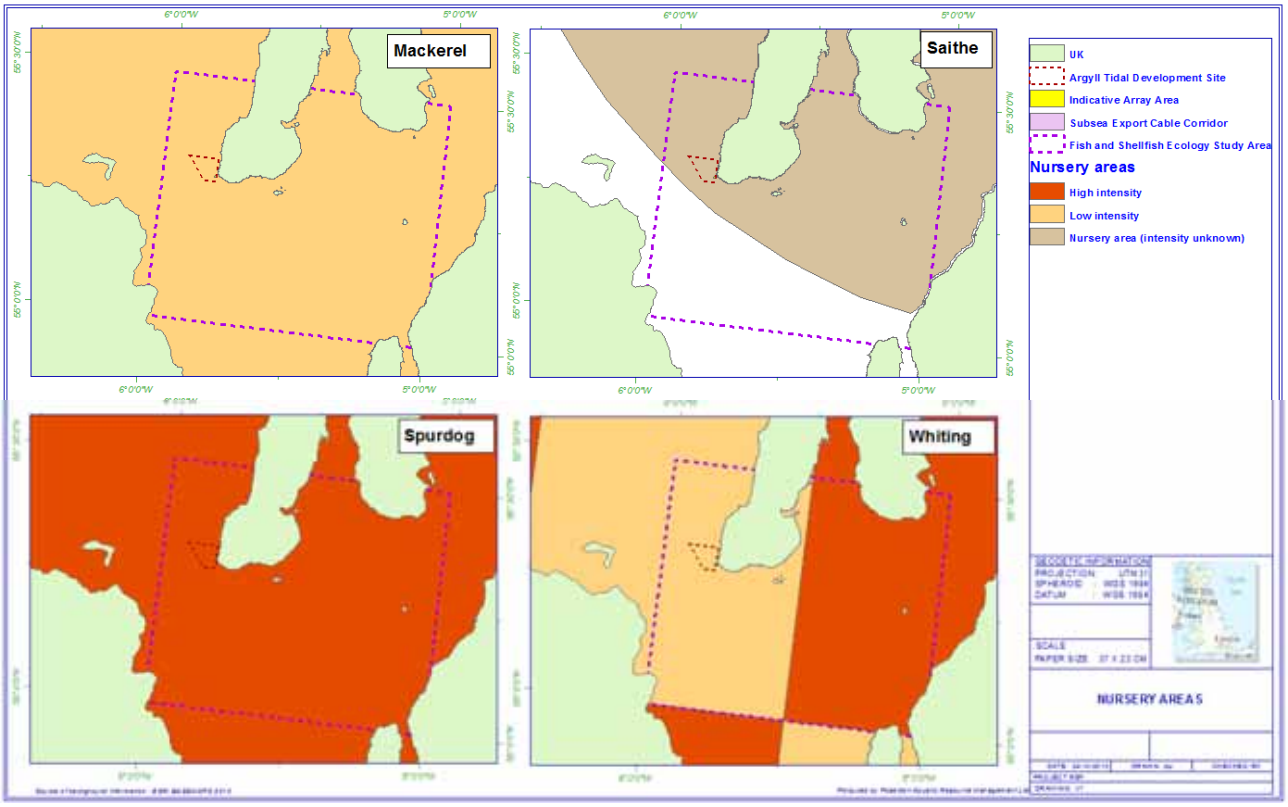
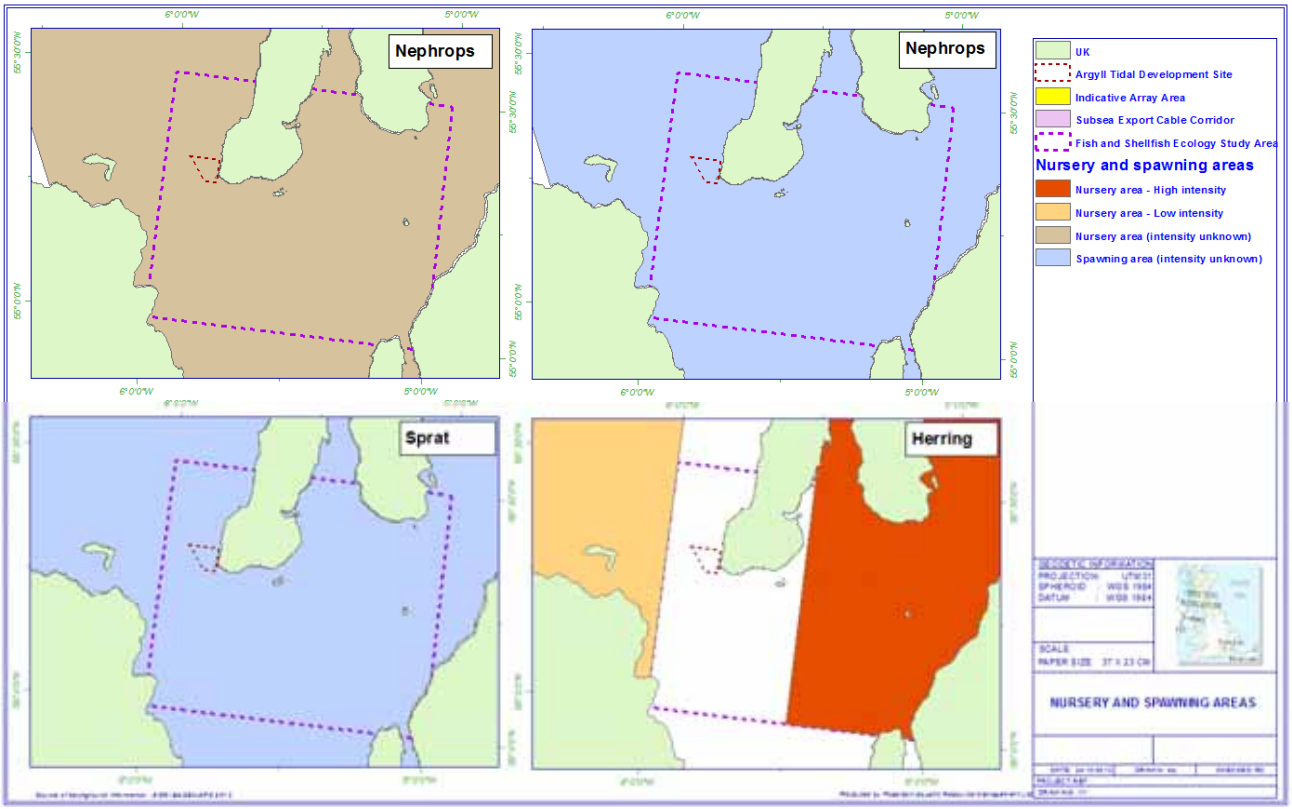


Figure 10.6 - Nursery grounds for nephrops and herring and spawning grounds for nephrops and sprat



10.4.4 Species of conservation importance

17. Table 10.2 shows species encountered on the west coast of Scotland, which are of conservation importance. 'Relevance' has been defined upon the basis of criteria provided by Cefas guidance (2004).

18. The UK Biodiversity Action Plan (UK BAP) is the UK Government's response to the Convention on Biological Diversity. It provides detailed plans for the protection of biological resources (species and habitats) of conservation importance. The IUCN Red List of Threatened Species identifies and provides information on plants and animals at risk of extinction.

Table 10.2 - Species of conservation importance

Species	Approach to Conservation	Relevance
Common skate *Rajo batis*	UK BAP; IUCN red list	Medium
Basking shark *Cetorhinus maximus*	UK BAP	Medium
Spurdog *Squalus acanthias*	IUCN red list	Medium
Cod *Gadus morhua*	IUCN red list	Medium
Haddock *Melanogrammus aeglefinus*	IUCN red list	Medium
High – Species present in the study area, which need to be considered in EIA Medium – Species that were historically present in the area but may not be present now, and species that may only occasionally occur in the area. These species may need to be considered in EIA but data are likely to be scant.		

10.4.5 Key finfish and shellfish species descriptions

19. The Scottish Marine Renewables Strategic Environmental Assessment (SEA)[14], lists a range of fish and shellfish species likely to be present across the west coast of Scotland (see Appendix A). Based on this, cross referenced with the criteria for determining species to include within the EA, together with the information outlined above on landings data, nursery areas, spawning grounds, and species of conservation importance, brief species descriptions are provided below for key finfish, shellfish, elasmobranchs and diadromous species. These have been informed by two principle sources: MarLin[15] and FishBase[16].

10.4.5.1 Finfish

20. Anglerfish, also known as monkfish, is present in waters from the low intertidal down to depths of 550 m and found mostly on sandy or muddy bottoms but is also present on shell, gravel and occasionally rocky areas. They occur in all waters around Britain and Ireland. Anglerfish mature at 4-6 years and spawn between May and June when up to a million eggs are released in a band of mucus about 10 m long, to drift in the open ocean. The Argyll Tidal Development Site is within a wider area known to be low intensity nursery ground for anglerfish. Data on spawning grounds is not available for this species.

21. Cod is a widely distributed demersal species that occurs throughout UK waters. Tagging has revealed that cod migrate in late summer and early autumn from the west coast of Scotland to the north coast, and return in the late winter and early spring[17]. Spawning can occur from January to April, usually peaking in February. Low intensity nursery grounds are recorded across the Argyll Tidal Development Site as part of a wider nursery area; higher intensity nursery grounds are located to the east of the Kintyre peninsula and in the Clyde.

22. European hake is a demersal species that is usually found between 70-350 m. It may be observed feeding alone on the bottom or in shoals in the water column. Most hake species show large vertical movements from near the sea bed, where they spend the day, into mid and surface waters at night to feed. Hake also show substantial offshore and along-shore migrations, a characteristic that is reflected in the large areas used for stock assessment and management. Hake are batch spawners releasing 2-7 million eggs. The Argyll Tidal Development Site is within a wider area known to be a low intensity nursery ground for hake. No hake spawning areas are recorded across the site.

23. Haddock *Melanogrammus aeglefinus* is a demersal species that occurs mainly in waters from 40–200m. Haddock mature at around 2–3 years of age, and can spawn anywhere in the area between the eastern Scottish coast and the Norwegian Deeps. Larvae hatch after one to two weeks and the young haddock remain in the open sea, near the surface, often seeking protection beneath the umbrellas of large Medusae (jellyfish). After one or two years, they leave the pelagic habitat and become demersal. Haddock spawning and nursery grounds are not recorded to overlap with the Argyll Tidal Development Site.

24. Herring is a pelagic species that is widely distributed off the west coast of Scotland. During the daytime they remain close to the seabed or in deep water, and they undertake diurnal feeding migrations into surface waters. Although a pelagic species, they are demersal spawners, depositing sticky eggs on stone and gravel in waters down to 200 m. For this reason, herring are considered particularly sensitive to seabed developments. The major northwest Scotland

[14] Scottish Executive (2007). The Scottish Marine Renewables Strategic Environmental Assessment (SEA)
[15] The Marine Life Information Network: MarLIN, accessed on 30/10/2013. www.marlin.ac.uk
[16] FishBase, accessed on 30/10/2013. www.fishbase.org/
[17] Scottish Executive (2007). The Scottish Marine Renewables Strategic Environmental Assessment (SEA)

spawning area (with spawning occurring in both spring and autumn) lies to the west of the Outer Hebrides and extends north along the north coast of mainland Scotland. There is another autumn spawning area around the Inner Hebrides and the Clyde Sea area is a spring spawning ground. After hatching the larvae are pelagic and drift with the currents and the juvenile nursery grounds tend to be close inshore from the Clyde along the entire west coast of Scotland and the Hebrides. No spawning grounds are recorded across the Argyll Tidal Development Site, with the closest spawning area approximately 35 km from the site. While nursery grounds are recorded in low intensity to the west of Kintyre and in high intensity to the east, they are not recorded across the Argyll Tidal Development Site.

25. Mackerel is a pelagic shoaling species that form extensive shoaling aggregations during the winter. Mackerel spawn in the summer where sperm and eggs are realised into the water and eggs hatch after 2-6 days. Juvenile mackerel live inshore until they are sexually mature, then move offshore to join the major schools. Mackerel are highly migratory so the stock areas are large. The Argyll Tidal Development Site is within a wider area known to be a low intensity nursery ground for mackerel. No mackerel spawning areas are recorded across the site.

26. Saithe is found in deeper waters (approximately 100 – 200 m) at the edge of the continental shelf where spawning takes place from January to April to the west of the Outer Hebrides. Juveniles are located in coastal waters that cover the entire west coast of Scotland and do not migrate into offshore waters until they reach 2 – 3 years. The migration takes place in spring. The pelagic eggs and larvae are widely distributed with nursery areas throughout inshore waters of the west of Scotland. The Argyll Tidal Development Site is within a wider area known to be a saithe nursery ground. No saithe spawning areas are recorded across the site.

27. Sprat *Sprattus sprattus* is a short-lived pelagic species that is widely distributed off western Scotland. They occur from the surface to about 100 m depth but are generally found in shallower waters. It is a batch spawner throughout the summer and eggs are pelagic. Nursery areas are in inshore waters along the west coast of Scotland. Mature fish often migrate inshore during the winter (September to March) and are sometimes commercially exploited. The Argyll Tidal Development Site is within a wider area known to be a sprat spawning ground.

28. Whiting is a benthopelagic species (i.e. living and feeding near the bottom as well as in midwaters or near the surface) and is usually found from 30 to 100 m, mainly on mud and gravel bottoms, but also on sand and rock. They are found extensively around the UK. Whiting migrate to the open sea after the first year of life. Eggs are pelagic and larvae and juveniles are associated with jellyfish. The Argyll Tidal Development Site is within a wider area known to be a whiting nursery ground. No whiting spawning areas are recorded across the site.

10.4.5.2 Shellfish

29. Brown crab is found in rocky areas, but also on sand, gravel and mud. After spawning (in late summer or autumn), eggs are carried by the female under the abdomen until they are ready to hatch. Hatching normally takes place in early summer, and the larvae are distributed by water movements before settling to the seabed as miniature adults. Tagging studies have shown that edible crabs may move up to a few kilometres a day, and hundreds of kilometres in the long term.

30. Lobster has a preference for rocky reef habitats. Spawning and hatching generally follows the same pattern as that described for brown crabs. They are rarely thought to undertake any significant migrations.

31. Nephrops distribution is limited by the extent of suitable, relatively soft, sediment in which they construct burrows where they spend most of their time, only coming out to feed and mate. Female Nephrops usually mature at three years of age and reproduce each year thereafter. They mate in early summer and spawn in September, carrying eggs under their tails until they hatch in April or May. The larvae develop in the plankton before settling to the seabed around eight weeks later. The Argyll Tidal Development Site lies within a wider area that is known to be a Nephrops spawning and nursery ground. As previously mentioned, due to their habitat requirements, Nephrops are not likely to be encountered in the development site.

32. Velvet crab *Necora puber* is mostly found in rocky areas with reefs, boulders and large stones. Spawning and hatching generally follows the same pattern as that described for brown crabs. Velvet crabs are rarely thought to undertake any significant migrations.

10.4.5.3 Elasmobranchs

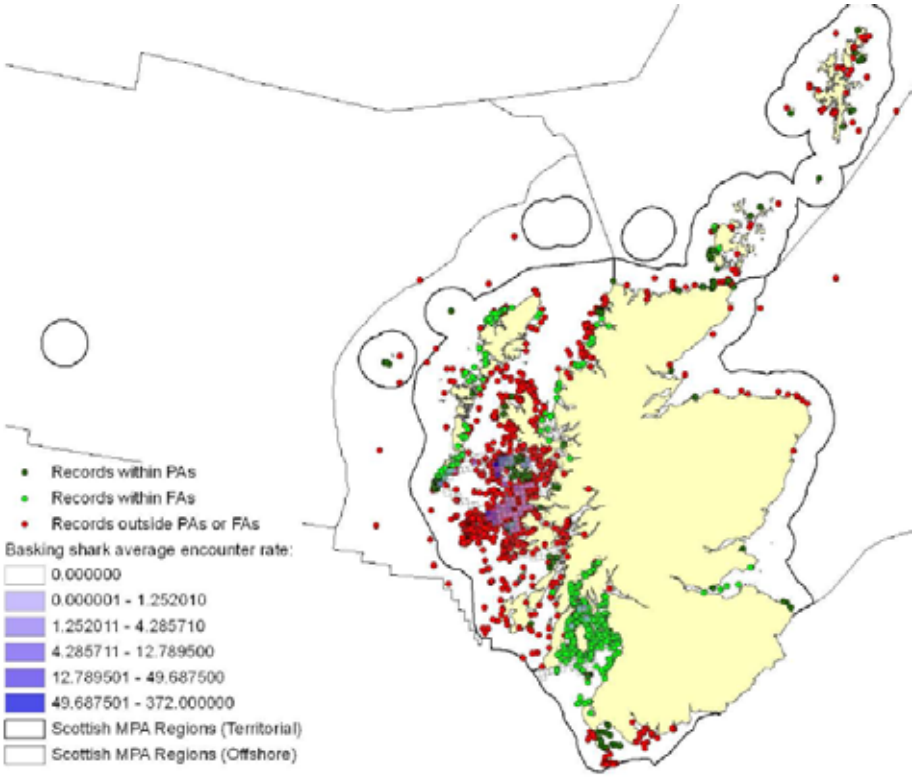
33. Common skate is a benthic species found in coastal waters mainly within the 200 m range. They mate in spring and the egg capsules are laid during the summer. Despite their name, common skate have a critically endangered status on the IUCN red list. Caught as bycatch in multispecies trawl fisheries, populations have undergone an extremely high level of depletion in the central part of its range around the British Isles since the early 20th century. It has been extirpated from most inshore areas, but is still caught in Scottish waters, although mainly around the Shetlands and off North-west Scotland, and also along the shelf edge and in the Celtic Sea[18]. The Argyll Tidal Development Site is within a wider area known to be low intensity nursery ground for common skate. Data on spawning grounds is not available for this species.

34. Spurdog is a small demersal shark of temperate continental shelf seas worldwide with highly migratory stocks. Spurdog is one of the more vulnerable species of shark because of its late maturity, low reproductive capacity, longevity, long generation time (25–40 years) and hence a very low intrinsic rate of population increase. The IUCN red list considers the Northeast Atlantic subpopulation to be critically endangered[19] with a decreasing population trend. Spurdog are epibenthic, but are not known to associate with any particular habitat. The Argyll Tidal Development Site is within a wider area known to be a high intensity nursery ground for spurdog. Data on spawning grounds is not available for this species.

35. Basking shark Cetorhinus maximus is a widely distributed pelagic species. This shark is named from its habit of 'basking' on the surface in good weather conditions, usually singly or in small groups, although it also carries out extensive vertical migrations between the surface and deep water on the continental shelf and shelf-edge. Scottish Natural Heritage have produced a distribution map for basking sharks within Scottish Waters (Figure 10.7). The highest frequency of sightings occur around Coll, Tiree and Mull; sightings are also notable within the Firth of Clyde. Very few sightings are recorded off the south west coast of the Kintyre peninsula. Recent tagging work has shown that they make extensive horizontal and vertical migrations to locate feeding hotspots, often associated with frontal systems. The basking shark produces live pelagic young. Basking sharks in UK waters are protected, principally under Schedule 5 of the Wildlife and Countryside Act (1981) and the Nature Conservation (Scotland) Act 2004. The Northeast Atlantic basking shark stock is considered to be endangered on the IUCN red list.

[18] IUCN (2006). http://www.iucnredlist.org/details/39397/0 Accessed on 01/11/2013
[19] IUCN (2006). http://www.iucnredlist.org/details/44168/0 Accessed on 01/11/2013

Figure 10.7 - Distribution of basking shark within Scottish waters, highlighting those records which are located within existing protected areas (PA) and fisheries areas (FA)[20]



10.4.5.4 Diadromous species

36. Atlantic salmon *Salmo salar* is widespread throughout Scotland. The amount of time spent in the coastal zone is limited with distribution dependent on the location of rivers suitable for spawning. Adult fish enter rivers from the sea at almost any time of year, but migrate into smaller spawning streams on elevated flows following rainfall in the autumn (September – November). After spawning in October – December the adult fish return seawards over a period of up to several months. There is limited information pertaining to the at-sea migration of salmon. Smolts are believed to move offshore in schools to deep-sea feeding areas. Atlantic salmon are found within the Machrihanish Water, which flows into the development area, and there is an active fishery for Atlantic salmon on the Barr Water, immediately to the north of the proposed development area[21]. The Firth of Clyde is known to support salmonid populations, which may pass through the development area during migrations to and from natal rivers. Catch returns collated by the Argyll District Salmon Fishery Board indicate no catches of salmon in the Kintyre district in 2012[22].

37. Sea trout *Salmo trutta* is also widespread throughout Scotland and has a life history very similar to that of the salmon. The main differences are that sea trout may return to fresh water after only a few months at sea, and the adults are generally smaller than salmon. Catch returns collated by the Argyll District Salmon Fishery Board indicate 35 catches of sea trout in the Kintyre district in 2012, all of which were from the Lochead Burn, which is located in the north of the

[20] SNH (undated) http://www.snh.gov.uk/docs/B988323.pdf Accessed on 29/11/2013
[21] Argyll District Salmon Fishery Board (201X) Scoping Response
[22] Argyll District Salmon Fishery Board (2013). http://argyll.dsfb.org.uk/files/2013/05/ARGYLL-DSFB-CATCH-RETURNS-2012.pdf Accessed on 01/11/2013

Kintyre peninsula. No catch records are noted for the rivers in the vicinity of the Argyll Tidal Development Site, including Allt a Ghobhainn, Ballinamoill and Balmagomery[23].

38. A number of other migratory species may occur in the waters off the west coast of Scotland, including lamprey species and European eel *Anguilla anguilla*. However, given their behavioural characteristics and ecological preferences, it is not likely that they would interact with the tidal device.

10.4.6 Species sensitivity to tidal developments

39. The Scottish Marine Renewables SEA[24] identifies the sensitivity of fish species to impacts associated with wave and tidal array developments. Table 10.3 adapted from the SEA and lists those species or species groups that may be present at the site and considered sensitive to tidal developments.

Table 10.3 - Sensitivity of fish to impacts from tidal arrays

Species	Smothering	Change in suspended sediment	Substratum loss	Decrease in water flow	EMF	Underwater noise
Herring *Clupea harengus*	High	Medium	High	High	Not sensitive	High
Sprat *Sprattus sprattus*	Not sensitive	Medium	Not relevant	Not relevant	Not sensitive	Unknown
Cod *Gadus morhua*	Not sensitive	Not relevant	Not relevant	Not relevant	Yes	High
Sandeels *Ammodytes spp.*	High	Low	High	Medium	Not sensitive	Unknown
Lemon sole *Microstomus kitt*	Low	Low	Not relevant	Not relevant	Not sensitive	Low
Plaice *Pleuronectes platessa*	Low	Low	Not relevant	Not relevant	Yes	Low
Spurdog *Squalus acanthias*	Not sensitive	Not relevant	Not relevant	Not relevant	Yes	Unknown
Lesser spotted dogfish *Scyliorhinus canicula*	Low	Not relevant	Not relevant	Not relevant	Yes	Unknown
Basking shark *Cetorhinus maximus*	Not sensitive	Low	Not relevant	Not relevant	Yes	Unknown
Porbeagle *Lamna nasus*	Not sensitive	Not relevant	Not relevant	Not relevant	Yes	Unknown
Tope *Galeorhinus*	Not sensitive	Not relevant	Not relevant	Not relevant	Yes	Unknown

[23] Argyll District Salmon Fishery Board (2013). http://argyll.dsfb.org.uk/files/2013/05/ARGYLL-DSFB-CATCH-RETURNS-2012.pdf Accessed on 01/11/2013
[24] Scottish Executive (2007). The Scottish Marine Renewables Strategic Environmental Assessment (SEA)

galeus						
Thornback ray *Raja clavata*	Low	Not relevant	Not relevant	Not relevant	Yes	Low
Common skate *Rajo batis*	Low	Not relevant	Low	Not relevant	Yes	Not sensitive

10.5 DEVELOPMENT DESIGN MITIGATION

40. No design mitigation is considered necessary in relation to the potential effects of the tidal device on fish and shellfish ecology.

10.6 ASSESSMENT OF POTENTIAL EFFECTS

10.6.1 Potential effects during Construction Phase

10.6.1.1 Impacts due to habitat disturbance

41. The project is expected to have minimal habitat disturbance. The 3.3kV AC export cable will be up to 1km in length and contained within a 100mm pipe filled with a dense gel to keep it resting on the seabed. The three moorings associated with the tidal device will be secured to the seabed via 100mm diameter pins grouted into drilled holes.

42. No sensitive or vulnerable species are known to be particularly associated with the habitat across the development site. Impacts on sessile organisms (such as mussels), species with limited mobility (such as whelks), and mobile crustaceans (such as brown crab, lobster and velvet crab) are considered to be of negligible significance.

43. The impact on any spawning or nursery habitat for anglerfish, cod, common skate, European hake, mackerel, spurdog, whiting, Nephrops, saithe and sprat are considered minimal in context of wider spawning and nursery grounds. Furthermore, characteristics of most species means they are not at risk (e.g. pelagic eggs, widespread spawning grounds). The impact due to habitat disturbance on teleost species with spawning/nursery grounds in the general area of the development site is considered to be negligible.

10.6.1.2 Impacts due to noise and vibration

44. The main noise impacts during the construction period (approx. 1 month) relate to three drilled holes for securing tidal device moorings, as well as vessel movements and cable laying, noting that the export cable will not be buried. In terms of offshore renewable energy development, pile driving is typically considered to be the main cause for concern in terms of construction activity due to the high sound pressure levels and broad band noise generated. It is not expected that there will be any requirement for piling during installation of the tidal device.

45. The effects of noise on fish can be divided into the following categories[25]:

- Lethality and physical injury;
- Traumatic hearing damage (i.e. temporary and permanent hearing loss); and
- Behavioral responses and masking of biologically relevant sounds.

46. Most of the fish and shellfish species likely to be encountered within the development site have a relatively low sensitivity to noise. Herring and sprat are exceptions and are considered to have a

[25] Hastings, M.C and Popper, A.N. 2005. Effects of Sound on Fish.

high sensitivity to noise (on account of their swim bladder). In relation to behavioural responses, 90dB results in a strong reaction in herring and 27dB results in a significant reaction.

47. A study in 2003 monitored noise of construction works at the Red Tunnel ferry terminal, in order to monitor any behavioural changes of nearby caged brown trout via video recordings. The result of double blind analysis of the caged fish showed no significant behavioural reactions during increased vessel movements associated with the construction works. It is therefore reasonable to assume that increased vessel traffic is unlikely to cause significant behavioural changes in sea trout or salmon[26].

48. Underwater noise levels from shallow water construction drilling operations are not available, however some measurements have been reported for oil and gas exploration and production drilling. Based on the available measurements, drilling noise is often of a low level, low frequency nature with several tonal components. There is some evidence that behavioural reactions by cetacea are proportional to the received level above background noise, but no known studies have considered the effects of drilling on fish.

49. Based on the construction activities proposed, noise levels are unlikely to be significantly higher than baseline noise conditions already experienced within the marine environment. Some avoidance by hearing specialists such as herring and sprat may occur. Overall the noise and vibration impacts on fish and shellfish are considered to be negligible.

10.6.1.3 Impacts due to increased suspended sediment concentration, turbidity and smothering

50. Activities related to the construction of the tidal development, such as drilling and cable laying can result in a temporary increase in turbidity through sediment re-suspension. These effects, however, will be short term and affect localised areas during construction with suspended sediment re-settling soon after works stop in a given place. Coarser sediment fractions are likely to be re-deposited on the seabed within about 50m of the works[27].

51. Increases in suspended sediment and turbidity are unlikely to be significant across the development site or cable route. Given the coarse nature of the seabed substrate and the high energy tidal conditions, it is expected that little material will be put into suspension during construction works, and what does enter suspension will be rapidly dispersed.

52. Based on the construction activities proposed, impacts due to increased suspended sediment concentration, turbidity and smothering are considered to be negligible for all species.

10.6.1.4 Impacts due to the release of sediment bound contaminants

53. Disturbance of contaminated sediments during device and cable installation may cause potentially detrimental impacts on species that are sensitive to contamination. However, there is no reason to expect seabed sediments present across the development site or cable route to be contaminated and therefore associated impact are considered to be negligible.

[26] Nedwell, J.R, Langworthy. J and Howell, D. 2003. Assessment of sub-sea acoustic noise and vibration from offshore turbines and its impact on marine wildlife; initial measurements or underwater noise during construction of offshore wind farms, and comparison with background noise. COWRIE
[27] Scottish Executive. 2007. Scottish Marine Renewables SEA. Environmental Report Section C SEA Assessment: Chapter C7 Fish and Shellfish.

10.6.2 Potential effects during Operational Phase

10.6.2.1 Impacts due to habitat disturbance

54. Post-construction monitoring at other offshore wind farm sites around the UK have not identified any short term negative environmental impacts caused by wind farm construction[28] [29].

55. Benthic post-installation monitoring around the SeaGen tidal turbine in Strangford Lough has also to date concluded that installation has not resulted in any significant changes to the benthic environment, and all observed changes are natural and seasonal.

56. In view of the above, the impact due to habitat disturbance during the operational phase of the tidal device is considered to be negligible.

10.6.2.2 Impacts due to noise and vibration

57. During the operational phase of the tidal development the main source of underwater noise will be from the rotation of the turbine and vibration mechanically generated from the turbine, which will be transmitted into the surrounding water.

58. The noise levels generated by the operational device are currently unknown as only reduced scale devices and one full scale 'mule' device without the electrical generator have been tested to date. However, they are not expected to be significantly higher than noise and vibration experienced at ambient conditions and as such the impact is considered to be negligible.

10.6.2.3 Impacts of electromagnetic fields

59. The University of Liverpool Centre for Marine and Coastal Studies and Cranfield University [30] [31] have undertaken studies, funded through COWRIE, to investigate electromagnetic field (EMF) emission from typical offshore subsea cables, in the context of the electric (E), induced-E (IE) and magnetic (B) fields. Studies have been largely driven by the need to consider the effects of EMF resulting from offshore wind farm subsea cabling.

60. The 3.3kV AC export cable will be up to 1km in length and contained within a 100mm pipe filled with a dense gel. The exact magnitude of the B and iE-field emissions from the cable are unknown, but expected to be in line or below that of the predictions made in the COWRIE reports due to the relative low voltage and additional insulation provided by the gel filled pipe when compared to standard offshore wind farm cables. The B-field will potentially be detectable to magnetically sensitive fish species and that the iE-field would be within the range that could either attract or repel electro-sensitive fish species. The impact of EMF will be highly localised, as the effects will only be detectable within approximately 10-20m from the cable[32].

61. Species potentially occurring in the local area for which there is evidence of response to B-fields are: eel, salmon, sea trout, plaice, lamprey and elasmobranch species. Encounters with a B-field may cause behavioural changes such as a change in swimming direction. It is likely that B-field emissions will be below the magnitude of the Earth's geomagnetic field.

[28] npower renewables Limited. 2007. North Hoyle 2nd years Construction Monitoring Report.
[29] BOWind. 2008. Barrow 1st Year Post Construction Monitoring Report. FLS-034378
[30] CMACS. 2003. Chapter 5: Biological Environment in: Seascape Energy. Burbo Offshore Wind Farm Environmental Statement.
[31] Gill, A.B, Gloyne-Phillips, I, Neal, K.J and Kimber, J.A. 2005. The potential effects of electromagnetic fields generated by subsea power cables associated with offshore wind farm developments on electrically and magnetically sensitive marine organisms – a review. COWRIE 1.5 EMF Review
[32] Gill, A.B, Huang, Y, Gloyne-Phillips, I, Metcalfe, J, Spencer, J and Wearmouth, V. 2008. COWRIE 2.0 EMF Phase 2

62. Species potentially occurring in the local area for which there is evidence of response to iE-fields are: lesser spotted dogfish, thornback ray, cod, plaice, sea and river lamprey, Atlantic salmon and eel. Electro-sensitive species will be expected to detect the iE-field emitted by a shielded cable up to a distance of 20m from the cable. The magnitude of the iE-field falls at the boundary between the likely attraction and repulsion of elasmobranch species. There is currently no evidence to show whether either attraction or repulsion will have a detrimental impact upon an elasmobranch species.

63. The impact due to the generation of EMF on magnetically and electrically sensitive species will be very localised and is considered to be of minor adverse significance.

10.6.2.4 Impacts of barriers to movement

64. There is a potential for the tidal device to form a barrier to the usual migration and transit patterns of marine finfish, either because of collision risk, aversive reactions to underwater noise, or perceptions of devices and associated infrastructure. This form of impact is more relevant in 'constrained' areas such as the mouths of sea lochs, estuaries or within a narrow sound; none of which apply in this case.

65. Any barrier effect is most likely to be felt by mobile fish species which frequently transit through the area. The area is not known to support any particular fish transits or migratory movements, whereby fish are known to specifically use this stretch of water.

66. The tidal device will be located in water of 35m depth and will have at least 10m above and below the device that would allow normal fish transits/migratory movements. As such the impact of barrier to movement is considered to be negligible.

10.6.2.5 Impacts of collision risk

67. Potential encounter rates between existing herring populations and 100 horizontal axis 8m radius turbines operating off the Scottish coast were modelled by Wilson et al[33]. The model incorporated a number of assumptions about the vertical distribution of herring, their swimming speeds and distribution. As escape (avoidance and evasion) behaviours by the fish to this type of device are currently unknown it was also assumed that the animals were neither attracted to nor avoided the immediate area around the turbine. While these assumptions could be further refined, the intent was to derive a ball-park figure for the number of potential physical encounters between rotors and animals. The model predicted that in a year of operation, 2% of the herring population would encounter a rotating blade, noting that encounters are not collisions, but may lead to a collision if the fish does not take evasive action. The calculated encounter rates between herring and turbines is of relatively low significance compared to losses from fisheries. Furthermore it is expected that this highly mobile species would be able to take some degree of avoidance action.

68. Basking sharks are known to have a risk of collision with vessel traffic on account of their feeding behaviour at or very close to the surface[34]. However, the risk of collision with tidal devices is less well understood. Notwithstanding this, the tidal development is located in an area where basking shark sightings are low (Figure 10.7) and the risk of collision is therefore expected to be minimal. Basking sharks are considered further in Chapter 9

[33] Wilson, B. Batty, R. S., Daunt, F. & Carter, C. 2007. Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science.
[34] Wilding, C. and Pizzolla, P. 2009. *Cetorhinus maximus*. Basking shark. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme Plymouth: Marine Biological Association of the United Kingdom. Available from: http://www.marlin.ac.uk/speciesbenchmarks.php?speciesID=2940 Accessed on 29/11/2013

69. Based on the information available, together with the fact that a single device will be deployed, any effect of fish, including basking sharks, associated with collision risk is considered be negligible.

10.6.2.6 Impacts of changes in water flow

70. The decrease in water flow resulting from extraction of tidal energy will potentially impact on habitats and species which are sensitive to changes to tidal flows and wave exposure. This impact mainly applies to shellfish species, which have low – medium sensitivity to changes in tidal flows, and to herring spawning grounds, which are usually based upon gravel beds created by high water flows[35].

71. Based on the development being a single device that is at least 10m above seabed it is considered that any changes in water flow would be negligible in terms of its impact on fish and shellfish resources.

10.6.3 Potential effects during Decommissioning Phase

72. The impacts produced during decommissioning are expected to be, at worst, of the same nature and magnitude as those on the construction phase.

10.7 MITIGATION MEASURES AND RESIDUAL EFFECTS

73. No mitigation measures are proposed in relation to impacts upon fish and shellfish resources.

74. The residual effects remain unchanged from those defined within the impact assessment outlined above and summaries below.

10.8 ASSESSMENT OF CUMULATIVE EFFECTS

75. There is one other marine energy project proposed near to the development site. OceanFlow Energy is currently undertaking environmental monitoring and permitting activities for an inshore site 15 km east of the Project on the mainland side of Sanda Sound. The proposal is for a single ¼ scale 35 kW demonstrator Evopod tidal device. Given the small scale of the device and geographic separation of the proposals, cumulative effects are unlikely.

10.9 SUMMARY OF EFFECTS (RESIDUAL EFFECTS)

76. A summary of the residual effects on fish and shellfish resources is provided in Table 10.4.

Table 10.4 – Summary of residual effects on fish and shellfish resources

Impact	Significance	Mitigation proposed	Residual effect
Potential effects during Construction Phase			
Habitat disturbance	Negligible	None	Negligible
Noise and vibration	Negligible	None	Negligible
Increased suspended sediment concentration, turbidity and smothering	Negligible	None	Negligible

[35] Scottish Executive. 2007. Scottish Marine Renewables SEA. Environmental Report Section C SEA Assessment: Chapter C7 Fish and Shellfish.

Release of sediment bound contaminants	Negligible	None	Negligible
Potential effects during Operational Phase			
Habitat disturbance	Negligible	None	Negligible
Noise and vibration	Negligible	None	Negligible
Electromagnetic fields	Minor adverse	None	Minor adverse
Barriers to movement	Negligible	None	Negligible
Collision risk	Negligible	None	Negligible
Changes in water flow	Negligible	None	Negligible
Potential effects during Decommissioning Phase			
As described for the Construction Phase			

FISH AND SHELLFISH APPENDIX

Shellfish	Fish	Fish
Crustaceans	Finfish	Elasmobranchs
Lobster *Homarus gammarus*	Cod *Gadus morhua*	Lesser spotted dogfish *Scyliorhinus canicula*
Nephrops *Nephrops norvegicus*	Ling *Molva molva*	Basking shark *Cetorhinus maximus*
Squat lobster *Galathea squamifera*	Whiting *Merlangius merlangus*	Porbeagle *Lamna nasus*
Crawfish *Palinurus elephas*	Mackerel *Scomber scombrus*	Tope *Galeorhinus galeus*
Edible crab *Cancer pagurus*	Sandeels *Ammodytes spp.*	Cuckoo ray *Leucoraja naevus*
Green crab *Carcinus maenas*	Sprat *Sprattus sprattus*	Spotted ray *Raja montagui*
Velvet crab *Necora puber*	Pollack *Pollachius pollachius*	Spurdog *Squalus acanthias*
Spider crab *Maja verrucosa*	Plaice *Pleuronectes platessa*	Common Skate *Rajo batis*
Brown shrimp *Crangon crangon*	Saithe *Pollachius virens*	Thornback ray *Raja clavata*
Bivalves	Haddock *Melanogrammus aeglefinus*	Diadromous species
King scallop *Pecten maximus*	Norway pout *Trisopterus esmarkii*	Salmon *Salmo salar*
Queen scallop *Aequipecten opercularis*	Flounder *Platichthys flesus*	Sea trout *Salmo trutta*
Razor clam *Ensis ensis*	Monkfish (angler) *Lophius piscatorius*	European eel *Anguilla anguilla*
Horse mussel *Modiolus modiolus*	Witch *Glyptocephalus cynoglossus*	
Mussel *Mytilus edulis*	Striped red mullet *Mullus surmuletus*	
Cockle *Cerastoderma edule*	John dory *Zeus faber*	
Native oyster *Ostrea edulis*	Sea bream *Spondyliosoma cantharus*	
Molluscs	Bass *Dicentrarchus labrax*	
Squid *Loligo spp.*	Hake *Merluccius merluccius*	
Whelk *Buccinum undatum*	Gurnards *Triglidae* spp	
Common periwinkle *Littorina littorea*	Dab *Limanda limanda*	
	Turbot *Psetta maxima*	
	Dover sole *Solea solea*	
	Lemon sole *Microstomus kitt*	
	Megrim *Lepidorhombus whiffiagonis*	
	Conger eel *Conger conger*	
	Herring *Clupea harengus*	
	Atlantic halibut *Hippoglossus hippoglossus*	
	Red gurnard *Aspitrigla cuculus*	

Shellfish	Fish	Fish
	Brill *Scophthalmus rhombus*	
	Long rough dab *Hippoglossoides platessoides*	

11 MARINE BIRDS

11.1 INTRODUCTION

1. This chapter of the Environmental Appraisal (EA) evaluates the effects of the proposed Argyll Tidal Demonstrator Project (hereafter referred to as "the Development") on the marine bird resource.

2. This assessment is supported by the following Appendices: a) MacArthur Green (2012) Argyll Tidal Array Seabird Survey Methodology. Report to Marine Scotland and Scottish Natural Heritage; b) Maps of seabird distribution; c) Excel spreadsheet of bird survey data.

3. The chapter provides information on the likely presence, relative abundance and distribution of marine birds, and how they vary spatially and temporally, within the vicinity of the Development and export cable routes.

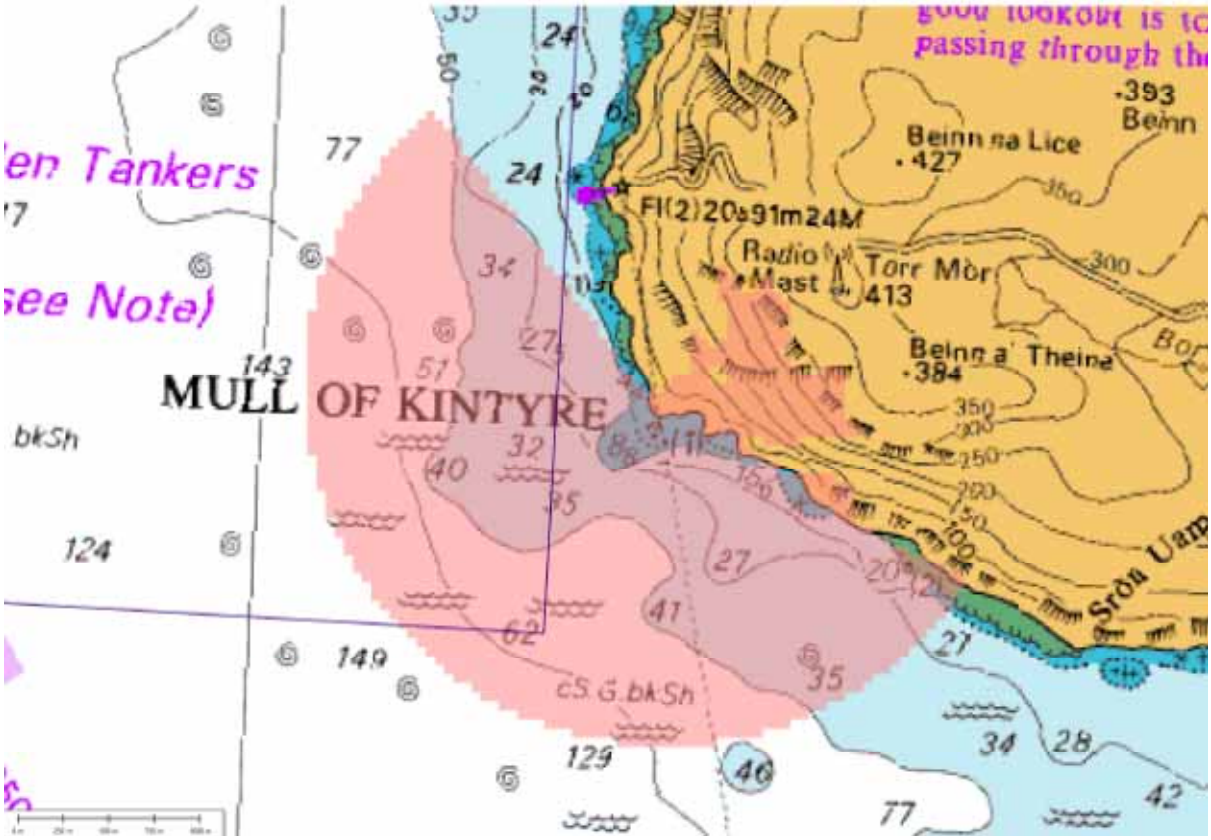
4. It also considers potential impacts to marine birds of the Development during construction, operation and maintenance, and decommissioning. Possible mitigation measures to reduce these impacts are considered as are cumulative impacts with other similar developments in the local region.

5. Scoping for this project (Eastman 2012) resulted in agreement that a combination of use of existing data and one year of Vantage Point (VP) observations of seabirds from a suitable VP near to Mull of Kintyre lighthouse Fog Signal would be appropriate to characterise the seabird community.

6. Discussions with Marine Scotland (MS) and Scottish Natural Heritage (SNH) led to an agreed methodology for data collection (MacArthur Green 2012), based on recommendations of Jackson and Whitfield (2011). Because the proposed deployment areas extend no more than approximately 1 km from shore, it was agreed that a shore-based Vantage Point (VP) would be appropriate. Observations were made from immediately in front of the Fog Signal building above Rubha na Lice, a position 40 m above sea level with a clear view across the sea to a distance theoretically limited by visibility, but practically by ability to detect animals at distance. Seabirds on the water were detected by scanning slowly over the area using a tripod-mounted telescope (Swarovski 30x or Optolyth 30x). Bearings were taken by compass, and distance estimated using an angulator (van der Heide et al. 2011). Marine mammals and basking sharks, and flying seabirds were initially detected using 10x40 binoculars, with the telescope used to identify animals where necessary, and to measure distance by angulator.

7. In practice, observations were to a distance of 2 km from the VP across an almost semi-circular area of sea bounded by the rocky coast (the arc was in fact slightly nearer to 190^{o} of viewshed rather than 180^{o}. This represents an area of approximately 6.5 km^2 of sea surface. The viewshed is shown in Figure 1 in MacArthur Green (2012) and is copied in Figure 11.1.

Figure 11.1 - Viewshed (pink) from the fog horn VP up to a maximum distance of 2 km. The viewshed extends approximately 800 m beyond the Development site and extensively upstream and downstream.



8. Initially, observations were carried out by Eddie Maguire and Iomhar McMillan working as a team (Maguire counting birds on the water, McMillan counting marine mammals, basking sharks and flying seabirds); data for surveys from June to October 2012). Later observations were made by Bob Furness (January 2013) and Claire Bailly (February to June 2013), working alone, with scans of seabirds on the water alternating with counts of marine mammals and basking sharks, and counts of flying seabirds, each of these being carried out once per hour (details in MacArthur Green 2012). All four fieldworkers have considerable experience of seabird and marine mammal survey and ecological studies. Maguire is Warden of the nearby Machrihanish Seabird Observatory and is a highly skilled field naturalist. Bob Furness and Claire Bailly have many years of experience of studying seabirds in many locations and have experience of surveying marine mammals and basking sharks in Scottish waters.

9. Fieldwork was carried out with the aim of collecting data from an average of 12 hours of survey effort per month, but with effort distributed seasonally to cover the range of tidal states rather than aiming for a specific number of hours in each month. Overall survey effort was 72 person-hours in 'autumn' (defined as August to October), 50 person-hours in 'winter' (defined as November to February), 30 person-hours in 'spring' (defined as March to mid-May), and 68 person-hours in 'summer' (defined as mid-May to July). This gave a total of 220 person-hours of survey work from the VP. No surveys were carried out when Beaufort sea-state was above sea-state 4, or when visibility was less than 2 km. Survey effort resulted in the following numbers of completed counts of seabirds on the water, and the same numbers of counts of marine mammals and basking sharks, and flying seabirds: 34 in autumn, 47 in winter, 30 in spring, and 53 in summer. In the field, data were recorded onto data sheets, and these were subsequently transcribed into an Excel spreadsheet in the office. The raw data are included with this report in a Technical Annex.

10. Positions of seabirds on the water, marine mammals and basking sharks were plotted in GIS. Because there is a clear and strong ecological gradient from shore, the use of Distance software to 'correct' for decreasing detectability with distance would be inappropriate for species that may be distributed in relation to that ecological gradient. Because the Development site (at present intended for a single tidal stream turbine) is small and the accuracy of position estimation using an angulator is low, it was considered inappropriate to estimate numbers of animals within the Development site and separately within a defined buffer around the Development site. Our analysis and interpretation is based on numbers of animals within the entire viewshed (a total area of approximately 6.5 km^2), and evidence of their spatial distribution within the viewshed based on the mapping of estimated positions. Positions of flying seabirds could not readily be defined, as the use of an angulator with flying seabirds is impractical. So numbers of flying seabirds were estimated in broad distance bands of 0-500m, 500-1000m, 1000-1500m and 1500-2000m, and recorded as heading North, South, or circling within the viewshed. However, in this report all flying seabirds are considered together regardless of distance band, as there seemed to be nothing useful to gain from an analysis of numbers flying within these specific distance bands, particularly in view of the small numbers of birds involved.

11. It would be inappropriate to add numbers of seabirds counted on the water (which represent a 'snapshot' of numbers per unit area) to numbers of seabirds counted flying past the site (which represent numbers per unit time passing a fixed line).

12. VP surveys were carried out from the Fog Signal above Rubha na Lice, with a viewshed from that point to a distance over the sea of approximately 2 km. The aim was to record marine birds, marine mammals and basking sharks seen in/on the water, and birds seen flying over the water, in order to describe the use of the site by different species, and hence to assess possible impacts on these animals of a tidal stream energy development.

13. Full details of the VP survey methodology, and its rationale, are provided in MacArthur Green (2012).

11.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

11.2.1 Data sources and guidance

14. The assessment has been undertaken in line with the following international conventions:

- Ramsar Convention on Wetlands of International Importance 1971;
- Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979;
- Bern Convention on the Conservation of European Wildlife and Natural Habitats; and
- The OSPAR Convention

15. The assessment has been undertaken in line with the following European legislation, policy, and guidance:

- Directive 2009/147/EC on the Conservation of Wild Birds (Birds Directive);
- Directive 92/43/EEC on Conservation of Natural Habitats and of Wild Fauna and Flora (as amended) (Habitats Directive);
- The Environmental Impact Assessment Directive 85/337/EEC (as amended); and
- Marine Strategy Framework Directive 2008/50/EC.

16. The following national legislation, policy and guidance are considered as part of the assessment:

- Marine (Scotland) Act 2010
- Marine and Coastal Access Act 2009
- The Wildlife and Countryside Act 1981 (as amended);
- The Wildlife and Natural Environment (Scotland) Act 2011;

- The Nature Conservation (Scotland) Act 2004 (as amended);
- The Electricity Act 1989;
- The Town and Country Planning (Scotland) Act 1997 as amended by the Planning (Scotland) Act 2006;

- The Conservation (Natural Habitats &c.) Regulations 1994 (as amended);
- The Conservation of Habitats and Species Regulations 2010;
- The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended);
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011;
- The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2004;
- The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2007;
- Environmental Impact Assessment (Scotland) Regulations 1999 (as amended);
- Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 (as amended);
- Environmental Impact Assessment (Scotland) Regulations 2011 (as amended);
- Marine Works (Environmental Impact Assessment) Regulations 2007;
- Electricity Works (Environmental Impact Assessment) (Scotland) Amendment Regulations 2008;

- Scottish Planning Policy, Scottish Government, 2010
- SERAD (Scottish Executive Rural Affairs Department) 2000. Habitats and Birds Directives, Nature Conservation; Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('the Habitats and Birds Directives'). Revised Guidance Updating Scottish Office Circular No 6/1995[i];
- The UK Biodiversity Action Plan (BAP)[ii];
- Birds of Conservation Concern (BoCC) 3 'Red List' (2009)[iii];
- Scottish Natural Heritage (July 2013) Assessing connectivity with Special Protection Areas, SNH;
- Guidance on the Electricity (Environmental Impact Assessment) (Scotland) Amendment Regulations 2008;
- Planning Circular 3 2011: Guidance on the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011;
- Planning Advice Note 1/2013: Environmental Impact Assessment
- Furness et al. 2012 ICES Journal of Marine Science 69: 1466-1479;
- Marine Scotland Licensing and Consents Manual: Covering Marine Renewables and Offshore Wind Energy Development (Draft) (Marine Scotland 2012);

17. The following data sources were considered as part of the assessment:

- SNH Site Link (www.snh.gov.uk/sitelink);
- NBN Gateway (www.searchnbn.net).
- BTO BirdTrack (http://blx1.bto.org/birdtrack/grid-refs/grid-species-by-location.jsp);
- Draft Marine Renewable Licensing Manual, Covering Marine Renewables and Offshore Wind Energy Development, October 2012, The Scottish Government.

11.2.2 Methodology for assessing wider-countryside ornithological interests

18. The evaluation for wider-countryside interests (interests unrelated to a SPA) involves the following process:

- identification of the potential effects of the Development;
- consideration of the likelihood of occurrence of potential effects where appropriate;
- defining the Nature Conservation Importance of the bird populations present;

- establishing the population's Conservation Status;
- establishing the Magnitude of the Likely Effect (both spatial and temporal);
- based on the above information, a judgement is made as to whether or not the identified effect is significant with respect to the EIA Regulations;
- if a potential effect is determined to be significant, measures to mitigate or compensate the effect are suggested where required;
- opportunities for enhancement are considered where appropriate;
- residual effects after mitigation, compensation or enhancement are considered

11.2.3 Habitats Regulations Appraisal Methodology

19. The Habitats Directive is transposed into domestic legislation by the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (the Habitats Regulations). Regulation 48 indicates a number of steps to be taken by the competent authority (in this case Argyll & Bute Council) before granting planning permission (the 'Habitats Regulation Appraisal'). In order of application, these steps are noted below:

    - Step 1: Consider whether the proposal is directly connected to or necessary for the management of the site (Regulation 48 (1b)). If not:
    - Step 2: Consider whether the proposal, alone or in combination, is likely to have a significant effect ("LSE") on the site (Regulation 48 (1a)). If so:
    - Step 3: Make an appropriate assessment of the implications for the site in view of that site's conservation objectives (Regulation 48 (1)).
    - Step 4: Consider whether it can be ascertained that the proposal will not adversely affect the integrity of the site ("Integrity Test") having regard to the manner in which it is proposed to be carried out or to any conditions or restrictions subject to which they propose that the consent, permission or other authorisation should be given (Regulation 48 (5 & 6)).

20. Following on from these first four steps set out in Regulation 48 there are a further four steps set out by the Habitats Regulations, detailed below:

    - Step 5: Refuse planning permission, subject to Regulation 49, unless it has been ascertained that site integrity is not adversely affected (Regulation 48 (5)).
    - Step 6: If the proposal fails the Integrity Test, consider if alternative solutions exist (Regulation 49 (1)). If there are alternative solutions then the competent authority should refuse planning permission. If no alternative solutions exist then proceed to next step.
    - Step 7: Consider whether the proposal must be carried out for imperative reasons of overriding public interest ("IROPI"). (Regulation 49 (1).
    - Step 8: If IROPI is considered to exist, consider whether one can secure any compensatory measures considered necessary to ensure the protection of the overall coherence of Natura 2000 (Regulation 53).

21. The information provided within this assessment will be sufficient to inform the Habitat Regulations Appraisal and the appropriate assessment (should SNH advise Marine Scotland that this is required) which falls within this (Step 3 above).

22. The significance of the impact is assessed in relation to the value of the receptor in Table 11.1.

Table 11.1- Sensitivity/Value of marine birds

Receptor value	Importance value of Marine flora and fauna	Site designations
High	International/National	Species listed under National or International legislation and policies e.g. listed in Birds Directive
Medium	Regional	Species that have been designated for their regional importance (Local BAP species). Impact on a known area inhabited by a species that is nationally rare or scarce which has a high to very high sensitivity to the impact in question.
Low	Local	Impact on a species that is not designated under national or international legislation and that has a low to moderate sensitivity to the impact in question.
Negligible	Lesser	Other species with little or no local importance or sensitivity to the impact in question.

23. Table 11.2 lists the definition of the Magnitude of the Impact (based on the Scottish Executive (2007) Significance Assessment Criteria).

Table 11.2 - Defining Magnitude of the Impact

Magnitude	Description
High	An impact affecting the entire population/habitat causing a decline in abundance and/or change in distribution beyond which natural recruitment would not return that population/habitat, or any population/habitat dependent on it, to its former level within several generations of the species being affected.
Medium	Damage or disturbance to habitats or populations above those experienced under natural conditions, over one or more generations, but which does not threaten the integrity of that population or any population dependent on it.
Low	Small-scale or short-term disturbance to habitats or species, with rapid recovery rates, and no long-term noticeable effects above the levels of natural variation experienced in the area. The impacts are not sufficient to be observed at the population level.
Negligible	An imperceptible impact in relation to the baseline condition of the receptor population.

24. Table 11.3 outlines the matrix used in assessing the significance of each impact to marine birds using both the Value of the Receptor (marine bird populations) and the Magnitude of the Impact. This provides a 'Worst Case scenario' and does not take into consideration the likelihood of occurrence. The magnitude of the Impact may be influenced by the sensitivity of the receptor to the potential impact.

Table 11.3 - Significance prediction matrix

Magnitude of Impact	Receptor Sensitivity			
	Lesser	Local	Regional	National/International
High	No impact	Moderate	Major	Major
Medium	No impact	Minor	Moderate	Major
Low	No impact	Negligible	Minor	Moderate
Negligible	No impact	Negligible	Negligible	Minor

25. It should be noted that any residual effect (the effect after the implementation of mitigation) which remains at the level of 'Moderate' or 'Major' is regarded by the EIA Regulations as being of significant effect.

11.3 BASELINE CONDITIONS

11.3.1 Species observed during surveys

26. The following species of birds were seen on or over the sea from the Mull of Kintyre viewpoint: Brent goose *Branta bernicla*, common eider *Somateria mollissima,* common scoter *Melanitta nigra*, red-throated diver *Gavia stellata*, great northern diver *Gavia immer*, northern fulmar *Fulmarus glacialis*, Manx shearwater *Puffinus puffinus*, northern gannet *Morus bassanus*, great cormorant *Phalacrocorax carbo*, European shag *Phalacrocorax aristotelis*, peregrine falcon *Falco peregrinus*, Eurasian oystercatcher *Haematopus ostralegus*, Eurasian curlew *Numenius arquata*, Arctic skua *Stercorarius parasiticus*, common gull *Larus canus*, lesser black-backed gull *Larus fuscus*, herring gull *Larus argentatus*, great black-backed gull *Larus marinus*, black-legged kittiwake *Rissa tridactyla*, Sandwich tern *Sterna sandvicensis*, common guillemot *Uria aalge*, razorbill *Alca torda*, black guillemot *Cepphus grylle*, common swift *Apus apus*, hooded crow *Corvus cornix* and common raven *Corvus corax*.

27. There were no records of common or Arctic terns, which might be expected to occur in the area during spring and early autumn, although there are no breeding colonies of terns within the breeding-season foraging range of Mull of Kintyre (ap Rheinallt et al. 2007). There were very few eider ducks, despite the large numbers of eiders that occur immediately to the north at Machrihanish. Indeed, in general there was considerably lower variety of bird species recorded at sea off Mull of Kintyre than at the nearby Machrihanish Seabird Observatory, a feature noted by Eddie Maguire who carried out the bird survey fieldwork at Mull of Kintyre between July and October 2012 and who is the warden at Machrihanish Seabird Observatory. His interpretation of this difference is that the greater sea depth at Mull of Kintyre and the high tidal flow in the area probably makes the site much less attractive to most bird species than the shallower and more sheltered coast at Machrihanish.

28. Of the species seen at sea, Brent goose was seen on only one occasion, when 16 flew south past the site on 22 September 2012. This is a typical date for autumn migration of Brent geese in Argyll, and small numbers are regularly seen from Mull, Colonsay, Islay, Tiree and Kintyre (ap Rheinallt et al. 2007). Since these birds do not normally land on the sea and would be most unlikely to be affected by a tidal turbine development, the species is not considered further here.

29. Common scoters were seen on two occasions; 8 birds flew south on 26 October 2012 and 8 birds flew south on 5 November 2012. Sea-watches at Frenchman's Rocks Islay and at Machrihanish

Seabird Observatory regularly record up to 50 common scoters passing in a few hours in autumn (ap Rheinallt et al. 2007) so the numbers seen passing Mull of Kintyre are very small by comparison with numbers occurring at those main migration flyways. Since no common scoters were seen on the sea at Mull of Kintyre and therefore would not be at risk of collision with a tidal turbine, and none were seen either on the sea or in flight in winter, this species is not considered further here.

30. The 'non-seabird' species seen in flight over the sea (peregrine, oystercatcher, curlew, swift, hooded crow and raven) are also scoped out from further consideration because they are species that do not enter the water and would not be likely to be vulnerable to disturbance effects of human activity associated with the Development.

31. This leaves 18 species of marine birds to be considered further (presented as 19 'taxa' as some data were recorded as 'Auks' when birds could not be identified to species). The mean numbers of birds counted on the water, and in flight past the site, in each season, are listed in Table 11.4.

32. Data on numbers of birds flying past the site are useful for site characterisation, providing an indication of the seabird community present in the general area. Data on numbers of seabirds on the water within the viewshed from the Vantage Point (VP) provide a better indication of which seabird species' populations might possibly be affected by the Development, since the main concerns would be risk of diving seabirds colliding with the turbine, and seabirds using the sea surface being displaced or disturbed by the turbine and associated human activity.

33. Species are listed in Table 11.4 in ranked order with the species with highest numbers (at any season) on the water listed first. These data show that gannets were by far the most abundant seabirds flying past the site. For most seabird species, numbers flying past were considerably greater than numbers on the water, indicating that the site is generally not very attractive for seabirds to forage but is used mainly as a commuting route. Highest numbers of most species flew past the site in autumn (12 out of 19 taxa showed an autumn peak of numbers). In contrast, highest numbers occurring on the water were in winter for 6, in summer for 5 and in spring for 2 taxa. Of the 19 taxa seen in the area, six were never seen on the water.

Table 11.4 - Mean numbers of seabirds observed on the sea and observed flying past the site in each season

Species	Mean number on sea: spring n=30	Mean number on sea: summer n=53	Mean number on sea: autumn n=34	Mean number on sea: winter n=47	Mean number in flight: spring n=30	Mean number in flight: summer n=53	Mean number in flight: autumn n=34	Mean number in flight: winter n=47
Manx sh'water	0.00	18.96	0.00	0.00	0.07	10.06	51.47	0.00
Kittiwake	0.00	14.30	0.00	0.00	0.30	0.91	17.03	0.85
Com. guillemot	0.60	7.21	0.06	0.19	0.00	1.70	0.79	1.64
Gannet	1.27	3.21	0.35	5.64	129.60	217.49	699.03	19.34
Great bb gull	0.00	0.02	0.03	1.57	0.70	0.49	1.71	1.26
Razorbill	0.13	0.28	0.62	0.77	0.13	0.58	14.68	2.79
Black guillemot	0.27	0.70	0.00	0.17	0.00	0.02	0.06	0.04
Shag	0.53	0.34	0.06	0.36	0.63	1.70	0.06	1.28
'Auk'	0.43	0.17	0.00	0.17	2.33	4.17	67.29	3.13
Great no. diver	0.07	0.00	0.00	0.26	0.00	0.00	0.06	0.04
Herring gull	0.17	0.09	0.03	0.06	0.20	0.58	2.24	0.47
Arctic skua	0.00	0.06	0.00	0.00	0.00	0.02	0.00	0.00

Red-thr. diver	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
Cormorant	0.00	0.00	0.00	0.00	0.03	0.08	0.18	0.00
Fulmar	0.00	0.00	0.00	0.00	0.00	0.70	3.10	0.09
Common gull	0.00	0.00	0.00	0.00	0.00	0.23	0.12	0.00
Lesser bb gull	0.00	0.00	0.00	0.00	0.00	0.04	0.26	0.00
Common eider	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
Sandwich tern	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00

(spring= 1 March to 14 May; summer= 15 May to 31 July; autumn= 1 August to 30 October; winter= 1 November to 28 February). Highest mean values for each species on the sea, and flying, are indicated by pale blue shading. Species are ranked in decreasing order of seasonally highest mean abundance on the sea, in order to help characterise the seabird community of the site.

34. The vulnerability of seabird populations to impacts from tidal turbines was assessed by Furness et al. (2012), and the vulnerability assessments in that work are listed in Table 11.5 for the seabirds observed at Mull of Kintyre.

35. Individual species accounts are presented below, in sequence from highest to lowest population vulnerability as assessed by Furness et al. (2012).

11.3.2 Black guillemot *Cepphus grylle*

36. Vulnerability score 9.9 (High). Mean diving depth 25 m, mean maximum diving depth 50 m (Furness et al. 2012).

37. Black guillemots were recorded at all times of year in small numbers, and predominantly close to shore, as is typical of this species (Forrester et al. 2007). Few were seen flying past the site (5 birds only). The highest mean numbers on the water occurred in summer at 0.7 birds per count. There was only one record of black guillemot as far from shore as the turbine site, with the vast majority of records from within 300 m of the shore. While detectability will decrease with distance from shore, black guillemots in summer plumage are fairly conspicuous birds, and this decrease in numbers beyond 300 m from shore is more likely to reflect their preference for habitat close to shore than any effect of detectability.

38. The relevant regional population is probably that of Kintyre, since black guillemots are resident birds which remain close to the breeding site throughout the year and tend to avoid open water far from the coast (Forrester et al. 2007), so it would seem appropriate to exclude black guillemots of Northern Ireland and Argyll islands as being separate populations. There were about 300 black guillemots in Kintyre (including Gigha) in Seabird 2000 (Mitchell et al. 2004) and in contrast to many other seabird species the numbers of black guillemots appear to have been stable throughout most of Scotland in recent decades (Foster and Marrs 2012).

39. The seasonally highest mean density of 0.7 birds on the sea within the viewshed would therefore represent about 0.2% of the regional population, and almost all of this small fraction occurs close to the mainland shore and not at the turbine site.

40. No Special Protection Areas include black guillemot as a designated feature, but the Scottish Government is currently considering candidate Marine Protected Areas (MPAs) which include sites with black guillemot as a designated feature. The closest of these to the Mull of Kintyre site is 'Clyde Sea Sill' which includes the black guillemot population of the Sanda Islands. This site lies about 15 km from Mull of Kintyre tidal site. However, since black guillemots tend to remain within a few km of the breeding site throughout the year, there is unlikely to be regular connectivity between the Mull of Kintyre tidal site and the 'Clyde Sea Sill' black guillemot feature. Bradstreet and Brown (1985) summarised data on foraging range of black guillemots as

indicating a maximum range from the nest site of 7 km, considerably less than the distance between Sanda Islands SPA and Mull of Kintyre tidal site, suggesting that there will be no connectivity between these two sites. The peak mean number at the site represents only about 0.2% of the regional (Kintyre) population. Seabird 2000 (Mitchell et al. 2004) recorded about 50 black guillemots on the coast between Southend and Machrihanish, and the small numbers observed at the site are likely to be a component of this group of birds.

11.3.3 European shag *Phalacrocorax aristotelis*

41. Vulnerability score 9.6 (High). Mean diving depth 25 m, mean maximum diving depth 40 m (Furness et al. 2012).

42. Shags were recorded on 28 of the 38 survey days. They were recorded throughout the year, but least frequently in autumn. Overall, 171 shags were recorded flying past the site, and 52 shags were recorded on the water. Mean numbers per count were highest on the sea in spring (0.53 birds per count) and in flight were highest in summer (1.7 birds per count).

43. Very few shags were seen as far from the shore as the turbine site, consistent with the known tendency of this species to remain relatively close to shore (Forrester et al. 2007).

44. Seabird 2000 recorded 3,341 breeding pairs of shags in Argyll and 301 pairs in Northern Ireland (Mitchell et al. 2004), so the regional population including immatures is likely to be around 8,000 birds. The seasonally highest mean density of 0.53 birds on the sea within the viewshed would therefore represent about 0.007% of the regional population, and almost all of this small fraction occurs close to the mainland shore and not at the turbine site.

45. There are no SPAs in Northern Ireland with shag as a designated species. The closest (by sea route) SPA in Scotland where shag is a feature is Mingulay and Berneray SPA which is 200 km from Mull of Kintyre so is well beyond the maximum foraging range of breeding shags (17 km, Thaxter et al. 2012).

11.3.4 Razorbill *Alca torda*

46. Vulnerability score 9.6 (High). Mean diving depth 20 m, mean maximum diving depth 60 m (Furness et al. 2012).

47. Razorbills were recorded throughout the year but with higher numbers in autumn and winter than in spring and summer. However, many birds were listed as 'Auks' rather than by species, so the detail of seasonality may be affected by seasonal differences in the proportions of birds classified as razorbill or common guillemot rather than 'Auk'. The numbers of razorbills flying past the site were considerably higher than numbers on the water, suggesting that the area is not an important feeding site but that many razorbills commute past, or migrate past the site.

48. Seabird 2000 (Mitchell et al. 2004) reported 9,056 razorbills at colonies in Argyll & Bute, and 24,084 razorbills at colonies in County Antrim (the stronghold of the species in Northern Ireland). The seasonally highest mean density of 0.77 birds on the sea (or 0.94 if all 'Auks' on the sea were razorbills rather than common guillemots) represents about 0.002% of the regional population.

49. The closest SPA with razorbill as a feature is Rathlin Island, which is between 23 and 28 km from Mull of Kintyre tidal site. The next closest is Mingulay and Berneray SPA which is 200 km from Mull of Kintyre. Thaxter et al. (2012) estimate the mean foraging range of razorbill as 23.7 km, and the mean maximum foraging range as 48.5 km with the highest maximum range reported as 95 km. So Mingulay and Berneray SPA lies well beyond the maximum foraging range, but Mull of Kintyre tidal site lies well within the foraging range of breeders from Rathlin Island SPA. There were 5,978 pairs of razorbills at Rathlin Island at site designation and 20,860 individuals counted

in Seabird 2000, so even if the birds wintering near to Mull of Kintyre were all from Rathlin Island SPA razorbill population, the seasonally highest mean number on the sea within the VP viewshed would represent only 0.004% of the SPA population.

11.3.5 Common guillemot *Uria aalge*

50. Vulnerability score 9.0 (High). Mean diving depth 50 m, mean maximum diving depth 100 m (Furness et al. 2012).

51. Common guillemots were recorded throughout the year but with highest numbers in summer, a pattern which seems to differ from that for razorbill. However, many birds were listed as 'Auks' rather than by species, so the detail of seasonality may be affected by seasonal differences in the proportions of birds classified as razorbill or common guillemot rather than 'Auk'. The numbers of common guillemots flying past the site were considerably higher than numbers on the water during autumn and winter, suggesting that the area is not an important feeding site at those times of year but that many common guillemots commute past, or migrate past the site.

52. However, in summer, numbers of common guillemots on the water were much higher than numbers flying past the site. This may indicate feeding by common guillemots in the area in summer, but also relates to the dispersal of fledglings accompanied by the male adult. Dispersing fledglings are flightless at this time of year so would be passing the site by swimming.

53. Seabird 2000 (Mitchell et al. 2004) reported 42,697 common guillemots at colonies in Argyll & Bute, and 98,546 common guillemots at colonies in County Antrim (the stronghold of the species in Northern Ireland). The seasonally highest mean density of 7.21 birds on the sea (or 7.38 if all 'Auks' on the sea were common guillemots rather than razorbills) represents about 0.005% of the regional population.

54. The closest SPAs with common guillemot as a feature are Rathlin Island SPA (28,064 pairs of common guillemots, 23 to 28 km to the west from the site), Ailsa Craig SPA (3,350 pairs of common guillemots, 45 km to the east from the site), North Colonsay and Western Cliffs SPA (6,650 pairs of common guillemots, 90 to 95 km to the north-west from the site), and Mingulay and Berneray SPA (20,703 pairs of common guillemots, 200 km to the north-west from the site). The mean foraging range of common guillemots is listed by Thaxter et al. (2012) as 37.8 km, and the mean maximum as 84.2 km. In view of the large numbers at Rathlin Island SPA and the fact that this site is by far the closest to Mull of Kintyre and the only one within the mean foraging range of this species, it is likely that this is the only one of these SPAs which has a common guillemot population with connectivity to Mull of Kintyre tidal site. The seasonally highest mean density of 7.21 birds on the sea (or 7.38 if all 'Auks' on the sea were common guillemots rather than razorbills) represents about 0.026% of the Rathlin Island SPA common guillemot population.

11.3.6 'Auk'

55. The term 'Auk' was mostly used for either common guillemot or razorbill where species could not be assessed. 'Auks' were recorded throughout the year but with highest numbers on the sea in spring and the highest numbers in flight in autumn, a pattern which seems to differ from that for razorbill or common guillemot. However, many birds were listed as 'Auks' rather than by species, so the detail of seasonality may be affected by seasonal differences in the proportions of birds classified as razorbill or common guillemot rather than 'Auk'. High proportions classified as 'Auks' in autumn can be attributed, at least in part, to the large numbers passing in flight in that season. Higher proportions classified as 'Auks' are also likely to have arisen when birds were further from the shore (so further from the VP).

11.3.7 Great cormorant *Phalacrocorax carbo*

56. Vulnerability score 7.0 (High). Mean diving depth 6 m, mean maximum diving depth 25 m (Furness et al. 2012).

57. Great cormorants were recorded on 3 survey dates, 6 May, 23 May and 23 October. There were 11 birds in total, all seen flying past the site. None were seen on the water.

58. Around 230 pairs breed in Argyll (ap Rheinallt et al. 2007), representing a regional population of around 600 birds when immatures are included, but wintering numbers are not well known. The highest seasonal mean number flying past was 0.18 birds per count in autumn. These may include some long-distance migrants, but if it is assumed that all are local birds then this represents 0.03% of the estimated regional population.

59. The closest SPAs with great cormorant as a designated feature are Sheep Island in Northern Ireland (249 pairs at designation, ca. 30 km from Mull of Kintyre) and Ynys Seiriol in Wales (776 pairs at designation, ca. 280 km from Mull of Kintyre). Thaxter et al. (2012) report mean foraging range of great cormorant as 5.2 km, and mean maximum range as 25 km. So both these SPA populations are beyond the mean maximum foraging range of this species. It also seems unlikely that breeders from Northern Ireland would commute across the North Channel to feed off Mull of Kintyre given that cormorants tend to remain in coastal waters and rarely cross open sea except during migration or post-breeding dispersal.

11.3.8 Great northern diver *Gavia immer*

60. Vulnerability score 4.1 (Moderate). Mean diving depth 6 m, mean maximum diving depth 60 m (Furness et al. 2012).

61. Great northern divers were seen on the water on 12 dates between 23 January and 25 April 2013. All records of birds on the water were of single birds except for three on 23 January 2013. Birds were seen in flight on 26 October 2012 (two individuals) and 5 November 2012 (two individuals).

62. Great northern diver is a common winter visitor to western Scotland, with probably in excess of 1,000 birds in Argyll waters during migration and perhaps half that number during midwinter, especially in areas such as Sound of Gigha, Coll and Tiree (ap Rheinallt et al. 2007). The highest seasonal mean number seen on the water was 0.26 birds per count in winter. This represents about 0.05% of the regional population. Great northern divers were seen mainly close to the shore, but extending out at least as far as the tidal turbine site.

63. There are no SPAs for great northern diver in west Scotland at present, but it is likely that sites will soon be designated for winter aggregations of this species, possibly including one or more sites holding well known large aggregations around Coll and Tiree, Mull, in Loch Indaal (Islay), or the Sound of Gigha. The last of these is close to Mull of Kintyre. Rather little is known of the movements of great northern divers within their winter home range, but the limited evidence suggests that individual birds are very site faithful, and tend to remain within a small home range (Forrester et al. 2007), which would suggest little or no connectivity between these likely future SPAs and Mull of Kintyre.

11.3.9 Red-throated diver *Gavia stellata*

64. Vulnerability score 3.8 (Moderate). Mean diving depth 4 m, mean maximum diving depth 9 m (Furness et al. 2012).

65. Two birds were on the water on 27 February 2013 but these were the only records of this species.

66. About 80 pairs of red-throated divers breed in Argyll (ap Rheinallt et al. 2007), but since the only records of this species were in the nonbreeding season, the appropriate regional population to compare with is the wintering population which may comprise a few hundred birds, and the migrant population consisting of some 6,000 to 7,000 birds which migrate past Argyll in autumn and spring (ap Rheinallt et al. 2007). The highest seasonal mean number seen on the water was 0.04 birds per count in winter. This represents less than 0.01% of the regional population. Red-throated divers were seen at least as far from shore as the tidal turbine site.

67. Firth of Clyde and Solway Firth both hold large aggregations of red-throated divers in winter and one or more of these sites may be considered for future designation as an SPA for wintering red-throated divers. However, it is unlikely that birds from those wintering areas would spend a significant amount of time at Mull of Kintyre, as divers seem to tend to be faithful to a relatively small winter home range (Forrester et al. 2007).

11.3.10 **Common eider** *Somateria mollissima*

68. Vulnerability score 1.5 (Low). Mean diving depth 3 m, mean maximum diving depth 35 m (Furness et al. 2012).

69. Common eiders were never seen on the water at the site, but there was a single record of three birds flying past the site on 7 May 2013.

70. A spring census of Eiders in April 1999 found 12,750 in the Clyde and another 5,250 in the area from Kintyre to Ardnamurchan (ap Rheinallt et al. 2007), a similar total to the number present in winter but indicating a small movement of some birds from wintering in the Clyde to breeding sites in Argyll (ap Rheinallt et al. 2007). The single record of three birds passing the site in early May could be consistent with this seasonal migration, although most Eiders in the west of Scotland would normally be in breeding areas by late April.

71. Two sites within 100 km of Mull of Kintyre are SPAs with common eider as a designated feature: Belfast Lough (685 nonbreeding common eiders; 68 km south of Mull of Kintyre) and Lough Foyle (50 nonbreeding common eiders; 83 km west of Mull of Kintyre). Since these sites are both across the North Channel, it is unlikely that there will be connectivity between these sites and Mull of Kintyre.

11.3.11 **Manx shearwater** *Puffinus puffinus*

72. Vulnerability score 1.5 (Low). Mean diving depth 1 m, mean maximum diving depth 26 m (Furness et al. 2012).

73. Manx shearwaters were recorded on 19 survey dates, between 24 April and 23 September, with highest numbers on the sea in late June and early July (700 birds on the sea on 10 July), and highest numbers flying past in early September (974 birds on 3 September). In total, 2,285 birds were counted flying past the site, and 1,005 were counted on the water. The highest seasonal mean numbers were 18.96 birds per count on the water in summer, and 51.47 birds flying per count in autumn. These data made this species the seasonally most abundant species on the water (in summer).

74. About 1,500 pairs breed in Argyll, and 4,600 pairs breed on the Copeland Islands in Northern Ireland. However, birds from Rum (where there may be as many as 120,000 pairs) may feed in Argyll waters and certainly migrate past Argyll in spring and autumn. So the relevant regional population is around 125,000 pairs plus associated immature birds, giving a total of about 300,000 birds. The seasonal highest mean numbers on the water (in summer) represent 0.006% of the

regional population. The seasonal highest mean numbers flying past the site (in autumn) represent 0.017% of the regional population.

75. Most Manx shearwaters seen on the water were north of the turbine site but between the shore and the distance of the turbine offshore. Although Manx shearwaters can dive down to several meters below the sea surface, most of the birds observed on the sea at Mull of Kintyre appeared to be resting rather than actively foraging.

76. In terms of HRA, the Rum population is the closest population designated as an SPA feature, and since this population composes most of the regional population considered above, the same conclusion of negligible impact applies for the Rum SPA Manx shearwater population.

11.3.12 **Northern gannet** *Morus bassanus*

77. Vulnerability score 1.4 (Low). Mean diving depth 6 m, mean maximum diving depth 30 m (Furness et al. 2012).

78. Gannets were present on the water on all 5 survey days in spring, on 9 out of 12 survey days in summer, 2 days out of 12 in autumn, and 6 out of 9 in winter. Counts of gannets on the water gave means of 1.3 in spring, 3.2 in summer, 0.4 in autumn and 5.6 in winter (from a total of 485 birds on the 38 survey days).Counts of gannets flying past the site gave means of 130 in spring, 217 in summer, 699 in autumn, and 19 in winter.

79. It is interesting to note that there was a very small proportion of the gannets on the water rather than flying in autumn (0.4/699=0.00057) but a relatively high proportion in winter (0.29). This suggests a strong seasonal change in behaviour. While in autumn adults commute past the site from Ailsa Craig on foraging trips to provision large chicks and some migrants may pass from other colonies, in winter when the colonies are not occupied the gannets arriving back seem to spend much time sitting on the water until numbers accumulate to give them confidence to return onto land. However, despite large numbers of gannets flying past the site, and large numbers sitting on the water near to the site in winter, numbers of observed plunge dives by gannets in the area were very small. Therefore, the site appears not to be a particularly important foraging area for gannets.

80. By plunge diving from the air into the water, gannets can use their momentum to get down to a theoretical maximum depth of about 10 m below the sea surface (Ropert-Coudert et al. 2009). In practice, studies of gannet diving by deployment of depth loggers show that, when they target large fish such as mackerel or herring, their mean dive maximum depth is around 4 m, with a maximum of 9 m (Garthe et al. 2013). When feeding on schools of small pelagic fish such as sandeels or capelin, dives can be even shallower, with fish being scooped from the surface, or can involve underwater ‘flight’ using the wings to make U shaped dives with extended periods below water chasing a school of small fish (Garthe et al. 2000), and this ability probably explains why gannets are reported to be able to dive to a maximum depth of 30 m on rare occasions (Furness et al. 2012). But in most cases gannet dives take them no more than 5 m below the sea surface, and dives to as much as 10 m are extremely rare (Garthe et al. 2013).

81. The mean maximum foraging range of breeding gannets is 229 km from colonies (Thaxter et al. 2012) so the Mull of Kintyre site lies well within the foraging range of gannets from Ailsa Craig SPA (45 km to the east). Wakefield et al. (2013) showed that gannets feed within areas closest to their own colony with very little overlap of the foraging ranges of birds from different colonies. So it is probable that all the gannets occurring at Mull of Kintyre during the breeding season (roughly March to September) originate from Ailsa Craig (Wakefield et al. 2013). A proportion of gannets at the site in October to February may be migrants from other colonies. Ailsa Craig held 27,130 apparently occupied nests in 2003-04 (Forrester et al. 2007). So the relevant regional

population to consider is the population of Ailsa Craig plus the immature birds associated with that colony, likely to give a total of at least 70,000 birds altogether. The seasonally highest mean number of gannets on the sea was 5.64 per count, occurring in winter when overall gannet numbers were low (only 19 per count flying past in winter compared with 217 in summer and 699 in autumn). These birds appear to have been resting on the water in the weeks before returning onto Ailsa Craig. This relatively high concentration on the water in winter therefore represents a seasonal pattern between the spring migration back to the colony area and reoccupation of their terrestrial habitat, and does not appear to be related to foraging within the area. The mean of 5.64 birds on the water in winter represents about 0.008% of the regional population

82. The nearest SPA for breeding gannets is Ailsa Craig, and this feature was classified as 'Favourable Maintained' when site condition was monitored in June 2004.

11.3.13 **Sandwich tern** *Sterna sandvicensis*

83. Vulnerability score 1.1 (Low). Mean diving depth 1 m, mean maximum diving depth 2 m (Furness et al. 2012).

84. There was only a single record of this species, with one bird flying past the site on 12 June 2013. No Sandwich terns breed in Argyll & Bute in most years, but Seabird 2000 reported 348 pairs in County Antrim, 1,555 pairs in County Down and 51 pairs in County Fermanagh (Mitchell et al. 2004). Despite the lack of regularly occupied breeding colonies in Argyll, the Sandwich tern is a regular migrant and summer visitor to the area, present in good numbers from early April to October, and very occasionally into early winter (ap Rheinallt et al. 2007). Peak numbers have tended to occur in July to September, with counts at Machrihanish Seabird Observatory often exceeding 50 birds in a day at this time of year (ap Rheinallt et al. 2007). The presence of only a single bird flying past the Mull of Kintyre site indicates that this site does not provide attractive habitat for this species by comparison to the much greater numbers occurring at Machrihanish.

11.3.14 **Great black-backed gull** *Larus marinus*

85. Vulnerability score 1.0 (Very low). Mean diving depth 0 m, mean maximum diving depth 1 m (Furness et al. 2012).

86. Great black-backed gulls were present in the area throughout the year. They were recorded sitting on the water mostly in winter (mean of 1.57 birds per count), with only single birds on the water in summer and autumn and none in spring. Numbers in flight were highest in autumn (mean of 1.71 birds per count) and winter (mean of 1.26 birds per count) and lower in spring (mean of 0.7 birds per count) and summer (mean of 0.49 birds per count).

87. Seabird 2000 reported 1,736 pairs of great black-backed gulls breeding in Argyll & Bute, 16 pairs in County Antrim and 55 pairs in County Down (Mitchell et al. 2004). This regional population of around 1,800 breeding pairs is likely to have an associated component of immatures and nonbreeders totalling a similar number to the breeding component, so the total population in the region is probably around 7,000 birds. There may also be some migrants arriving in winter from more northern populations (including possibly Iceland), although numbers of migrant great black-backed gulls arriving in the west of Scotland are much smaller than numbers migrating into the North Sea from northern Scandinavia (Forrester et al. 2007). The mean of 1.57 birds on the water in winter represents about 0.022% of the regional population.

88. There are 5 SPAs for breeding great black-backed gulls in the far north of Scotland and one in the Isles of Scilly. All of these sites are far beyond the maximum foraging range of this species (the closest is North Rona and Sula Sgeir SPA, more than 450 km to the north by the shortest sea route, whereas mean foraging range of breeding great black-backed gulls is thought to be less

than 40 km (Langston 2010) and based on data for closely related large gulls maximum foraging range is unlikely to exceed 200 km at most (Thaxter et al. 2012)).

11.3.15 **Black-legged kittiwake** *Rissa tridactyla*

89. Vulnerability score 0.9 (Very low). Mean diving depth 0 m, mean maximum diving depth 1 m (Furness et al. 2012).

90. Kittiwake achieved the second highest seasonal mean abundance on the water in the study area, with a mean of 14.3 birds per count in summer (but means of zero in all three of the other seasons). These birds on the water in summer appear mainly to have been resting in the area. Numbers in flight passing the site were low in spring (0.3 birds per count), moderate in summer (0.91) and winter (0.85) but high in autumn (mean of 17.03 birds per count). These observations indicate an extensive autumn migration past the site, but it would appear that kittiwakes do not normally feed in the area, and only in summer were birds seen sitting on the water, apparently resting.

91. Seabird 2000 reported 8,976 pairs of kittiwakes in Argyll & Bute, 12,109 in County Antrim, 498 in County Londonderry and 453 in County Down. There will be an associated component of immature and nonbreeding birds, so the total regional population is likely to be around 50,000 birds. In that context, the highest seasonal mean number on the water (14.3 birds) represents 0.029% of the estimated regional population.

92. The SPA suite for breeding kittiwakes is very extensive, comprising 33 sites in Britain and Northern Ireland. Of these, Rathlin Island (6,822 pairs; 23-28 km to the west), Ailsa Craig (3,100 pairs; 45 km to the east) and North Colonsay and Western Cliffs SPA (4,512 pairs; 90-95 km to the north) are the closest to Mull of Kintyre tidal energy site. The mean foraging range of breeding kittiwakes is around 25 km and the mean maximum range around 60 km (Thaxter et al. 2012), indicating possible connectivity between kittiwakes from Rathlin Island SPA and Ailsa Craig SPA. However, given that the Ailsa Craig colony is around the Mull of Kintyre and is also nearly twice as far as the Rathlin Island colony, it seems likely that connectivity with Rathlin would be much higher than with Ailsa Craig. The mean numbers on the water at the site in summer (14.3 birds per count) represent 0.10% of the number in the Rathlin Island SPA population, so even if all of the kittiwakes on the water within the Mull of Kintyre viewshed came from Rathlin Island SPA, the proportion of the population within the viewshed would still be very small.

11.3.16 **Herring gull** *Larus argentatus*

93. Vulnerability score 0.8 (Very low). Mean diving depth 0 m, mean maximum diving depth 1 m (Furness et al. 2012).

94. Herring gulls were recorded throughout the year in small numbers. In terms of numbers on the water at the site, herring gull ranked only 10th species, with highest seasonal mean of 0.17 birds per count in spring. Numbers flying past the site were higher than on the water in all seasons, but peaked at only 2.24 birds per count in autumn.

95. Seabird 2000 recorded 15,370 pairs in Argyll & Bute, 101 pairs in County Antrim and 608 pairs in County Down (Mitchell et al. 2004). With associated immatures and nonbreeders this is likely to represent a total regional population of around 50,000 birds, and a further similar number occur in the Clyde Sea area nearby but are not included in this total. The seasonal peak mean number on the water (0.17 birds per count) represents 0.0003% of this regional total.

96. Only two of the SPAs with significant numbers of herring gulls are close to Mull of Kintyre: Rathlin Island SPA lies 23-28 km to the west, and Ailsa Craig lies 45 km to the east. Rathlin Island held

4,037 pairs of herring gulls at designation, but the colony declined to 14 pairs in 1999 (JNCC web site); these represent a component of the seabird assemblage and not a population of international importance. Ailsa Craig held 2,250 pairs of herring gulls at designation. The seasonal peak of 0.17 herring gulls on the water within the viewshed per count in summer represents 0.002% of the number of herring gulls in the Rathlin Island SPA population at designation. It represents 0.6% of the Rathlin Island herring gull population size of 1999. However, herring gulls have a breeding season mean foraging range of 10.5 km and a mean maximum foraging range of 61.1 km (Thaxter et al. 2012), so the Mull of Kintyre tidal energy site lies well beyond the mean foraging range from Rathlin Island.

11.3.17 **Common gull** *Larus canus*

97. Vulnerability score 0.7 (Very low). Mean diving depth 0 m, mean maximum diving depth 1 m (Furness et al. 2012).

98. No common gulls were recorded on the water, but the species was seen flying past the site on 4 of the 38 survey days, with all records in July or early August. In total, 16 birds were recorded, giving a mean of 0.23 birds per count in summer and 0.12 birds per count in autumn.

99. Common gull is widely distributed across western Argyll as a breeding species (ap Rheinallt et al. 2007). Seabird 2000 recorded 2,683 pairs at coastal colonies in Argyll & Bute, 107 pairs in coastal colonies in County Antrim and 276 pairs in coastal colonies in County Down (Mitchell et al. 2004). Including associated nonbreeders and immatures, the regional population is therefore probably around 8,000 birds.

100. The very small numbers seen passing the site and the lack of any birds on the water indicate that the site is not favoured habitat for this species.

101. Only three sites have been designated as SPAs for breeding common gulls in Britain and Ireland; Tips of Corsemaul and Tom Mor SPA near Inverness, Rathlin Island SPA and Lough Neagh and Lough Beg SPA in Northern Ireland. The mean foraging range of breeding common gulls is 25 km, and the maximum recorded is 50 km (Thaxter et al. 2012), so only the colony at Rathlin Island SPA (which is 23-28 km to the west) is within potential range of the Mull of Kintyre site. Rathlin Island SPA had 64 pairs of common gulls at designation, forming a part of the assemblage of over 20,000 breeding seabirds.

11.3.18 **Lesser black-backed gull** *Larus fuscus*

102. Vulnerability score 0.7 (Very low). Mean diving depth 0 m, mean maximum diving depth 1 m (Furness et al. 2012).

103. No lesser black-backed gulls were seen on the water. Only 11 were recorded in flight, on a total of 4 survey days between July and early September, giving a mean of 0.04 birds per count in summer and 0.26 birds per count in autumn.

104. Lesser black-backed gull is patchily distributed across western Argyll as a breeding species, with largest colonies on Coll, Tiree, Colonsay, Firth of Lorne and Gigha (ap Rheinallt et al. 2007). Seabird 2000 recorded 3,235 pairs at coastal colonies in Argyll & Bute, 485 pairs in coastal colonies in County Antrim and 548 pairs in coastal colonies in County Down (Mitchell et al. 2004). Including associated nonbreeders and immatures, the regional population is therefore probably around 10,000 birds.

105. Ailsa Craig SPA (45 km to the east) includes a designated population of 1800 pairs of lesser black-backed gulls. Rathlin Island SPA (23-28 km to the west) includes 155 pairs of lesser black-

backed gulls as a component of the seabird assemblage of over 20,000 breeding seabirds. Lough Neagh and Lough Beg SPA (80 km to the south-west) includes 450 pairs of lesser black-backed gulls as a component of the seabird assemblage of over 20,000 breeding seabirds. Lesser black-backed gulls have a mean foraging range from the colony of 71.9 km, and a mean maximum foraging range of 141 km (Thaxter et al. 2012), so all three of these SPA populations include the Mull of Kintyre tidal energy site within their maximum foraging range, while Ailsa Craig and Rathlin Island colonies include it within their mean foraging range. There is therefore potential connectivity between all three of these SPA populations of lesser black-backed gulls and Mull of Kintyre tidal energy site. However, no lesser black-backed gulls were seen on the water within the viewshed at any time of year, and numbers flying past the site during the breeding season were extremely small (a mean of 0.04 birds per count in summer).

11.3.19 **Arctic skua** *Stercorarius parasiticus*

106. Vulnerability score 0.6 (Very low). Mean diving depth 0 m, mean maximum diving depth 1 m (Furness et al. 2012).

107. Arctic skuas were seen on 2 dates out of 38. Single birds were on the water on 28 June 2012 and 10 July 2012 (two records on this latter date possibly of the same individual as both were dark phase adults). One bird was recorded flying past the site on 10 July 2012 and may possibly have been the same individual again as it was also a dark phase adult.

108. There are only about 10 pairs of Arctic skuas remaining in Argyll after several decades of continuing decline in breeding numbers, but several hundred birds pass through the region in spring and autumn migrations and some nonbreeders from high latitude populations summer in the area (ap Rheinallt et al. 2007). The highest seasonal mean number on the water was 0.06 per count in summer, and the highest seasonal mean number flying past was 0.02 per count in summer. These numbers can be calculated to represent around 0.01 to 0.1% of the regional population of Arctic skuas, but probably represent just a single individual spending a few days in the area.

109. The UK's Arctic skua SPA suite is entirely in Orkney and Shetland. Consequently, no SPA population of this species has breeding season foraging connectivity with Mull of Kintyre tidal site.

11.3.20 **Northern fulmar** *Fulmarus glacialis*

110. Vulnerability score 0.5 (Very low). Mean diving depth 0 m, mean maximum diving depth 4 m (Furness et al. 2012).

111. No fulmars were recorded on the water. Birds were seen in flight past the site on 14 dates between 22 May and 5 November. In total, 144 birds were counted in flight. The highest numbers were seen in late August and early September, with 58 on 30 August 2012 and 31 on 3 September 2012. The highest seasonal mean number occurred in autumn with a mean of 3.1 birds flying past the site per count.

112. Over 8,000 pairs breed in Argyll (ap Rheinallt et al. 2007) and over 4,700 pairs in Northern Ireland (Mitchell et al. 2004), and there are likely to be similar numbers of immature birds associated with these breeding populations, so the regional population is around 30,000 birds. The highest seasonal mean therefore represents less than 0.01% of the regional population.

113. The closest SPA populations of fulmars to Mull of Kintyre tidal energy site are at Rathlin Island SPA (23-28 km to the west where 1,482 pairs of fulmars form part of the assemblage of over 20,000 breeding seabirds), at Mingulay and Berneray SPA (12,500 pairs of fulmars 200 km to the

north-west) and St Kilda SPA (62,800 pairs 340 km to the north-west). Mean breeding season foraging range of fulmars is 47.5 km, and mean maximum range is 400 km (Thaxter et al. 2012), so all three of these SPA populations will include Mull of Kintyre tidal energy site within their maximum foraging range, and Rathlin Island SPA fulmar population includes the site within their mean foraging range.

11.4 DEVELOPMENT DESIGN MITIGATION

114. The CoRMaT device will be positioned mid-water column and will be inaccessible to most seabirds. Diving seabirds tend to feed in the upper layers of the water column and the chosen operational depth of the turbine will reduce the risk to these birds by location below the area of greatest activity. Seabirds that feed predominantly at the sea floor will not benefit from the choice of operational depth. These species, e.g. shag, black guillemot and red-throated diver tend to feed in coastal waters and placement of the turbine some distance from the shore will reduce any potential impact on active feeding areas.

11.5 ASSESSMENT OF POTENTIAL EFFECTS

115. The potential effects on populations of all of the species that are scoped are assessed, including species considered to be of Very low vulnerability (Furness et al. 2012).

116. Possible impacts on seabird populations of tidal stream turbines and associated infrastructure and human activity, and the assessment of possible impacts, were reviewed by Wilson et al. (2007), Awatea (2008), ICES (2010), Langton et al. (2011), Witt et al. (2012), Furness et al. (2012), MacArthur Green (2013) and Robbins in press. Recently, empirical data on responses of marine birds to deployed tidal stream energy devices have begun to become available (e.g. University of Exeter 2010, Royal Haskoning 2011).

117. A tidal turbine and its associated moorings could cause injury, or death, as a result of collision. A tidal turbine and its associated infrastructure could displace seabirds that prefer to feed in areas of high tidal flow from their preferred foraging habitat. Noise from the structures and human activity associated with tidal stream energy devices could increase the level of disturbance of seabirds, which could increase their energy expenditure, or reduce their foraging rate, or result in displacement of birds from foraging habitat. However, seabirds are very much less sensitive to noise generated underwater than are marine mammals (Wilson et al. 2007), and direct effects of noise on seabirds are thought to be unlikely to occur at tidal turbines (Furness et al. 2012). Accidental release of contaminants from tidal turbines is considered to be a negligible risk for seabirds in view of the small amounts of contaminants involved, the dilution effect and the general robustness of most seabirds to low levels of most kinds of contaminants in seawater (Furness et al. 2012). Changes to suspended sediments would be unlikely to affect seabirds directly, but might possibly have indirect effects through the food web by influencing lower trophic levels. Deployment of tidal energy devices could affect lower trophic levels in the food web not only by altering suspended sediments but also by changing water flow patterns (especially downstream from devices) and possibly by acting as fish attracting devices, and thereby could have secondary impacts on seabirds through alterations to their food supply or food availability. Of these effects, collision mortality impacts are likely to have the greatest potential influence on seabird populations (Wilson et al. 2007, ICES 2010, Furness et al. 2012) so are the main focus here.

11.5.1 Construction

118. Construction and decommissioning are periods when disturbance levels may be higher than during operation. Displacement of birds during construction and decommissioning may therefore be greater than during operation. However, with a single device as in this case, construction will

be completed in a relatively short time scale and disturbance due to construction will be very localised. The same would apply for decommissioning. It is therefore considered that the impacts on seabird populations of construction and decommissioning of a single device will be negligible spatially and temporally in view of the low densities of seabirds using this area. There will be no significant effects under the terms of the EIA Regulations.

11.5.2 Operation

119. The design of the Nautricity CoRMaT device appears to present a relatively higher risk of collision mortality for deep-diving seabirds than would some other designs, as it has exposed rotating blades and is tethered in the water column with associated anchoring cables and buoyancy cables plus flotation devices. There are, therefore, several structures into which seabirds could swim while chasing fish. However, since the device is at least 10 m below the sea surface, displacement effects of the device are likely to be very low, and collision risk could only affect seabirds that dive deeper than 10 m.

120. Furness et al. (2012) ranked seabird species according to their likely population vulnerability to impacts from tidal stream energy devices. The rankings were considered to apply primarily to the operational phase of a project; during construction and decommissioning the levels of disturbance may be higher. That ranking can be used to inform the likelihood of an impact of a tidal energy device on seabird populations: impacts are most likely to be detectable for seabird species with high vulnerability scores and where the Development site holds a high proportion of the relevant population of that species. Conversely, impacts are very unlikely to affect species with low or very low vulnerability scores, except possibly where the Development site holds a very high proportion of the population of that species. Population vulnerability scores, and estimates of the seasonally highest proportion of the regional population present on the sea within the viewshed from the VP are shown in Table 11.5.

Table 11.5 - Population vulnerability scores, and vulnerability classification of seabirds in relation to tidal stream energy development (from Furness et al. 2012), and the seasonally highest mean number present on the water

Species	Vulnerability score	Vulnerability class	Mean seasonally highest % of regional population on water within viewshed	Rank of peak seasonal abundance on the water in relation to regional population size
Black guillemot	9.9	High	0.200	1
European shag	9.6	High	0.007	8
Razorbill	9.6	High	0.002	11
Common guillemot	9.0	High	0.005	10
Great cormorant	7.0	High	0.000	
Great northern diver	4.1	Moderate	0.050	3
Red-throated diver	3.8	Moderate	0.010	6
Common eider	1.5	Low	0.000	
Manx shearwater	1.5	Low	0.006	9
Northern gannet	1.4	Low	0.008	7
Sandwich tern	1.1	Low	0.000	
Great black-backed gull	1.0	Very low	0.022	5
Black-legged kittiwake	0.9	Very low	0.029	4
Herring gull	0.8	Very low	0.000	
Common gull	0.7	Very low	0.000	

Lesser black-backed gull	0.7	Very low	0.000	
Arctic skua	0.6	Very low	0.060	2
Northern fulmar	0.5	Very low	0.000	
* Seasonally highest mean number present on the water as a percentage of the regional population of that species.				

121. It is evident from the data in Table 11.4 that numbers of seabirds on the sea in the vicinity of the Development (i.e. throughout the entire viewshed and not just at the Development site) are extremely low even during their seasonal highest abundance.

11.5.2.1 Black Guillemot

122. Highest abundance on the sea in relation to regional population size is for black guillemot (0.2% of the regional population occurring within the viewshed in summer). One reason for this relatively high proportion for this species is the definition of the regional population being that of Kintyre, a small area with a small population of black guillemots (estimated at around 300 birds). Black guillemot is also identified as the species likely to have the highest vulnerability to tidal stream energy devices. However, most black guillemot activity within the viewshed occurred close to shore, with only a single record of black guillemot occurring as far from shore as the device location. Twenty-three out of 24 records of black guillemots on the water were of birds less than 700 m from the shore, and most were of birds within 300 m of the shore. Even bearing in mind that birds far from shore are more likely to be overlooked, there is a very clear and strong preference for foraging close to shore in this species, a behaviour which is well documented in the literature. For example, Forrester et al.(2007) state '*Foraging areas are generally inshore*' and '*These* [groups] *are often in shallow water, such as the mouths of sea lochs or bays, or among small islands*'. Mitchell et al. (2004) state '*Most black guillemots feed close inshore*'. This is not surprising given that black guillemots feed primarily on intertidal fish species, and feed mainly in shallow sea, often associated with kelp (Ewins 1990). However, they are capable of diving down to a maximum depth of 50 m (Furness et al. 2012), and will occasionally forage more than 300 m from shore, and up to 2000 m from shore (Mitchell et al. 2004). So while the proportion of the regional population at risk due to feeding at the Development site is very much less than the 0.2% of the population occurring within the viewshed, very small numbers of black guillemots may be at risk of collision mortality or injury due to the Development.

123. Given the very small number of black guillemots observed close to the Development, displacement and disturbance are unlikely to affect the population. Since black guillemot numbers at the site are small, and their activity is predominantly coastal and not normally as far from shore as the tidal turbine site, the impact of a tidal turbine Development on the regional population is assessed as Negligible. There will be no significant effect on black guillemot under the terms of the EIA Regulations.

11.5.2.2 Arctic skua

124. The second highest proportion of the regional population of a species occurring on the sea within the viewshed is for Arctic skua (0.06% of the population within the viewshed in summer). Arctic skua is considered to have a Very low population vulnerability to tidal energy devices. This relatively high proportion of population is due to the summer population size of this species in the region being very small, so that one bird on the water within the viewshed on three survey counts across two dates represents 0.06% of the regional population. Arctic skuas are aerial or surface feeding birds, so would not be at risk of collision with underwater structures. They are not readily disturbed by boats or people when at sea, and would be very unlikely to be affected in any way by the presence of a tidal turbine. Given the assessed very low vulnerability of this

species, and the indication that the site is only visited sporadically by the occasional nonbreeding bird, impact on the regional Arctic skua population is assessed as Negligible. There will be no significant effect on Arctic skua under the terms of the EIA Regulations.

11.5.2.3 Great northern diver

125. The third highest proportion of the regional population of a species occurring on the sea within the viewshed is for great northern diver (0.05% of the population within the viewshed in winter). Great northern diver is considered to have a Moderate population vulnerability to tidal energy devices.

126. All of the great northern divers observed on the sea were closer to the shoreline than the deployment site. This represents the preferred habitat of great northern divers in winter. According to Forrester et al. (2007) great northern divers are '*coastal*' and '*found in sheltered bays but equally at home around stormy headlands, often as much as 10 km offshore, coming closer to shore during periods of bad weather*'. In Shetland, highest numbers occur in sheltered coastal areas such as the Bluemull triangle, around the Scalloway islands, and in larger Voes (Pennington et al. 2004). In Argyll, larger numbers occur in sheltered coastal sites such as the Sound of Gigha, Loch Indaal, the coastal bays of Coll and Tiree (ap Rheinallt et al. 2007). This suggests that in winter, great northern divers generally prefer foraging close to the coast, and particularly in somewhat sheltered waters rather than in open sea. Long (2006) noted that wintering great northern divers prefer more sheltered and calmer coastal waters than red-throated divers, and fed mainly in water only about 5 m deep.

127. The observation that none of the great northern divers observed at sea within the viewshed were as far from the coast as the Development site suggests little or no impact of the Development on this species. However, great northern divers clearly can feed further offshore than those observed from the viewshed, and they are capable of diving to 60 m depth even though their mean dive depth is only 6 m (Furness et al. 2012). So while the proportion of the regional population at risk due to feeding at the tidal Development site is very much less than the 0.05% of the population occurring within the viewshed, very small numbers of great northern divers may be at risk of collision mortality or injury due to the Development.

128. Although divers are considered to be particularly prone to disturbance, given the very small number of great northern divers observed close to the Development, displacement and disturbance are unlikely to affect the population. Impact of the Development on the regional population is assessed as Negligible. There will be no significant effect on great northern diver under the terms of the EIA Regulations.

11.5.2.4 Kittiwake

129. The 4th ranked species on the water as a proportion of regional population was kittiwake, with an average of 14.3 birds on the water within the viewshed in summer. This represents 0.029% of the regional population. Kittiwakes are essentially surface-feeding seabirds, and do not normally dive more than 1 m below the sea surface, so will not be at risk of collision with tidal turbine structures. Kittiwakes forage over large areas, and displacement from a small site would be unlikely to have any impact at a population level, but they are not thought to be sensitive to disturbance by noise or by human activity, so impact of the Development on the regional kittiwake population is assessed as Negligible. There will be no significant effect on kittiwake under the terms of the EIA Regulations.

11.5.2.5 Great black-backed gull

130. The 5th ranked species on the water as a proportion of regional population was great black-backed gull, with an average of 1.57 birds per count on the water in winter. This represents

0.022% of the regional population. Great black-backed gulls are surface-feeding seabirds, and do not normally dive below the sea surface more than their body length, so are confined to feeding within less than 1 m from the surface. They will not be at risk of collision with tidal turbine structures. Great black-backed gulls are not thought to be sensitive to disturbance by noise or by human activity, so impact of the Development on the great black-backed gull population is assessed as Negligible. There will be no significant effect on great black-backed gull under the terms of the EIA Regulations.

11.5.2.6 Red-throated diver

131. The 6th ranked species on the water as a proportion of regional population was red-throated diver. Numbers on the water within the viewshed in winter (a mean of 0.04 birds per count) represent about 0.01% of the regional population (but also represent only two individuals on one occasion). Although divers are considered to be particularly prone to disturbance, given the very small number of red-throated divers observed close to the Development, displacement and disturbance are unlikely to affect the population. Red-throated divers generally prefer sheltered coastal habitat during winter (Forrester et al. 2007), but the only two birds of this species seen within the viewshed were at distances offshore comparable to the distance of the Development. Red-throated divers generally feed in shallow water, with a reported mean dive depth of only 4 m and a maximum dive depth of 9 m (Furness et al. 2012). Given that the Development will be at least 13 m below sea level, this implies that red-throated divers would not dive deep enough to be at risk of collision with the tidal turbine or its associated structures. Impact of the Development on the regional population is assessed as Negligible. There will be no significant effect on red-throated diver under the terms of the EIA Regulations.

11.5.2.7 Gannet

132. The 7th ranked species on the water as a proportion of regional population was gannet, with an average of 5.64 birds on the water within the viewshed in winter. This represents 0.008% of the regional (and local SPA) population. The very small proportion of the regional population at the site, and the apparent lack of diving activity by birds during most of the observations, and the fact that dives deeper than 10 m below sea surface are 'extremely rare' (Garthe et al. 2000)(so would not normally reach the turbine or its infrastructure) indicate that the impact on the regional population from a tidal stream energy Development on the site can be assessed as Negligible. There will be no significant effect on gannet under the terms of the EIA Regulations.

133. The nearest SPA for breeding gannets is Ailsa Craig, and this feature was classified as 'Favourable Maintained' when site condition was monitored in June 2004. Since this has already been considered as the relevant regional population, it can be concluded that a tidal Development at Mull of Kintyre will have negligible impact on the integrity of the Ailsa Craig SPA. There is no likely significant effect on the SPA under the terms of the Habitats Regulations.

11.5.2.8 Shag

134. The 8th ranked species on the water as a proportion of regional population was shag, with an average of 0.53 birds on the water within the viewshed in spring. This represents 0.007% of the regional population. Four of the shags observed on the sea within the viewshed were as far from the coast as the tidal site or beyond it. So while this represents less than 10% of the shags recorded in the viewshed (most were within 300 m of the shore), there is the possibility that a very small number will feed at the Development site. Shags can dive to as much as 40 m below sea level, so could collide with turbine structures, and so there is a risk of collision mortality. Shags are known to occasionally become trapped in underwater structures (for example in lobster pots), and this risk is especially high for juvenile shags, so there is likely to be a higher mortality risk due to collision or entanglement at the tidal turbine infrastructure for juvenile shags.

However, studies of shags at the tidal turbine in Strangford Narrows (Royal Haskoning 2011) found no impact on the shag population there; no collision mortality was recorded and there was no change in shag numbers using the area for feeding (though this turbine is very different in design). Because the seasonally highest mean density of 0.53 birds on the sea within the viewshed represents only about 0.007% of the regional population, and 90% of this small fraction occurs closer to the mainland shore than the turbine site, the impact of a tidal turbine Development on the regional population can be assessed as Negligible. There will be no significant effect on shag under the terms of the EIA Regulations.

135. The closest (by sea route) SPA where shag is a designated feature is Mingulay and Berneray SPA which is 200 km from Mull of Kintyre so is well beyond the maximum foraging range of breeding shags (17 km, Thaxter et al. 2012). It is therefore safe to conclude that there will be no likely significant effect of the Development at Mull of Kintyre on the integrity of Mingulay and Berneray SPA.

11.5.2.9 Manx shearwater

136. The 9th ranked species on the water as a proportion of regional population was Manx shearwater, with an average of 18.96 birds on the water within the viewshed in summer. This represents 0.006% of the regional population. Manx shearwaters can dive to a maximum of 26 m below sea level (Furness et al. 2012), so could reach the turbine and its infrastructure, and so there is a risk of collision mortality or injury. However, the mean dive depth is only 1 m, so it is likely that extremely few birds would get deep enough to collide with the structures. Also, our observations from the VP indicate that most of the Manx shearwaters seen on the sea within the viewshed were 'rafting' and not feeding. Manx shearwaters roost on the sea in flocks ('rafting' behaviour) either prior to flying ashore to colonies at night, or simply to rest at sea. Although Manx shearwater was one of the most abundant birds at the site, both in terms of numbers of birds on the water and numbers of birds flying past the site, the very small proportion of the regional population at the site, and the apparent lack of diving activity by birds indicate that the impact of the Development on the regional population of Manx shearwaters can be assessed as Negligible. There will be no significant effect on Manx shearwater under the terms of the EIA Regulations.

137. In terms of HRA, the Rum population is the closest Manx shearwater population designated as an SPA feature, and since this population composes most of the regional population considered above, the same conclusion of negligible impact applies for the Rum SPA Manx shearwater population. Hence it can be concluded that there will be no impact of the Development at Mull of Kintyre on the integrity of the Rum SPA. There is therefore no likely significant effect on the SPA under the terms of the Habitats Directive.

11.5.2.10 Common guillemot

138. The 10th ranked species on the water as a proportion of regional population was common guillemot, with an average of 7.21 birds on the water within the viewshed in summer (or 7.38 if all birds classified as 'Auks' were common guillemots). This represents 0.005% of the regional population. Common guillemots can dive to at least 100 m below sea level, and their mean dive depth is 50 m, so it is certain that these birds could easily reach the depth of the tidal turbine and its associated infrastructure. VP observations indicate that some common guillemots were on the sea surface as far from shore as the Development site, and were almost certainly diving in that area, so there is a risk of collision mortality for this species. Displacement or disturbance impacts seem unlikely in view of the results of monitoring seabird behaviour at the tidal turbine in Strangford Narrows (Royal Haskoning 2011). However, the very low proportion of the regional population found within the viewshed at any time of year (maximum of only 0.005% in summer) indicates that the impact of the Development on the regional population can be assessed as

Negligible. There will be no significant effect on common guillemot under the terms of the EIA Regulations.

139. The seasonally highest mean density of 7.21 birds on the sea (or 7.38 if all 'Auks' on the sea were common guillemots rather than razorbills) represents about 0.026% of the Rathlin Island SPA common guillemot population. This very low proportion indicates a negligible impact of the Development on the Rathlin Island SPA common guillemot population, and so no impact of the Development on the integrity of Rathlin Island SPA. There is therefore no likely significant effect on the SPA under the terms of the Habitats Regulations.

11.5.2.11 Razorbill

140. The 11th ranked species on the water as a proportion of regional population was razorbill, with an average of 0.77 birds on the water within the viewshed in winter (or 0.94 if all birds classified as 'Auks' were razorbills). Razorbills can dive to 60 m below sea level, and their mean dive depth is 20 m (Furness et al. 2012) so birds could be at risk of collision with the tidal turbine and its associated structures. VP observations indicate that some razorbills were on the sea surface as far from shore as the Development site, and were almost certainly diving in that area, so there is a risk of collision mortality for this species. Displacement or disturbance impacts seem unlikely in view of the results of monitoring seabird behaviour at the tidal turbine in Strangford Narrows (Royal Haskoning 2011). The seasonally highest mean density of 0.77 birds on the sea (or 0.94 if all 'Auks' on the sea were razorbills rather than common guillemots) represents about 0.002% of the regional population. In view of this very low proportion, it is assessed that the impact of the Development on the regional population of razorbills will be Negligible. There will be no significant effect on razorbill under the terms of the EIA Regulations.

141. The closest SPA with razorbill as a feature is Rathlin Island, which is between 23 and 28 km from Mull of Kintyre tidal site. The next closest is Mingulay and Berneray SPA which is 200 km from Mull of Kintyre. Thaxter et al. (2012) estimate the mean foraging range of razorbill as 23.7 km, and the mean maximum foraging range as 48.5 km with the highest maximum range reported as 95 km. So Mingulay and Berneray SPA lies well beyond the maximum foraging range, but Mull of Kintyre tidal site lies well within the foraging range of breeders from Rathlin Island SPA. There were 5,978 pairs of razorbills at Rathlin Island at site designation and 20,860 individuals counted in Seabird 2000, so even if the birds wintering near to Mull of Kintyre were all from Rathlin Island SPA razorbill population, the seasonally highest mean number on the sea within the VP viewshed would represent only 0.004% of the SPA population. It is therefore safe to conclude that there will be no effect of the Development at Mull of Kintyre on the integrity of Rathlin Island SPA. There is therefore no likely significant effect on the SPA under the terms of the Habitats Regulations.

11.5.2.12 Other species of seabirds

142. Other seabird species were never seen on the water, but only flying past the site. For these species, collision mortality or injury does not represent an issue, and disturbance or displacement is very unlikely to affect the population given that the birds appear simply to be passing directly along the coastline and not using the site for foraging or resting. For these species (great cormorant, common eider, Sandwich tern, herring gull, common gull, lesser black-backed gull, and northern fulmar, we assess the impact of the Development on their regional (and SPA) populations as Negligible. There will be no significant effect on these other seabird species under the terms of the EIA Regulations.

11.5.2.13 Evidence from Strangford tidal turbine

143. Empirical data from post-construction monitoring of the tidal turbine in the narrows at Strangford Lough (University of Exeter 2010, Royal Haskoning 2011) indicate that there have been

no significant impacts on any seabird species at this site (which is an SPA and Ramsar site for a number of bird species). No collision mortality was observed or inferred for any seabird species, and while displacement was detected in a minority of species, it was on a trivial scale and had no effect on overall numbers within the Narrows (University of Exeter 2010, Royal Haskoning 2011). According to Royal Haskoning (2011) birds tended to avoid the immediate location of the turbine structure, but were displaced only a few m from that, and '*there was no evidence of any overall decrease in the abundance of each bird group within Strangford Narrows. Therefore the displacement which was detected by statistical analysis is deemed to be on a very small scale which is of no biological significance*'.

144. In view of the lack of any significant impact of the tidal turbine in Strangford Narrows on seabirds in that relatively small site (including black guillemots), we can reinforce the conclusion that any effect on seabird populations from development of the Argyll Tidal turbine will be Negligible.

11.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

145. No further mitigation is proposed.

146. Residual effects on seabird populations will be Negligible.

11.7 ASSESSMENT OF CUMULATIVE EFFECTS

147. Regulated developments that could also affect marine birds cumulatively include the Sound of Islay Tidal Array and the Evopod floating tidal turbine test module at Sound of Sanda.

148. The recommended approach to assess cumulative impacts of tidal and wave energy developments on seabirds has been presented by MacArthur Green (2013) in a Report to The Crown Estate.

149. However, since impacts of the tidal device at Mull of Kintyre are assessed as Negligible, their contribution to Cumulative Impact on seabird populations will also be Negligible.

11.8 SUMMARY OF EFFECTS (RESIDUAL EFFECTS)

150. Residual effects are assessed as Negligible for all seabird species recorded at the Development site.

11.9 STATEMENT OF SIGNIFICANCE

151. The predicted Significance for the populations of seabirds is classified as 'Minor' because all seabirds are classified as High Receptor Value and impacts are assessed as Negligible for all species.

11.10 REFERENCES

ap Rheinallt, T., Craik, J.C.A., Daw, P., Furness, R.W., Petty, S.J. and Wood, D. 2007. Birds of Argyll. Argyll Bird Club, Lochgilphead.

Bradstreet, M.S.W., and Brown, R.G.B. 1985. Feeding ecology of the Atlantic alcidae. In The Atlantic Alcidae. Ed. by D.N. Nettleship, and T.R. Birkhead. Academic Press, London.

Eastman, D. 2012. Proposed Argyll Tidal Array Scoping Report June 2012. Ref. 02923-000082.

Ewins, P.J. 1990. The diet of black guillemots Cepphus grylle in Shetland. Holarctic Ecology 13: 90-97.

Forrester, R.W., Andrews, I.J., McInerny, C.J., Murray, R.D., McGowan, R.Y., Zonfrillo, B., Betts, M.W., Jardine, D.C. and Grundy, D.S. 2007. The Birds of Scotland. Scottish Ornithologists' Club, Aberlady.

Furness, R.W., Wade, H.M., Robbins, A.M.C. and Masden, E.A. 2012. Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. ICES Journal of Marine Science 69: 1466-1479.

Garthe, S., Benvenuti, S. and Montevecchi, W.A. 2000. Pursuit-plunging by northern gannets (*Sula bassana*) feeding on capelin (*Mallotus villosus*). Proceedings of the Royal Society of London B 267: 1717-1722.

Garthe, S., Guse, N., Montevecchi, W.A., Rail, J-F. and Grégoire, F. 2013. The daily catch: flight altitude and diving behaviour of northern gannets feeding on Atlantic mackerel. Journal of Sea Research, in press.

Jackson, D. and Whitfield, P. 2011. Guidance on survey and monitoring in relation to marine renewables deployments in Scotland. Volume 4. Birds. Unpublished draft report to Scottish Natural Heritage and Marine Scotland.

Long, D.J. 2006. Common loon populations at Morro Bay, California: Summary of an eight month fall-to-spring study. Pp. 26-34 In: Hanson, A., Kerekes, J. and Paquet, J. (eds.) Limnology and Aquatic Birds. Canadian Wildlife Service Technical Report Series No. 474.

MacArthur Green 2012. Argyll Tidal Array Seabird Survey Methodology. Report to Marine Scotland and Scottish Natural Heritage.

MacArthur Green 2013. Ornithological Cumulative Impact Assessment Framework Pentland Firth and Orkney Waters Wave & Tidal Projects. Report commissioned by The Crown Estate.

Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. 2004. Seabird Populations of Britain and Ireland. T & AD Poyser, London.

Ropert-Coudert, Y., Daunt, F., Kato, A., Ryan, P.G., Lewis, S., Kobayashi, K., Mori, Y., Grémillet, D. and Wanless, S., 2009. Underwater wingbeats extend depth and duration of plunge dives in northern gannets *Morus bassanus*. Journal of Avian Biology 40: 380-387.

Royal Haskoning 2011. SeaGen Environmental Monitoring Programme Final Report. Royal Haskoning, Leith. http://seageneration.co.uk/files/SeaGen-Environmental-Monitoring-Programme-Final-Report.pdf

Robbins, A. 2012. Analysis of bird and marine mammal data for Bilia Croo Wave Test Site, Orkney. SNH Commissioned Report 592.

Robbins, A. in press. Analysis of bird and mammal data for Fall of Warness Tidal Test Site, Orkney. SNH Commissioned Report.

University of Exeter 2010. The impacts of the SeaGen tidal turbine on the avian community of the Strangford Lough Narrows.

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W. and Burton, N.H.K. 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation 156(SI): 53-61.

Van der Heide, T., van der Zee, E., Donad, S., Eklöf, J.S., Eriksson, B.K., Olff, H., Piersma, T. and van der Heide, W. 2011. A simple and low-cost method to estimate spatial positions of shorebirds: the telescope-mounted angulator Journal of Field Ornithology 82: 80 - 87.

Wakefield, E.D., Bodey, T.W., Bearhop, S., Blackburn, J. et al. 2013. Space partitioning without territoriality in gannets. Science 341: 68-70.

Wilson, B., Batty, R.S., Daunt, F. and Carter, C. 2007. Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science, Oban.

[i] SERAD (Scottish Executive Rural Affairs Department) 2000. Habitats and Birds Directives, Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('The Habitats and Birds Directives'), Revised Guidance Updating Scottish Office Circular No 6/1995.
[ii] UK Biodiversity Action Plan.
[iii] Eaton, M.A., Brown, A.F., Noble, D.G., Musgrove, A.J., Hearn, R.D., Aebischer, N.J., Gibbons, D.W., Evans, A. and Gregory, R.D. (2009). Birds of conservation concern 3. The population status of birds in the United Kingdom, Channel Islands and Isle of Man, British Birds 102: 296-341.

12 CULTURAL HERITAGE

12.1 INTRODUCTION

1. RES commissioned Headland Archaeology to carry out a desk-based cultural heritage assessment of a site for a single device tidal stream demonstration project and grid connection at the south-western most point of the Kintyre peninsula. This chapter describes the baseline conditions relating to cultural heritage, and identifies any potential impacts on the historic environment, both within and beyond the site boundary, that may result from the proposed development. The report is separated between onshore and offshore elements for clarity.

12.1.1 Site description

2. The development site is located in Southend parish, which is south-west of Campbeltown on the south-west point of the Kintyre peninsula on the west coast of Scotland. Current proposals are for a tidal demonstration project, a cable landing point and an onshore connection to the existing grid infrastructure including a small container compound. This report covers both the onshore area, which encompasses a steep hillside of rough grazing, and the offshore area of the development. The offshore development lies in the southern approaches to the Sound of Jura to the west of Kintyre, extending from Macrihanish Bay in the north to Carskiey Bay in the south out to the edge of the deep water channel.

3. The Mull of Kintyre peninsula forms the eastern boundary of the 21km wide North Channel between Scotland and Northern Ireland, 11km of which is occupied by the International Maritime Organisation shipping route which is extremely busy with an average of 3.5 ship movements per day. However, there is far less shipping traffic further inshore towards Kintyre. The seabed shelves and reached 50m 2-3km from the shore increasing to 100m at a distance of 1.5 – 4km from the shore. The MoD has various military practice areas in the region.

4. An area immediately to the north has been leased for offshore wind, a telecom cable runs to the south-west of the site and there is interest in the development of tidal energy off the coast of Northern Ireland. There are no fish or shellfish farms in the area of the site.

12.2 ASSESSMENT METHODOLOGY

12.2.1 Policy and guidance

5. The assessment has been undertaken with reference to relevant legislation, National Planning Policy and Guidance, and Regional and Local Planning Policy relating to Cultural Heritage.

12.2.1.1 Legislation

6. Scheduled Monuments and Listed Buildings are protected by statute. Legislation regarding Scheduled Monuments is contained within The Ancient Monuments and Archaeological Areas Act 1979. Legislation regarding Listed Buildings is contained in The Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997. Technical amendments to both Acts are contained in The Historic Environment (Amendment) (Scotland) Act 2011. Under this legislation it is an offence to carry out works which affect the fabric of a Scheduled Monument or Listed Building without the prior written consent of the Scottish Ministers.

12.2.1.2 National Planning Policy and Guidance

7. The Scottish Government's planning policies in relation to cultural heritage are set out in paragraphs 110-124 of Scottish Planning Policy (The Scottish Government, February 2010), and

covered in more detail in Scottish Historic Environment Policy (Historic Scotland, December 2011) and Planning Advice Note 2/2011: Planning and Archaeology. Further specific guidance is given in Historic Scotland's Managing Change in the Historic Environment series of guidance notes, of which Setting (Historic Scotland 2010) is particularly relevant.

12.2.1.3 Regional and Local Planning Policy

8. Guidance issued by Argyll and Bute Council relevant to this assessment is contained in the following documents:

    - Argyll and Bute Structure Plan (November 2002)
    - Argyll and Bute Local Plan (August 2009)
    - Argyll and Bute Council Proposed Local Development Plan (February 2013)

12.2.1.4 Maritime Policy and Guidance

9. This assessment takes account of the following legislative procedures and guidelines:

    - Marine (Scotland) Act 2010;
    - Protection of Wrecks Act 1973;
    - The Protection of Military Remains Act 1986;
    - Ancient Monuments and Archaeological Areas Act 1979;
    - Merchant Shipping Act 1995;
    - Valetta Convention;
    - ICOMOS; and
    - UNESCO

10. A full outline of this legislation is included in the Cultural Heritage Appendix D.

11. This appraisal has been compiled in line with industry best practice and the marine historic environment guidance. Many recent publications relate to the renewable energy industry, which has been a catalyst for establishing good practices for offshore industrial projects with possible archaeological implications. Guidance publications consulted include:

    - Institute for Archaeologists (IfA) guidelines: Standard & Guidance for Archaeological Desk Based Assessment (2008);
    - Joint Nautical Archaeology Policy Committee (JNAPC) Code of Practice for Seabed Development;
    - COWRIE Historic Environment Guidance for the Offshore Renewable Energy Sector (2007);
    - COWRIE Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore renewable Energy (2008);

- COWRIE Guidance for Offshore Geotechnical Investigations and Historic Environment Analysis: guidance for the renewable energy sector (forthcoming);
- The Crown Estate (2010). Offshore Renewables Protocol for Archaeological Discoveries;
- The Crown Estate (2010). Round 3 Offshore Renewables Projects Model Clauses for Archaeological Written Schemes of Investigation;
- Historic Scotland's Marine Heritage Strategy 2012-15; and
- Towards a Strategy for Scotland's Marine Historic Environment (Historic Scotland 2009)

12. The following sources of information were referred to:

- The West of Scotland's Archaeology Service's Historic Environment Record (WoSAS's HER);
- National Monuments Record of Scotland (NMRS) held by the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), including maritime losses;
- Historic Scotland Schedule of Ancient Monuments and List of Buildings of Special Architectural or Historical Interest and Designated Wrecks;
- The National Library of Scotland (for historic charts and maps only);
- Relevant internet resources, including Scotland's Places (www.scotlandsplaces.gov.uk) and aerial imagery from Google Earth ;
- UK Hydrographic Office Wrecks and Obstructions Database (SeaZone);
- Ministry of Defence (military remains only);
- Receiver of Wreck (ROW);
- Admiralty Charts;
- Relevant SEA reports and Coastal Survey Assessment reports; and
- Other readily accessible published sources and grey literature e.g. marine geophysical and geotechnical survey reports.

12.2.2 Assessment of marine bathymetric survey data

13. The bathymetric survey was conducted by NetSurvey in October and November 2012 from a single survey vessel, MV Polestar. Bathymetric data was acquired using a multibeam echosounder system and presented in .csar format at 2m resolution for archaeological review by Headland Archaeology with appropriate processing and viewing software.

14. This enabled the data to be replayed and interrogated in order to effectively assess the position, extent and nature of any potential targets. All information with regard to the survey conditions was provided in order to gauge the quality of the data for the identification of potential cultural heritage assets.

15. Two data sets were provided:

i. 2012 HI1355 Kintyre 2mSB.csar

ii. 2013 HI1355 Kintyre extension SB2m.csar

16. The data were subjected to an initial scan for any targets of potential cultural heritage interest, after which the data were assessed in detail to:

- familiarise the maritime archaeologist with the survey area;
- correlate anomalies with previously recorded sites;
- identify the absence of anomalies in the vicinity of previously recorded sites;
- identify anomalies indicative of hitherto unrecorded sites; and
- check the accuracy of the position, nature and extent of known wrecks.

17. The data was viewed using CARIS Easy view 4.0 at an approximate scale of 10mm to 30m to identify potential assets with subsequent adjustments of scale to illustrate assets or potential assets. All targets were 'tagged' and then assessed for their archaeological potential. The initial potential of identified targets was gauged using a ranking system (see Table 12.1 below) as a means of prioritising potential assets in order to inform subsequent interpretation. It must be stressed that the ranking system is only seen as an indicative basic guide and is not used as a substitute for final professional judgement. See Cultural Heritage Appendix C for the table of identified assets.

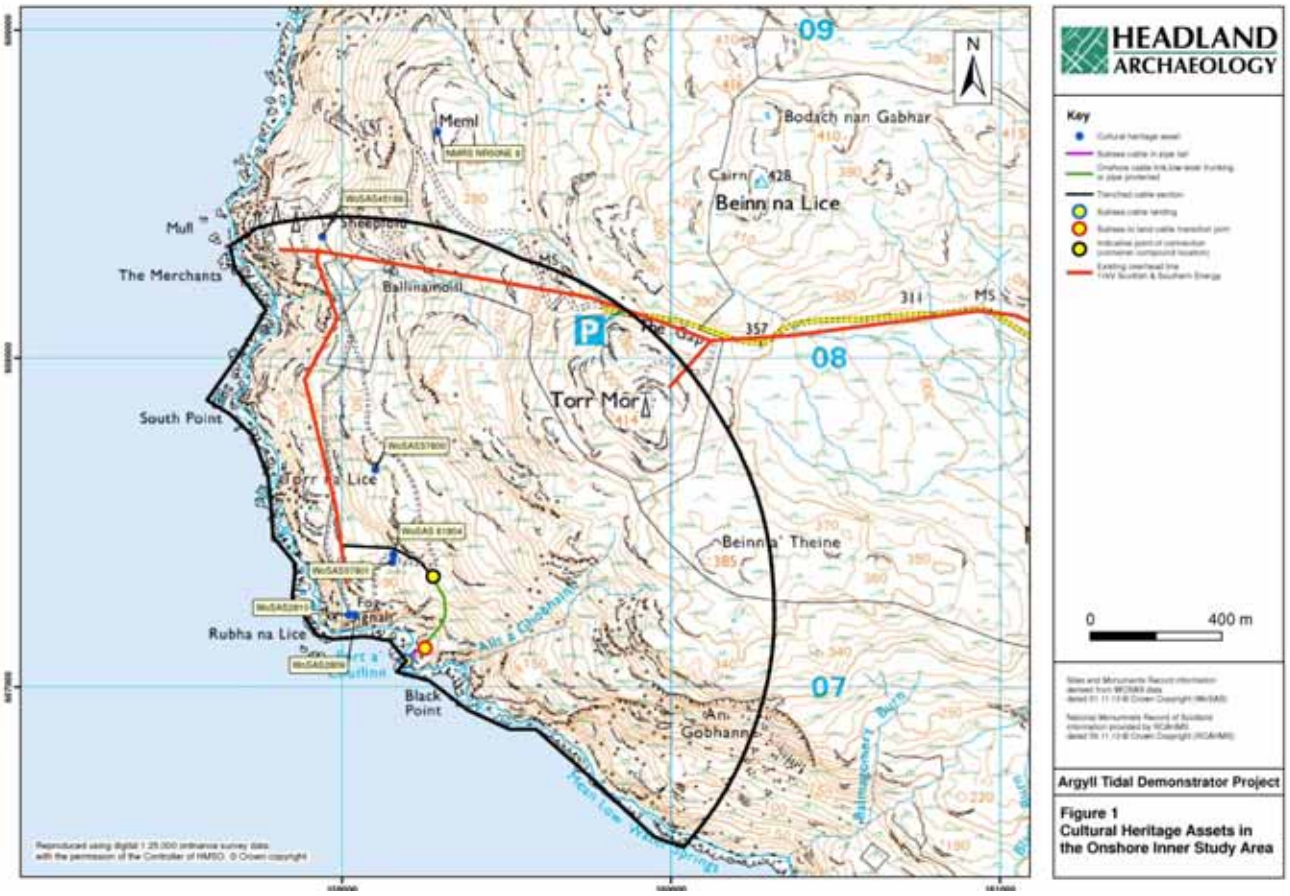
Table 12.1 - Guideline criteria for assessing potential

Potential of asset	Character of anomaly
HIGH	A target that is identified as a known archaeological asset or in the vicinity of such; or a target that is clearly recognisable as a well preserved feature or maritime loss such as a vessel or aircraft (or parts of) and any associated debris.
MEDIUM	A target that exhibits characteristics likely to represent the remains of a feature or maritime loss such as a vessel or aircraft including any associated debris; or fragments of the same.
LOW	An isolated or fragmentary target that is recognised to be of some interest but likely to be modern debris or a natural feature.

12.2.3 Onshore study areas

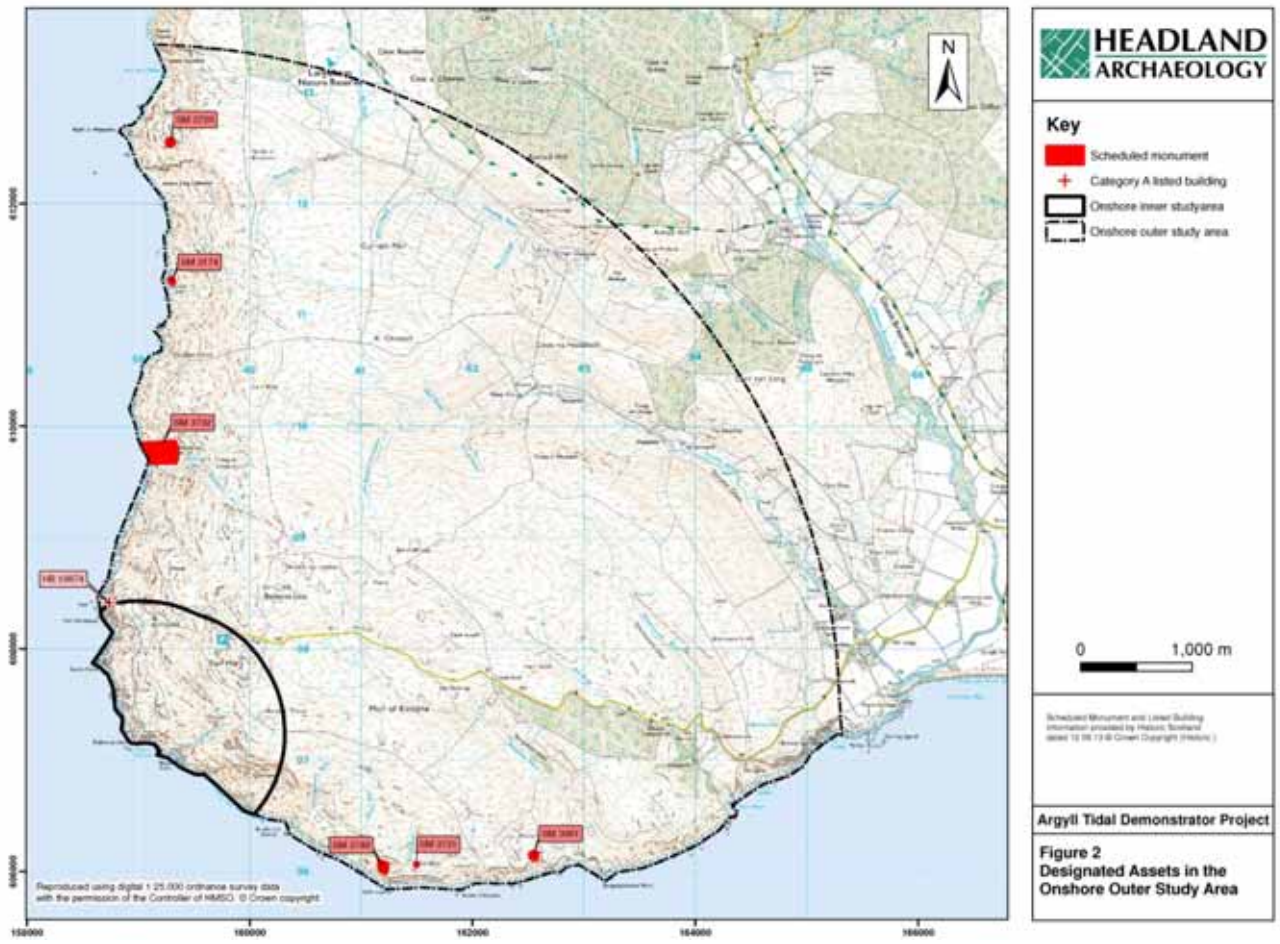
18. Two onshore study areas have been defined for the purposes of assessment. The onshore inner study area (Figure 12.1) is a 1km study area surrounding the onshore cable corridor. Owing to the restricted area of the onshore cable corridor the larger 1km study area will enable a better understanding of the archaeological potential of the development area. All cultural heritage assets in this area will be considered.

Figure 12.1 - Cultural heritage assets in onshore inner study area



19. The onshore outer study area extends to 5km beyond the onshore inner study area (Figure 12.2). Potentially significant impacts in this area are limited to effects on the settings of designated assets (Scheduled Monuments, Listed Buildings, Conservation Areas, Inventory Gardens and Designed Landscapes and Inventory Battlefields).

Figure 12.2 - Designated assets in the onshore outer study area



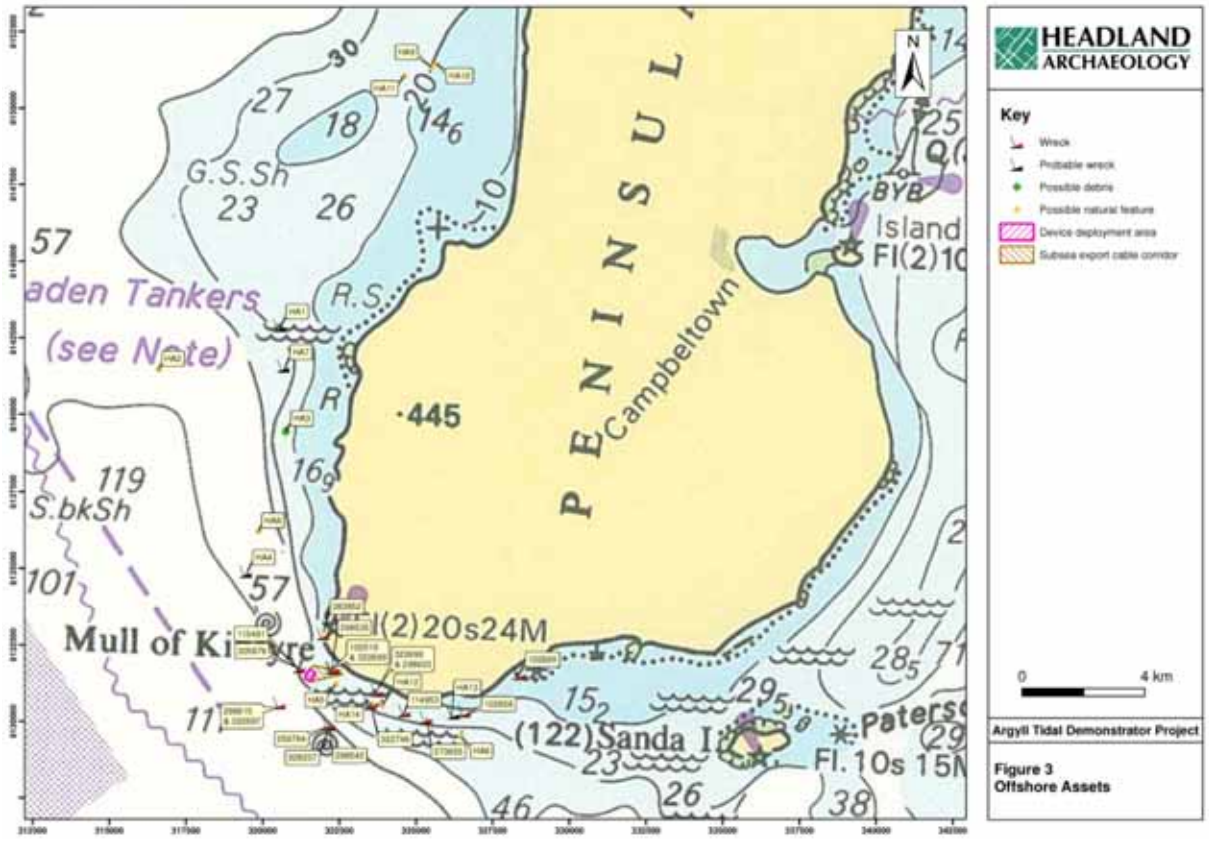
20. Datasets downloaded from Historic Scotland's Data Services website were used to compile lists of designated heritage assets within the outer study area, and WoSAS HER and NMRS data was consulted for background information within the 1km study area.

21. Significant impacts on the settings of assets at distances of more than 5km are considered unlikely except in the case of assets of exceptional significance, which derive much of their significance from their wider landscape setting. A rapid appraisal of the 1:50,000 Ordnance Survey maps of the surrounding area did not identify any such assets

12.2.4 Offshore study areas

22. The offshore study area is shown on Figure 12.3. The proposed development site area is located 800m offshore covering an area of approximately 77,260m2 this is effectively an area of search within which the single demonstration device will be located and connected to the grid connection at the south – western most point of the Kintyre peninsula by an export cable. The offshore element has not been separated into inner and outer study areas as is usual practice as the proposed development site is too small to make this practicable.

Figure 12.3 - Offshore assets



12.2.5 Data presentation

23. Heritage assets within the onshore study areas are referred to by their Historic Scotland, WoSAS number or NMRS number and are shown on Figure 12.1, and listed in Appendix 1, Table 1. Heritage assets within the offshore study areas are referred to by their six digit identification number from the Canmore database collated by the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) (Appendix A). Probable and possible heritage assets discovered in the analysis of the bathymetric survey data have been ascribed a Headland Archaeology (HA) number (Appendix C).

12.2.6 Assessment of archaeological potential

24. An assessment of the potential for currently unknown assets within the inner study area is based on an appraisal of known assets recorded in the NMRS and WoSAS HER in the surrounding area, and previous archaeological work. Potential is defined as the likelihood of previously unknown heritage assets being discovered if the entire inner study area was to be excavated archaeologically, and the likely cultural significance of any such assets. The distribution and type of known sites in the vicinity, considered in relation to environmental factors such as geology, topography and soil quality, is most relevant to this assessment. Regard is also paid to the distribution of fieldwork and the likely accuracy and relevance of its results in regard to the inner study area. Land use factors affecting survival or visibility of archaeological remains, such as arable agriculture or forestry, are also taken into account. Archaeological potential is then assigned to one of the five categories outlined in the table below. The examples are provided as an aid to decision making and allow for professional judgement to be exercised.

Table 12.2 - Archaeological potential

Potential	Definition	Example
High	The study area almost certainly contains numerous undiscovered heritage assets, some of which are likely to be of high cultural significance.	The inner study area lies in an extensive area of cropmarks, but local landuse is not conducive to the formation of cropmarks. Features associated with the cropmarks almost certainly extend into the inner study area but have not been identified because of these local conditions.
Moderate	The study area is likely to contain undiscovered heritage assets of more than negligible cultural significance, and it is possible, though unlikely, that some of these may be of high cultural significance.	The inner study area lies in an area with scattered, but discrete areas of prehistoric settlement, identified in the course of watching briefs on large-scale topsoil strips. No fieldwork has been undertaken within the inner study area. The topography and geology of the inner study area are suitable for settlement.
Low	The study area may contain undiscovered heritage assets, but these are unlikely to be numerous and any assets present are highly unlikely to be of high cultural significance.	The inner study area lies in an area with very few known archaeological sites that has seen a substantial amount of fieldwork. It matches the tested areas in terms of topography, geology and known landuse history.
Negligible	The study area is highly unlikely to contain undiscovered heritage assets of more than negligible cultural significance.	The inner study area lies in an upland region well above the historic limit of cultivation with no sites in comparable areas nearby. Archaeological sites survive as upstanding features in the absence of agriculture and hence are relatively easily identified in these conditions. It has been subject to professional pre-forestry survey, which identified no new sites.
Nil	There is no possibility of undiscovered heritage assets existing within the study area.	The entire inner study area has been subject to extensive ground disturbance known to have been of sufficient depth to remove all archaeological features, e.g. opencast mining.

12.2.7 Assessment of cultural significance

25. An assessment of cultural significance is given for all known heritage assets that are potentially affected by the development. The cultural significance of heritage assets depends on statutory designation or, in the case of undesignated assets, the professional judgement of the assessor. 'Cultural significance' is a concept defined in SHEP Annex 1, Section 3 which should not be confused with the unrelated usage of 'significance' in referring to impacts in EIA. Assets of National Importance (as defined in SHEP Annex 1, 7-10), which include Scheduled Monuments, non-designated assets considered to be of schedulable quality, Category A Listed Buildings, Inventory Gardens and Designed Landscapes and Inventory Battlefields, are assigned the highest level of cultural significance. Assets of regional or more than local importance are considered of medium significance, while assets of local importance are considered of low significance. Category B and C(S) Listed Buildings are categorised, respectively, as being of regional and local importance (Historic Scotland 2011, 12).

Table 12.3 - Guideline criteria for assessing the significance of heritage assets

Cultural significance	Guideline Criteria
High	Scheduled Monuments, Category A Listed Buildings and undesignated archaeological assets of national importance
Medium	Category B Listed Buildings and undesignated archaeological assets of regional

	importance
Low	Category C(S) Listed Buildings and undesignated archaeological assets of local importance
Negligible	A badly preserved or extremely common type of archaeological asset or building of little value at local, regional or national levels

26. The cultural significance of monuments and other heritage assets derives from a wide range of characteristics which, following SHEP Annex 1, Section 5, are grouped into three categories:

    - Intrinsic - those relating to the fabric of the asset;
    - Contextual – those relating to the monument's place in the landscape or in the body of existing knowledge; and
    - Associative – more subjective assessments of the associations of the monument, including with current or past aesthetic preferences.

27. The assessment of sensitivity consists in an analysis of the characteristics that contribute to the overall cultural significance of the asset, and their relative weighting. Not all the characteristics listed in SHEP Annex 1 need be present for an asset to be assigned to a certain level of importance; and different characteristics will contribute to a greater or lesser extent depending on the type of asset and its unique attributes. The cultural significance of a heritage asset derives both from its physical fabric and from its setting, which is defined by Historic Scotland (2010, paragraph 2.1) as 'the way in which the surroundings of a historic asset or place contribute to how it is experienced, understood and appreciated'.

12.3 BASELINE CHARECTERISTICS - ONSHORE

12.3.1 Previous investigations

28. There have been no previous archaeological investigations within the onshore inner study area. This reflects the remote, undeveloped nature of the area rather than precluding an absence of archaeology in the area.

12.3.2 Geology

29. The solid geology of the onshore inner study area is composed largely of Southern Highland Group metamorphic rocks (psammites and pelite). The superficial geology of the area where present is diamicton till.

12.3.3 Prehistoric

30. The earliest designated assets recorded in the onshore outer study area date from the Iron Age. There appears to have been significant activity in this period with two forts (Index No 3174 & 3748), two duns (Index No. 3081 & 3720) and a roundhouse or hut circle all of probable Iron Age date (Index No 3731) within the area. These assets are all located in naturally defensive locations around the coast of Kintyre.

31. Of possible prehistoric date within Inner Study Area are the circular enclosure and clearance cairns of Rubha na Lice (WoSAS 57801 & 61804). The date of these assets is not clear; the description within the WoSAS site report could date them anywhere between the Bronze Age through to the early medieval period. It is also possible that these two references refer to the same site owing to their proximity, and both sites were recorded by the Kintyre Antiquarian and Natural History Society.

12.3.4 Medieval and post-medieval

32. There is no evidence for medieval activity within the onshore inner study area. However it is possible that some of the shieling huts and townships in the wider area have their origins in the medieval period. Shieling huts are commonly found in upland areas close to localised areas of good hill pasture, and were occupied seasonally from medieval times through to the nineteenth century. The majority were simple turf or stone huts, generally found in groups close to small watercourses, and survive as grassy mounds or banks. While no shieling huts are recorded within 1km of the site they are a site type which would be expected in such a landscape and a walkover of the area may produce results.

33. Within the onshore inner study area there are remains of two buildings (WoSAS 57800 & 61670) for which there is little information. It is possible that they are site types dating to the post-medieval period; they may be the remains of shieling huts or small farm buildings.

34. In the onshore outer study area the scheduled monument Balmavicar Township (Index No.3732), may have its origins in the medieval period. The exact date of this township is uncertain but it predates the Pont Gordon map dated 1636-1652 so it may well have been founded in the medieval period.

12.3.5 Modern

35. Just to the northwest of the onshore inner study area is the Mull of Kintyre Lighthouse (HB19874) which was built in 1787-1788 and was one of the first lighthouses to be built by the Commissioners of the Northern Lights. It was built to aid the passage through the east side of the North Channel, the northern entrance to the Irish Sea. The original building was rebuilt between 1821 and 1830 as a more permanent structure and this is largely the building seen today. The Mull of Kintyre Lighthouse was automated in 1996 (http://www.nlb.org.uk/lighthouse library/lighthouse/mull-of-kintyre/ accessed 01.11.13). Of the assets recorded within the Inner Study Area, three are directly related to the working of the lighthouse; two foghorns (WoSAS 2809 & 55359) and a signal station (WoSAS 2810) there is a further building (WoSAS 45189) recorded close to the lighthouse which may also be related.

36. Of note within the outer study area is the site of the 1994 Chinook Helicopter crash site. It can be presumed that all remains of this helicopter will have been removed during the subsequent crash site investigation. A memorial (NMRS NR50NE 8) in memory of those that lost their lives in the crash roughly marks the location of the crash site to the north east of the Mull of Kintyre Lighthouse.

37. The remainder of the inner and outer study areas is largely in use as unimproved rough sheep grazing.

Table 12.4 - Heritage assets in the inner study area

Asset No.	Name	Asset type	Period	Cultural significance
WoSAS 2809	Black Point	Foghorn	Modern	Medium
WoSAS 2810	Black Point	Signal Station	Modern	Medium
WoSAS 45189	Mull Lighthouse	Building	Modern	Low
WoSAS 57800	Torr Na Lice	Buildings	Post medieval to modern	Low
WoSAS 57801	Rubha Na Lice	Enclosures; Structures; Clearance Cairn	Possibly Prehistoric	Medium
WoSAS 61670	Torr Na Lice	Structure	Probably post medieval to	Medium

			modern	
WoSAS 61804	Rubha Na Lice	Circular Enclosure; Clearance Cairn; Structure	Possibly Prehistoric	Medium

12.3.6 Archaeological potential onshore

38. This area of the Kintyre peninsula has seen relatively little archaeological fieldwork due to its remote location and the lack of development in the area. It is clear from the known archaeology in the surrounding area that there has been activity in the area since at least the Iron Age and there were settlements in the wider area from the medieval period. The potential for previously unrecorded upstanding and subsurface archaeological assets to survive within the inner study area is considered to be low to moderate. The exception to this is in the areas of steep hillside which would not have been attractive to settlement or agriculture in antiquity in these areas the archaeological potential will be negligible. It is therefore considered that there is low to moderate potential for previously unrecorded cultural heritage assets to survive within the inner study area.

12.3.7 Heritage assets in the onshore outer study area

39. There are seven Scheduled Monuments in the Outer Study Area (Table 12.5). As discussed, these include five sites which date from the Iron Age (Index No. 172, 265, 3503, 3504 & 3550) and two sites of probable post-medieval date (Index No. 3502 & 3552).

Table 12.5 - Scheduled monuments in the outer study area

Index no.	Site name	Easting	Northing
3081	Borgadel Water dun	162550	606143
3174	Dunan fort	159300	611304
3719	Largiebaan shielings	160760	613975
3720	Rubh' a' Mharaiche dun	159287	612550
3731	Sron Uamha hut circle	161496	606058
3732	Sron Uamha fort	159209	609766
3748	Balmavicar Burn township	161198	606041

40. There is one Listed Building within the outer study area; the Category A listed building the Mull of Kintyre Lighthouse (HB19874) as detailed in Table 12.6.

Table 12.6 - Listed buildings in the outer study area

HB no.	Site name	Category	Easting	Northing
19874	The Mull of Kintyre Lighthouse	A	158740	608412

41. There are no inventory gardens and designed landscapes, inventory battlefields or conservation areas within the outer study area.

12.4 ASSESSMENT OF CULTURAL SIGNIFICANCE - ONSHORE

12.4.1 Heritage assets within the onshore inner study area

12.4.1.1 Designated assets

42. There are no designated assets within the onshore inner study area

12.4.1.2 Undesignated assets

43. There are no non-statutory assets of national importance within the onshore inner study area.

44. Of the undesignated assets related to the Mull of Kintyre Lighthouse the foghorn (WoSAS 2809) and the signal station (WoSAS 2810) are considered to be of regional importance and medium significance. This is due to their importance as part of the working elements of the Mull of Kintyre Lighthouse and their value to the operations of this often fog-covered lighthouse.

45. The memorial to the Chinook Helicopter crash (NMRS NR50NE 8) is considered to be of local importance and low sensitivity. While the memories the memorial invokes are of high significance the memorial itself is of limited cultural significance and could easily be replaced by a similar memorial.

46. The Rubha na Lice enclosures and clearance cairns (WoSAS 57801 & 61804) are possibly the remains of prehistoric homesteads and associated clearance cairns as such these assets are considered to be of regional importance and medium significance.

47. The building and structures (WoSAS 45189, 57800 & 61670) from the descriptions in the WoSAS reports appear to be the remains of post-medieval to modern farmsteads/ buildings. These assets are considered to be of local to regional importance and low to medium significance. The value of these assets is uncertain due to the uncertainty over their level of preservation and date.

12.4.2 Heritage assets within the onshore outer study area

48. There are seven scheduled monuments in the outer study area of national importance and high sensitivity.

49. There is also one category A listed building of national importance and high cultural significance.

12.5 PREDICTED EFFECTS OF THE ONSHORE DEVELOPMENT

12.5.1 Potential impacts

50. Potential impacts resulting from the proposed development include physical impacts affecting the fabric of heritage assets, and impacts on the settings of heritage assets. Any planned construction works that involve ground disturbance can result in physical impacts: these could occur during the construction of access tracks, the subsea cable landing point, and the erection of the overhead line poles. Movement of plant can also result in accidental damage to upstanding archaeological assets. Overhead lines can also result in impacts on the setting of heritage assets, by affecting key views towards or from the heritage asset.

12.5.1.1 Heritage assets affected in the onshore inner study area

51. There is potential for accidental construction effects on the Rubha na Lice enclosures and clearance cairns (WoSAS 57801 & 61804) during the excavation of the cable trench. As only point locations are given in the HER data set for these assets it will be necessary to do a field survey of these assets to determine their extents. Following this survey it will be possible to microsite the

trench around the area to insure no upstanding archaeological features are affected during its excavation.

52. It is considered that there is low to moderate potential for previously unrecorded cultural heritage assets to survive within the inner study area. However it is considered that there is low potential for direct impacts on previously unrecorded cultural heritage assets during construction due to the limited construction footprint.

53. The potential for setting impacts on the cultural heritage assets in the surrounding area has been considered. As the overhead line will be connecting into an existing grid connection it is considered that the change from baseline will be limited. It is also considered that due to the distance from the grid connection corridor to the surrounding designated assets there is no potential for a significant impact on the setting of these assets.

12.6 SUMMARY OF ONSHORE IMPACTS

54. Direct construction impacts on the Rubha na Lice enclosures and clearance cairns (WoSAS 57801 & 61804) will be avoided through mitigation. Following mitigation there will be no impacts on the Rubha na Lice assets or any other known cultural heritage assets as a result of the development.

55. It is considered that there is low potential for previously unrecorded cultural heritage assets to be subject to direct construction impacts as a result of this development.

56. The potential for setting impacts on designated assets has been considered for the operational stage of the development. No significant impacts on the setting of cultural heritage assets are predicted.

12.7 BASELINE CHARECTERISTICS - OFFSHORE

12.7.1 Geology

57. The geology of the area is dominated by gravelly sand. There is a hard rocky area around the Mull of Kintyre with the remaining majority of the substrate being made up of sand and/or gravel according to the required sediment description. There are no relative sea level (RSL) studies specific to the Mull of Kintyre, but RSL change in this area can be inferred from studies along the west coastline of Scotland, Islay and Ardyne (e.g. Dawson *et al*, 1998; Smith *et al*, 2007). A general trend for RSL change for this area of Scotland has been observed from radiocarbon dated deposits (e.g. peats) used as RSL index points, which shows that the main post-glacial RSL rise in this area began at c 10,000 (before present) BP and attained a maximum of c 10 m ordnance datum (OD) at approximately 7,500 BP. Following this, RSL then began to fall to its present level due not only to falling sea levels but also to the rate of glacio-isostatic uplift following the melting of the ice sheets. This uplift has been calculated at a rate of 1-2mm per annum for this part of western Scotland (Shennan and Horton 2002).

58. More recent studies, focusing on the Ayrshire coastline have shown that RSL change is more complicated when investigated on a local scale. Studies from the northern area of the central west coast (e.g. Sissons, 1974) have shown that the main post-glacial shoreline lies some 10m above OD, which has been confirmed from onshore basal peat deposits (see above) and that the main post glacial shoreline is at the highest altitude, being closer to the centre of glacio-isostatic uplift. However studies such as Smith et al (2006) have shown that this shoreline is widely displaced along the coast and overlaps in places with the Blairdrummond shoreline, which is of a later age. These features have been dated by Smith *et al* (2007) along the southern Ayrshire

coast as occurring at 6,800 BP (at 7.8m OD) and 4,200 BP (at c.9m OD), respectively; thus showing RSL rise around 4,200 BP with the formation of the Blairdrummond shoreline, occurring at the periphery of the area of glacio-isostatic uplift (Smith *et al*, 2007). Following this the area conforms to the model of Shennan and Horton (2002), with sea-level falling to its current level.

12.7.2 Archaeological potential offshore

59. The steep rise in sea-level in this area combined with the rate of isostatic uplift and rocky nature of the steep, imposing coastline suggests there is little potential for the presence of intertidal organic deposits at Rubha Na Lice.

12.7.3 Heritage assets in the offshore study area

12.7.3.1 Designated assets

60. There are no wrecks controlled or designated, either under section 1 of the Protection of Wrecks Act 1973, under the Protection of Military Remains Act 1986, or as maritime scheduled ancient monuments, within the study area.

12.7.3.2 Undesignated assets

61. There are sixteen recorded maritime incidents within the study area (see Appendix B; Figure 3), one eighteenth century wreck, nine nineteenth-century wrecks, and six twentieth-century wrecks. Of these only four actual wrecks sites appear to have been located on the seabed, (which may be a result of the poor correlation between different datasets which often site the same incident in very different locations); the nineteenth century steamship New York (Canmore ID 253905) is cited as well broken in 18m (UKHO ID 158345), the twentieth century paddle steamer Glendale (Canmore ID 114953) is cited as 'very little left. Wreck is in 8m' (UKHO ID 133734), the steamship Mobeka (Canmore ID 102665), surveyed by HMS Bulldog in 1984 and reviewed in 2004 (UKHO ID 11705), and the barge Menck (Canmore ID 322698 & 298603) has been sighted above the HW line during a survey by HMS Bulldog in 1985 and subsequently by NetSurvey during the current study in 2012 (UKHO ID 89197).

62. Four wrecks have been declared 'dead' in that no remains could be located on the seabed. These include the twentieth century steam trawler Nordale (Canmore ID 102658; UKHO ID 119595) and the barge Sea Wolf (Canmore ID 298615 & 322697; UKHO ID 89196), neither of which were found during surveys conducted by HMS Bulldog in 1985 or by NetSurvey during the current study. The nineteenth century steamship Macedonia (Canmore ID 102519 &322699) is listed as dead, even though it was not searched for by HMS Bulldog and it is reported as 'lying in 10m, completely smashed to pieces and lying between huge boulders' (the source is cited as SIBI) (UKHO ID 11680). NetSurvey thought they had identified remains of the twentieth century motor fishing vessel Defiance (Canmore ID 322746) during the current study but the anomaly appears too large to be the wreck and is more likely geological. It has therefore been deemed 'dead' by UKHO (ID 89256).

12.8 ASSESSMENT OF CULTURAL SIGNIFICANCE - OFFSHORE

12.8.1 Heritage assets within the offshore study area

63. There are no non-statutory assets of national importance within the offshore study area.

12.8.1.1 Results from analysis of bathymetric survey data

64. Fourteen potential cultural heritage assets were identified following analysis of the bathymetric data (see Appendix C). Three anomalies (HA01, HA04 & HA07) clearly indicate the location of cohesive wreck sites with the highest archaeological potential. Five sites (HA08, HA09, HA010, HA012, & HA013) are of moderate archaeological interest. Three anomalies (08, 09, 010) represent discrete compact mounds which are unlike the background topography/geology thereby indicating archaeological potential. Two anomalies could be archaeological or natural; one (012) appears to be a circular feature sitting in a scour pit and the other (013) represents an amorphous feature which could possibly indicate buried remains. The survey company identified (014) as the location of a known wreck, the motor fishing vessel Defiance, but the UKHO record has subsequently been amended stating that the feature is too large to represent the wreck and is more likely geological. We would concur with this view. The remaining five anomalies (HA02, HA03, HA05, HA06 & HA011) are of low archaeological potential, as although the features are unusual and interesting, in the balance of probability they are more likely geological than archaeological.

12.9 PREDICTED EFFECTS OF THE OFFSHORE DEVELOPMENT

12.9.1 Potential impacts

65. Potential impacts on the maritime cultural resource resulting from the offshore development include physical impacts affecting the fabric of heritage assets and impacts on the settings of terrestrial heritage assets. Any planned construction works that involve ground disturbance including foundations for the tidal demonstration project and laying of the marine and inter-tidal export cable can result in physical impacts. Anchoring and temporary propping during the construction phase can also result in accidental damage to upstanding archaeological assets. The tidal demonstration project might also impact on the setting of heritage assets, by affecting key views towards or from the heritage asset.

12.9.2 Heritage assets affected in the offshore inner study area

66. The distribution of known maritime heritage assets in this area is so sparse that the location of the tidal array installation and the export cable can be designed in order to avoid all known heritage assets as well as those identified in the bathymetric survey. Three known wrecks are recorded on the western edge of the proposed development (Jeanie (Canmore ID 305876), Sea Flower (Canmore ID 298535), and Signal (Canmore ID 115491)), but no remains have been located on the seabed and the export cable will run to the east so there should be little threat to these sites by the proposed development.

67. There is potential for direct impacts on previously unrecorded maritime heritage assets but given the sparsity of known assets this risk is low. In addition, the previously unknown wrecks that have been revealed in the bathymetric survey are so obvious that they are almost impossible to miss.

68. Moreover, the rate of isostatic uplift combined with the nature of the coastline at Rubha Na Lice, Mull of Kintyre suggests there is limited potential for intertidal and shoreline deposits of palaeo-environmental interest.

69. The potential for setting impacts on the cultural heritage assets in the adjacent landscape as a result of the tidal array installation is mitigated both by the low profile of the tidal array and the burial of the export cable so there is no potential for a significant impact on the setting of these assets.

12.10 SUMMARY OF OFFSHORE IMPACTS

70. The sparsity of known offshore cultural heritage assets is such that the tidal array installation and the route of the buried export cable can be designed in such a way as to avoid all known assets.

71. Given the sparsity of known assets and the clarity with which previously unknown wrecks have been detected by the bathymetric survey it seems unlikely that further unknown assets will be encountered.

13 COMMERCIAL FISHERIES, SHIPPING AND NAVIGATION, MILITARY AND MUNITIONS

1. This chapter of the Environmental Appraisal (EA) evaluates the effects of the proposed Argyll Tidal Demonstrator Project (hereafter referred to as "the Development") on the Human Environment.

2. The chapter should be read in conjunction with the Navigational Risk Assessment (NRA) which considers in more detail any marine safety risk that may result from the Development.

13.1 COMMERCIAL FISHERIES

13.1.1 Introduction

3. This section of this chapter evaluates the effects of the Development on Commercial Fishery activities in the region.

13.1.2 Assessment Methodology

4. In line with the other chapters of this EA, the assessment of the potential effects of the device has followed the steps of:

    - Identification of the potential effect of the Development;
    - Consideration of the likelihood of occurrence of potential effects;
    - Considering the sensitivity of the receptor
    - Establishing the magnitude of the likely effect

5. Following establishment of the parties actively using the area for commercial fishing, the above steps have largely been undertaken through direct discussion with identified users of their activities and the likely effects on these of the demonstration project.

13.1.3 Data Sources

6. The following data sources have been used to establish the level of fishing activity in the region:

    - ICES Spatial Facility. 2012, ICES, http://geo.ices.dk/index.php
    - The UK Fishing Vessel List for over 10m and under 10m vessels, Marine Management Organisation. 1 April 2012, http://marinemanagement.org.uk/fisheries/statistics/vessel.htm
    - Scottish Sea Fisheries Statistics 2010, Scottish Government. 2010. http://www.scotland.gov.uk/Publications/2011/09/09155012/0
    - Conflict Resolution (CORE) and demonstration planning for tidal devices around the Mull of Kintyre. K. Alexander et al (2011).
    - Meeting with Joanna Holbrook, Senior Fishery Officer, Marine Scotland – Compliance, Campbeltown Fisheries Office (20 Aug 13)
    - Communications and meeting with local fishermen Harry and Kenny Campbell (22 Aug 12, 30 Sep 13)

- Meetings with representatives from the Clyde Fishermans Association (CFA) (Archie Macfarlane – 10 Aug 12, Richard Johnstone – 21 Aug 12, Andy Harrsion – 1 Oct 13) and formal response to Array Scoping Opinion Request

7. In addition, ahead of the array scoping process, details of the project were discussed with the following fisheries stakeholders in order to inform, seek any information that may influence design and siting as well as to understand any concerns regarding the Development.

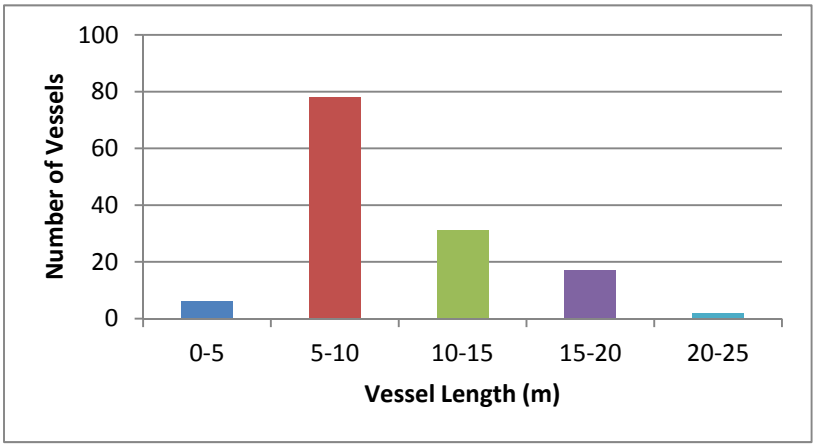
    - Clyde Inshore Fisheries Group – Billy Sinclair
    - Small Isles and Mull Inshore Fisheries Group - Allan Henderson
    - Northern Ireland Fish Producers Association – Dick James

13.1.4 Site characterisation

8. The Development Site is located in the International Council for the Exploration of the Sea (ICES) Division VIa – West Scotland and falls within ICES rectangle 39E4.

9. There are a number of small harbours and ports along the western coast of Scotland. The main administrative port in the region of the Development Site is Campbeltown. As of April 2012 there are 87 vessels under 10 m registered to the port and 47 vessels over 10 m. As shown in Figure 13.1, the majority of vessels are relatively small with vessel lengths between 5m and 10m, few vessels are over 15m in length.

Figure 13.1 - Length profile of commercial fishing vessels registered to Campbeltown



10. Scottish Sea Fisheries Statistics (2010) show that 97% of active Scottish based vessels under 15m target shellfish using the following methods:

    - Creel fishing (82.8%)
    - Nephrops trawl (10.5%)
    - Mechanical Dredging (2.1%)
    - Shell Fishing by hand (4.3%)
    - Suction dredging (0.2%)

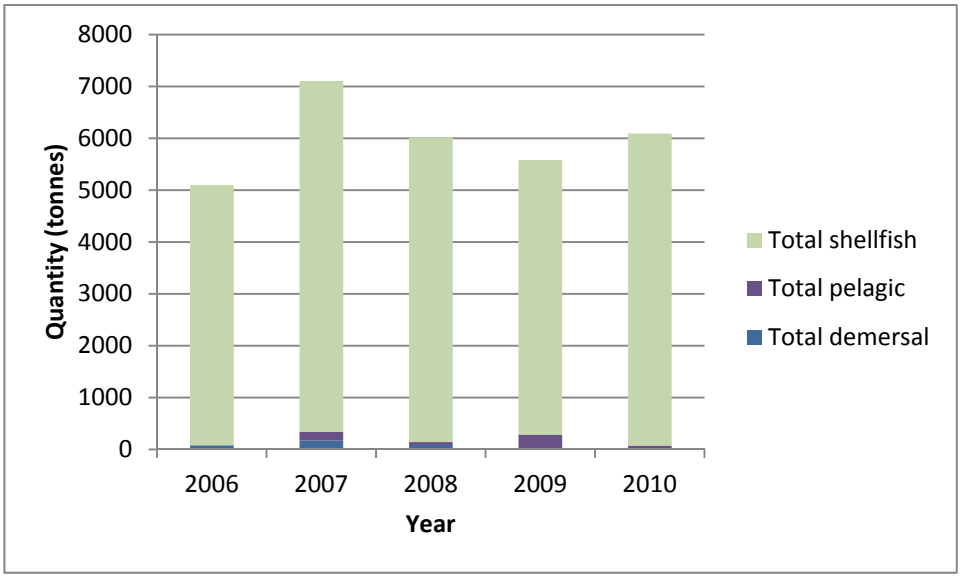
11. The most common fishing method practised by Scottish vessels under 15m is creel fishing. To a lesser extent, demersal species such as cod, haddock, monkfish and dogfish are targeted using single trawls, lines and gill netting.

12. Creels or pots are usually set in 5-40m of water although this is dependent on the location being fished. In the area of the proposed development, creels are fished for crab and lobster up to a depth of 130m[1]. The baited pots are normally strung together on a lead line of up to 100 pots, but can also be set singularly. Pots are used to target crustaceans including lobsters and different species of crabs (edible, velvet etc), as well as nephrops.

13. Pots are generally allowed to soak for 12 to 48 hours and then retrieved. On occasion, pots are left longer, but after around two days they no longer fish since the bait has deteriorated or been eaten. Furthermore, the crabs and lobsters may become aggressive and fight. If the crabs or lobsters are undersize or soft they are returned to the sea. If they are berried (carrying eggs) they are sometimes retained for sale (there is no legislation preventing this in this area).

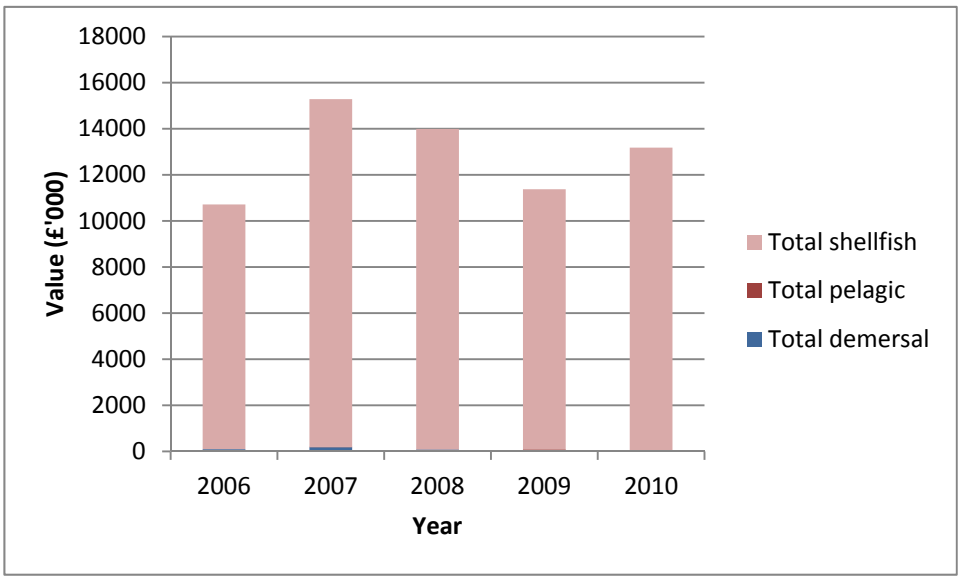
14. The total liveweight volume and value of landings into Campbeltown are presented for 2006 to 2010 in Figure 13.2 and Figure 13.3.

Figure 13.2 - Liveweight volume of landings into Campbeltown from 2006 to 2010



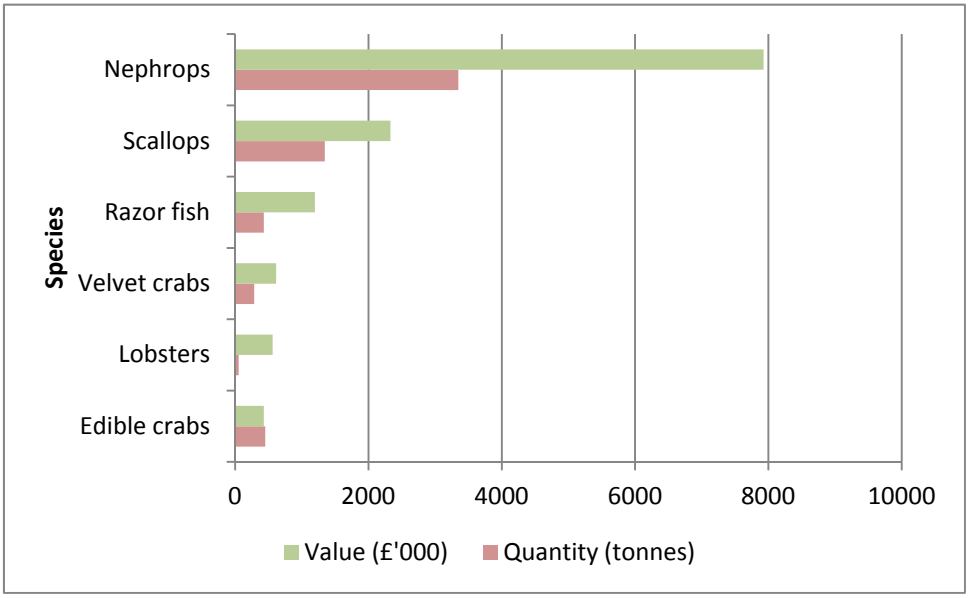
[1] CFA Scoping Response to Argyll Tidal Array - August 2012

Figure 13.3 - Value of landings into Campbeltown from 2006 to 2010.



15. Figure 13.4 represents the liveweight and value per species landed into Campbeltown by UK vessels. Nephrops dominate the catch in terms of both weight and value. However, it is understood that creel fishing, scallop dredging and scallop diving are likely to be more common within the area and therefore species composition caught in this area will primarily be scallops edible crabs, velvet crabs and lobster.

Figure 13.4 - Liveweight volume and value per species landed in Campbeltown in 2010



16. Once the wider regional context was known it was important to understand the specific fishing activities in the region. Representatives from The Clyde Fishermans Association (CFA) were able to confirm that approximately 10-20 vessels regularly transited close to the development site when steaming between Campbeltown and the prawn fishing grounds of Gigha Island. Weather conditions permitting, the fishing vessels transit close inshore to the Mull during the hours of darkness in order to arrive at the fishing grounds at first light. In bad weather they will be about 3nm of the coast. The CFA were also able to confirm that the area was unsuitable most types of

fishing with only creeling being suited to the location. The Campbeltown Fisheries Office were able to confirm that 2 or 3 fisherman actively used the area near the device for this activity and through speaking to other people in Campbeltown the applicant was able to establish that the relevant local fisherman were Harry and Kenny Campbell of Southend and potentially Campbell Keates of Machrihanish. Meetings and calls with these people were then arranged.

17. Harry and Kenny confirmed that they are the only fishermen who operate in the area, fishing for lobster and crab from a 10m boat based in Campbeltown. They lay approximately 600 pots in strings of 25 close to the shoreline around the Mull of Kintyre; from Sandra Island to about 2nm north of the Kintyre lighthouse. They lay the pots according to the nature of the seabed which may mean passing over the proposed cable route. They also stated that the area where the device is to be located is not suitable for potting due to the nature of seabed and they are therefore unlikely to deploy pots in or close to the proposed device location. The lobsters and crabs are harvested daily from April to August and they work during daylight hours only. Outwith those months they work further along the coast towards Campbeltown also for lobsters and crabs. As far as they are aware there are no other fishermen operating in the area. As mentioned above, about 20 nephron trawlers operate much further out towards Gigha Island.

13.1.5 Development design mitigation

18. The device deployment location has been chosen to maximise peak tidal flows in the area. As stated above, this location coincides with an area of undulating seabed unsuitable for potting so potential displacement effects are minimised.

13.1.6 Assessment of potential effects;

19. There are two primary potential effects associated with the tidal device, these are reduced access to fishing grounds and potential displacement from these areas due to the physical obstacle of the turbine and moorings and the possibility of loss or damage to gear should fishing activities coincide with the device location. Re. the former, as described above, the device location is outwith the preferred fishing locations in the area and for this reason and the small footprint of the device on the seabed, displacement effects are not expected during the operational life of the Development. As deployment of the device and subsea cable is likely to take place during the summer months, there is the potential for fishing activities to be interrupted for the short period when these works are being undertaken. However, given the planned short duration of these works, the potential disturbance is anticipated to be minimal.

20. Given the unsuitability of the device location for creeling, fishing activity in the vicinity of the device is expected to be minimal so any potential risk of the creels becoming entangled during retrieval operations is more likely to be associated with subsea cable rather than the device and its moorings. It is recognised however that the tidal conditions can make precise manoeuvring in the region difficult and there is also the risk of drifting into proximity of the Development in the event of an engine failure. Local fisherman have confirmed that there is no danger of the boat being compromised as they would immediately cut the line to the pot. They have also confirmed that due to the strong tides and depth of water, anchoring in the area would be a last resort and only in an emergency situation.

13.1.7 Mitigation measures and residual effects;

21. In order to minimise the potential impact during construction and deployment of the device, it is likely that a temporary 500m Safety Zone around the device will be applied for to prohibit active fishing in the area for this period. Crucially, promulgation of all information associated with the deployment including vessel types, methods and timings of activities will be shared in advance of construction with local fisherman as well as the wider marine community.

22. To minimise the potential for snagging on the pipe protected cable, the routing of the pipeline within the consent corridor will be chosen to minimise any spans where it is not possible to fully locate on the surface. The results of the geophysical survey results presented in the Physical Environment Chapter of this EA suggest that this will be possible and the pipe installer has indicated it also their preference to keep spans minimal to maximise the integrity of the pipe solution. In addition the 'as built' location of the device and cable will be notified to local fisherman and other mariners and the device itself marked on the admiralty chart of the area once deployed.

23. It is unclear at this stage whether the device will be marked by a surface piercing buoy. The applicant intends to hold further discussions with the Northern Lighthouse Board in order to establish the most effective navigational marking strategy for the device. One of the benefits of the fully submerged design of the device is that there will be no surface hazard. General feedback from fisherman and other marine users is a preference not to introduce a surface marker which in itself may become a hazard, particularly in this location where the sea state may often mean any visibility of a marker could be poor. These sea states also mean that it will be difficult for a marker to accurate remain on station at the device.

24. It can be reasonably expected for the prudent mariner to make a reasonable deviation to avoid transiting over the tidal device. However, as described more fully in Section 18.2.1 of the NRA for the project, the NOREL Navigation sub-group "Under Keel Clearance – Policy Paper – Guidance to developers in assessing minimum water depth over tidal devices" provides recommendations on the minimum chartered vertical depth sufficient to ensure that a vessel that does decide to transit close by does not come into contact with the device thereby protecting the vessel, its crew and cargo along with the tidal device. At the proposed deployment depth of 35m, the Chartered Vertical Depth of 10m is less than the NOREL guidance of 15m. However, the NOREL calculation assumes a very much worst case maximum draught vessel clearance of 7m, much greater than that of the 10m vessel that is active in the area and the calculation itself includes additional conservancy and safety margins.

13.1.8 Assessment of cumulative effects;

25. There is one other marine energy project proposed near to the development site, OceanFlow Energy's inshore site 15 km east of the Project on the mainland side of Sanda Sound. Although the fisherman that are active near the Development also fish in this region outwith the summer months, given the small scale of the Oceanflow test device (4.5m diameter) significant cumulative effects are unlikely.

13.1.9 Summary of effects (residual effects);

26. Given the low level of commercial fishing activity in the area and unfavourable fishing conditions at the device location, it is anticipated that the development will have not have any significant impact with any effects being negligible.

13.2 MILITARY ACTIVITY

13.2.1 Introduction

27. This section of this chapter evaluates the effects of the Development on military activities in the region.

13.2.2 Assessment methodology

28. In line with the other chapters of this EA, the assessment of the potential effects of the device has followed the steps of:

- Identification of the potential effect of the Development;
- Consideration of the likelihood of occurrence of potential effects;
- Considering the sensitivity of the receptor
- Establishing the magnitude of the likely effect

29. Once these steps have been completed, a judgement is made as to whether or not the identified effect is likely to be significant. If a potential effect is determined to be significant, measures to mitigate or compensate the effect are suggested where required and the residual effect after mitigation considered.

13.2.3 Data sources

30. The following sources have been used to establish baseline conditions:

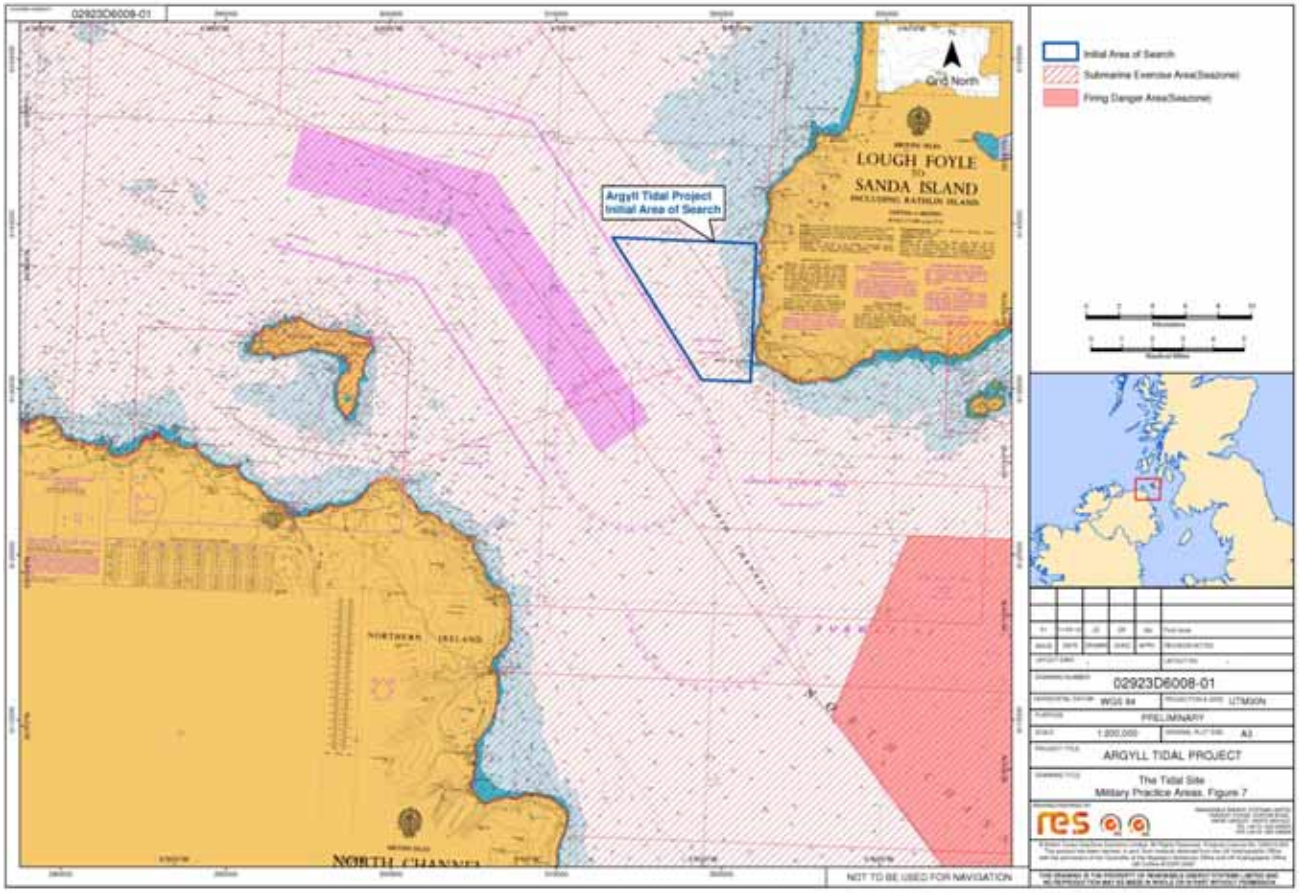
- Practise and Exercise Area (PEXA) Chart Q6403 which the limits and names of the exercise area close to the development site, namely Sanda.

- Dialogue with MOD directly, namely discussions with Jon Wilson, Safeguarding Team, Defence Estates (May 12) and Lt. Commander Clive Hayward, Clyde Naval Base at Faslane (July 12).

13.2.4 Site characterisation;

31. The amount of military activity in western Scotland is considerable and large areas are designated as military practice and exercise areas (PEXA). The Ministry of Defence (MOD) operates in the area of the Development Site and Submarine Exercise Areas are shown on the Admiralty Chart for the area as shown on Figure 13.5. It is understood that vessels pass through the North Channel from the Faslane Naval Base on the Gare Loch to the patrolling areas in the North Atlantic.

Figure 13.5 - Military practice areas



13.2.5 Assessment of potential effects;

32. Potential effects of the device relate primarily to the operation of the device rather than during the construction and decommissioning periods although temporal disruption to military exercises/movement through the North Channel during the transportation and installation of the device at the Development Site are possible.

33. During operation the device has the potential to act as a barrier for submarine vessel movements through the North Channel. Numbers of submarine movements are not known but given the device location at approximately 1km from shore at a water depth of ~35m, the small scale nature of the device (up to 14m diameter in 21km wide North Channel) barrier effects are not expected.

34. One potential effect that is not yet understood is the possibility of any acoustic output associated with the tidal device effecting military sonar. As a full scale generating device has not been operational to date, acoustic data is not yet available for the device. However, it is not thought that any acoustic output of the device would have any significant impact on the background levels already influenced by many marine users such as cargo vessels using the International Maritime Organisation (IMO) Traffic Separation Scheme (TSS) routing in the centre of the North Channel. There is no accessible evidence to suggest any such sonar impact will arise and the NRA for the Development does not anticipate any adverse effects on navigation systems from acoustic interference arising from the device.

13.2.6 Mitigation measures and residual effects;

35. No mitigation measures are proposed in relation to impacts on military activities.

13.2.7 Assessment of cumulative effects;

36. There is one other marine energy project proposed near to the development site. OceanFlow Energy is currently undertaking environmental monitoring and permitting activities for an inshore site 15 km east of the Project on the mainland side of Sanda Sound[2]. The proposal is for a single ¼ scale 35 kW demonstrator Evopod tidal device. Given the small scale of the device (4.5m diameter) and geographic separation of the proposals, cumulative effects are unlikely.

13.2.8 Summary of effects (residual effects);

37. It is anticipated that the Development will have not have any significant impact on military activities in the area with any effects being negligible.

13.3 SHIPPING AND NAVIGATION

13.3.1 Introduction

38. A number of stakeholders have been consulted with regard to shipping and navigation as well as review of the relevant literature such as the important 'Clyde Cruising Club Sailing Directions and Anchorages: Firth of Clyde'.

39. As a full Navigation Risk Assessment has been undertaken for the site separately this chapter will only provide a summary of the results of that assessment.

13.3.2 Site Characterisation;

40. Traffic in the general area is largely defined by larger vessels operating further offshore and smaller vessel operating inshore closer to the Mull.

41. The large vessels make use of the deep water International Maritime Organisation (IMO) Traffic Separation Scheme (TSS) that controls the north-west approaches to North Channel between Mull of Kintyre and Rathlin Island. Typically these consist of Cargo and Naval vessels.

42. Inshore, smaller vessels are typically operating including:

- small local passenger ferries including the *Lord of the Isles, Loch Ranza* and the *Isle of Lewis/Arran*.
- Recreational craft such as yachts as evident with two medium recreational craft user routes in the RYA "UK Coastal Atlas of Recreational Sailing (2008)" just off the Mull.
- Fishing vessels as described earlier in this chapter.

43. Common routes for yachts around the Mull are from Sanda Island to Gigha or Port Ellen and from Glenarm and Ballycastle marinas in Northern Ireland to Gigha and beyond. The requirement for all vessels to cross the TSS at right angles means that many craft from Northern Ireland pass through the wider Development site boundary. Although vessels will often be in water deeper than 50 m i.e. further offshore than the proposed deployment location, in favourable weather the preferred route round the Mull is 100 to 200 metres off the point (inshore of the proposed deployment location) to avoid the overfalls. The inshore tidal stream turns one hour earlier than the offshore stream and is particularly important for small craft going to, or coming from, the

[2] http://www.oceanflowenergy.com/project-details2.html

direction of Gigha. The area between a line running west from the Mull of Kintyre lighthouse to the southern edge of the Development Site boundary, for about a mile offshore is characterised by eddies and overfalls while the boundary between the inshore and offshore tidal streams can cause further turbulence. Moreover, a big westerly swell can exacerbate the turbulence of these waters as there will be interference between it and waves reflected back from the cliffs. Vessels going round the Mull do not have any possibility of shelter between Sanda Island and Gigha so timing to pass through this tidal gate is important. Moreover, allowance needs to be made for sudden unforecast changes in weather such as, for example, encountering fog once the Mull has been passed. Vessels may round the Mull at any time of day or night to catch the tide.

13.3.3 Assessment of potential effects;

44. Although the Development Site boundary covers a large area and the boundary is crossed by the two medium recreational craft user routes, the small scale of the single device, its submerged nature and location within the highly turbulent and region of strongest currents means that displacement of vessels from established routes is unlikely.

45. Temporary disturbance to regular traffic during construction is likely with a safety zone applied for as described earlier in this chapter.

46. The NRA provides a full assessment of the risks and identifies 52 potential hazards[3].

47. Crucially, the hazards are all deemed to be acceptable and the navigation risk resulting from the installation of the tidal device will be minimal. The overall density of present and anticipated traffic does not present a serious risk of collision although the device may be considered to be a hazard to surface navigation;

48. Although within the "Acceptable" category a mooring system failure during the operational phase of the project was considered to be the highest risk associated with the project.

13.3.4 Mitigation measures and residual effects;

49. To address surface navigation risk, marking of the device is an option although a marker itself may cause more of a risk that the standalone device. As described elsewhere in this chapter, the applicant intends to discuss this further with Marine Scotland and the Northern Lighthouse Board.

50. In dealing with risk of device/mooring failure, the following measures are proposed.

- The mooring system will be approved by an appropriate classification society; this is also a requirement of the Applicant's Agreement for Lease with The Crown Estate.
- Telemetry measures will be installed to continually monitor the device enabling the device to be switched off immediately in an emergency event.
- Regular inspections of the mooring system as part of the device operation and maintenance plan should be undertaken.
- The operator will develop appropriate contingency plans and emergency response procedures in the form of a The Emergency Response Cooperation Plan (ERCoP) in agreement with the relevant stakeholders.

[3] Although this is quite a large number of potential hazards, this is actually much less than typical for alternative marine renewable developments such as offshore wind farms.

13.3.5 Assessment of cumulative Effects;

51. The NRA assesses the cumulative effects of the Development. In terms of other marine energy projects, cumulative impacts with OceanFlow Energy's test device some 15 km east of the Development are not anticipated due to the geographic separation and small scale of both projects.

13.3.6 Summary of effects (residual effects);

52. It is anticipated that development will have not have any significant impact on shipping and navigation activities in the area with any effects being negligible.

13.4 MUNITIONS

13.4.1 Introduction

53. This section of this chapter addresses the potential threat to the Development posed by the remnants of historical military activity.

13.4.2 Site Characterisation

54. The level of military activity in western Scotland is considerable and large areas of the coastal waters are designated as military practice and exercise areas (PEXA). The Ministry of Defence (MOD) operates in the area of the Development Site and Submarine Exercise Areas are marked on the Admiralty Chart for the area, as shown on Figure 13.5. Currently, no live military exercises or training activities are permitted within the study site.

55. A Preliminary Unexploded Ordnance (UXO) Risk Assessment (desktop study) was commissioned to assess the likely threat level posed by munitions in the Argyll Tidal demonstration project area of interest. The assessment was completed by Ordtek Ltd and is attached as an appendix to this chapter for further reference.

56. Further, site data in the form of a series of drop-down video transects was recorded to inform characterisation and assessment of the benthic environment in the proposed deployment regions. No UXO was identified on the seabed during the video review process.

13.4.3 Assessment of Potential Effects

57. From the considerable historical catalogue used in the completion of the UXO desktop assessment, the Ordtek study found no direct evidence of the presence of live explosive ordnance within the Argyll Tidal project area of interest.

58. Numerous potential sources of UXO contamination of the site were highlighted – the three main sources are captured below:

    i. Explosive remnants of war from an action not recorded.

    ii. Munitions dumped and not recorded.

    iii. Migration from a known threat source.

59. Migration over long distances along the seabed due to tidal streams and currents is possible but unlikely and the area of interest is known to be unsuitable for trawling, eliminating commercial fisheries activity as a potential cause of migration.

60. The "live" UXO most likely to be found in the area of interest are sunken moored mines.

61. In terms of probability of encounter, munitions and ordnance paraphernalia used by the military during historical training exercises were deemed the most likely to have left a legacy of contamination, the consequence being that the potential UXO risk is elevated above what is considered background level for the UK.

13.4.4 Mitigation measures and residual effects;

62. The potential threat posed by UXO will be considered during construction planning. It is not anticipated that any direct mitigation measures will be required.

13.4.5 Summary of effects (residual effects);

63. The level of threat posed by UXO in the Development area of interest was determined to be slightly above that of background level for coastal waters of the UK but with appropriate pre-construction planning the risks will be reduced to as low as reasonably practical.

14 SEASCAPE AND LANDSCAPE, TOURISM, SOCIO-ECONOMIC AND TRAFFIC AND TRANSPORT CONSIDERATIONS

1. This chapter of the Environmental Appraisal (EA) evaluates the effects of the proposed Argyll Tidal Demonstrator Project (hereafter referred to as "the Development") on seascape and landscape resource and considers the impacts on tourism, traffic and transport and socio-economic effects.

14.1 SEASCAPE AND LANDSCAPE

14.1.1 Introduction

2. This section of this chapter evaluates the effects of the Development on the seascape and landscape resource.

14.1.2 Assessment methodology

3. As the CoRMaT device is fully submerged and no visual impact is expected, only the effects of the onshore infrastructure have been considered in this section. As discussed in Chapter 13, it is uncertain at this point whether the device will require to be marked by a surface buoy, there are pros and cons of having such a marker. A typical 'Yellow Special Marker Buoy' is shown in Figure 14.1.

Figure 14.1 Typical yellow special marker buoy

4. Marine Scotland has confirmed that no visual impact assessment is required for a marker buoy deployment.

14.1.3 Data sources

5. The following data sources have been used:

- Gilliespies Landscape Architects. Feb 2010. North and South Kintyre Landscape Capacity Study. Accessed at: http://www.argyll-bute.gov.uk/node/30769#lcs_kintyre
- Environmental Resources Management. 1996. Landscape assessment of Argyll and the Firth of Clyde. Report to Scottish Natural Heritage.
- Faber Maunsell and Metoc Plc. 2007. Scottish Marine Renewables SEA, Environmental Report. Report to the Scottish Executive.

14.1.4 Site characterisation

6. The peninsula of Kintyre is a smooth undulating plateau, in places dropping quite dramatically to the sea. Along the coast there are many opportunities to enjoy panoramic views to the west, to Jura and Islay and to the east to Arran and Bute. The Mull is covered by the local landscape designation 'Area of Panoramic Quality' in the local plan[1].

7. The landscape character of the Mull at the southwest tip of the peninsula to which the Development Site is adjacent has been described as 'Upland Forest Moor Mosaic' (Environmental Resources Management, 1996), broadly characterised by an upland plateau with rounded ridges, craggy outcrops and an irregular profile. There are very few buildings, occasional isolated dwellings on edges of moor and little public access.

8. The landscape is to a large extent inaccessible and relatively uninhabited. The nearest settlements are Campbeltown and Southend, some 20 km and 10 km from the Development Site respectively. There are no dwellings immediately adjacent to the Development Site, with the Mull of Kintyre Lighthouse being the only building on the coastline near the site.

9. Seascape may be defined as 'the coastal landscape and adjoining areas of open water, including views from land to sea, from sea to land and along the coastline' (DTI, 2005). The coastline of the southern end of the Mull of Kintyre has a seascape described as 'Rugged Coastal Shelf and Headlands with Wide Open Views to Sea' (Faber Maunsell and Metoc, 2007), which comprises wild rugged landscape with open views to sea.

10. The exposed nature and wildness of the landscape, along with epic scale views of sea and sky seascape make these elements sensitive to change.

14.1.5 Development design mitigation

11. The key design consideration of the device is the fully submerged nature which removes any visual impacts. Turning to the onshore infrastructure, the individual elements (described in Chapter 4) have been designed to minimise visual impacts.

[1] Argyll and Bute Local Plan (Adopted 2009)

14.1.5.1 Cable landing

12. The cable landing consists of a 12" outer diameter j-tube has been located within an existing crevice in the inter-tidal rock which should minimise protrusion and visibility of the landing infrastructure.

14.1.5.2 Transition joint and land cable

13. Where conditions permit, it is planned to bury the onshore cabling. Burial will be possible on the higher areas where ground conditions are appropriate for trenching e.g. for the sections of cable either side of the electrical compound. However, there are sections of the power transfer route where steep slopes and exposed ground will make trenching dangerous. For health and safety reasons, cables layed on these sections will be protected in a flexible plastic cable duct, either shallow buried or pinned to the surface. The colouration of the ducting will be chosen to blend with the existing vegetation and it is anticipated that the vegetation surrounding both the buried and exposed sections of the cable routes will quickly grow back and reduce visibility of the infrastructure[2]. Surface-layed route sections will be clearly marked and warning signs will be displayed as required.

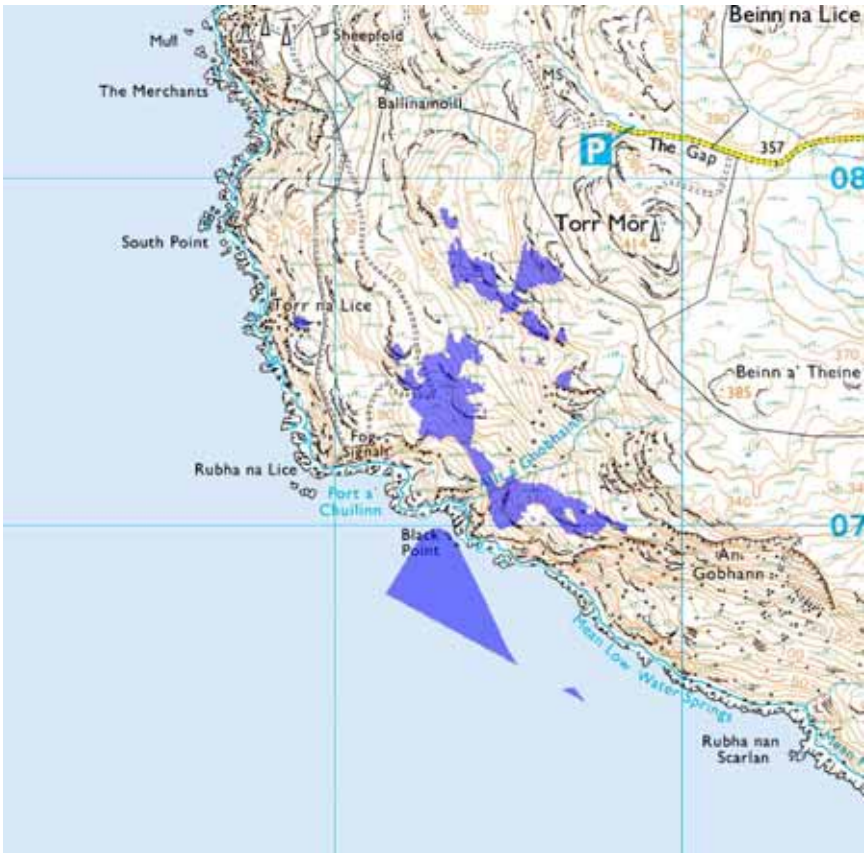
14.1.5.3 Electrical compound

14. The major component of the onshore infrastructure is the electrical compound which contains the containers housing the electrical equipment necessary to connect the device to the local Distribution Network. As well as ensuring a small footprint for the compound, the site has been chosen to minimise the visibility from the surrounding areas. The compound is set back approximately 200m from the coastline and sits in a natural depression, shielding the equipment from views from the sea and from the Mull of Kintyre lighthouse area to the north which is frequented by tourists.

15. The height of the containers within the compound has also been kept to the minimum required. The principle of adopting a vernacular appearance will be followed when considering the colouration of the electrical containers and any security fencing. The predicted visibility of the compound is shown in Figure 14.2.

[2] For information, historically air was pumped from the lighthouse to sound the foghorn and some sections of the pipe that was used to carry this air remain in place, these sections are well screened by existing vegetation.

Figure 14.2 - Theoretical compound viewshed



14.1.6 Assessment of potential effects;

16. As can be seen in Figure 14.2, the visual impact of the compound is very limited, with only limited views predicted from the sea as inshore mariners pass by and look up the valley in the proximity of the landing point near Black Point[3]. Wider views of the coastline from west of the Mull as shown on Figure 14.3 will remain unaffected with the compound not visible in views to either the lighthouse or the fog horn. If the receptor is close to shore they may have visibility of the cable landing and the immediate transition to the ducted cable of the higher ground.

[3] Please note that due to a lack of terrain data in the offshore region the viewshed appears to 'cut off' approximately 400m from the shoreline. However, views beyond this point are expected to be limited given the large separation (>750m) between the receptor and the compound.

Figure 14.3 – Typical view of the lighthouse from the sea

17. Onshore, there is no visibility from key locations where members of the public are likely to be present: the Mull lighthouse, the fog horn, the car park located at 'The Gap' or the telecommunications mast on Torr Mor. Only those on foot who have walked towards the fog horn via the higher track will be aware of the presence of the compound and associated infrastructure.

18. Although this EA does not require assessment of the grid connection elements, these were considered during the design of the project. By making use of the existing overhead line supplying the fog horn, the visual impact of the grid connection upgrades was unchanged.

14.1.7 Mitigation measures and residual effects;

19. No further mitigation measures are proposed.

14.1.8 Summary of effects (residual effects);

20. Due to the modest scale of the onshore infrastructure and limited number of people expected to be in the immediate vicinity of the electrical compound, it is anticipated that the Development will have not have any significant impact on the seascape and landscape resource with any effects being negligible.

14.2 SOCIO-ECONOMICS, TOURISM AND RECREATION, TRAFFIC

14.2.1 Introduction

21. This section evaluates the socio-economic impact of the Development and the effects on tourism and recreation in the region and briefly considers the traffic and transport impacts of the Development.

14.2.2 Data sources

22. This section is primarily based on information gathered from the following organisations through the scoping process when an array was being considered (before reducing project scale to single device only) and through subsequent dialogue with key stakeholders including:

- Royal Yachting Association (Scotland)
- Campbeltown Sailing Club
- Argyll and Bute Council
- Surfers Against Sewage
- Scottish Canoe Association
- Transport Scotland
- Machrihanish Golf Course

14.2.3 Site characterisation;

14.2.3.1 Socio-economics

23. The Kintyre Peninsula is located on the west of Scotland and stretches approximately 30 miles south from East Loch Tarbet to the Mull of Kintyre in the south. The local authority for the area is Argyll and Bute Council.

24. The principal town of the area is Campbeltown with a population of around 5000. The area's economy has long relied on fishing and farming although Campbeltown has a reputation as a producer of some of the world's finest single malt whisky. There are currently three active distilleries in the town, Glen Scotia, Glengyle and Springbank.

25. Kintyre has seen a decline in many of its industrial activities over the years, with fishing and the Campbeltown shipyard suffering and closure of the Machrihanish Air Force Base. Regeneration through the creation of a wind turbine assembly and tower fabrication facility at Machrihanish has been unsteady.

14.2.3.2 Tourism and recreation

26. The rugged and remote nature and wide sea views of the Mull of Kintyre peninsula are to a large extent the foundation for tourism and recreation in the area. Sir Paul McCartney's' 1977 track ‘Mull of Kintyre’ performed by Wings was written in tribute to the picturesque peninsula. Local attractions and popular recreational activities include the items listed below and shown in Figure 14.4:

- Walking – The Kintyre Way stretches some 87 miles from Tarbert at the north end of the peninsula, to Dunaverty in the south and allows walkers to experience the communities and landscape the peninsula has to offer.

- The Kintyre Trail – A road based trail between the towns and villages on Kintyre highlighting the features to be taken in along the way.

- Wildlife and Nature – The Scottish Wildlife's Trust Largiebaan Reserve attracts visitors keen to see seabirds, raptors and a range of flora. The Seabird Observatory at Machrihanish is a popular location for watching local wildlife and attracted over 2700 visitors in 2006. Wildlife watching boat trips run out of Campbeltown to Sanda Island, Ailsa Craig and the Mull of Kintyre.

- Golf – Kintyre is home to 5 golf courses including the classic Machrihanish links course which was ranked the number 39 course outside of the United States by Golf Digest in 2005.

- Whisky – Campbeltown is home to 3 whisky distilleries, Springbank and Glengyle open to visitors by way of appointment.

- Surfing at the Machrihanish and Dunaverty beaches.

- Sea kayakers traverse the Mull of Kintyre and also use the headland for tidal training.

- Sailing – Where the sea state permits, yachting is popular in the waters around the Mull.

- Angling – Both sea fishing and fresh-water fly fishing take place.

- Diving – Open water dives take place at various sites around the Kintyre Peninsula, including Campbeltown Loch (wreck of the Breda), near the island of Sanda and off Machrihanish.

- Campbeltown hosts an annual music festival and annual agricultural show.

Figure 14.4 – Tourism activities around the Mull of Kintyre

14.2.3.3 Transport and Traffic

27. The Kintyre Peninsula is primarily served by the A83 that runs down the western coast of the peninsula before heading southeast to Campbeltown. From Campbeltown, two B-roads head south towards Southend (B842) and west towards Machrihanish (B843) respectively. Access to the coast immediately adjacent to the Development Site is limited with just a single track road heading

from Southend to a location known as 'The Gap' immediately above the Mull of Kintyre lighthouse. A twisty narrow private road then leads from this point down to the lighthouse.

28. Campbeltown Airport lies to the North of the Development Site. The airport is a former RAF air base but since 1996 has been operated by Highlands and Islands Airports. The airport offers a twice daily service from Glasgow. In addition to scheduled service flights, the airport can accommodate the needs of most air services such as training flights, aircraft trials and charter flights.

14.2.4 Assessment of potential effects;

14.2.4.1 Socio-economics

29. In terms of socio-economic effects, the Development Site has already provided some local employment opportunities during the feasibility stages including contracts to local wildlife surveyors, transport contractors and vessel providers. In addition, with multiple personnel working on the project, revenue has been generated for local hoteliers and other local businesses.

30. These opportunities will increase during the construction phase with limited longer-term revenues throughout its operational life. Specifically, use of the facilities at Machrihanish Airbase for the cable-in-pipe preparatory installation works has been discussed and agreed in principal with Machrihanish Airbase Community Company. Given the various marine activities that are proposed, there will also be further opportunities relating to vessels and diving operations from Campbeltown Harbour.

14.2.4.2 Tourism and recreation

31. With regard tourism and recreational activities, it is recognised that the Development could have a potential effect on yachting in the area. Concerns have been raised with regard to the navigational risk associated with any surface markers. This has been assessed in detail in the NRA and concludes that impact on navigation resulting from the installation of the tidal device will be minimal.

32. The strong tidal current and exposed nature of the area means that any diving in this particular area would only be undertaken by experienced divers and therefore the likelihood of recreational diving in this area is expected to be low. Again, the strong tides at the device location mean it is more likely that anyone sea kayaking around the Mull will be further inshore of the device. There will also be no infrastructure at the surface between the device and the cable landing. With regard to surfing at Dunaverty Bay, the Development is located some 10km from the beach and will not affect swell conditions on that surf location.

33. With regard to walkers, the route of the Kintyre Way at its closest remains some 7km from the Development but there are also other visitors to the Lighthouse who drive the single track road for the spectacular sea views and wild moorland. There will be no visibility of the Development from either the car park at 'The Gap' or at the lighthouse itself. Only those who venture further from the lighthouse over challenging terrain will be able to view the onshore infrastructure. There is the potential that the Development itself will attract some people to the Mull. However, these numbers are expected to be low, particularly as the device will be fully submerged.

14.2.4.3 Traffic and transport

34. As described in Chapter 5, during construction and decommissioning there will be a temporary increase in vehicle movements along the minor and private roads from Southend to the lighthouse and there is the potential for short term disruption to local traffic and access. As construction is

likely to take place in the summer months, this may coincide with an increased number of visitors to the lighthouse at that time of year. However, for the short construction period envisaged and with the traffic control measures proposed during this period including the use of a convoy vehicle for the container deliveries and a consideration of delivery timings to avoid peak road usage the impact during construction is not considered to be significant.

35. Once the Development is operational, it is expected that the number of vehicles movements to the site will not be much greater than those already associated with the operation and maintenance of the lighthouse so any effects will be negligible.

14.2.5 Mitigation measures and residual effects;

36. Where possible, the applicant will continue to seek local input and contractors involvement in the project.

37. In terms recreational marine users, the applicant intends to consult with RYA Scotland on how best to promulgate information about the Development to the recreational sector.

14.2.6 Summary of effects (residual effects);

38. It is anticipated that the Development will have a minor positive socio-economic impact and with any effects on tourism, recreation and traffic minimal and limited to the short construction period. Once in operation the effect of the Development on these aspects will be negligible.

15 ECOLOGY

15.1 INTRODUCTION

1. This chapter of the Environmental Appraisal (EA) evaluates the effects of the proposed Argyll Tidal Demonstrator Project (hereafter referred to as "the Development") on the ecological resource. The assessment was completed by MacArthur Green Ltd.

2. In order to determine the potential ecological impacts of the Development, this chapter:

    - describes the current ecological condition of the Development site and the immediate surrounding area;
    - identifies the potential for ecological impacts and the potential for mitigation of these impacts; and
    - assesses the residual impacts remaining after mitigation has been implemented.

3. This chapter considers impacts arising during the construction, operation and decommissioning phases of the Development. The Development is described in full within Chapter 4: Project Description.

4. This Chapter is supported by the following Technical Appendices:

    - National Vegetation Classification Survey;
    - Terrestrial Protected Species Surveys.

15.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

15.2.1 Legislation and guidance

5. The following legislation and guidance are considered as part of the assessment.

    - Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna ("Habitats Directive");
    - Council Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy ("Water Framework Directive");
    - Environmental Impact Assessment Directive 85/337/EEC (as amended);
    - Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations (2011);
    - The Water Environment and Water Services (Scotland) Act 2003 (WEWS);
    - The Wildlife and Countryside Act 1981 (as amended);
    - Nature Conservation (Scotland) Act 2004 (as amended);
    - The Wildlife and Natural Environment (Scotland) Act 2011;
    - The Protection of Badgers Act 1992;

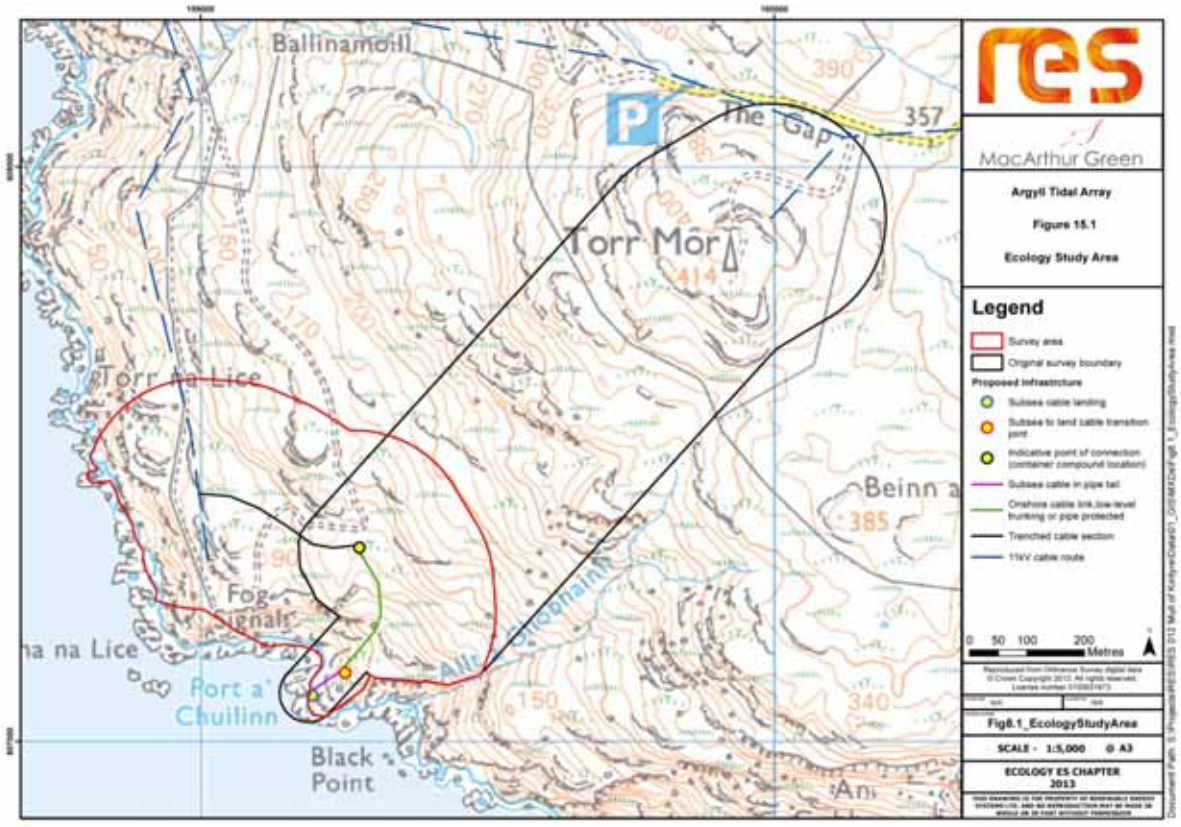
- The Conservation (Natural Habitats &c.) Regulations 1994 (as amended) (the Habitats Regulations);
- SERAD (Scottish Executive Rural Affairs Department) 2000. Habitats and Birds Directives, Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('The Habitats and Birds Directives'). Revised Guidance Updating Scottish Office Circular No 6/1995;
- Policy Advice Note PAN 1/2013 - Environmental Impact Assessment (Scottish Government 2013);
- Planning Circular 3 2011;
- Nature Conservancy Council (1989). Guidelines for selection of biological SSSIs;
- Argyll and Bute Local Biodiversity Action Plan (2009); and
- IEEM (2006) Guidelines for ecological impact assessment in the UK.

15.2.2 Baseline characterisation

15.2.2.1 Study area

6. The area of field survey in which habitat and protected species surveys were undertaken was based upon a preliminary layout which shared the same cable land fall location as the finalised version, but followed a cable route north-east to a connection at Torr Môr (Figure 15.1).

Figure 15.1 - Ecology study area



7. Ecological surveys were undertaken within a 200m buffer of this initial proposed trenched cable route (except at the landfall location on the upper rocky shore where a 50m buffer was used due to the predominance of bare rock along the shore and safety access restrictions – Figure 15.1). A subsequent change in the proposed infrastructure subsequent to survey completion meant that some of the layout (mainly the trenched cable section) was outside of the original area surveyed. However given surveyor experience of the study area, its small size, the type of habitats present, the surveys carried out for the earlier layout (which still cover parts of the proposed layout), and photos of the study area, it was possible with the aid of high resolution imagery to use this information to determine the habitats present.

8. Consequently the study area comprises the finalised cable route with a 200m buffer, although the assessment is also informed by results of any surveyed areas outside of this study area.

15.2.2.2 Desk study

9. A desk study was undertaken to collate available ecological information in relation to the Development. This comprised a thorough search of available online datasets as provided by the National Biodiversity Network (NBN) Gateway and SNH's Sitelink (www.gateway.snh.gov.uk). The desk study searched for records within 5 km of the Development boundary; the results are summarised in Section 15.3 'Baseline Conditions'.

15.2.2.3 Field surveys

10. The following field surveys were undertaken in October 2013 to establish the baseline ecological conditions in the (preliminary) study area, and were undertaken in line with standard methodologies and guidance. An interpretation of imagery of un-surveyed areas of the finalised route was also carried out:

    - National Vegetation Classification (NVC) survey;
    - Badger survey;
    - Otter survey;
    - Water vole survey; and
    - Reptile survey.

11. The full suite of survey methods and results is provided within the Technical Appendices.

15.2.3 Methodology for Assessing Wider-Countryside Interests:

12. The evaluation for wider-countryside interests (interests unrelated to a Natura 2000 site) involves the following process:

    - Identification of the potential effect of the Development;
    - Consideration of the likelihood of occurrence of potential effects where appropriate;
    - Defining the Nature Conservation Importance of the habitats or species' populations present;
    - Establishing the habitat or species population's Conservation Status;
    - Establishing the magnitude of the Likely Effect (both spatial and temporal);

- Based on the above information, a judgement is made as to whether or not the identified effect is significant with respect to the EIA Regulations;
- If a potential effect is determined to be significant, measures to mitigate or compensate the effect are suggested where required;
- Opportunities for enhancement are considered where appropriate;
- Residual effects after mitigation, compensation or enhancement are considered.

13. Each effect should be contextualised for each habitat/population. In the case of non-designated habitats or populations, the reference is at the Natural Heritage Zone scale, which has been determined by SNH, based on the separation of different areas across Scotland that host similar ecological characteristics. The magnitude of the effect on the receptor can therefore compared against the NHZ habitat extent or population, which is in this case NHZ 14 (Argyll and West Islands). In certain circumstances it may also be relevant to compare effects against the national extent of habitat or reference population for a particular receptor.

15.2.4 Determining Nature Conservation Value

14. Nature Conservation Value is defined on the basis of the geographic scale given in Table 15.1 (which follows standard IEEM (2006) guidance). Attributing a value to a receptor is generally straightforward in the case of designated sites, as the designations themselves are normally indicative of a value level. For example, an SAC is undoubtedly of European (International) importance. In the case of species, assigning value is less straightforward as detailed in IEEM (2006) *'it is necessary to consider its distribution and status, including a consideration of trends based on available historical records'*. This means that even though a species may be protected through legislation at a national or international level, the relative value of the population on site may be quite different (e.g. the site population may consist of a single transitory animal, which within the context of a thriving local/regional/national population of a species, is clearly of local or regional value.

15. Where possible, the valuation of habitat/populations within this assessment will make use of any relevant published evaluation criteria (e.g. Nature Conservancy Council guidance on selection of biological Site of Special Scientific Interest (SSSIs)). Furthermore, JNCC/NBN guidance (2008) has been consulted where relevant in order that cross-referencing of classifications within different systems can be standardised (e.g. correctly matching NVC types with Annex I habitats where relevant etc).

16. The term used for the ecological receptors affected at the site is 'Valued Ecological Receptors' (VERs).

17. Where relevant, information regarding the particular receptor's conservation status shall also be considered in order to fully define its value. This will enable an appreciation of current population or habitat trends to be incorporated into the assessment.

Table 15.1 - Approach to evaluating valued ecological receptors

Value	Description
International	An internationally designated site (e.g., SAC), or site meeting criteria for international designations.
	Species present in internationally important numbers (>1% of biogeographic populations).
National	A nationally designated site (SSSI, or a National Nature Reserve, NNR), or sites meeting the criteria for national designation.
	Species present in nationally important numbers (>1% UK population).
	Viable areas of priority habitat listed on Annex I of the Habitats Directive and smaller areas of such habitat that are essential to maintain the viability of that ecological resource.
Regional (Natural Heritage Zone or Local Authority Area)	Species present in regionally important numbers (>1% of Regional or Natural Heritage Zone (NHZ) population); and regionally important populations of a species.
	Regionally significant and viable areas of key habitat identified as being of regional value in the appropriate NHZ.
Local	Local Nature Reserves.
	Areas of semi-natural ancient woodland smaller than 0.25 ha.
	Areas of habitat or species considered to appreciably enrich the ecological resource within the local context, e.g., species-rich flushes or hedgerows.
Negligible	Usually widespread and common habitats and species. Receptors falling below local value are not normally considered in detail in the assessment process.

18. The following sections further define the methods used to evaluate magnitude of likely effects and Nature Conservation Value.

15.2.5 Method used to evaluate the magnitude of likely effects

19. Effect magnitude refers to changes in the extent and integrity of an ecological receptor. The only definition of ecological 'integrity' is found within circular 6/1995 (2000) which states that "*The integrity of a site is the coherence of its ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified*". Although this definition is used specifically regarding European level designated sites (SACs and SPAs), it is applied to wider countryside habitats and species for the purposes of this assessment.

20. Determining the magnitude of any likely effects requires an understanding of how the ecological receptors are likely to respond to the Development. This change can occur during construction, operation or after the decommissioning of the Development.

Effects can be adverse, neutral or beneficial. Effects are judged in terms of magnitude in space and time. There are five levels of spatial effects and four levels of temporal effects as described in

21. Table 15.2 and Table 15.3.

Table 15.2 - Definition of spatial effect magnitude upon the VERs

Spatial Magnitude	Definition
Very High	Would cause the loss of the majority of a receptor (>80%), or would be sufficient to damage a receptor sufficient to immediately affect its viability.
High	Would have a major effect on the receptor, sufficient to result in short-term losses and impacts upon its long-term viability. For example, more than 20% habitat loss or damage.
Moderate	Would affect the receptor in the short and medium-term, but should not alter its long-term viability. For example, between 10 - 20% habitat loss or damage.
Low	Would have a minor effect upon the receptor, either of sufficiently small-scale or of short duration to cause no long-term harm. For example, less than 10% habitat loss or damage.

Table 15.3 - Temporal effect magnitude

Temporal Magnitude	Definition
Permanent	Effects continuing indefinitely beyond the span of one human generation (taken as 26+ years), except where there is likely to be substantial improvement after this period in which case the category Long Term may be more appropriate.
Long term	Between 15 years up to (and including) 25 years.
Medium term	Between 5 years up to (but not including) 15 years.
Short term	Up to (but not including) 5 years.
Negligible	No effect.

15.2.6 Significance criteria

22. Table 15.4 outlines the matrix used in assessing the significance of each impact to habitats or species using both the Value of the VER and the Magnitude of the Impact. This provides a 'Worst Case scenario' and does not take into consideration the likelihood of occurrence. The magnitude of the Impact may be influenced by the sensitivity of the receptor to the potential impact.

Table 15.4 - Significance prediction matrix

Magnitude of Impact	Nature Conservation Value				
	Negligible	Local	Regional	National	International
Very high	Minor	Moderate	Major	Major	Major
High	Negligible	Minor	Moderate	Major	Major
Moderate	Negligible	Minor	Minor	Moderate	Moderate
Low	Negligible	Negligible	Negligible	Minor	Minor

23. Table 15.5 details the significance criteria that have been used in assessing the effects of the Development:

Table 15.5 - Significance criteria

Significance Level	Definition
Major	This is a significant effect, as the effect is likely to result in a long term significant adverse effect on the integrity of the receptor.
Moderate	This is a significant effect, as the effect is likely to result in a medium term or partially significant adverse effect on the integrity of the receptor.
Minor	The effect is likely to adversely affect the receptor at an inconsequential level by virtue of its limited duration and/or extent, but there will probably be no effect on its integrity. This is not a significant effect.
Negligible	No material effect. This is not a significant effect.

24. Using these definitions, it must be decided whether there will be any effects which will be sufficient to adversely affect the VER to the extent that its Conservation Status deteriorates above and beyond that which would be expected should baseline conditions remain (i.e. the 'do nothing' scenario). Furthermore, these predictions will be given with a level of confidence relative to the effect being assessed (in line with IEEM 2006).

25. It should be noted that any residual effect (the effect after the implementation of mitigation) which remains at the level of 'Moderate' or 'Major' is regarded by the EIA Regulations as being of significant effect.

26. Residual Impact Significance is assessed after any mitigation measures are applied. A conclusion on the significance of residual impacts is then drawn, based on the same process as described above.

15.2.7 Cumulative assessment

27. Cumulative effects are not possible to evaluate through the study of one development in isolation, but require the assessment of effects when combined with other developments or activities regulated by the EIA process. The context in which these effects are considered is heavily dependent on the ecology of the receptor assessed. For example, for water voles it may be appropriate to consider effects specific to individual catchments, should the distance between neighbouring catchments be sufficient to assume no movement of animals between them. Therefore an assessment of cumulative impacts is made for each receptor, appropriate to its ecology.

15.2.8 Limitations

28. The limitations associated with the impact assessment of the Development are outlined below.

29. Limitations exist with regard to the knowledge base on how some species, and the populations to which they belong, react to effects. A precautionary approach is taken in these circumstances, and as such it is considered that these limitations do not affect the robustness of this assessment.

30. The NVC survey was carried out on the 23rd October 2013; this is not the optimal season for carrying out vegetation surveys. However, despite the time of year a large number of species are still readily identifiable in October, particularly the species which were encountered within the habitats of the survey area such as the rushes, sub-shrubs, bracken and other common vascular plants present. Therefore the still readily identifiable nature of many plants means the survey can still be relied upon to accurately represent the habitats present within the study area.

31. As described within Section 15.2.2.1 'Study Area' above the Development infrastructure layout changed post-baseline surveys and as a result a section of the layout was not surveyed in the field as it fell outside of the original study area. However the use of high resolution aerial imagery, photographs of the area and knowledge gained from the initial surveys meant it was possible to map and classify the small un-surveyed section, and this is therefore not considered a significant constraint for assessing habitats.

32. Given the type of habitats in this area, their marginal value to protected species and the level of protected species use of the original larger study area (i.e. no signs) then this is not considered a significant constraint to the assessment of protected species.

33. The study area contained very steep slopes to the sea in many areas and some patches were surveyed from suitable vantage points for Health & Safety concerns. Using surrounding accessible habitats as a proxy for the communities present, these habitats were still easily identifiable and are not considered a constraint.

15.3 BASELINE CONDITIONS

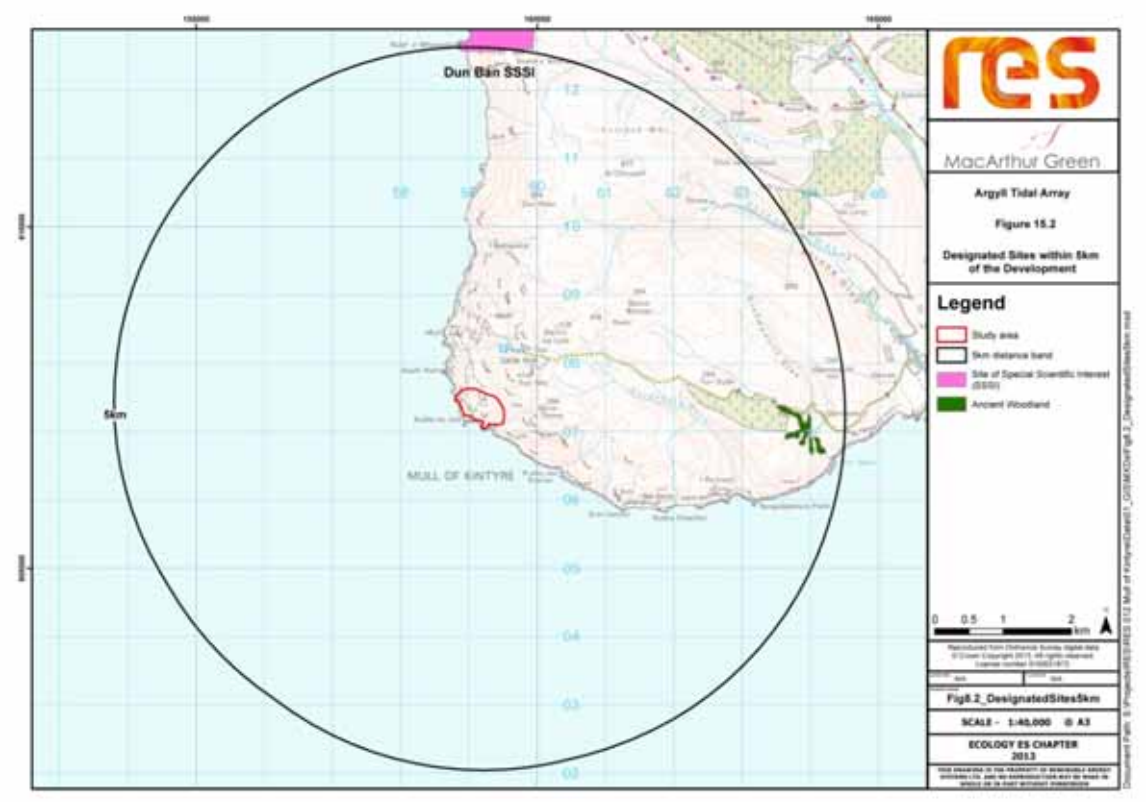
15.3.1 Desk study

34. No designated sites are present within the Development site. The following designated site is present within 5 km of the boundary of the Development (from sites designated for their ecological importance only) (Figure 15.2)):

    - Dun Ban Site of Special Scientific Interest (SSSI) - designated for its subalpine calcareous grassland and tall herb ledge habitats. Located approximately 5 km to the north of the study area.

35. An area of ancient woodland is also located around 4km east of the study area (Figure 15.2).

Figure 15.2 - Designated Sites within 5km



36. The survey area falls within OS tile NR50 which is a small tile that covers the south-west corner of the Mull of Kintyre, a search on NBN Gateway for species records in this tile from 1990 onwards contained records for the following:

    - Mountain hare *Lepus timidus*; and
    - Pipistrelle bat *Pipistrellus* sp.

37. No evidence of either of these species was however recorded during baseline field surveys.

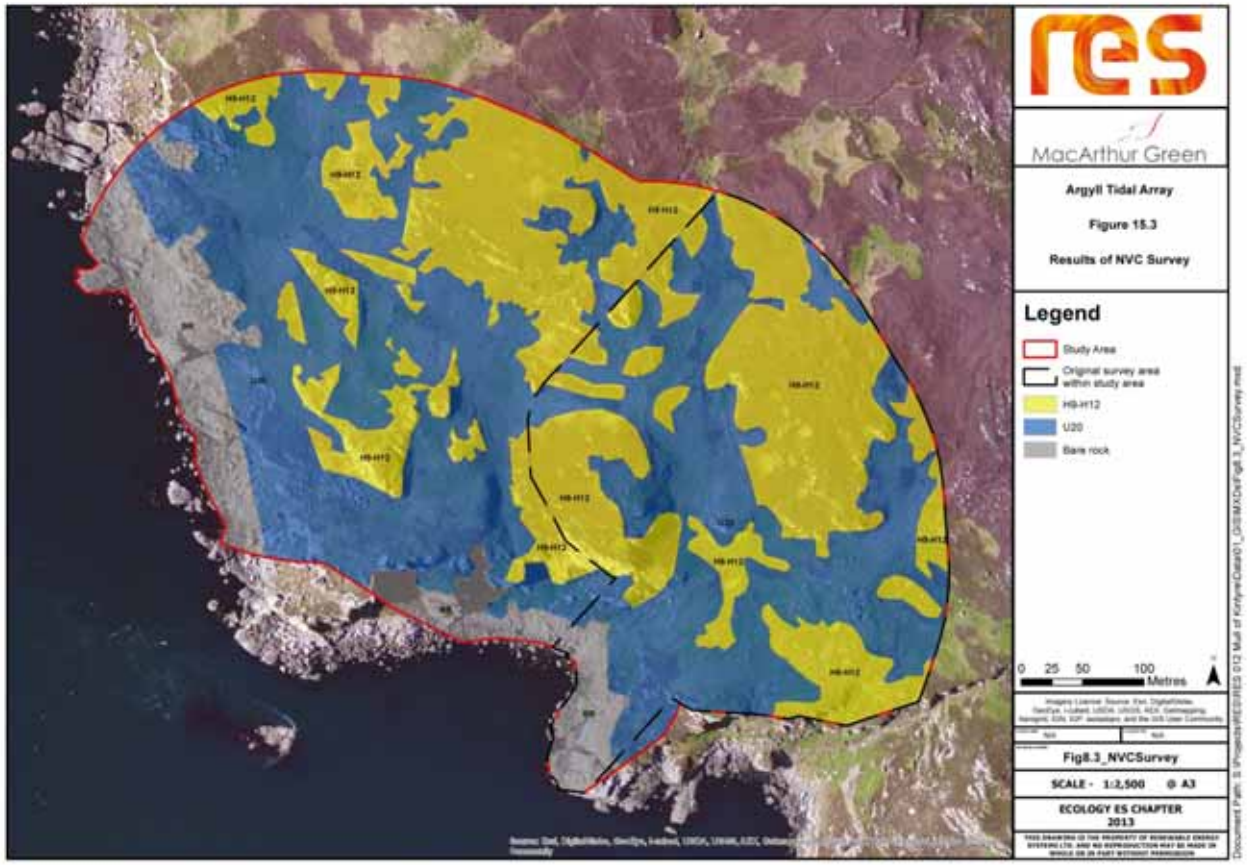
15.3.2 Field surveys

15.3.2.1 NVC habitat surveys

38. Three classifiable types of vegetation and habitat were recorded in the study area (Figure 15.3). These are:

    - Dry Heath: H9-H12 “Intermediate”; and
    - Grassland: U4 and U20.

Figure 15.3 - NVC survey results



39. Most areas were able to be assigned a conventional NVC community, however some bare rock areas did not fit into any NVC community. These are common within many of the other communities described above, particularly the dry heaths over steep rocky outcrops. A further community present over large parts of the study area, which is not accurately described in the NVC but exhibits many of the characteristics of two separate heath communities, is described as an intermediate community between the two. In this assessment it has been termed "H9-H12 Intermediate heath". For further details, see the Technical Appendix.

40. No habitats recorded within the updated study area were considered to be dependent on groundwater as per SEPA guidance (SEPA, 2012).

41. A summary of the habitats present is presented below.

15.3.2.1.1 Dry heath:

42. Dry heath is abundant in the study area on the steep rocky slopes and outcrops towards the shoreline.

43. **H9-H12 Intermediate heath:** The dry heath within the study area does not fit readily within conventional NVC community codes or habitat descriptions. It is very species poor and the vascular cover is almost exclusively dense *Calluna vulgaris,* infrequently interrupted with a sparse covering of scattered grasses, sedges or other sub-shrub associates. The basal layer, when not completely shaded out by *Calluna vulgaris* is also species poor and consists of a carpet of a few bulky mosses and occasionally *Cladonia* spp. lichens. This habitat type is quite common in parts of Scotland.

44. This habitat dominates over the study area's steep slopes and rocky outcrops with thin peats and soils. A number of the patches in the wider area have been burned, and in these areas the *Calluna vulgaris* is more sparse and scorched and contains some grasses as well as many young shoots of *Calluna vulgaris* and some sparse *Erica cineria*. Although it is species-poor and in degraded condition, being subject to burning and bracken encroachment, it technically qualifies as a Habitats Directive (92/43/EEC) Annex I community 'European Dry Heath'.

15.3.2.1.2 Calcifugous Grassland

45. **U20** *Pteridium aquilinum – Galium saxatile* **grassland:** This grassland community occurs on well aerated and often moist soils which are base-poor to circumneutral (Cooper, 1997). It is a community of little ecological value. Areas where *Calluna vulgaris* thins out are dominated by *Pteridium aquilinum* within the study area. U20 is very extensive throughout the study area on slopes towards the shoreline. These areas mapped as U20 were very heavily dominated by *Pteridium aquilinum* and frequent scattered associates including *Galium saxatile* and *Agrostis* spp.

46. **U4** *Festuca ovina – Agrostis capillaris – Galium saxatile* **grassland**: U4 grassland was not noted within the updated study area in an extent large enough to map, however it was noted as occasional small fragments within the U20 community were the bracken cover subsided and allowed the grass sward to be more prominent. These areas contained many of the common associates of which *Agrostis* spp., are the most abundant.

15.3.2.2 Protected species surveys

47. The surveys found no evidence of protected species within the area surveyed and prevailing habitats largely unsuitable for all species surveyed. Further details of the surveys are presented in the Technical Appendix.

15.3.2.2.1 Otter

48. No signs of otter were found within the original study area. The only watercourse in and around the study area is the *Allt a Ghobhainh*; this is a small, narrow, steep and rocky burn which is potentially of marginal value to any otters in the area as it offers negligible foraging or commuting potential. The watercourse is also very exposed with no areas for holts and few, if any, suitable for couches.

15.3.2.2.2 Water Vole

49. No water vole signs were recorded along any watercourse, flush, or drainage channels within the original study area during surveys. Suitable habitats for water vole are scarce; most watercourses were of low suitability given the gradient, substrates, fast flows and limited food supply present. A few smaller marshy and flushed areas were marginally better as abundant *Juncus* spp. were present, however no signs were found and they are unlikely to be present within the study area.

15.3.2.2.3 Badger

50. No evidence of badger was found within the original study area during surveys. The land in and around the study area is generally peat based and wet, or very shallow and rocky, this combined with an absence of any woodland or scrub cover in the area makes the area largely unsuitable for sett building. There is potential for foraging if badgers are present within the wider area but this is also rather limited and no field signs were found. It is unlikely badgers inhabit the study area.

15.3.2.2.4 Reptiles

51. No reptiles were noted during surveys.

15.4 DEVELOPMENT DESIGN MITIGATION

52. None required.

15.5 ASSESSMENT OF POTENTIAL EFFECTS

15.5.1 Scope of assessment

53. This section provides an assessment of the likely effects of the Development on the VERs. For each VER, the potential effect is assessed for the construction (installation) and operation phases of the Development's terrestrial cable route. Decommissioning effects have been scoped out of the assessment as although the exact process of decommissioning is not known at present (see Chapter 4), the effects, if any, will be of a similar type, and a similar or lesser magnitude than during the construction phase and so do not require separate consideration.

54. Only those receptors confirmed across the Development site and considered to be 'Valued' (i.e. VERs) are detailed below.

55. Based on the results presented in Section 15.3 'Baseline Conditions' above, all protected species are scoped out of the assessment due to the lack of records during baseline surveys and the general low suitability of habitat for each species. No effects are therefore predicted due to the Development.

56. The Dun Ban SSSI, and area of ancient woodland (Figure 15.2), are also scoped out of the assessment due to their distance from the Development. As the SSSI's designated feature is vegetation and the Development is not hydrologically connected to it, or to the ancient woodland area, there will be no effects on these receptors.

57. A summary of the habitats identified as VERs within the site is given in Table 15.6, together with the justification for this qualification. This shows that only dry heath is the only VER scoped in to the assessment.

Table 15.6 - Valued Ecological Receptors

Valued Ecological Receptor	Nature Conservation Value	Relevant Legislation/Guidance & Justification
Dry heath	Local	Dry heath is listed as an Annex 1 habitat in the Habitats Directive and is part of the Lowland and Upland Heath Habitat Action in the Argyll & Bute LBAP. However, due to the habitat's species-poor and degraded condition within the study area, it is not considered to qualify as an Annex I habitat. It is therefore considered to be no greater than Local Nature Conservation Value.
Calcifugous grassland	Negligible	U20 is a widespread grassland across the UK and is of little ecological value. Although more confined to upland areas in Scotland, the extent of U4 grassland was negligible even at a local level. The receptor is therefore of Negligible Nature Conservation Value and scoped out of the assessment.

58. This assessment concentrates on the potential effects of construction and operation of the Development upon those VERs identified during survey work. In terms of impacts upon habitats,

effects can be direct (i.e. derived from land-take) and indirect (i.e. changes caused by effects to supporting systems such as groundwater).

15.5.2 Construction effects

15.5.2.1 Dry heath

59. The most tangible effect during the installation of the cable route will be direct habitat loss and indirect (through drying effects upon neighbouring habitats) habitat loss.

60. Dry heath is a common habitat type within the study area. Evidence of muirburn has caused some degradation to this habitat and there is bracken encroachment. The total amount of direct habitat loss will be much less than the 5.3 ha of dry heath recorded within the study area, which represents 46.3% of the overall habitat extent that was surveyed. Indirect habitat loss/change is also likely to be trivial within a local or regional context. When considering the above, and accounting for the relative abundance of the habitat within the wider area (Figure 15.3), an effect magnitude of Low spatial and Long Term temporal is assigned.

61. Although European Dry Heath is a Habitats Directive (92/43/EEC) Annex I community, within the study area the dry heath is species-poor and in degraded condition, being subject to burning and bracken encroachment. The habitat therefore has a Nature Conservation Value of Local; the overall effect significance is therefore considered to be Negligible and Not Significant in the context of the EIA Regulations (Table 15.4).

15.5.3 Operational effects

15.5.3.1 Dry heath

62. Habitat loss during the construction phase has been considered in the Construction Effects section above. No further effects are predicted during the operational phase.

15.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

15.6.1 Measures prior to construction

63. Although no significant effects have been identified as a result of the Development, it is considered necessary that mitigation measures are implemented in order that these effects identified can be avoided or reduced further, where appropriate.

64. Pollution Prevention Measures will be included in the Construction Method Statement to be agreed with Argyll & Bute Council in consultation with SNH and SEPA in advance of construction. These measures will ensure no likely significant effect will occur on dry heath habitat.

65. Although the habitat is of low potential importance for breeding birds, in line with The Wildlife and Countryside Act 1981 all reasonable measures will be taken to avoid disturbance to breeding birds and to avoid damage to, or destruction of, nest sites.

15.6.2 Construction measures

66. The agreed pollution prevention measures will be implemented by the developer and infrastructure contractor.

67. A briefing with regards the ecological sensitivities on the site will be given to all site personnel prior to their commencing work on the site.

15.6.3 Residual effects

68. With the implementation of the mitigation measures as described above, it is considered that all construction and operational effects will remain Negligible and will be therefore be Not Significant in the context of the EIA Regulations.

15.7 ASSESSMENT OF CUMULATIVE EFFECTS

69. This section is required to assess the potential cumulative effects of the Development combined with other nearby existing or proposed projects or activities that are subject to an EIA process. The primary concern with regard to the assessment of cumulative impacts is to identify situations where impacts on habitats or species populations that may be acceptable from individual developments or activities, are judged to be unacceptable combined with impacts from other developments or activities.

70. The Assessment of Potential Effects (see 15.5) that dealt with the Development alone concluded that no effects will occur beyond a Negligible level of significance for any VER, which is not significant in the context of the EIA Regulations. As such, no cumulative effects are predicted, when the Development is combined with any other projects or activities.

15.8 SUMMARY OF EFFECTS (RESIDUAL EFFECTS)

71. The only VER scoped in to the assessment of effects of the Development, both alone and cumulatively, was dry heath habitat. Unmitigated a Negligible level of effect was predicted during the construction phase due to habitat loss. With the mitigation measures outlined in Section 15.6 to give greater confidence in the conclusions, the residual effect remains of Negligible significance.

15.9 STATEMENT OF SIGNIFICANCE

72. When considering the assessment detailed above it is concluded that there will be no more than a Negligible level of effect due to the Development, alone and cumulatively, on the ecological resources within the study area. Consequently the effects of the Development will be not Significant under the terms of the EIA Regulations, particularly when mitigation measures outlined in Section 15.6 are deployed.

15.10 REFERENCES

Cooper, E.A. (1997). *Summary Descriptions of National Vegetation Classification grassland and montane communities*. ISBN 1 86107 433 3

IEEM (2006) *Guidelines for ecological impact assessment in the UK.* Chartered Institute of Ecology and Environmental Management.

JNCC/NBN (2008). *NVC & Other Classification* (webpage and link to corresponding xls) http://jncc.defra.gov.uk/page-4266.

SEPA. (2012). *Guidance Note 4 - Planning Advice on Windfarm Developments*. Scottish Environment Protection Agency.

16 SUMMARY

16.1 BACKGROUND

1. Argyll Tidal Ltd ("the Applicant") is proposing to install a single CoRMaT tidal device ("the Development") off the southwest tip of the Mull of Kintyre, Argyll and Bute.

2. The project consists of offshore and onshore elements and the Applicant is therefore applying to Marine Scotland Licensing (MS-LOT) for a Marine License to deploy and operate the Development and to Argyll and Bute Council for planning permission for the onshore elements of the Development.

3. The offshore elements of the project are the CoRMAT tidal turbine and associated pin pile foundations and moorings. Power is brought to shore via a cable protected within a pipe on the seabed. Onshore elements include the cable landing and onshore cable transition from the landing location to a small electrical compound. From this point, a short section of trenched cable is used to tee-in to the existing 11kV Distribution Network.

4. This document is an Environmental Appraisal (EA) for the Development that has been collated by the RES Ltd ("the Agent") to provide information to MS-LOT, Argyll and Bute Council, statutory consultees and other interested parties about the proposed development and its likely environmental effects. The purpose is to identify likely significant environmental impacts so that these can be taken into account in arriving at the planning and consenting decisions.

5. In addition to the EA a Navigational Risk Assessment (NRA) has also been prepared.

16.2 ENVIRONMENTAL APPRAISAL

6. This EA is based on desktop studies of existing information, site specific surveys - both onshore and offshore, consultation with stakeholders and a 12 month vantage point environmental survey.

16.2.1 Biological and ecological environment

7. The benthic ecology assessment concluded that there is limited likelihood for significant areas of seabed habitat with features of conservation importance and no Priority Marine Features were evident from the video data collected. The location of the device will be in the vicinity of tideswept, circalittoral rock or sediment influenced rock habitats (CR.HCR and CR.MCR). The biotopes associated with these habitats communities are influenced by strong tidal currents/wave action and sediment movement and as such are likely to be relativity resistant to moderate to low levels of disturbance resulting from the installation of an offshore tidal device.

8. The EA acknowledges that the design of the Nautricity CoRMaT device appears to present a relatively higher risk of collision mortality for deep-diving seabirds than would some other designs, as it has exposed rotating blades and is tethered in the water column with associated anchoring cables and flotation devices. The vulnerability of bird species using the site was considered. However, the numbers of seabirds on the sea in the vicinity of the Development (throughout the entire viewshed of the vantage point that was used during the surveys and not just at the Development Site) are extremely low even during their seasonal highest abundance. The EA concludes that any effect on seabird populations from development of the project will be Negligible.

9. The EA established that numbers of marine mammals using the site are low, the location being used for transit rather than residency, foraging or breeding. Although there could be short-term

effects during construction these are likely to be negligible or minor. During operation the effects were concluded to be negligible.

10. Basking sharks were considered in the EA and their activity level in the area assessed. Based on the vantage point survey data, general observations from the area and tracking data, it was concluded that basking sharks are not normally to be found at the site. The predicted significance for the population is classified as 'Not Significant' and no mitigation measures are proposed.

11. The Fish and shellfish resource was considered and the significance of any effects from the Development considered negligible with the exception of the potential impact of electromagnetic fields during operation which were considered as minor adverse but very localised to the vicinity of the pipe-protected cable.

12. With regard to the onshore ecological resource, it was established that the onshore vegetation and habitat consists of 'Dry Heath' and 'Grassland', there are also areas of bare rock. No evidence of any protected species was found. The most tangible effect of the development will be very limited direct loss of these habitats along the cable route and at the compound location. Although European Dry Heath is an Annex 1 Community, within the study area, the heath is species-poor and in degraded condition and the overall significance effect was considered to be negligible.

16.2.2 Human environment

13. In a cultural heritage context, the EA determined that there is potential for accidental effects during construction on one onshore feature but this will be avoided by identifying the exact location of the feature pre-construction. The EA concludes that the distribution of known maritime cultural heritage is so sparse that the Development can be designed in such a way as to avoid all known assets. The bathymetric survey identified some previously unknown wrecks and the EA concludes that it is unlikely that further assets will be encountered.

14. It was established that commercial fishing activity in the region is extremely low with a limited level of creeling activity in the region of the Development. Potential impacts were reduced further by siting the device in an area unsuitable for this type of fishing. Given that displacement from fishing grounds is unlikely and the export cable pipeline will be layed on the seabed, the EA concludes that the Development will not have any significant impact on commercial fishing.

15. The wider impacts on shipping and recreational craft were considered as part of a separate Navigational Risk Assessment. Although a number of potential hazards were identified, the effects and risks were concluded to 'Acceptable'. Primary risks pertain to surface navigation and device mooring failure. With regard to surface navigation, the Applicant is to discuss further with MS-LOT and the NLB as to the need for and appropriate form of identification and/or marking of the Development. Mitigation measures are proposed with regard to device failure. The Development is close to a military practice area but no effects are predicted.

16. Due to the fully submerged nature of the tidal device and the small scale and remoteness of the onshore project elements, seascape and landscape effects were assessed to be negligible. Some positive socio-economic effects are predicted through short-term employment opportunities and use of local businesses during construction. Impacts on tourism and recreation are considered to be negligible, the minimal effect on yachting mitigated further through appropriate promulgation of information to mariners. There will be limited impacts on traffic using the minor road to the lighthouse during construction but these effects will be temporary.

16.3 HABITATS REGULATION APPRAISAL

17. The Habitats Directive has been considered by assessing whether the Development is directly connected to or necessary for the management of a range of sites and considering whether the proposal, alone or in combination, is likely to have a significant effect on these sites.

18. With regard to marine mammals, the Development has the potential to affect the South East Islay Skerries Special Area of Conservation (SAC) which is designated for harbour seals. In view of evidence from the Seagen project in the Strangford Loch, based on the low number of seals at the Development Site in a regional and national context and in relation to the population size at the SAC, it was assessed that the project will have no likely significant effect under the Habitats Regulations.

19. Turning to marine birds, the EA has considered a number of species and Special Protection Areas (SPAs). Gannet were seen on the water in low numbers, 0.008% of the regional and local SPA (Ailsa Craig) population. Given the low numbers of birds seen it was concluded that a tidal turbine would have negligible impact on the integrity of the SPA and no likely significant effect under the Habitats Regulations. The closest SPA designated for shag is the Mingulay and Berneray SPA, some 200 miles from the Development. The maximum foraging range for shag is 17km so the EA concluded that there will be no likely significant effect on the integrity of that SPA.

20. The Rathlin Island SPA is approximately 25km from the Development and has both common guillemot and razorbill as a feature. The low numbers of guillemot on the site in term of the SPA indicated that there was no likely significant effect. With regard to razorbill, the EA concluded that if all of the birds wintering near to Mull were from this SPA, the seasonally highest mean number on the sea would only represent 0.004% of the SPA population. Therefore, again there is no likely significant effect on the SPA.

21. Finally, on average, 0.006% of the regional population of Manx shearwater were seen on the water within the viewed covering the development site. The Rum SPA is the nearest designated SPA where Manx shearwater are a feature and this population composes mostly of the regional population. It was concluded that there is no likely significant effect and the integrity of the SPA will not be impacted.

16.4 CONCLUSION

22. All of the potential effects of the Development have been considered. At greatest, any potential effect is considered minor with almost all of the potential effects identified as negligible. Overall the impact of the Development on the human, physical, biological and ecological resource, both onshore and offshore is considered Not Significant.