RWE npower renewables

Bristol Channel Zone Limited

Atlantic Array
Environmental Impact Assessment Scoping Report

April 2010

An RWE Innogy company

Bristol Channel Zone Limited

Atlantic Array

Environmental Impact Assessment Scoping Report

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Atlantic Array Environmental Impact Assessment Scoping Report

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EXECUTIVE SUMMARY

Bristol Channel Zone Limited (BCZL) is proposing to develop a wind farm in the Bristol Channel Round 3 Zone. The proposed project, known as Atlantic Array, would be located approximately 14 km from the North Devon coast, approximately 16 km from the South Wales coast and approximately 13km north of Lundy Island in the Bristol Channel. The project could comprise between 187 and 416 wind turbines, and would have a total generating capacity of up to 1,500 megawatts (MW).

The initial Atlantic Array project area was selected as a suitable development site due to a number of key attributes including an excellent wind resource, no direct overlap with areas of nature conservation importance, good options for port facilities suitable for both construction and operation, suitable seabed for foundations and subsea cable installation, and a secured grid connection point onshore.

BCZL has undertaken a detailed review of the constraints (biological, physical and human) affecting the entire Bristol Channel Zone to determine the optimal locations for the Atlantic Array project within The Crown Estate lease area. In order to ensure timely delivery of the project, BCZL has been undertaking long lead surveys of the area for ornithology interests since early 2009 to ensure a robust baseline description of the site and its environs. Boat-based surveys for marine mammals, which will be undertaken for a 12 month period, have also been initiated in early 2010. Both the ornithology and marine mammals survey protocols have been developed in conjunction with Natural England, the Countryside Council for Wales and the Joint Nature Conservation Committee.

The project would require development onshore, comprising electrical infrastructure to enable the electricity generated by the offshore wind turbines to be transferred into the National Grid transmission system. BCZL has also undertaken a review of the environmental and engineering constraints affecting the onshore connection.

The purpose of this scoping report is to provide, based on existing information, an overview of the project, the site (and surrounding region) and the potential impacts and sensitive receptors which will require detailed consideration within the subsequent EIA. The objective of collating this information is to submit this to the IPC who will provide an opinion on the on proposed content, methodologies and key issues to be included in the Environmental Impact Assessment (EIA). The IPC will compile this opinion after consulting with a range of statutory consultees. We then also intend to issue to a wider group of stakeholder and are planning to request comments to be provided directly us so we can feed these comments in to the EIA process.

This scoping report presents details on the baseline environment around the Atlantic Array onshore and offshore development area and identifies potential impacts that may arise as a result of the development. Potential surveys/studies to inform the EIA process are listed, along with discussion about possible mitigation and monitoring measures that could be implemented to reduce the significance of any impacts. BCZ will issue the scoping report to a wide group of stakeholders in order to obtain feedback on the proposed scope of work and to inform the EIA process.

Introduction

1.1 Bristol Channel Zone Limited is proposing to develop a wind farm in the Bristol Channel in the south west of the United Kingdom. Bristol Channel Zone Limited specialises in developing projects for the generation of electricity from renewable sources and is a wholly owned subsidiary of RWE Npower Renewables, which is in turn wholly owned by RWE Innogy. RWE Innogy is a European-wide renewable energy company owned by RWE AG.

1.2 BCZL intends to submit an application for a Development Consent Order (DCO) to the Infrastructure Planning Commission (IPC) to develop a new wind farm in the Bristol Channel to be known as Atlantic Array Offshore Wind Farm. In addition, the DCO will include options for associated development away from the wind farm site that is deemed necessary for its construction and operation.

1.3 The application will comprise full details of all development proposals and will be accompanied by an Environmental Statement (ES) (prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009) and other documents including a statement on pre-application consultation.

1.4 This scoping report sets out the proposed content, methodologies and key issues to be included in the Environmental Impact Assessment (EIA) and the resulting ES to be submitted with the application. The ES itself will be presented as a single document with separate onshore and offshore volumes for ease of reference. The purpose of this document is to obtain a scoping opinion from the Infrastructure Planning Commission (IPC). It is also intended that this report builds on consultation carried out to date and to support consultation by BCZL with statutory and non-statutory consultees and stakeholders on the scope of the EIA required for the proposed Atlantic Array Offshore Wind Farm.

1.5 The scoping report is structured in sections relating to principal topic areas. An overview of the project, including both onshore and offshore aspects, the developer and the assessment and consents process is included by way of an introduction section (Chapter 1). This is then followed by a description of the project (Chapter 2); an overview of the consultation process (Chapter 3); scoping of environmental effects offshore and onshore (Chapters 4 and 5 respectively); and summary tables of potential effects (Chapter 6); mitigation and monitoring (Chapter 7); and conclusions (Chapter 8).

1.6 Within Chapters 4 and 5, the scoping of environmental effects, the approach for each specific topic is presented, including a description of baseline conditions from literature reviews (and in some cases field work) followed by an assessment of potential effects and the studies and assessment approaches proposed to address these within the EIA.

Round 3 Offshore Wind Farm Programme

1.7 On 4 June 2008 The Crown Estate launched its Round 3 leasing programme for the delivery of up to 25 GW (gigawatts) of new generation capacity from offshore wind by 2020.

1.8 In September 2008, RWE Npower Renewables Limited, the UK division of European renewable energy company RWE Innogy, purchased Channel Energy Limited from North Devon-based specialist wind power development company Farm Energy. The acquisition of Channel Energy supported RWE Npower Renewables Limited’s aim of developing an offshore wind farm under

the The Crown Estate's third leasing round for offshore wind farms. Channel Energy holds an agreement to connect the 1,500 MW Atlantic Array project to the National Grid.

1.9 In March 2009 RWE Npower Renewables Limited submitted a bid for the Bristol Channel Zone to The Crown Estate under this third licensing round for UK offshore wind farms and was awarded the development rights in January 2010.

1.10 As per the instructions of the The Crown Estate, Bristol Channel Zone Limited was set up by RWE Npower Renewables Ltd as a 'Special Purpose Vehicle' for undertaking the development of the Bristol Channel Zone. Ownership of Channel Energy Limited was formally passed from RWE Npower Renewables to Bristol Channel Zone Limited. Following formal approval of the Atlantic Array project from The Crown Estate it will be Channel Energy Limited that will apply for planning approval for the Atlantic Array development.

Project Overview

1.11 Located in the southwest of the UK, the Severn Estuary and Bristol Channel together form the largest estuarine system in the UK. The estuary is characterised by its wide funnel shape, strong currents and extreme tidal range, with the second largest tidal range in the world, which exposes huge mudflats and sand banks in the area. The northern shore borders the South Wales coalfield and has areas of heavy industry; the southern shore in the counties of Somerset and Devon is mainly agricultural. The channel opens out into the Celtic Sea to the west, with its main freshwater inputs from the rivers Severn, Avon, Usk and Wye. This huge body of water is 45 km across in the west but narrows to less than 10 km by the time it reaches Clevedon. In the outer Bristol Channel, the seabed reaches depths of 50-60m, becoming shallower eastwards to 10-20m in the inner Bristol Channel (Mackie *et al.*, 2006). Nobel Sands, a major sand wave field, dominates the outer Bristol Channel at the north of the proposed development area, with major bank features such as the Helwick Bank (off the Gower Peninsula) and Nash Bank (off Swansea Bay) along the Welsh coastline, and Stanley Bank sand bank to the south around Lundy.

1.12 The proposed Atlantic Array Offshore Wind Farm (OWF) project site area, located within the boundary of the wider Bristol Channel Zone is shown in Figure 1.1. The Atlantic Array project, which is the subject of this scoping report, includes the offshore turbine area presented in Figure 1.1; the export cable route[1]; the landfall site; and the three candidate onward terrestrial routes from the landfall location to the grid connection point at Alverdiscott. It is this broader complete project together with the selected landfall option that will be the focus of the full Environmental Impact Assessment (EIA) process. Inevitably, some topics will require consideration of varying spatial extents as defined by the sensitive receptors considered under each discrete subject area. Where appropriate, these are specified in the relevant sections of this document.

1.13 As it is early in the development process the megawatt size of the turbines to be used is undecided, however it is expected that the proposed Atlantic Array project would consist of between 187 and 416 turbines with a total capacity of approximately 1,500 megawatts. The offshore site, excluding the export corridor, extends over approximately 492 km^2 in water depths of 23 to 56 m. At the closest point to shore it would be approximately 14 km from the North Devon coast, approximately 16 km from the South Wales coast and approximately 13km north of Lundy.

[1] The final route from the turbine array to landfall is yet to be determined, though options for landfall location and onward cable routeing are presented within this document.

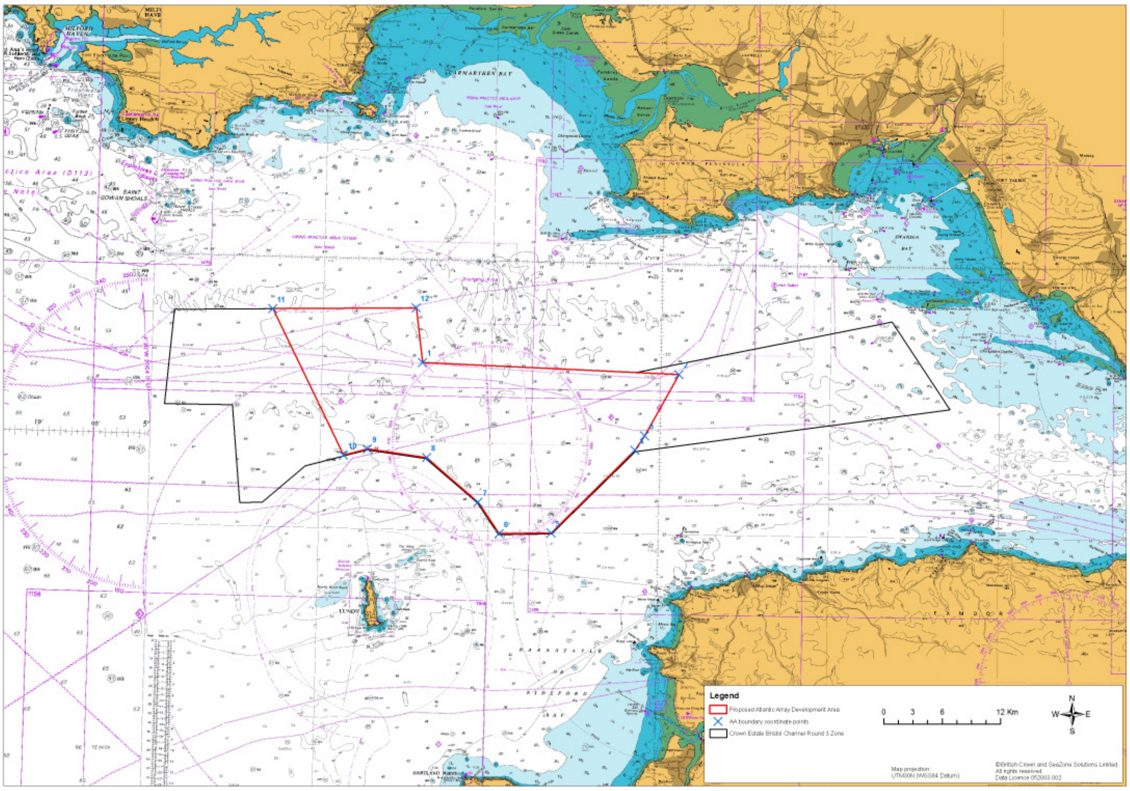

Figure 1.1: Location of the proposed Atlantic Array offshore wind farm project area (turbine array) within the Round 3 Bristol Channel Zone.

1.14 In addition to the offshore elements of the scheme, Atlantic Array will also require associated development onshore, comprising electrical infrastructure to enable the electricity generated by the offshore wind turbines to be transferred into the National Grid transmission system. The grid connection point for Atlantic Array agreed with National Grid is the Alverdiscott 400kV substation, approximately 5km to the south of Bideford, North Devon.

Background information

1.15 The Crown Estate's marine assets include over 55% of the foreshore around the UK, approximately half of the beds of tidal rivers, and most of the seabed out to the 200 nautical mile (nm) limit of the UK Renewable Energy Zone.

1.16 In Round 1 of offshore wind farm development, The Crown Estate awarded RWE npower Renewables Ltd North Hoyle OWF. Consent for the scheme was gained in August 2002. RWE npower Renewables Ltd also purchased the assets of Rhyl Flats OWF as a fully consented site in December 2002. North Hoyle has been operational since November 2003, and Rhyl Flats commenced operation in December 2009.

1.17 In November 2002 the Department of Trade and Industry (DTI), which in 2008 became the Department of Energy and Climate Change[2] (DECC), issued a consultation document entitled

[2] The DTI was disbanded on 28 June 2007 and its responsibilities were taken over by the newly formed Department for Business, Enterprise and Regulatory Reform (BERR). On 03 October 2008 the climate change and energy activities of BERR were transferred to the Department of Energy and Climate Change (DECC) where they still sit. BERR itself was disbanded on 06 June 2009.

'Future Offshore', which presented a strategic framework as the basis for expansion of the offshore wind industry. In July 2003, the DTI and The Crown Estate announced the second round for offshore wind farm development following publication of the Strategic Environmental Assessment (SEA) Environment Report. As part of Round 2 RWE npower Renewables Ltd were awarded the 750 MW Gwynt y Môr Offshore Wind Farm off the coast of North Wales and the 1200 MW Triton Knoll project area by The Crown Estate in December 2003. In November 2008, npower renewables acquired 50% of the equity in Greater Gabbard Offshore Winds Limited from Scottish and Southern Energy (SSE).

1.18 The consent applications and supporting ES for Gwynt y Môr were submitted in October 2005. Consents for the offshore elements of this project were granted in December 2008.

1.19 On 10 December 2007, John Hutton, Secretary of State for Business Enterprise and Regulatory Reform (BERR), announced the commencement of a SEA to examine 25 gigawatts (GW) of additional UK offshore wind energy generation capacity by 2020. This follows the 8 GW planned for Rounds 1 and 2. On 4 June 2008, The Crown Estate announced proposals for the third round of offshore wind farm leasing.

1.20 The Crown Estate's Round 3 offshore wind programme consists of nine zones around the UK coast. RWE Npower Renewables Limited were awarded the rights to develop the BCZ. The Atlantic Array OWF is the only project planned by BCZL within the zone, with a proposed capacity of 1,500 MW.

The Developer

Bristol Channel Zone

1.21 RWE Npower Renewables Limited is the UK subsidiary of RWE Innogy and is one of the UK's leading renewable energy developers and operators, committed to developing and operating wind farms and hydro plant to generating produce sustainable electricity. The company operates 18 hydroelectric power projects and 23 wind farms in the UK.

1.22 RWE Npower Renewables' offshore wind farm portfolio includes two operational offshore wind farms, North Hoyle, as well as Rhyl Flats off the coast of North Wales. RWE Npower Renewables' Round 2 portfolio includes a 50% share of the Greater Gabbard offshore wind farm project in the Thames Estuary strategic area, which was the first Round 2 project to enter construction.

1.23 Bristol Channel Zone Limited is wholly owned by RWE Npower Renewables.

Project Team

1.24 RWE has appointed RPS Group plc (RPS) to be the lead consultants for both the offshore and onshore EIA elements of the Atlantic Array project. Supporting RPS throughout the EIA process will be a number of organisations with expertise in specialist aspects of offshore wind EIA (see Table 1.1).

Table 1.1: Organisations involved in the Atlantic Array OWF scoping report and main EIA.

Discipline	Organisation
Lead EIA consultant	RPS Energy
Ornithology	ECON Ecological Consultancy

Coastal Processes	ABPmer
Commercial Fisheries	Gannet Scientific
Shipping and Navigation	Strategic Marine Services Ltd
Landscape and Visuals	RPS Group
Marine Mammals	Seiche Measurements Ltd
Benthic Ecology	RPS Group
Fish and Shellfish Ecology	RPS Group
Nature Conservation	RPS Group
Terrestrial Ecology	RPS Group
Terrestrial Hydrology and Geology	RPS Group
Soils, Agriculture and Land Use	RPS Group
Traffic and Transport	RPS Group
Air Quality	RPS Group
Noise and Vibration	RPS Group
Community Effects	RPS Group
Historic Environment (terrestrial)	RPS Group
Coastal and Martine Archaeology	Wessex Archaeology
Legal Advice	Bond Pearce Solicitors
Aerial Surveys (Ornithology)	Wildfowl and Wetlands Trust (WWT); HiDef/WWT (summer 2009)

Consents

Consents process

1.25 Significant changes have been made to the planning system under the Planning Act 2008 and the Atlantic Array project will fall under the auspices of the new regime. Under this legislation the development of an offshore wind farm of over 100 MW is classified as a nationally significant infrastructure project (NSIP) and will require a Development Consent Order (DCO) from the new independent Infrastructure Planning Commission (IPC). The DCO will replace a number of consents formerly required for a project of this type. A formal EIA will be required as part of the application for a DCO. The DCO will provide for the project in its entirety, i.e. both the offshore and the onshore aspects, with onshore electrical grid connection works comprising ‘associated development’ under the new regime. An Environmental Statement (ES), the report documenting the EIA process, will be prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations (2009). These Regulations have been laid before Parliament and came into force in October 2009.

1.26 Before an application for a DCO is submitted to the IPC, broad consultation with key stakeholders and the local community and interest groups is required. The Infrastructure Planning (Environmental Impact Assessment) Regulations (2009) also require that formal

consultation is undertaken with the local authorities and statutory bodies during the preparation of the ES, before the application is made. The Marine Management Organisation (MMO) will be engaged with, together with the relevant local authorities with coastal and landward jurisdictions within which the potential development footprint falls, in order to ensure local consultation at both authority and community level.

1.27 For the purposes of this scoping report, 'onshore' refers to the land from mean low water mark to the connection with the National Grid transmission system; 'offshore' refers to the area seaward of the mean high water mark.

1.28 As identified above, the landfall works, onshore cabling and substation extension would be classed as associated development forming part of an application for a DCO to the IPC under Section 37 of the Planning Act 2008.

1.29 Prior to any application to the IPC, the Infrastructure Planning (Applications and Procedure) Regulations 2009 will require a programme of community consultation to be agreed with the relevant local authorities. Under the IPC regulations 'relevant local authorities' are defined as those directly impacted by the project. In the case of the Atlantic Array project this relates to the necessary onshore works under the following jurisdictions:

- North Devon Council: if landfalls at Saunton Sands or Woolacombe are used and cable routes from these landfalls as far as the authority boundary at the Taw-Torridge estuary.
- Torridge District Council: for the landfall at Cornborough Range, for the connection point at Alverdiscott and for all cable routes south of the estuary towards Alverdiscott.
- Devon County Council: for all route options.

1.30 The DCO may also need to include any works needed to re-position any of the transmission towers on existing overhead 400 kV transmission lines which may also require consent under the new regime of the Planning Act 2008. An exception to this would be if the final design were to fall within the scope of 'permitted development'.

1.31 The new procedure dispenses with the need for separate planning permission and consents under Section 36 or 37 of the Electricity Act 1989 (Section 32), the Town and Country Planning Act and can also dispense with the need for licences under the Food and Environment Protection Act (FEPA) and the Coast Protection Act (CPA), licences for the latter two legislative instruments having recently been consolidated by a Marine Licence under the Marine and Coastal Access Act 2009. Any need for EIA under the marine licence will be provided for through that undertaken for the DCO application; the Infrastructure Planning (Environmental Impact Assessment) Regulations (2009) applying to the relevant elements of the NSIP.

1.32 In addition to the principal licences, any other required consents and licences will be identified during the project development stage and consultations with statutory bodies, which it may be possible to include within the DCO application. This will include FEPA and CPA consents to be granted separately by the Welsh Assembly Government.

National Policy and Offshore Wind Development

1.33 The Planning Act 2008 sets out the consenting system for major infrastructure projects including those in the energy sector. Part 2 of the Act specifies the provisions in relation to National Policy Statements (NPS), which set the framework for decisions by the Infrastructure Planning Commission (IPC). The draft National Policy Statements also identify relevant environmental considerations. Seven draft NPSs have been published to date, including an Overarching Energy

NPS (EN-1); the draft Renewables NPS (EN-3); and the draft Electricity Networks NPS (EN-5). These completed their consultation in February 2010.

Environmental Impact Assessment

1.34 The EC Directive 85/337/EEC, as amended by Directive 97/11/EC (the EIA Directive), requires an EIA to be completed in support of an application for development consent for certain types of project.

1.35 Offshore wind farms are listed in Annex II of the Directive, as 'installations for the harnessing of wind power for energy production (wind farms)', and these provisions have been transposed into UK legislation. Although not specifically addressed in the Directive or the Regulations, the need for an EIA for the onshore cables and substation extension arises from them forming part of the offshore wind farm project.

1.36 The EIA process, undertaken for and presented in the resultant ES that will be produced for this project, will be undertaken to comply with The Infrastructure Planning (Environmental Impact Assessment) Regulations (2009). These Regulations set out the statutory process and minimum requirements for the provision of adequate environmental information to enable EIA.

1.37 Consideration will also be given to the following throughout the EIA process:

- EU Habitats Directive; and
- EU Birds Directive.

1.38 The relationship between the onshore and offshore aspects of the EIA and with other documents that are submitted with the planning application for a development consent order will be explained within the Environmental Statement. This will include details of the consultations that have been undertaken in the preparation of the applications, which will be provided as a separate report in conformance with the new process.

Approach to EIA

1.39 The development of offshore wind farms is complex, and much of the final design of both the turbine array (for example layout, foundation type, inter-turbine cabling and turbine model) and the associated infrastructure (for example export cable route, installation methodology, onshore cable route and substation design/location) is refined throughout the development process. This flexibility is necessitated by factors including site specificities in ground type, meteorological conditions and environmental sensitivities as well as technological improvement and economic considerations; the understanding and definition of which develops as more information is gathered during feasibility work and site surveys.

1.40 In order to accommodate such dynamic design considerations, it has become relatively routine practice to employ a 'Rochdale envelope[3]' approach within an EIA. This method involves assessing impact with the project assuming all 'worst case scenario' options are employed. For example, if several foundation types are proposed then the impact assessment of the scheme is based upon the foundation type known to have the largest impact. Hence if this assessment

[3] Case law (i.e. R.V. Rochdale MBC Ex. Part C Tew 1999 - "the Rochdale case") established that "indicative" sketches and layouts etc. cannot provide a sufficient basis for the determination of applications for outline planning permission for EIA development. In respect of DCO consent, the final scheme constructed must have been covered by the scope of the EIA.

shows no significant impact then it can be safely assumed that all other lesser options will also have no significant impact.

1.41 Where such design or methodology options remain at the time of application, these will be clearly identified in the ES together with the reasons for such required flexibility.

Appropriate Assessment

1.42 When a plan or project, alone or in combination with other plans or projects, is considered to have a likely significant effect on a European site (i.e. on internationally important habitats and/or species), and is not directly associated with the management of the site for nature conservation, the developer is required to provide the Competent Authority with information to undertake a test of likely significance. This process may subsequently involve the completion of an Appropriate Assessment by the Competent Authority under the Conservation (Natural Habitats &c) (Amendment) (England and Wales) Regulations 2009. The determination on both matters, i.e. the formal assessment of whether a likely significant effect will occur and the AA, should this be required, is undertaken during the examination process. For the purposes of a NSIP such as Atlantic Array, the Competent Authority will be the Infrastructure Planning Commission (IPC).

1.43 BCZL are aware of the need to provide sufficient information on the development proposals in order for any Habitats Regulation Assessment (HRA) to be undertaken by the IPC as part of the formal application process. However BCZL is similarly aware of the benefits of providing detailed information during the pre-application stage through both initial assessment and consultation with relevant statutory environmental bodies in order to ensure that the level of detail provided on the scheme enables an AA to be conducted by the IPC, should this be required. The report submitted with the application for Atlantic Array (under Reg 5(2)(g) of the Infrastructure Planning (Applications; Prescribed Forms and Procedures) Regulations 2009 will therefore be developed in consultation with relevant statutory bodies during the pre-application stage and will include, where necessary, any proposed mitigatory measures which might be required. Early discussion will be undertaken with the Government's specialist nature conservation advisors, notably Natural England (NE), the Countryside Council for Wales (CCW) and the Joint Nature Conservancy Committee (JNCC). Key interest groups such as the RSPB will also be involved early in the project development process.

1.44 The Bristol Channel Zone lies outside any European designated sites and thus direct impacts are unlikely to arise on cited habitats from the installation of wind turbines, however there are a number of Natura 2000 sites in relatively close proximity, along both the English and Welsh coastal areas which will be carefully considered in the ES. The export cable route may, depending on the final option(s) selected, run through or close to several designated sites, although it is important to note that the preferred route is yet to be determined. Even where no direct overlap (in terms of the OWF site or export cable corridor) is anticipated, there may be potential indirect effects on the features for which sites are designated, including Annex II species. The potential for effects on such mobile species, together with migratory fish species protected under EU legislation and terrestrial species including bats, in addition to designated habitats both on and offshore, has been highlighted in the recent Appropriate Assessment on the Round 3 programme. A clear focus on such species will, therefore, be given within both the ES and the Reg 5(2)(g) report, building on the Plan-level AA conducted by TCE as the project-level details are developed.

1.45 In order to inform the EIA, there is thus a clear requirement to obtain site specific data on cited habitats and species within the Atlantic Array OWF development Zone. The approaches to data capture, including spatial and temporal scope specific to each discipline, are presented in the

following sections of this Scoping Report for subsequent discussion and agreement with regulators, stakeholders and statutory bodies.

1.46 For offshore wind farms, Appropriate Assessment may be required for the following types of effects:

- Effects of construction noise on marine mammals;
- Effects of export cable installation on sub-tidal and inter-tidal habitats (including benthic biotopes and saltmarsh habitats);
- Effects of disturbance arising from wind farm construction and export cable installation on bird species;
- Effects of operational wind farms on bird species, including collision risk of migratory and breeding birds, displacement and/or barrier effects; and
- Effects of onshore cable routing on designated terrestrial sites or species

1.47 The high level AA completed by TCE on the tendering round for the next generation of offshore wind farms in UK waters, known as ‘Round 3’, of which the Atlantic Array project is a component, identified both plan-level and Zone specific considerations which potentially require assessment as part of a HRA under the Habitats Regulations. The findings included that the Round 3 Plan is not anticipated to have a likely significant effect on Natura 2000 sites on the basis that the general environmental measures highlighted would mitigate the potential for such to arise. However, importantly the report highlighted that the magnitude (and therefore significance) of potential impacts can only be meaningfully assessed at a site-development scale. The assessment of the potential for likely significant effect on Natura 2000 sites arising from the development proposals for Atlantic Array will, therefore, be based on both the findings of the issues identified in the TCE AA for the Bristol Channel Zone and any which become apparent during the site-specific pre-application assessment work.

1.48 As noted above, the Habitats Regulations require that the likely effects of plans or projects on European sites (and, as a matter of policy, Ramsar sites) are considered both alone and in-combination with other plans or projects. As such, cumulative and in-combination assessment will form a component of the assessment work for Atlantic Array (see specific section below).

1.49 There are a range of studies and initiatives providing data and aiming to increase understanding for offshore renewable energy developments as well as a wider range of coastal and offshore developments and activities. In particular COWRIE[4] (Collaborative Offshore Wind Research Into the Environment) has commissioned several studies that will be drawn upon to inform the assessment of effects on sensitive receptors for both the potential HRA and the wider EIA for Atlantic Array. These include work on underwater noise (piling etc), electromagnetic field effects (EMF), ornithological survey and assessment techniques and guidance on cumulative impact assessment; providing contemporary thinking on aspects such as effect significance and potential mitigation which may be applied where appropriate. The outcomes of these studies will be taken into consideration when formulating an approach to addressing issues implied by any Appropriate Assessment.

[4] COWRIE is a registered charity set up to advance and improve understanding and knowledge of the potential environmental impacts of offshore windfarm development in UK waters.

Cumulative and In-Combination Effects

1.50 The need to consider cumulative and in-combination impacts is also a requirement of the EIA process. Here, cumulative refers to all other wind farm projects and in-combination refers to other marine projects or licensed activities, for example marine aggregate extraction. Projects considered in the assessment will include existing projects as well as those currently in the planning system which could interact with the Atlantic Array development either spatially or temporally. The inclusion of both current and proposed projects or activities provides for consideration of effects drawn from both the existing baseline and the future predicted baseline for the actual construction of the project between 2014 and 2019. Agreement on a list of schemes which should be included in the assessment will be sought with the relevant local authorities.

1.51 The scales over which Atlantic Array and other projects or activities occur (and thus offer the potential for interaction) are important considerations in this aspect of the assessment process. Predicted zones of influence and potential spatial or temporal overlaps will therefore be intrinsic components of the cumulative and in-combination assessment.

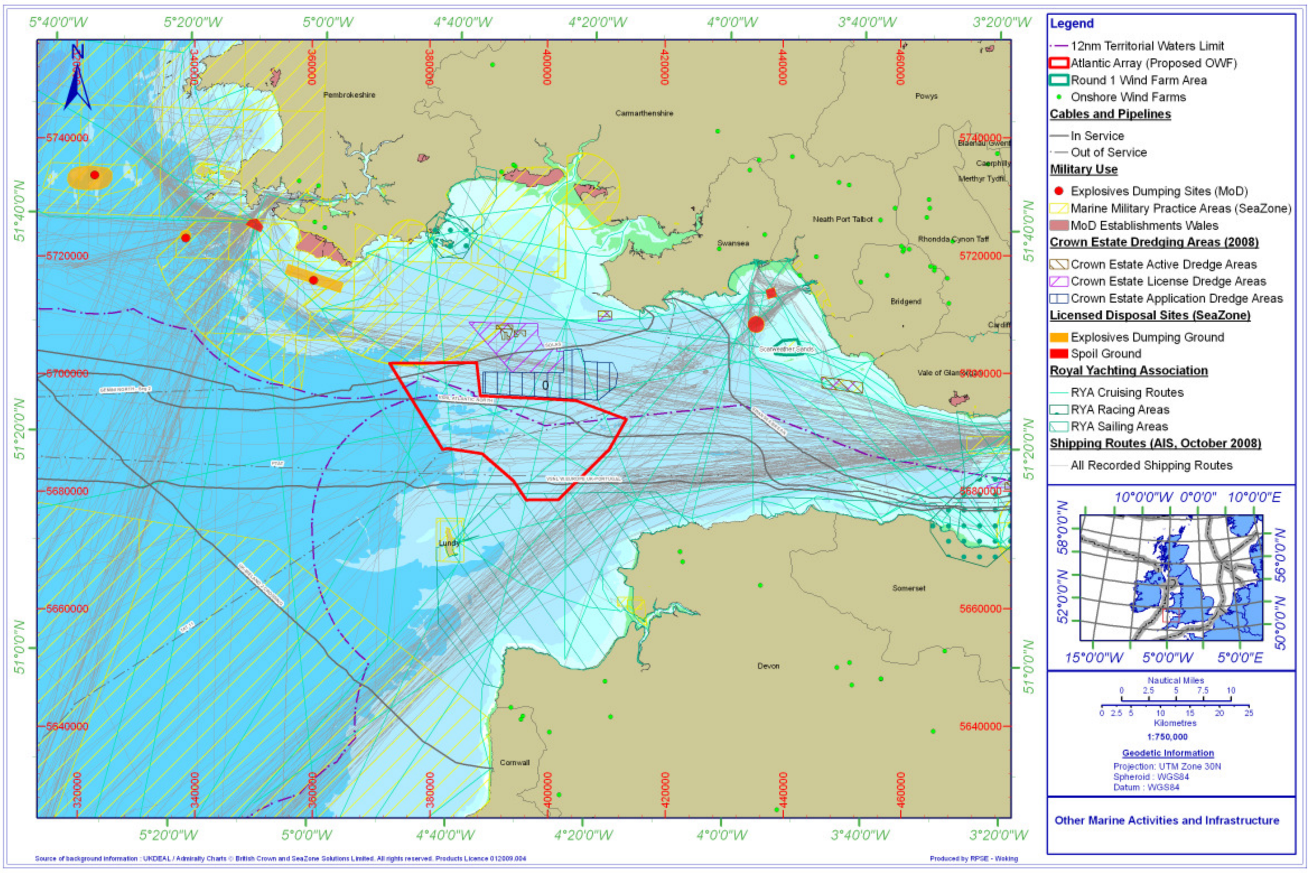

Figure 1.2: Other marine users in the Bristol Channel.

1.52 In summary, the following activities and projects will need to be considered in relation to the cumulative and in-combination impact assessment offshore:

- Other Wind Farms[5]
- Marine aggregate extraction licensed and proposed sites;
- Commercial fisheries activity;
- Subsea cables and pipelines;
- Commercial shipping;
- Recreational sailing/boating;
- Port/harbour development (potentially); and
- Severn Tidal Power project.

1.53 The Severn Tidal Power project bears specific mention as although not formally in the planning domain, it is well known that feasibility studies for development of a major tidal range scheme in the Severn Estuary are currently ongoing. The potential for in-combination effects to arise from this scheme with Atlantic Array is difficult to meaningfully assess given that there is no known resolution on whether the project is likely to be progressed, nor indeed the design of the project (i.e. barrage, lagoon, tidal fence etc.). For the purposes of the cumulative and in-combination assessment for Atlantic Array, the current strategy will be to consider potential additive or synergistic effects on the basis of the best available information at the time of the assessment. The assessment is likely to be relatively generic given the uncertainties associated with the tidal range project, unless firm proposals are available within the Atlantic Array NSIP application timeframe. This being the case, detailed in-combination assessment (i.e. including aspects such as design criteria, physical processes modelling) would fall to the Severn Tidal Power scheme to undertake rather than Atlantic Array.

1.54 Whilst the Atlantic Array proposal constitutes the entirety of the proposed offshore wind farm (OWF) development within the Bristol Channel Zone (BCZ), the conditions of The Crown Estate (TCE) lease require that future consideration be given to development in the western area of the Zone. Any such future development will fall outwith the current process for both the EIA and DCO provisions as importantly, the proposed Atlantic Array OWF will achieve the Total Zone Capacity (TZC) target under the auspices of a single project. Even so, the ES for Atlantic Array will deal with possible future westward extension within the BCZ in a similar manner to that proposed for the Severn Tidal Power scheme. Potential implications of such development will be identified in generic terms, the detail of which will be provided if any future project were to be taken forward. In the event of a further project being proposed in the western area of the zone then this would be subject to separate scoping, EIA and DCO procedures undertaken specifically for such an extension. It is important also to note that BCZL is not committed to undertaking any such additional development within BCZ since this would exceed the TZC agreed with TCE for the Zone.

1.55 The EIA process will also identify cumulative and in-combination effects within the onshore development areas, including other onshore developments which may affect receptors in the vicinity of the cable route or at any substation location. These may include aspects such as ecology and nature conservation; historic environment; landscape and visual character; however the actual topic areas where detailed consideration will be required will depend much on the final

[5] Note, this will likely comprise solely onshore wind farms as the only other known proposed offshore wind farm development in the area was Scarweather Sands, which has now been formally withdrawn from the planning process.

grid connection route and any associated development, such as a new substation. Relevant local authorities will be consulted on other development types that might have an effect in combination with the onshore grid connection.

Role of the Scoping Report

1.56 Whilst there is no formal requirement in the EIA Regulations to seek a Scoping Opinion or produce a Scoping Report prior to submission of an ES, it is recognised as best practice to do so. Guidance on pre-application consultation under the Planning Act 2008 (CLG September 2009) recognizes the advantages of scoping consultations (paragraphs 6 and 71). Previous guidance issued by the Office of the Deputy Prime Minister in Circular 2/99 'Environmental Impact Assessment: A Guide to procedures' acknowledges in paragraph 82 that the role of EIA is to examine "the main or significant effects to which a development is likely to give rise".

1.57 The scoping of an EIA by which these main or significant effects are identified is, therefore, an important preliminary procedure, which sets the context for the study. Indeed, guidance produced by the Environment Agency (2002) states that:

> *"Scoping is a critical stage early in the EIA process. It provides an opportunity for developers and their consultants to identify and assess the key environmental impacts and issues of concern, facilitated by thorough consultation with, amongst others, planners, statutory and non-statutory consultees, no-governmental organisations (NGOs) and the public."*

1.58 The role of this EIA Scoping Report is to identify the key environmental parameters likely to be significantly affected by the construction, operation and decommissioning of the proposed Atlantic Array project and to identify relevant environmental studies for the competent authorities and statutory consultees to consider. Based on the review of available literature, consideration of potential impact pathways and receptors, identification of data gaps and the requirement of surveys and studies to address these, this report also includes a provisional contents list for the ES for the Atlantic Array project; Volume I (offshore) and Volume II (onshore) (Appendix I).

1.59 Regulation 6(2) of the Infrastructure Planning (Environmental Impact Assessment) Regulations (2009) requires that a request for a scoping opinion includes:

- A plan sufficient to identify the land;
- a brief description of the nature and purpose of the development and of its possible effects on the environment; and
- such other information or representations as the person making the request may wish to provide or make.

1.60 In that context, the objectives of this scoping report include the following:

- Identify potential environmental issues associated with the project;
- assess those environmental issues which should be considered further in the final reports to accompany the planning application;
- provide a basis for consultation, where appropriate, with statutory and non-statutory consultees on the relevant environmental issues for the purposes of EIA;
- define what methods will be used to assess the environmental effects of the proposal; and
- where appropriate, agree with statutory and non-statutory consultees on these methods.

1.61 The contents list has been prepared to support a formal scoping opinion request that will be made to the IPC who will in turn consult with the relevant competent authorities and key statutory consultees to seek their comment on the adequacy of the proposed studies.

Strategic Environmental Assessment

1.62 The environmental report for the offshore energy SEA was published for consultation in January 2009, providing consideration of areas identified by TCE as offering 'indicative economic potential for offshore wind' as part of a UK wide assessment. Following the consultation period, the Government's decision on the SEA and TCE's Round 3 Zones was published on the 24th June, which was to adopt a plan/programme for offshore energy, encompassing some 25GW of wind generation capacity and allowing TCE to continue with the competitive leasing round (Round 3).

1.63 The process of site selection undertaken by RWE included detailed assessments of the BCZ following publication of the environmental report in January. Although there are specific issues to be addressed, particularly in terms of the potential for effects to arise on European designated sites and features, the findings of the SEA and the subsequent adoption of the Round 3 development programme provides for development within this area, with spatial constraint being assessed on the basis of site- and receptor-specific sensitivity.

1.64 The proposed Atlantic Array OWF is located within the Bristol Channel R3 Zone and thus conforms with the strategic development plan/programme for Round 3. In carrying out the EIA for Atlantic Array, consideration will be given to the conclusions of the SEA report and the subsequent strategic level Appropriate Assessment conducted by TCE, together with consultation responses to the SEA, as given in the post-consultation report and associated consultee response documents.

Best Practice

1.65 The EIA process for this project will adhere to best practice as appropriate to the project. Appendix II outlines best practice guidance documents covering a broad range of EIA activities concerning offshore wind development.

1.66 Of specific relevance to this project under the current regime, BERR (now DECC) has published:

- Guidance on the Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2000, Urn 01/789, September 2000.

1.67 In addition to the above, the Department for Communities and Local Government has consulted on proposed amendments to Circular 02/99 and on new EIA guidance. This has been considered where relevant.

1.68 Further guidance may be forthcoming on the Infrastructure Planning (Environmental Impact Assessment) Regulations (2009). Guidance has also been provided on pre-application procedures under the Planning Act 2008, some of which is relevant to EIA. These, together with the relevant aspects of previous best-practice guidance will be taken in to account during the Atlantic Array EIA.

PROJECT DESCRIPTION

The Need for Atlantic Array

2.1 The draft National Policy Statements (NPS) establish the case for NSIPs, having integrated economic, environmental and social objectives in order to deliver sustainable development. They provide a clear statement of policy and the nature of infrastructure development necessary to deliver the Government's wider goals of improving people's quality of life, economic prosperity and protecting and enhancing the environment. Draft NPS EN-1 (Overarching NPS for Energy) and EN-3 (Renewable Energy Infrastructure) establish and confirm the need for energy infrastructure in the UK, including the development of offshore wind farms.

2.2 The threat of climate change is a major concern for the ongoing environmental, economic and social stability of human societies and the earth upon which they depend. The urgency of potential climate change is a matter that has received the highest attention at all levels of government around the globe. As the vast majority of governments and scientific literature agrees, there is an immediate need to stem the production and emission of damaging levels of greenhouse gases into the atmosphere arising from agriculture, industrial airborne emissions and importantly, the burning of fossil fuels for energy and transport.

2.3 In recognition of the pressing need to act in order to prevent catastrophic climate change, the United Nations convened the UN Framework Convention on Climate Change (the Earth Summit) in Rio de Janeiro in June 1992. This convention was aimed at "*stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*". While the treaty itself arising from this convention was not binding it did provide for legally binding protocols that would be mandatory.

2.4 One such mandatory protocol was the Kyoto Protocol, which was adopted in 1997 and as of November 2009 had been ratified by 187 member states. This protocol committed signatories to an overall reduction in greenhouse gases emissions to individually specified levels. The UK is a signatory to this protocol.

2.5 In parallel to the UN framework, the (then) 27 EU member states in 2007 agreed an overall union-wide reduction in greenhouse gas emissions of 20% by the year 2020 compared to 1990 levels. As its contribution to this binding EU target, the UK was charged with implementing a national reduction of 15% of greenhouse gas emissions compared to 1990 levels. Over and above this EU target the UK has introduced the Climate Change Act 2008, committing to a legally binding target of at least 34% reduction by 2020 and at least an 80% cut in by 2050.

2.6 Arising from these commitments the UK government has identified the pressing need to reduce overall reliance upon fossil fuels for the generation of electricity. Specifically this means significantly increasing the proportion of electricity generated from renewable sources, and in particular wind. The UK has a significant pool of potential resource when it comes to wind power generation, particularly offshore, which represents a significant opportunity for the achievement of the country's renewable energy targets. The UK Renewable Energy Strategy was published in July 2009, taking account of 2008 consultation responses on how to drive up the use of renewable energy in the UK. This strategy sets out how the UK will meet its share of the new EU

targets. As at December 2009[6] the UK had an installed offshore wind generation capacity of 688.2 MW, with a further 1,156 MW under construction and 3,633 MW consented.

2.7 In addition to environmental factors such as climate change and acid rain, the production of energy from domestic and renewable resources increases the security of supply for the UK. It helps in reducing overall dependence on other states for the supply of energy, particularly as prices for commodities such as coal and oil continue to rise.

2.8 The proposed development, Atlantic Array, represents the opportunity for the generation of significant levels or reliable, domestically sourced and importantly, greenhouse gas emission-free electricity for the UK. The proposed overall output of the scheme is envisaged to be equivalent to replacing a coal fired power station and hence reducing the equivalent amount of greenhouse gas emissions year on year for the life of the project.

2.9 The annual generation expected from Atlantic Array would be equivalent to the approximate domestic needs of around 1.1 million average UK households[7]. This is equivalent to over 40% of the domestic electricity consumption for the South West of England and over 90% of the domestic electricity consumption for Wales[8].

Objectives of the Development

2.10 The proposed Atlantic Array development has the following objectives:

- To generate clean electricity from offshore wind in the Bristol Channel;
- To provide local employment and income for the South West of England and South Wales;
- To build on and improve the employment and wider economic prospects of the nearby parts of England and Wales;
- To increase the security of energy supply within the UK;
- To contribute to renewable energy targets both locally, nationally and as part of the EU in general.

Site Location

2.11 The Atlantic Array site is located in the Bristol Channel in the south west of the United Kingdom. The coordinates for the offshore elements of the Atlantic Array project area are listed in Table 2.1 below.

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[6] www.bwea.com/statistics accessed on 2 December 2009.

[7] Energy predicted to be generated by the proposal is derived using long term wind speeds calculated by meteorological models seeded with historical weather data obtained from satellite, surface-based and airborne measurement systems. This enables a calculation to be made to estimate the average annual energy production for the site based on 250 turbines each of rated capacity 6.15 MW. The energy capture predicted and hence derived homes equivalent or emissions savings figures may change as further data are gathered." Equivalent homes supplied is based on an annual electricity consumption per home of 4700 kWh. This figure is supported by recent domestic electricity consumption data available from The Digest of UK Energy Statistics and household estimates and projections from the UK Statistics Authority.

[8] Regional and local electricity consumption statistics sourced from The Department of Energy and Climate Change Energy Trends December 2008.

Table 2.1: Co-ordinates for the Atlantic Array Offshore Wind Farm (projected as WGS84, UTM Zone 31N)

Point	Latitude (Degrees and Decimal Minutes)	Longitude (Degrees and Decimal Minutes)
1	51° 24.297' N	4° 36.127' W
2	51° 23.899' N	4° 13.399' W
2	51° 20.473' N	4° 16.355' W
3	51° 19.642' N	4° 17.183' W
4	51° 14.977' N	4° 24.467' W
5	51° 14.881' N	4° 29.047' W
6	51° 16.600' N	4° 30.956' W
7	51° 19.022' N	4° 35.593' W
8	51° 19.432' N	4° 40.831' W
9	51° 19.062' N	4° 42.923' W
10	51° 27.083' N	4° 49.497' W
11	51° 27.316' N	4° 36.801' W
12	51° 24.297' N	4° 36.127' W

2.12 The project is located approximately 13 km off the North Devon coast, approximately 16 km from the South Wales coast and approximately 13km north of Lundy Island in the Bristol Channel. The site is approximately 40 km east-west and 24 km north-south.

2.13 Water depths within the project area range from 23m LAT in the east to 56m LAT in the west (Chart Datum (CD)), with an extreme tidal range (difference between Lowest Astronomical Tide and Highest Astronomical Tide) of approximately 8 to10m.

Site Selection

2.14 In developing the current site boundary RWE went through a detailed site selection process, taking into account a wide range of environmental, economic and social factors. The following key attributes were critical in the site selection process:

- An excellent wind resource, which increases with distance from the shore;
- Outside of areas of nature conservation importance;
- Good options for port facilities suitable for construction and operation;
- Good seabed properties for foundations and subsea cable installation; and
- A secured grid connection point.

The Proposed Development

2.15 The proposed Atlantic Array development is for an offshore wind generating facility based upon between 187 and 416 turbines. The exact number of turbines is yet to be determined, though this

will depend largely on the turbine size and capacity available at the time of procurement. These are likely to be capable of generating between 3.6 and 8 MW each, with the overall expected installed capacity of the wind farm being approximately 1500 MW.

2.16 The offshore aspects of the development are likely to comprise the following key components:

- Offshore wind turbines and their associated foundations;
- Meteorological masts and their associated foundations for monitoring wind speeds prior to and during construction and the performance of wind turbines during the operation phase ;
- Offshore platforms (substations/converters stations) supporting some of the wind farm's electrical equipment, and possibly incorporating offshore facilities for operation and maintenance of the wind farm;
- Subsea cables between the turbines and the offshore substations, and between the offshore substations and the shore;
- Scour protection on inter-array and export subsea cables as required.

2.17 In determining the optimum design for the offshore aspects of the project, there are many considerations to be made including:

- Wind conditions;
- Support structures & foundation options;
- Construction and logistics techniques;
- Electrical design;
- Seabed characteristics and ground conditions;
- Metocean characteristics; and
- Operations and maintenance requirements.

2.18 The principal components of the onshore aspects of the development comprise:

- The landfall site with associated jointing between the offshore and onshore cable;
- Onshore underground cable routes and/or overhead lines; and
- Substation

2.19 The landfall locations for the export cables from the wind farm remain to be determined, however potential landfall locations at Cornborough Range, Saunton Sands and Woolacombe have been identified as shown on Figure 2.1 and Figure 2.2. Details of these locations and the onward routeing of the electricity cables and associated infrastructure are presented below. BCZL expects that the landfall location will be determined prior to the formal consultation processes with local authorities, key stakeholders and the local community and interest groups referred to in the Consents section above. The selection will be driven by an assessment of engineering and environmental constraints and informal discussions with key local authorities and environmental stakeholders.

2.20 As introduced earlier in this report, a Rochdale envelope approach will be adopted for the purposes of the Atlantic Array EIA to provide for flexibility in the final option selection for these aspects, allowing a valid assessment of potential effects arising from the project to be made by the developer, relevant authorities and stakeholders regardless of the final design of the

development. Information currently available on potential design options is summarised in the following sections.

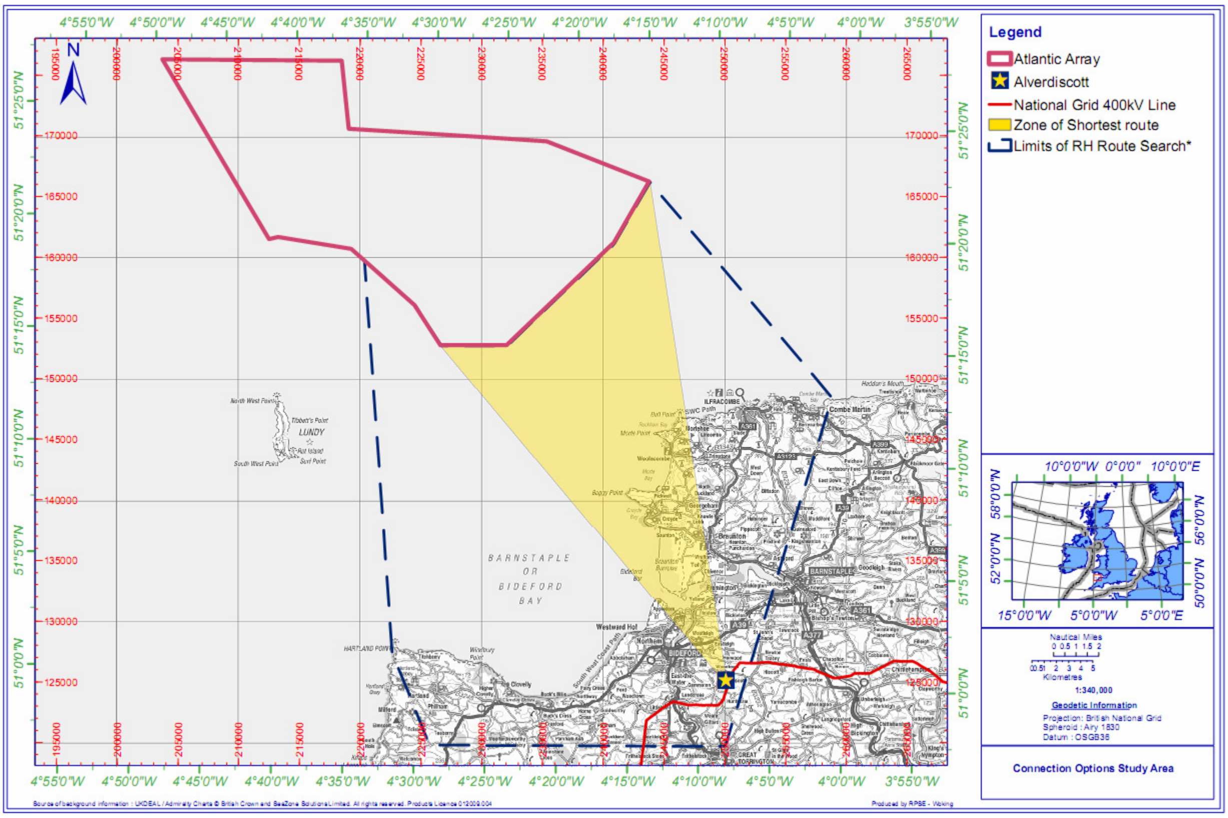


Figure 2.1: Onshore study area.

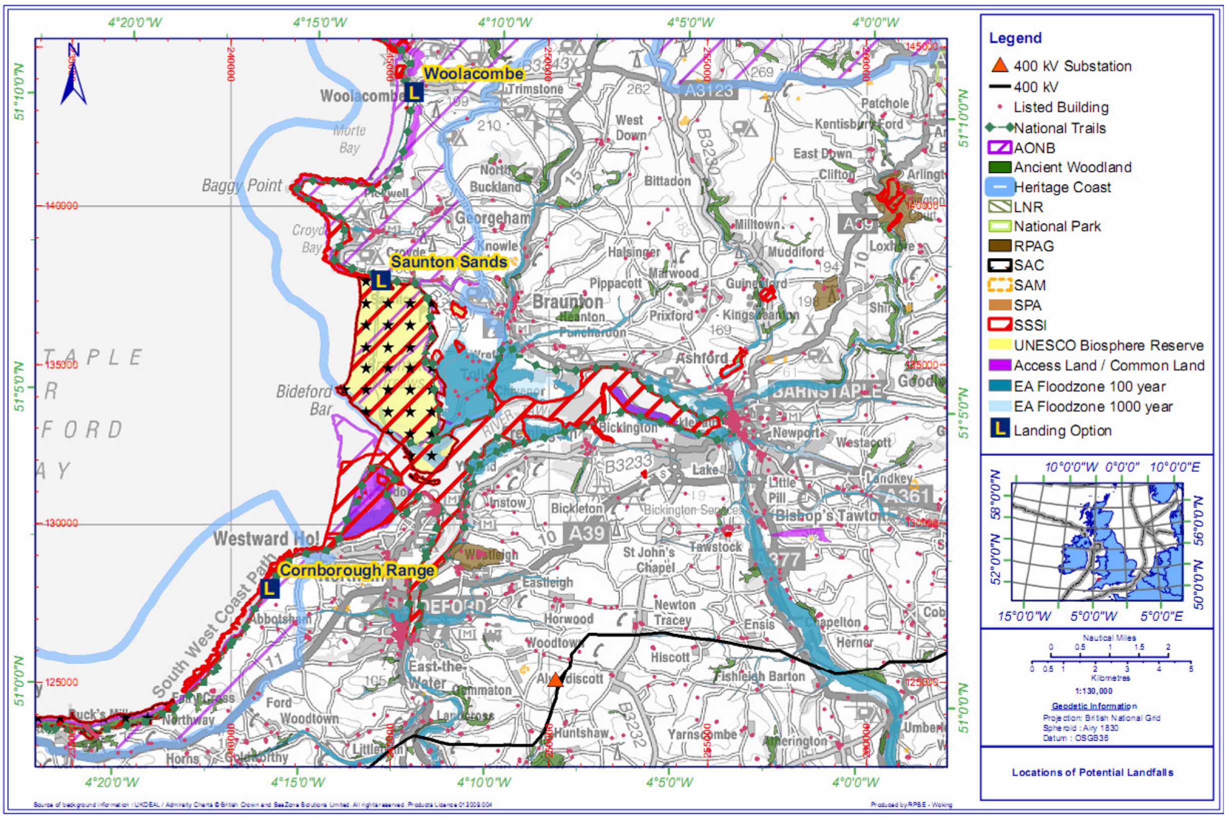


Figure 2.2: Location of potential landfalls and substations

Turbine Support Structures and Foundations

2.21 The overriding factors influencing the choice of foundation for a specific project are the type of wind turbine to be used, the nature of the ground conditions on the site and the metocean characteristics. These factors have a strong influence on project economics. Currently there is only limited information available on turbine types and the site ground conditions, pending more detailed studies. Preliminary engineering work indicates that the following foundation design options will be considered:

- Steel monopiles;
- Steel reinforced concrete monopile;
- Multipile/jacket;
- Tripod;
- Gravity base; and
- Suction caisson.

2.22 It is possible that more than one type of foundation may be used across the project area. A brief description of the expected installation methods for each of the foundation options is outlined below. A detailed description of fabrication, installation, and decommissioning methods for each foundation type considered will be included within the Environmental Statement.

Steel Monopiles

2.23 Monopiles are welded steel tubular sections which are installed vertically into the seabed either by driving using a pile driving hammer, or by a combination of driving and drilling, where harder ground conditions are encountered. The dimensions of the monopiles that maybe used will depend on the size of the turbines, the hydrodynamic forces and the ground conditions encountered at the Atlantic Array site.

Steel Reinforced Concrete Monopile

2.24 Such structures comprise a number of pre-cast concrete ring sections. These are fitted together and grouted prior to floating out to the construction site. Once on site, the monopile is positioned on the seabed and installed to the required depth in the ground by drilling from the inner radius of the pile, after initial seabed penetration by weight of the monopile.

Multipile - Braced Jacket Design

2.25 Jacket structures typically consist of three or four main legs which are linked by a supporting matrix of cross-braces. Jacket foundations are commonly of a design similar to that used for oil and gas platforms. Installation of the jacket involves the transportation of the prefabricated foundation, with transition piece already in place, to the site for positioning on the seabed. Generally, there is little or no requirement for seabed preparation. Commonly, each of the main legs terminates with a sleeve through which a pile is driven and subsequently grouted or swaged to the jacket pile sleeves. Drilling of piles may be required where ground conditions dictate and piles can be pre-installed using a template prior to installation of the foundation.

Tripod

2.26 Tripod foundations are similar to jacket foundation concepts but they comprise a fewer number of larger diameter tubular members. As the name suggests, three legs support a central support for the transition piece and turbine. Tripods can also be of an asymmetric design. The structure is piled to the sea bed through pile sleeves at the base of each leg in the same manner as the multi-pile concept. Piles can be pre-installed prior to the foundation installation using a template with the tripod subsequently lowered into position and secured by a grouted or swaged connection. Alternatively the foundation can be positioned on the sea bed, and the piles driven through pile sleeves.

Gravity base

2.27 Gravity base foundations have a large diameter steel or concrete base, which sits on the seabed to support the turbine tower. The gravity base solution relies on the weight of the structure to ensure that horizontal loads will not cause any upward forces on the base, and it will therefore remain in contact with the seabed. Downward forces are resisted by the base bearing onto the seabed. The gravity base structures would be filled with sand, rock or iron-ore ballast to increase the weight without adding to structural costs. Before installation of a gravity base foundation, preparation of the seabed may be required. This preparation commonly involves dredging (to remove soft material) and/or backfilling to provide a flat surface. Gravity foundations may be designed with steel skirts around the perimeter of the base, which penetrate into the soil, and allow under-base grouting.

Suction Caisson

2.28 The suction caisson is a large diameter foundation, which has skirts which penetrate the seabed. The caisson relies on the skin friction between the skirt and the sediment, and differential pressure between the inside of the base and the surrounding weight of water. This design enables a lighter structure than the gravity base while still ensuring that horizontal loads will not cause any upward forces on the base. Suction caissons may be used at the base of monopile, tripod and jacket/multipile foundations. Depending on the sediment conditions encountered, it may be necessary to pump grout under the base to ensure good contact between the base and the seabed.

Scour protection

2.29 Scour protection material is likely to be required around the bases of the all the foundation types to ensure structural integrity. Turbine support structures will also include secondary steelwork for cable j tubes, corrosion protection and to allow for access by operations personnel. Wind turbines and their associated structures also include appropriate lighting & marking as an aid to navigation.

Offshore Electrical Infrastructure

2.30 The offshore electrical infrastructure for the project will comprise three key components:

- Offshore substation platforms located within the turbine array;
- Cables within the array will collect energy from the turbines and transmit it to the offshore substations; and

- Export cables linking the offshore substation to the onshore electricity system, allowing the energy generated by the turbines to be used onshore.

2.31 Engineering design work is currently under way to review and assess a range of different design options for the electrical system. This process will determine the number and size of the offshore substations, and also the number of export cables. There may be either 2 or 3 substations and between 6 and 10 export cables.

2.32 As with the turbines themselves, the offshore substation platforms will be mounted on foundations secured to the sea-bed. Given the size of the substations, these foundations are likely to be of a steel jacket type. However, all foundation types listed in section 2.6 will be considered as part of the assessment.

2.33 Installation of the electricity cables (inter-array and export cables) will be either by ploughing or jetting. A cable plough installs cables by lifting a wedge of sediments and placing the cable beneath the wedge and then placing the wedge of sediments back into its original position. A jetting tool usually uses a high-pressure water jets to fluidise a narrow trench into which the cable is subsequently placed. The jetted sediments naturally settle back onto the seabed giving a degree of back-fill into the trench.

Onshore Electricity Infrastructure

2.34 National Grid is responsible for developing and maintaining an efficient, co-ordinated and economical GB electricity transmission system. This includes determining where it is appropriate for power generation projects such as the Atlantic Array to connect to the system. In this case, National Grid has granted to Bristol Channel Zone Limited, through its subsidiary Channel Energy Limited, an agreement which would allow connection of the Atlantic Array OWF to the existing substation at Alverdiscott, approximately 5 km south east of Bideford, North Devon, for 1,500MW. It is therefore proposed that Atlantic Array would be connected at this location.

2.35 Electricity will be carried between the landfall to Alverdiscott by means of a number of buried cables or possibly overhead lines. If an overhead solution is possible it could involve replacement or upgrading of existing overhead lines (decision subject to further engineering scrutiny and discussions with National Grid and other relevant parties).

2.36 Each marine cable from the offshore wind farm would be jointed to an onshore cable configuration at a cable landfall site. The landfall site would be at a location onshore behind any sea defences and cables would be installed within ducts drilled beneath any beach and sea wall. As made clear in the onshore elements of this report the final landfall is likely to be determined prior to the formal consultation process with local authorities, key stakeholders and the local community and interest groups referred to in the Consents section above. Each cable would be jointed within a transition pit measuring approximately 10 m long, 3 m wide and 1.5 m deep and made of concrete. Following construction of the cable corridor, transition pits would need to be accessible during the project life and therefore agricultural operations would not be possible over them. Separation distances between transition pits are typically 3 m.

2.37 Terrestrial cables would be buried between the transition pits at the landfall site and the onshore substation. Depending on the export voltage of the wind farm, the construction cable corridor for buried cables would be either 45m (for six cables at 220 kV), 54m (for nine cables at 154 kV) or 57m (for ten cables at 132 kV). This corridor allows for space for construction at either side, an access track and 3m separation between each cable. Cables would be buried in trenches and routed to avoid settlements and features of environmental importance where feasible. Land over the buried cables would be restored to its former use and therefore agricultural operations could

resume on the land above the cables. Hedges that were in existence prior to construction would be reinstated but new hedge or tree planting would be prohibited to ensure adequate protection of the cables.

2.38 An onshore substation is required to increase voltage from the export voltage of the windfarm to 400kV either close to the coast or adjacent to the existing 400kV substation at Alverdiscott. If the new substation is sited close to the coast, the ongoing connection to Alverdiscott could be via a reduced number of buried cables or by overhead line (potential upgrade/replacement of existing overhead lines). The new substation is likely to require a compound of approximately 300m x 350m or 10.5ha (excluding any landscaping or habitat enhancement requirements). The maximum elevation of any buildings is anticipated to be 15m although lightning protection equipment could be higher than this. A potential coastal substation candidate is Yelland (near Barnstaple), the site of a former coal powered generating station. The site is now a 14 hectare brown field area designated for power generation and employment purposes.

2.39 A preliminary engineering and environmental assessment has shortlisted a number of candidate landfall options within the search area between Hartland Point to the West and Combe Martin Bay to the North based on the topography of the coast, the local geological structure, engineering feasibility and environmental constraints. The preliminary shortlist of landfall options includes from West to North: Cornborough Range near Westwood Ho!, Saunton Sands and Woolacombe Bay (see Figure 2.2).

Cornborough Range

2.40 A landfall option has been identified at Cornborough Range as shown on Figure 2.2. This is located south of Westward Ho! and the Taw-Torridge estuary and to the north west of Abbotsham. A point has been identified at which the cliffs are relatively low and there is a long area of gently sloping land at the cliff top. The beach in this area is backed by low cliffs and an initial site visit confirmed that the site is likely to be suitable for a landfall utilising Horizontal Directional Drilling (HDD) to drill beneath the cliff face. There is an existing sewerage outfall at Cornborough installed in 2001.

Saunton Sands

2.41 Figure 2.2 shows the location of the landfall at Saunton Sands. This option is located at the northern edge of Braunton Burrows to the west of Saunton and north of the Taw-Torridge estuary. In this area, Saunton Sands provides a wide, sandy beach, which is accessed from the B3231 via an access road and car park.

2.42 The beach and burrows behind it form the northern edge of Braunton Burrows Special Area of Conservation. In order to minimise effects on the dune system, it is proposed that HDD would be utilised to pass beneath the dunes. This would require construction activity within the existing car park and in an area east of the dune system and golf club.

Woolacombe

2.43 A number of potential landfall options were identified at the northern end of Woolacombe Sands beach in the area shown on Figure 2.2. Woolacombe Sands is a wide sandy beach which is accessed from the B3343 and Challacombe Hill via the beachside car park. The beach is flat with a gentle slope up towards the car park behind and is overlooked by the Woolacombe Bay hotel.

2.44 The landfall options in this area would be located within the beachside car park or the car park south of the hotel.

2.45 The following provides more detail on the cable route options from each of the potential landfall locations identified above making a grid connection at Alverdiscott.

Cable Route Options

2.46 Indicative cable routing options are shown in Figure 2.3, Figure 2.4 and Figure 2.5. These indicate the likely broad alignment of the route. The required construction width would be up to 57 m within the corridor shown and would avoid designated sites and residential properties where feasible.

Cornborough Range to Alverdiscott

2.47 Cornborough Range is one of the few low points in the cliffs between Hartland Point and Westwood Ho!. A potential buried cable corridor has been identified which routes from the landfall location around the south of Bideford and then east to Alverdiscott. This route is substantially contained within agricultural land but would require a crossing of the River Torridge, the A39 and the A339.

2.48 This option could comprise buried cables from the landfall site to a substation extension adjacent to the existing substation at Alverdiscott. Alternatively, an intermediate substation closer to the coast could be considered, reducing the number of ongoing cables to Alverdiscott.

2.49 No overhead line options have been identified for this landfall site. This route is shown in Figure 2.3.

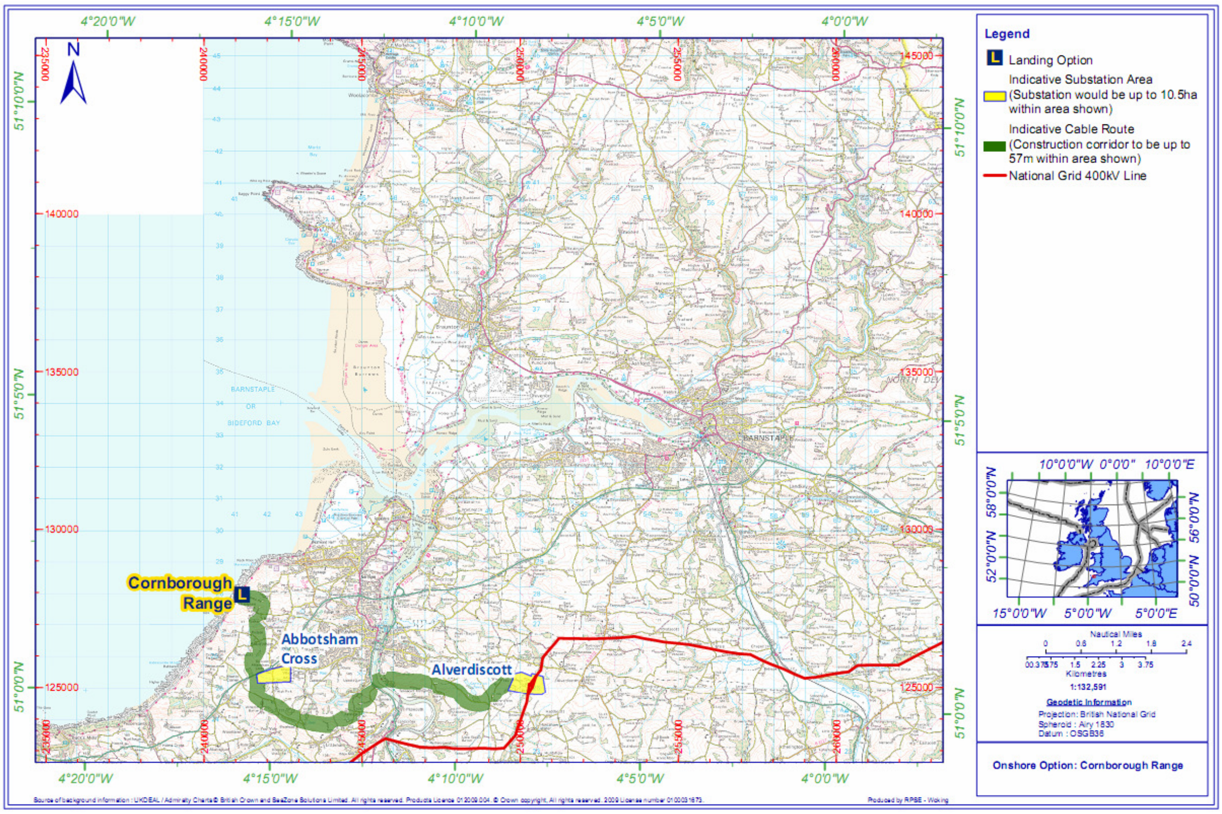


Figure 2.3: Onshore option - Cornborough

Saunton Sands to Alverdiscott

2.50 Saunton Sands is a large, flat sandy beach adjacent to Braunton Burrows. The marine cables would be terminated within the car park at the northern end of the beach and then a further HDD operation would be required to drill under the SAC features into the Saunton Sands Golf Club car park. Cables would then be routed south close to Burrows Close Lane and then east between Braunton Great Field and Braunton Marsh before heading south to a new substation at Yelland. This would require a river crossing to Yelland using HDD.

2.51 From Yelland, cables may be either buried or placed overhead by upgrading the existing 132 kV overhead line to 400 kV.

2.52 Alternative options that may further reduce the effect on Braunton Burrows would also be considered.

2.53 This route is shown in Figure 2.4.

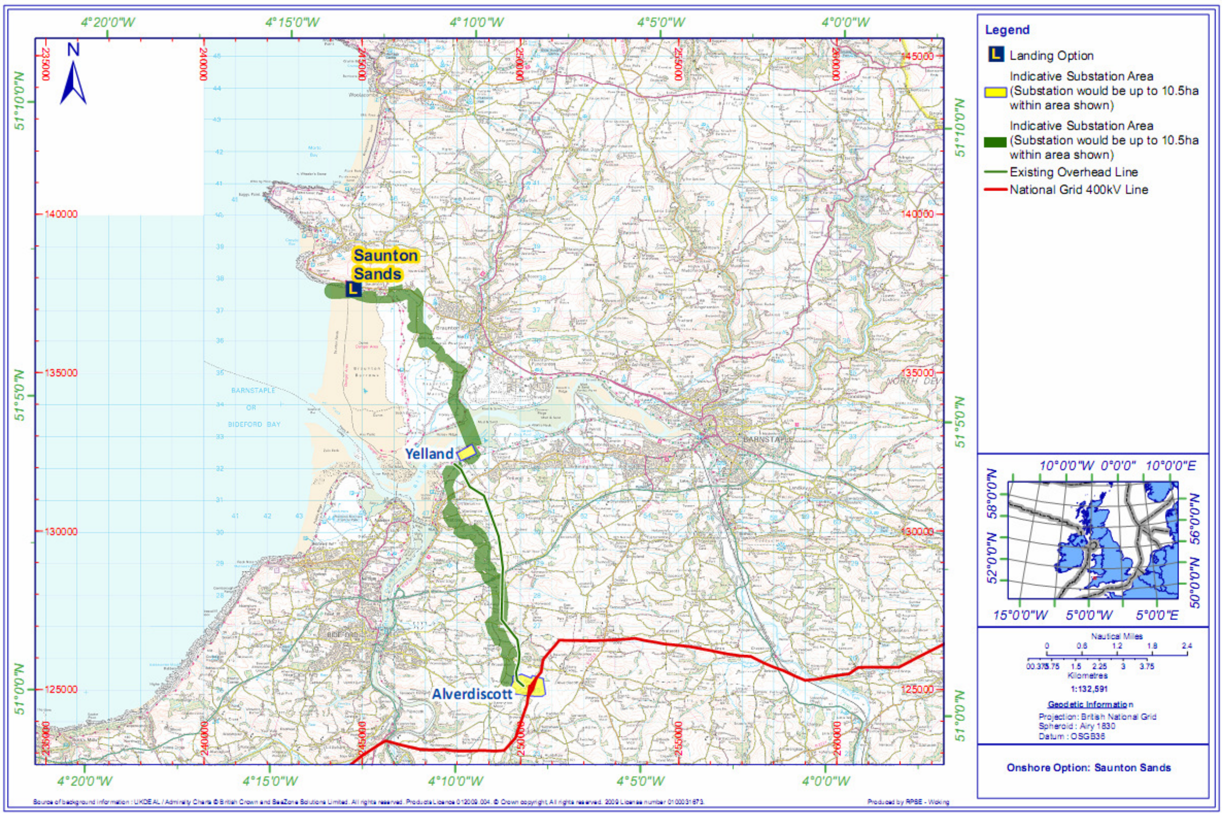


Figure 2.4: Onshore option - Saunton Sands

Woolacombe to Alverdiscott

2.54 Woolacombe has a large, flat sandy beach. Marine cables would be terminated within the beach car park within the town or at the car park south of the Woolacombe Bay hotel. Cables would then be trenched to a new substation at Yelland either routing to the west of Braunton (as described for the Saunton Sands option above) or to the east of Braunton. The route would require a crossing of the River Taw and the A39.

2.55 As for the Saunton Sands option, the route from Yelland may utilise either buried cables or overhead lines replacing of the existing 132kV overhead line.

2.56 These routes are shown in Figure 2.5

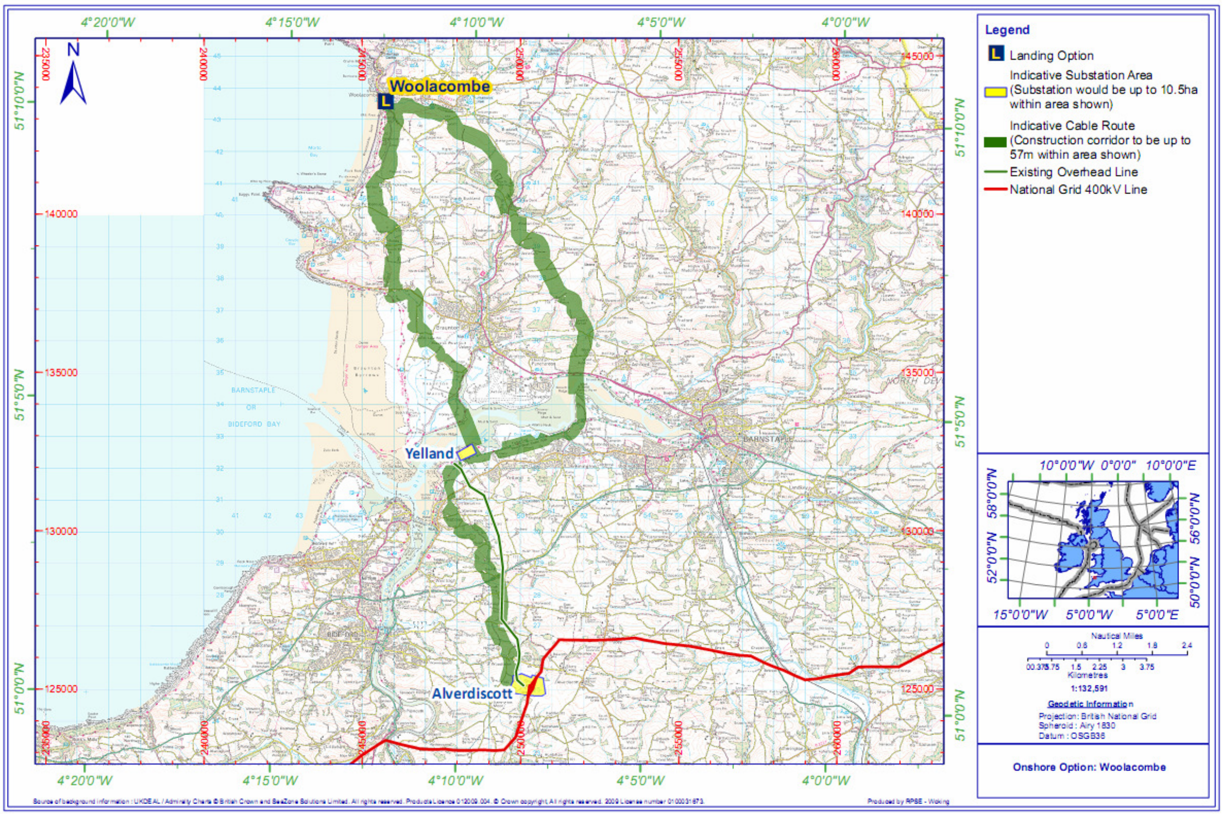


Figure 2.5: Onshore option - Woolacombe

Electrical Substation Development

Alverdiscott Substation Extension

2.57 The existing substation location at Alverdiscott is shown on Figure 2.1.

2.58 The existing substation is located within a grassland field used as grazing land and is sited centrally within this field, with a variety of overhead lines crossing the land.

2.59 It is anticipated that there is sufficient land near the existing substation to accommodate the requirement for 10.5 hectares avoiding the existing overhead lines.

Alternative Substation Options

2.60 For each of the landfall options, it would be possible to construct a 132kV/400kV, 154kV/400kV or 220kV/400kV substation on land near the existing Alverdiscott substation as described above. However, a substation located between the landfall options and Alverdiscott has also been considered. This would allow the onward connection route to Alverdiscott to be completed either by a reduced number of cable circuits (and therefore reduced corridor width) or by overhead line. The number of circuits would reduce to two (from six, nine or ten) and the cable corridor would reduce to 25m (from 45m, 54 or 57m).

2.61 This section describes the identified substation locations for each landfall location.

Cornborough Range

2.62 For the Cornborough Range landfall, options have been considered in the area around the A39 roundabout at Abbotsham Cross, south of Abbotsham near the retail and leisure development known as Atlantic Village. However, it is recognised that some land in this area is identified for future housing development in the Core Strategy and that the area is likely to be a candidate for long term expansion of Bideford and Northam.

Saunton Sands

2.63 Yelland would be the target location for a substation from a landfall at Saunton Sands. Whilst consideration has also been given to other potential substation locations in the vicinity, no suitable areas have been identified given the presence of Braunton Burrows, the town of Braunton, Braunton Great Field and Braunton Marshes.

Woolacombe

2.64 Yelland would also be the target location for a substation from a landfall at Woolacombe. A number of sites were also considered closer to Woolacombe. However, given the topography, elevation and land area required none of these were deemed appropriate.

Offshore installation issues

Foundations

2.65 Foundation installation will take place in the first offshore construction season of the project, prior to the installation of the turbines. Methods of installation for foundations vary significantly depending upon the foundation type selected. Techniques typically employed include::

- Pile driving
- Seabed levelling (for gravity bases)
- Drilling and Grouting
- Pile connection activities in the case of multipile solutions

Offshore Wind Turbines

2.66 Following foundation installation offshore wind turbines will be erected. Commonly towers and nacelles are pre-erected or erected individually at the site using a crane barge. Blades are subsequently fitted to the tower/nacelle structure as individual components or in a part assembled state.

2.67 Export cables will be brought to shore from the offshore substations to the chosen landfall location. The route for the export cable to shore is yet to be defined. A detailed assessment of the physical seabed conditions, the seabed ecology and the use of the seabed by other industries will be undertaken to guide the locations of the cables. The final target burial depth will be determined as part of the detailed engineering design work. Cable burial will vary depending on the nature and long-term stability of the seabed, and an assessment of damage risk, dictated by a cable burial risk assessment.

2.68 The extent to which of the various burial techniques are used will be dependent on the result of a detailed seabed survey of the final cable route and associated burial risk assessment process. It is likely that some form of ploughing or jetting, or combination of both, will be used.

2.69 Rock dumping, frond mats or grout bags may be used to protect the cable ends where they enter the J-tube and may be utilised when ground conditions result in the cable being laid near to or on the surface. It is conceivable that the laying of cable protection may also be necessary after burial, where sections of cables are too shallow or have otherwise become exposed as informed by the post installation inspection or periodic maintenance surveys.

Cable crossings

2.70 A number of telecommunications cables cross the Bristol Channel Zone and as such it is anticipated that a number of cable crossings will be required. The design of the crossing will be agreed with the cable owner/operator to ensure that integrity of all the assets is maintained.

Scour protection

2.71 Scour can occur around the base of a foundation when seabed sediment is winnowed away as a result of the flow of water around the structure. A number of options for scour could be considered for installation at Atlantic Array, depending on the final project design process, ground conditions and scour assessments. These could include:

- Rock and gravel dumping
- Protective aprons
- Mattresses
- Flow energy dissipation (frond) devices

2.72 The installation of scour protection material will be carried out using a ship or barge, for example using an on-board fall pipe system. Alternatively, custom-built vessels equipped with side-dump facilities, grabs or fall pipe with ROV can also be used.

Meteorological Masts and Other Project Development Equipment

2.73 Meteorological masts are used to measure meteorological characteristics at a development site. As part of the development of the Atlantic Array OWF, BCZL intends to install meteorological masts to measure wind speeds in the area, prior to the wind farm being built.

2.74 Consent to construct meteorological masts are applied for separately to the main Atlantic Array project. An application for consent to construct a meteorological mast within the main Atlantic Array project been submitted to the newly formed Marine Management Organisation. The exact location of the masts is to be confirmed, but they will be sited within the development area. Masts will comprise a steel lattice tower with associated foundation, the height of which will be up to 120m above mean sea level. Further masts will be constructed as part of the main project, to monitor performance of the wind turbines once they are installed.

2.75 Waverider buoys and/or Acoustic Doppler Wave & Current Profiler (AWACs) have been deployed across the site to measure oceanographic conditions. Waverider buoys are free-moving floating buoys, while AWAC's are bottom-mounted using an anchor with a small marker buoy. Both waveriders and AWAC's collect a range of wave data, while AWAC's also collect current information. Consent has already been granted for the metocean equipment, so this is not considered as part of the EIA for Atlantic Array.

Construction Phase

2.76 Offshore construction work is proposed to commence in 2014/2015 with the preliminary engineering work indicating that the construction period will last four to six years. Only limited information is available at present on the nature of the construction process, since the major parameters of the proposed development have not yet been defined in detail. Key to defining the construction methodologies (and therefore the likely construction activities) will be choices on the following:

- Port(s) used as the base for the construction phase
- Vessels to be used for the offshore construction works
- Foundation types
- WTG selection

2.77 Decisions on the above will be addressed during the detailed design and EIA phase.

2.78 A number of ports exist on the South Wales and South West English coasts that may be suitable for much of the construction and operation activities required for the wind farm project. Part of the detailed project design and logistics planning for the project involves assessing a number of potentially suitable port facilities.

2.79 In addition to using ports for the construction of the wind farm, consideration will be given to the components of the wind farm being brought directly to the project site from their point of manufacture.

2.80 It can be assumed that the key stages associated with the installation of the wind farm are likely to be as follows::

- Detailed pre-construction site investigation (e.g. CPT, boreholes and high resolution geophysics), subject to a separate consent application process
- Foundation installation and associated site preparation
- Installation of tower, nacelle, hub and blades of the wind turbine generators
- Installation of monitoring meteorological masts
- Installation of offshore transformer substations
- Installation of inter-array transmission cables
- Installation of transmission cables between substations and to shore
- Construction of the required onshore electrical infrastructure (such as terrestrial cables, substations and overhead lines) to link the development to the National Grid transmission system

2.81 Construction compounds and storage facilities will be required at the ports used as the construction base(s). In addition, construction compounds, laydown areas and access/haulage tracks will be required for the construction of any onshore electrical infrastructure. Port development is outside the scope of the EIA as any such project would be subject to a separate and independent application process.

Project Operation and Maintenance

2.82 Once commissioned, the wind farm will operate automatically with each wind turbine operating independently of the others. The operation and control of the wind farm will be managed by a Supervisory Control and Data Acquisition (SCADA) system, installed at each turbine and at the onshore control base. The SCADA system will enable the remote control of individual turbines or the wind farm in general, as well as information transfer, storage and the shutdown of any wind turbine if required. A number of maintenance options are under consideration for the project. The most likely scenario is that access to the wind turbines for maintenance purposes would be by boat and ladder, from an onshore operational base. The potential use of helicopters and floating hotels for transferring and accommodating maintenance staff offshore is also being explored and will be considered through the EIA process. Wind turbines are likely to require a major service every 12 months, with an intermediate service after 6 months. Periodically large components such as gearboxes and blades can be required. In this case a large crane vessel, similar to that used for turbines installation would be used to carry out the necessary works.

Decommissioning

2.83 The Crown Estate lease for the Atlantic Array site is for 50 years. The design life of the turbines and other components of the wind farm are likely to be in the order of 20-30 years and therefore it is possible that some refurbishment or replanting may occur. If the decision to refurbish or replant the turbines was made then any relevant consents or licences required would be applied for at that time.

2.84 At the end of the Crown Estate lease period, it is a condition of the lease as well as statutory requirement, through the provisions of the Energy Act 2004, that the proposed Atlantic Array OWF is decommissioned. Under the statutory process, BCZL is required to prepare a decommissioning plan at the request of the SoS and prior to construction, funds must also be set aside for the purposes of decommissioning. For the purposes of the EIA, the decommissioning of the wind farm is likely to be the reverse of the construction process, with some exceptions. Current thinking suggests that piled foundations would be removed to just below seabed with due consideration made of likely changes in seabed level, whilst gravity base and suction caisson foundations would be removed completely. Currently there is no statutory requirement for decommissioned cables to be removed, however the necessity to remove cables will be reviewed at the time in terms of environmental impact of the removal operation and safety of the cables left *in situ*. Following decommissioning the OWF components, seabed equipment will be removed and the site reinstated. It is expected that decommissioning will require similar vessels to construction and will take approximately 3 to 4 years.

Consultation

Overview of Consultation

3.1 As described earlier in this document, the scoping report provided here forms the principal material for submission to the IPC for the purposes of requesting a scoping opinion under s8(3) of the Infrastructure Planning (EIA) Regulations 2009. Separate consultation on the proposed development of the Atlantic Array OWF will be undertaken as part of the requirements under the Planning Act 2008, specifically section 42; the requirement to pre-consult with consultees, local authorities and other affected persons; and section 47; the requirement to consult the local community in accordance with a statement of community consultation (SoCC). The SoCC will, as prescribed in the Planning Act, be agreed in consultation with the local authority (section 47(2)). This consultation is likely to involve the final determined landfall rather than all the candidate landfalls referred to above.

3.2 In preparing the scoping report to provide for the requirements under section 8(3) of the Infrastructure Planning (EIA) Regulations, preliminary consultation with a number of bodies and organisations has been conducted. This preliminary engagement is outwith the formal process which will be instigated through the notification of the IPC under Regulation 6(1) of the EIA Regulations that an Environmental Statement will be provided for the project, and notably precedes the consultation process requirements noted above relevant to the Planning Act 2008 provisions.

3.3 In consulting on this project it is BCZL's aim to:

i) introduce the proposed project;

ii) identify and discuss particular issues of concern; and

iii) discuss the need and scope of studies/surveys that may be required to inform the EIA process.

3.4 Consultation, in line with the requirements of the EIA Regulations 2009 will continue throughout the EIA process, including a series of public exhibitions and meetings to provide details on the proposed scheme. This is likely to be undertaken alongside the consultation process agreed with the Local Authority under the Planning Act requirements; specifically the agreed SoCC.

SCOPING OF ENVIRONMENTAL EFFECTS – OFFSHORE DEVELOPMENT

Introduction

4.1 As set out in previous sections, it is anticipated that there will be a single ES for the Atlantic Array project. This would have separate onshore and offshore volumes for ease of reference.

4.2 The offshore volume of the ES will be structured to allow all relevant environmental information to be readily accessible. The initial part of the offshore ES will contain the introductory chapters relating to the project as a whole, including the description of the project, an outline the main alternatives considered during the evolution of the project and the methodology adopted for the EIA. The remainder of this volume of the ES will contain the topic by topic environmental information. A table of contents of the offshore part of the ES is listed in Appendix I.

The Physical Environment

Geological Considerations

General

4.3 Within the Bristol Channel the present day scenario and the distribution of sediments on the seabed has been controlled by a combination three recent geological events:

i) The establishment of the Bristol Channel drainage basin during the Late Tertiary,

ii) Effects of the Late Devensian and preceding glaciations,

iii) The subsequent rise in sea level to present day levels and the establishment of fully-marine conditions and high tidal range.

4.4 The following summary has been developed based on publicly available data for the area within and around the Atlantic Array site. The objective of this is to develop a preliminary understanding of the bathymetry, seabed sediment and solid geology to a depth of approximately 50m to give a preliminary understanding of the possible seabed and sub-seabed conditions within the Atlantic Array site.

Bathymetry

4.5 The Seabed across the Atlantic Array site is illustrated in Appendix III. Water depths at the Atlantic Array site vary from 26.5m below Chart Datum (CD) in the north of the site to 56m below CD in the west of the site (Figure 4.1). The scale of the map in Appendix III means that significant seabed features such as sand waves and glacial

geomorphological features are absent from this image and the smooth nature of the bathymetry on the chart may not be representative of the actual seabed conditions present.

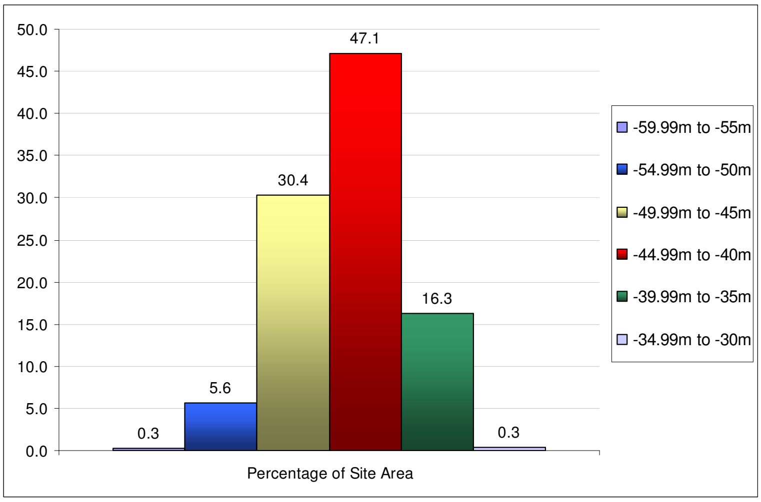


Figure 4.1: Histogram of water depths across site.

Sea Bed Features

4.6 BGS maps (Figure 4.2) indicate that an area of sandwaves occupy the central area of the Atlantic Array indicating a mobile seabed. Sand banks are found to the southwest of the Atlantic Array site as indicated in Figure 4.2. BGS maps (Appendix IV) suggest that seabed sediments are absent over the extreme east of the Atlantic Array site indicating that quaternary and / or solid strata are present at seabed.

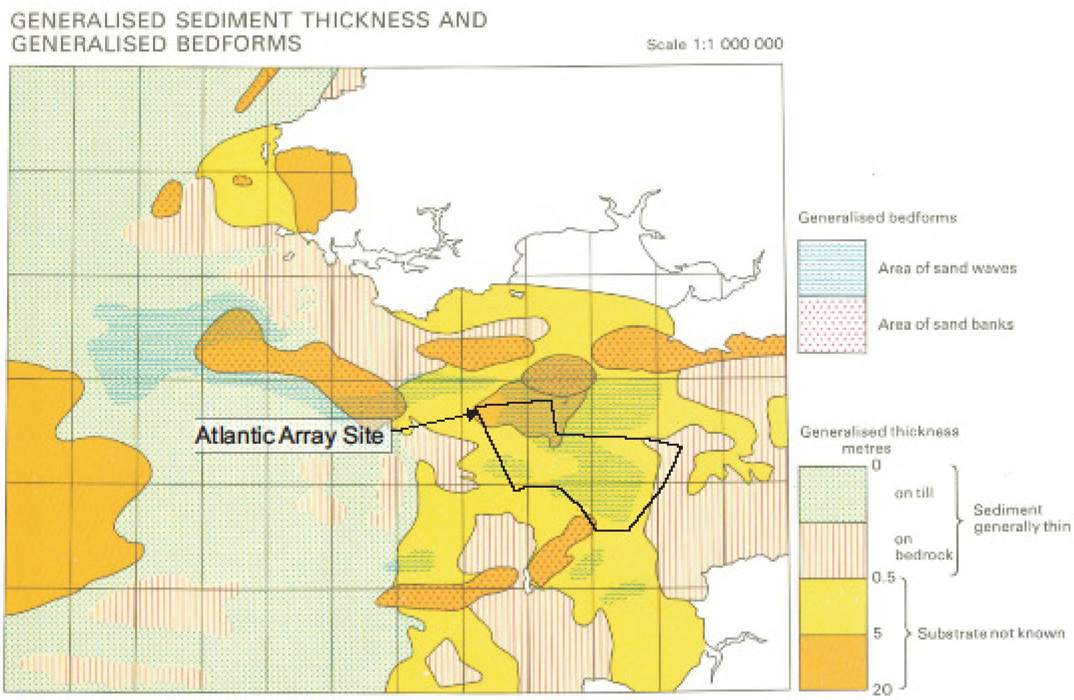


Figure 4.2: Generalised sediment thickness and generalised bedforms (BGS, 1983b)

Sea Bed Sediments

4.7 Regional information produced by the BGS (1983b) shows that superficial sediments are predominantly composed of sandy gravel (sG), gravelly sand (gS) and sand (S) with small areas of gravelly muddy (clayey) sand (gmS) and gravel (Appendix V). Sandier superficial sediments are found over the northwest part of the site whilst more gravelly units are found to the southeast.

4.8 Superficial sediments across the Atlantic Array site are predominantly 0.5m – 5m thick with small areas to the north and south attaining thicknesses of between 5m and 20m (Figure 4.2).

Pleistocene and Holocene Deposits

4.9 With the extreme reworking experienced by the region during the last glaciations, the lowermost glacial units show a huge range in composition and include boulder clays, sands and gravels with varying silt and clay content representing deposition in both terrestrial to marine environments.

4.10 Information from the BGS (Tappin et al, 1994) suggests that the quaternary geology of the area is likely to be less than 100m thick with possible rock outcrops at the surface. Quaternary deposits in the Bristol Channel and Lundy area are undifferentiated by the BGS. As such it is not currently possible to characterise the quaternary soils at the Atlantic Array site, however BGS boreholes carried out in the general area suggest that the following formations may be found:

- Surface Sands Formation,
- Western Irish Sea Formation,
- Cardigan Bay Formation,

4.11 The Surface Sands Formation is composed of sand and is occasionally gravelly or shelly. These deposits are generally less than 2m but can be more than 60m in channels.

4.12 The Western Irish Sea Formation is interpreted to be composed of clay, silt, cobbles and boulders and is generally less than 10m thick but infill deposits can be as much as 200m.

4.13 The Cardigan Bay formation is only found in one borehole from the Bristol Channel. Where the formation has been sampled only the Upper Till Member is interpreted to be present.

Solid geology

4.14 The solid geology underlying the site can be broken down into four separate phases of Earth's history (Appendix V). These comprise (from youngest to oldest) Tertiary, Cretaceous, Jurassic and Triassic strata.

4.15 Tertiary deposits occur along the southern margin of the Atlantic Array site and are interpreted to be over 300m thick. The upper units comprise mainly clay and immature brown coal, (lignite) and described by Tappin et al (1994) as "red, grey and brown, in part mottled, silty and sideritic". Strength data for the units are not available.

4.16 Upper Cretaceous deposits are found over the central part of the Atlantic Array site. These strata are described by the BGS (1983a) as “varicoloured clays and sandstones with brecciated lignite rootlet beds”. This deposit is approximately 500m thick (Tappin *et al* 1994).

4.17 Strata of Jurassic age is found in an east-west belt through the central and southern parts of the Atlantic Array site. Jurassic strata in the Bristol Channel comprise predominantly mudstone, siltstone and, sandstone with less common limestone beds.

4.18 Triassic strata is interpreted to be present generally over the northernmost part of the site. The material is composed of “red mudstone and siltstone, and siltstone with rare sandstone beds.

Structural influences

4.19 The area within and around the Bristol Channel has a complex tectonic history comprising faulting, folding, with igneous intrusions (Tappin *et al,* 1983). These structural influences may have significant consequences to founding at the Atlantic Array Site.

4.20 The Sticklepath-Lustleigh fault zone is located one mile southwest of the Atlantic Array site; development of which may have resulted in brecciated fault zones to have developed in the general area of the Atlantic Array site. Numerous other faults are also found in the area.

4.21 Numerous folds occur across the Atlantic Array site. Strata over the north and west parts of the Atlantic Array site typically dip north and northeast at angles of 10° to 30°. Oligocene strata within the Stanley Bank Basin dip to the southwest at angles of up to 5°. Folds have their axes generally aligned from east to west and dip to north or south.

4.22 Intrusive igneous dykes have been mapped to the southwest of the Atlantic Array site and as such may extend across the proposed site.

4.23

Coastal and Marine processes

Introduction

4.24 This section outlines the scope of assessment planned for the study of coastal and marine processes in relation to the construction of Atlantic Array.

Background Data/Information

4.25 The following data sources have been used to characterise the hydrodynamic regime within the Atlantic Array wind farm site:

- UKHO charts (Co-tidal and navigation)
- Renewables Atlas (ABPmer *et al,* 2008)
- Bristol Channel Marine Aggregate Research Project (Posford Duvivier & ABP Research & Consultancy Ltd, 2000),

- The Outer Bristol Channel Marine Habitat study (Mackie *et al,* 2007 and James *et al,* 2004).
- Marine Aggregate Environmental Statements for Nobel Sands (ERM, 2002 and ERM, 2009)

Tidal Range

4.26 Within the Atlantic Array site mean tidal range varies between 6.85 and 8.15m during a spring and 3.36 and 4.01m during neaps with tidal range increasing in a west to east direction, this can result in an increase in tidal range of 1.3m during spring tides between the western and eastern ends of the wind farm (Figure 4.3).

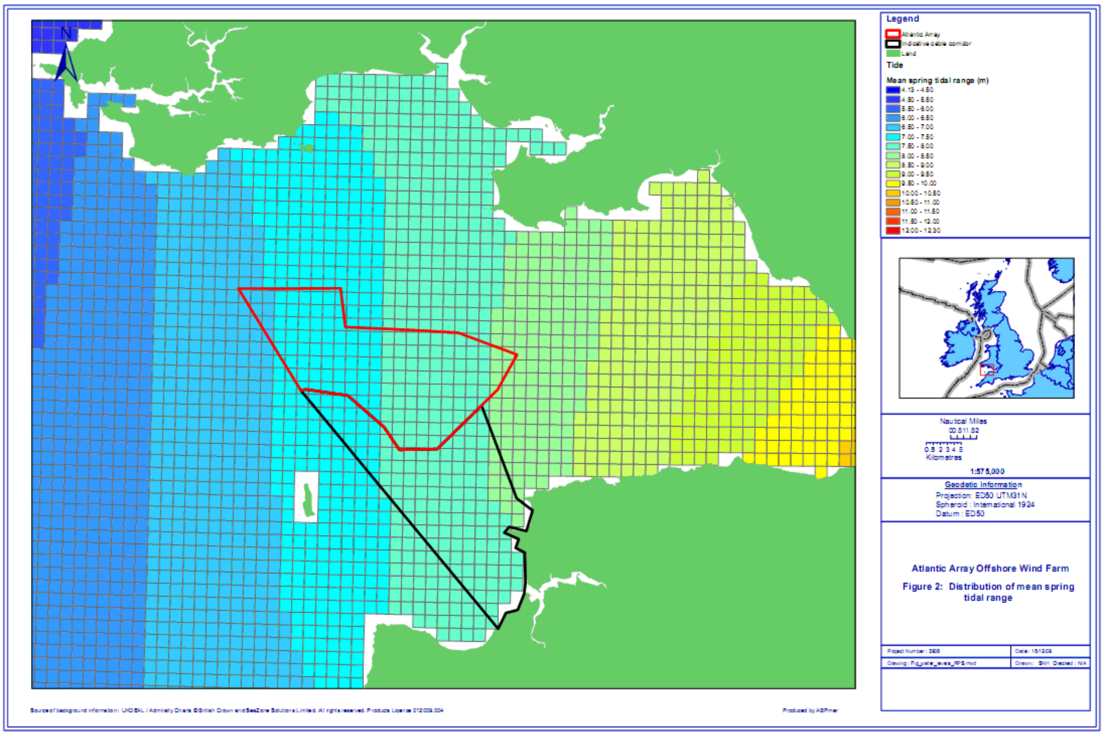


Figure 4.3: Distribution of mean tidal spring range

4.27 The mean spring tidal range is classed as hypertidal (defined as tides with a range of over 6 m). The high tidal range is commonly explained by a combination of resonance with the incident North Atlantic tidal wave approaching the Bristol Channel and with further amplification and convergence as the tide moves into the funnel shaped form of the Severn Estuary. The argument for tidal resonance is supported by studies undertaken by IOS (Fong and Heaps, 1978) and latterly by POL (2001).

Non-Tidal Influences

4.28 The relevant Shoreline Management Plan (SMP) (Halcrow, 1998) calculated surge events at Lundy to the south of the Atlantic Array site; this study gave a 1 in 200yr return period value of 4.70mOD. Actual surge values within the Atlantic Array site will be calculated as part of the development process.

Future Sea Level Rise

4.29 Future sea level rise results from the net effect of global change and the local change in land levels due to glacial rebound and subsidence. The guidance for coastal management in the South West region of the UK indicates that 423.5mm of net sea level rise can be expected by the year 2060 (Defra, 2006.

4.30 As the lease for the scheme is a 50 year period, both sea level rise and lunar tidal influences should be considered in the baseline definition.

Tidal Currents

4.31 An overview of tidal currents suitable for characterising the regime at scoping level within the study area can be sourced from the Renewables Atlas (ABPmer *et al*, 2008) (Figure 4.4). This indicates that during a mean spring tide, peak near-bed currents (10% above the seabed) vary between 0.78 and 1.11m/s and 0.39 and 0.54m/s during a mean neap tide. Spatially, currents increase towards the east in line with the increase in tidal range.

Wave Regime

4.32 The wave climate can be characterised at a broad level using the renewables atlas. This indicates that the wave climate within the wind farm site is relatively active with an annual mean significant wave height ranging between 1.52 and 1.79m The wave height tends to decrease in an easterly direction as the waves encounter shallower water depths within the upper Bristol Channel and Severn Estuary.

4.33 The relatively large waves encountered within the Bristol Channel are a consequence of the west to east orientation. This allows the generation of local waves during westerly winds over a large fetch and the propagation of swell waves generated distal to the Bristol Channel to propagate into the study area.

Sediment Regime

Seabed Deposits

4.34 Within the Bristol Channel, gravel sized sediment populations dominate in the greater water depths with the smaller, sand sized material dominating in shallower water depths. Localised areas of exposed bedrock occur in the centre of the channel. Mud deposits are typically located in the bays and in particular further upstream in the Severn Estuary. This sediment distribution is typical of a highly mobile regime, with the larger sizes and exposed bedrock coinciding with the most mobile areas. It should be noted that the gravel sized sediments only form a lag (thin) deposit over the underlying bedrock (Tappin *et al*, 1994).

4.35 The sediment population within Atlantic Array site mirrors that observed over the deeper waters of the Bristol Channel; gravel (G), gravely Sand (gS), sandy Gravel (sG) and sand (S) populations and a area of bedrock which is located on the eastern margin of the site. Figure 4.4 illustrates the sediment population over the proposed zone and wider area as determined during the Outer Bristol Channel Marine Habitat Study (OBCMHS) (Mackie *et al*, 2006). Sediments within the Bristol Channel are representative of a highly worked seabed and consequently tend to form well sorted, discrete sediment populations.

4.36 The coarse nature of the seabed sediments means that the mobilisation of bed sediments through construction activity is likely to be limited both spatially and temporally.

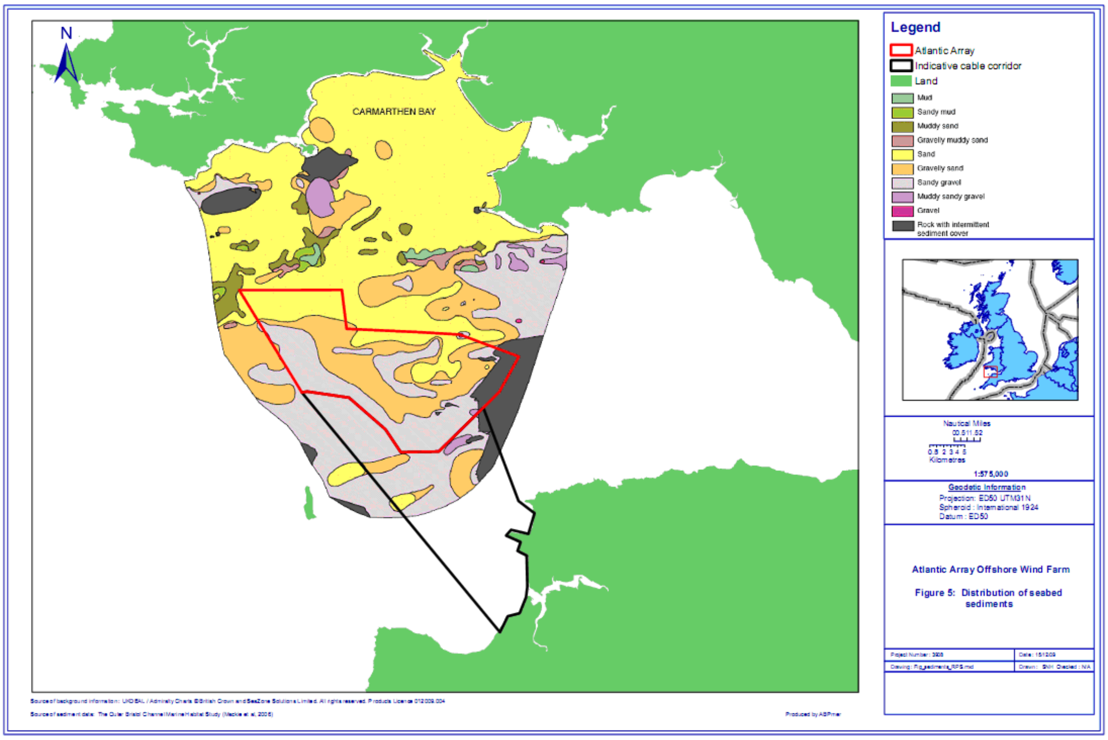


Figure 4.4: Distribution of seabed sediments. .

Seabed Features

4.37 The Atlantic Array development site is situated on the North Outer Bristol Channel Sands (NOBel Sands) and the South Outer Bristol Channel Sands (SOBel Sands). Nobel Sands is a large sand wave field located to the south-west of Worms Head and covering the northern part of the Atlantic Array site. The largest sand wave recorded during the OBCMHS survey was 16 m high, whilst the UKHO has recorded heights of 19 m in this area (James *et al*., 2004). Sobel Sands has isolated sand waves on a pavement of gravelly sediment covering the southern part of the Atlantic Array site.

4.38 These sand waves are typically orientated along a north-south axis, indicating an east-west alignment of the sediment transport pathways. It is noted that geophysical evidence collected during the OBCMAS and the comparison of historical survey data suggests that whilst the upper part of the sand waves are mobile, as supported by the presence of megaripples, the overall structure and position of the sand wave features are self maintaining and remain in a state of *in-situ* equilibrium (Mackie *et al*, 2006). The sand wave field extends between Carmarthen Bay and Barnstaple Bay, merging with the sand patches and sheets found at greater water depths (Tappin *et al*, 1994).

4.39 The Helwick Sands feature is situated approximately 13.5 km to the north of the Atlantic array wind farm site and adjacent to the Gower Peninsula. The bank is approximately 13 km long, 1-2 km wide and reaches a maximum height of 30 m above the surrounding seabed. The feature principally comprises sands and extensive dune features are present (Velegrakis *et al,* 2000). The dunes are aligned perpendicularly to the prevailing tidal current although the asymmetry is both spatially

and temporally variable, the presence of the dunes and the sensitivity of their morphological characteristics to the fluctuations of the tidal flow suggest that the bank's sediments are mobile under the tidal currents (Velegrakis *et al*, 2000). Sediment tracer studies have shown an exchange of sediment between East Helwick and the beaches along the Gower Peninsular (Posford Duvivier and ABP Research & Consultancy, 2000).

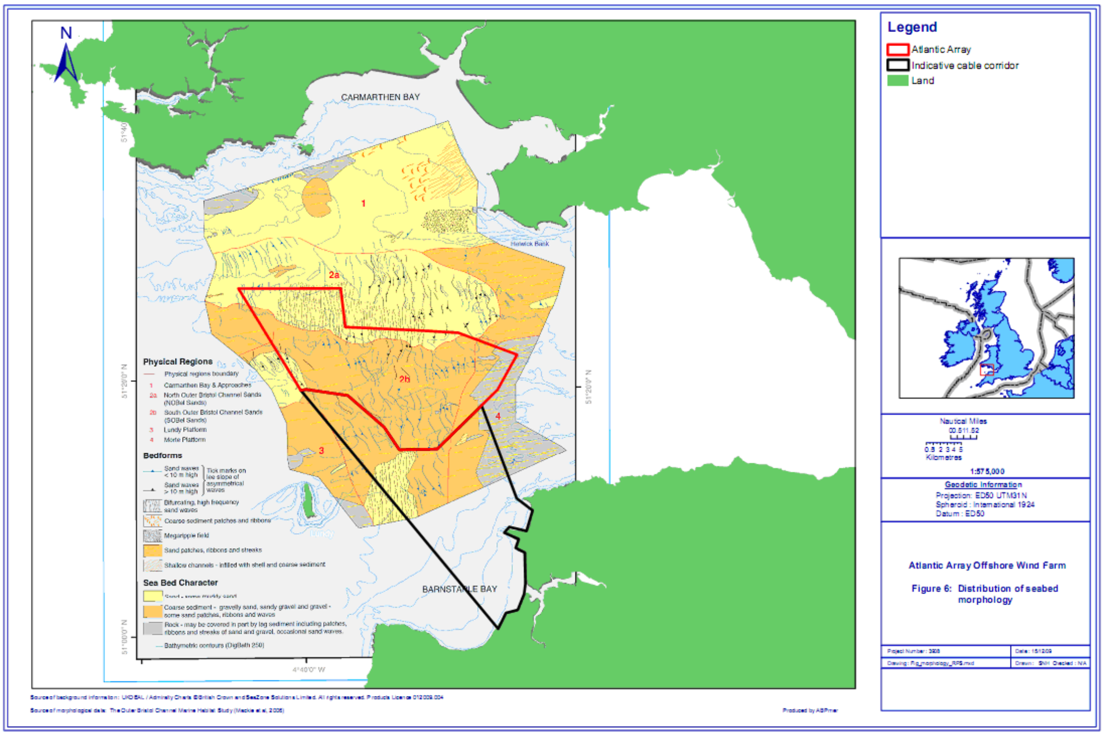


Figure 4.5: Distribution of seabed morphology.

Seabed Mobility

4.40 The sea bed deposits in the deeper waters of the Bristol Channel (and hence in the vicinity of Atlantic Array) are under the dominant control of the tidal regime (Posford Duvivier and ABP Research, 2000).

4.41 The sediment transport pattern within the Bristol Channel and Severn Estuary system has been extensively studied and whilst it there is little information regarding the associated sediment budget, the generalised large-scale transport patterns can be described as below (and illustrated in Figure 4.6):

- Sediment 'parting zone' at the interface between the Severn Estuary and the Inner Bristol Channel. It should be noted that this parting zone has also been classified as a mutually evasive transport mechanism (Harris and Collins, 1991). Here ebb directed transport occurs in the centre of the channel whilst flood directed transport occurs within the nearshore;
- Easterly sediment transport from the 'parting zone' into the Severn Estuary;
- Westerly sediment transport from the 'parting zone' through the Bristol Channel and the Atlantic array site;
- Local sediment circulation around headlands and islands; and
- Easterly transport mechanism within the nearshore of the Bristol Channel.

4.42 The EIA will include a detailed analysis of sediment mobility. This will include an assessment of the potential for mobilisation of different fractions of the sediment population, as found in the different water depths and morphological environments, and as sampled for the study, using site specific current measurements. There is also a need to assess how this potential is enhanced under different wave conditions.

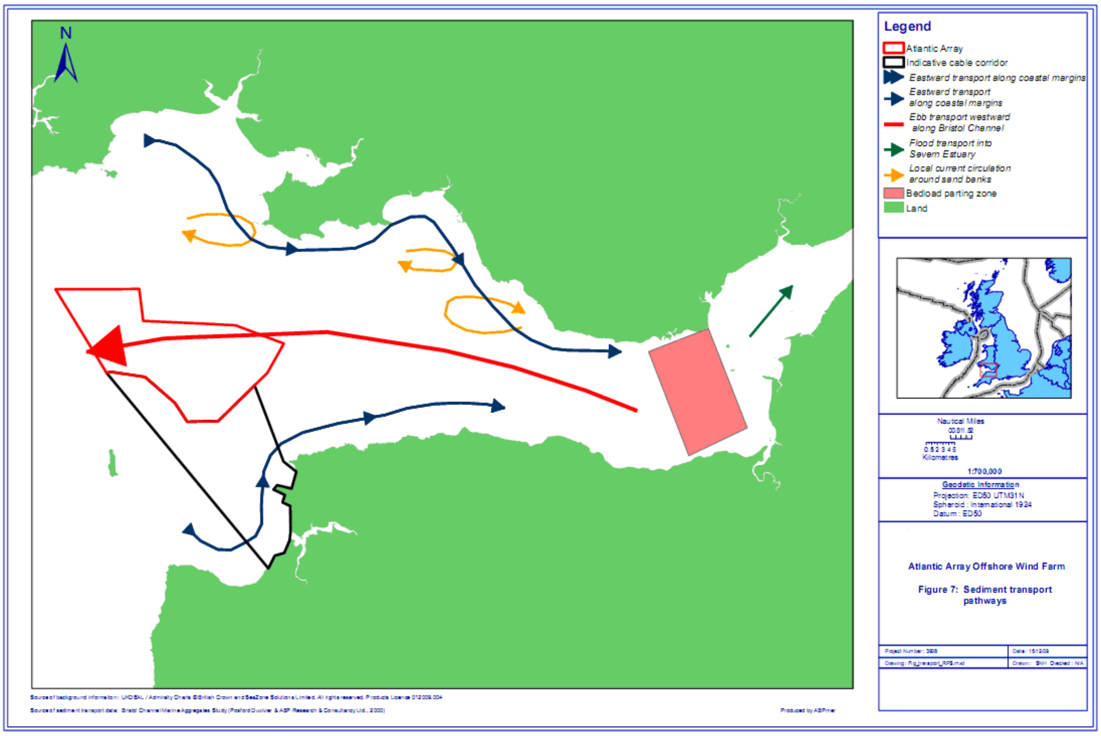


Figure 4.6: Sediment transport pathways

Suspended Sediment Concentrations

4.43 Surface water suspended sediment concentrations are reported to increase from <5 mg/l in the Outer Bristol Channel to >500 mg/l in the Severn Estuary (Amos and Alfoldi, 1979). It is reported that near-bed suspended concentrations are typically higher than those of surface concentrations where surface : bed concentration ratios are, on average, 1:4 (Collins, 1983). Concentrations are slightly higher in embayments, for example values of 20 mg/l are recorded at Carmarthen Bay. Peaks of suspended concentrations are also observed as a result of wave effects in the shallower waters (Collins, 1983). No direct measurements of SSC could be found for the Atlantic Array site.

4.44 The net direction of suspended sediment transport is westerly, from the Severn Estuary to the Bristol Channel, as presented in Figure 4.6.

Summary of surveys/additional studies

4.45 It is recommended that the following survey work is understand to adequately characterise the site in terms of oceanographic / coastal processes at the Atlantic Array site:

- Grab samples
- Geophysical data collection

  - Bathymetry
  - Seismic
  - Side scan sonar
- Geotechnical data collection
  - Boreholes
- Metocean data

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact	Increase in suspended sediment concentration during installation of foundations / cables or during operation following scour around foundations resulting in elevated suspended sediment concentrations and deposition of suspended sediment on sensitive receptors.
Survey/Study Proposed to Assess Impact	▪ Grab sampling (to include drop down videos and / or sample photos) as part of benthic survey. ▪ Boreholes to characterise sediment variability with depth below the seabed surface ▪ Field measurements of background (pre-construction) suspended sediment concentrations. ▪ Geophysical survey including side scan sonar and bathymetric surveys to provide information on the nature and form of the seabed in the development area. ▪ Numerical modelling
Method of Impact Assessment	Grab sample and geophysical data collection techniques to assess likely sediment type and the location of sensitive receptors (for example *Sabellaria* reef or shellfish beds). The release of this sediment type will then be characterized based on the data provided in the project design statement (PDS) or similar and then simulated using plume modelling techniques to assess the likely pathway, concentration and fate of this sediment. The measurement of suspended sediment concentrations at a number of locations prior to the construction of the wind farm will allow the establishment of background levels.

Potential Impact	Changes to sediment transport pathways (suspended or bedload) resulting in changes to the local sediment regime.
Survey/Study Proposed to Assess Impact	▪ Geophysical survey including side scan sonar and bathymetric surveys to provide information on the nature and form of the seabed in the development area. ▪ Grab samples ▪ Conceptual understanding of sediment transport regime ▪ Hydrodynamic / sediment transport modelling

Method of Impact Assessment	Determination of baseline transport pathways through the review of bedform asymmetry, other studies and the modelling of pathways without the wind farm structures in place. Any changes to sediment transport vectors can then be determined through the use of appropriate modelling techniques. Interpretation of modelling results will be made in the context of a conceptual understanding of the sediment regime that draws together all available literature and data.

Potential Impact	Impacts on swell (wave period height and direction) in lee of development leading to impacts on surfing resource in the lee of the development. Changes will be most likely along the coastline in the lee of the wind farm site during the prevailing wave direction (The Gower Peninsular) although the distance of the development from the coast means impacts are unlikely.
Survey/Study Proposed to Assess Impact	▪ Wave data ▪ Wave modelling
Method of Impact Assessment	Establish baseline wave climate using wave datasets collected pre-construction. Apply wave models with realistic worst case definition of the array in place to determine any changes to the wave characteristics caused by the wind farm under a number of different wave direction / height scenarios.

Potential Impact	Changes to erosional / depositional processes along the adjacent coastline impacting on morphology and consequently habitats, infrastructure and recreational surfing resource. Changes will be most likely along the coastline in the lee of the wind farm site during the prevailing wave direction (The Gower Peninsular and Carmarthen Bay) and along the coast in closest proximity (Bideford Bay) although the distance of the development from the coast means impacts are unlikely.
Survey/Study Proposed to Assess Impact	▪ Wave data ▪ Wave modelling
Method of Impact Assessment	Wave modelling will establish potential changes to the wave climate arising as a result of the development. If any changes to the wave regime at the coastline are detected it will be necessary to investigate these impacts in further detail. To do this it will be necessary to understand the nature of the adjacent shoreline and any ongoing changes experienced. A littoral drift model can then be applied to model how these changes to the wave climate would impact longshore transport at the coastline.

Potential Impact	Scour around foundations leading to changes to seabed morphology.
Survey/Study Proposed to Assess Impact	Grab sampling (to include drop down videos and / or sample photos). ▪ Boreholes to characterise sediment variability with

	depth under the seabed surface ▪ Field measurements of background (pre-construction) suspended sediment concentration. ▪ Geophysical survey. ▪ Empirical calculations / numerical modelling
Method of Impact Assessment	The potential for scour to occur around turbines is assessed using empirical equations which take into account the bed sediment type and the hydrodynamic conditions encountered in the vicinity of the turbine foundations.

Potential Impact	Changes in seabed morphology leading to the exposure of the cables (inter-array and export cable) and undermining of foundations.
Survey/Study Proposed to Assess Impact	▪ Quantitative analysis of historic bathymetric variation ▪ Conceptual understanding of sediment regime
Method of Impact Assessment	The historic natural variability in seabed form can be evaluated through the comparison of historical charts and surveys which in turn will allow the assessment of the likelihood of cable or foundation exposure. Understanding of the form and function of the seabed and associated bedforms will draw on this analysis in conjunction with conceptual understanding of the sediment regime.

Cumulative and In-combination Impact Assessment

Cumulative

4.46 The only wind farm development in close proximity to the Atlantic Array site is the Round 1 Scarweather Sands project which was planned for construction in Swansea Bay. However, development of this site has been cancelled and therefore no cumulative impacts need to be considered.

In Combination

4.47 All activities listed with relevance to Atlantic Array are listed in Table 4.1. Of particular note is the marine aggregate extraction site (site 476) to the north of Atlantic Array.

4.48 In addition to site 476 the Resource Management Association is also considering dredging on site 486 to the south of 476 and immediately to the north of the Atlantic Array (see Figure 1.2 for location). At this stage no ES has been submitted.

Table 4.1: Sea bed users for consideration of cumulative and in-combination effects of relevance to Atlantic Array

Activity/development	Sites/developments	Consequence for ES

Marine Aggregate Extraction Sites	Area 476 (licensed) and 486 (prospective)	Plumes generated during aggregate dredging could have the potential to combine with plumes generated during turbine installation or cable burial at Atlantic Array.
Sub-Sea Cables and Pipelines	Crossed by six telecommunication cables and no pipelines	No in-combination effect as no ongoing impact is present from the existing cables.
Port Development (Main Ports)	Swansea Pembroke	No in-combination effect as no ongoing impact is present at or near the Atlantic Array site from these developments.
Dredging (Capital and Maintenance)	None in or near development site.	N/A
Spoil Disposal Site	None in or near development site.	N/A
Offshore Wind Farms	None in or near development site.	N/A

4.49 Overall it is considered only necessary to investigate impacts relating to the potential in-combination impacts between Atlantic Array and aggregate dredging. The potential impact and proposed assessment methodology is outlined in the following table.

Potential Impact	The interaction between plumes of sediment created by dredging in Area 476 or 373 (and potential future extraction in Area 486) and the installation of turbines or the burial of cables as part of Atlantic array.
Survey/Study Proposed to Assess Impact	▪ Information from the assessment of sediment plumes arising from the installation of turbines, scour or the burial of cables (see relevant table above). ▪ Dredging information (amount dredged, frequency of dredging, type of sediment dredged, typical state of tide during dredge as provided in dredging ES) ▪ Plume modelling.
Method of Impact Assessment	Information on the amount of sediment released during dredging will be ascertained from the available information. The sediment released will then be modelled alongside the release from the wind farm construction activity to assess the likelihood of any interaction. If interaction is shown to exist in the model then the likely deposition pattern will be investigated with respect to sensitive benthic receptors.

Potential Mitigation and monitoring

4.50 Potential mitigation options, including the potential use of scour protection, will be considered as part of the main EIA. Details of the exact type and nature are pending the outcome of assessments recommended here.

The Biological Environment

Benthic Ecology

Introduction

4.51 A desk based literature review of existing marine ecology data has been undertaken and this has focused on sourcing data collected within or in close proximity to the Bristol Channel (St David's Head to Bude, north Cornwall), supplemented by information on the marine ecology of the wider marine environment where available. A range of data sources have been reviewed to inform this scoping exercise, comprising both broad scale studies and site specific assessments and characterisation work in the general area, and these are briefly summarised below.

Background Data/Sources

4.52 The oil and gas Strategic Environmental Assessment data and technical reports for Area 8 (the South West) provides a useful bibliography for the area, in particular those reports on the Benthos of SEA 8 (Pinnion *et al.,* 2007, Voisey and Tyrrell, 2004) which has been drawn upon for this study. In addition, there have been several large-scale benthic surveys on the Bristol Channel and Severn Estuary. These include studies undertaken on the benthic fauna of the deep-water channel of the Severn Estuary between Flat Holm and Kings Road (Warwick *et al*., 2001), a broad scale study consisting of over 500 benthic samples analysed for the Severn Estuary and Bristol Channel (Mettam *et al*., 1994), a comprehensive benthic invertebrate survey of the Outer Bristol Channel carried out in 1972-73 (Warwick and Davies, 1977, Warwick and Uncles, 1980) and the more recent 'Outer Bristol Channel Marine Habitat Study' undertaken by the British Geological Survey (BGS) and the National Museum Wales (NMW) between 2003 and 2005 (Mackie *et al*., 2006).

4.53 These broad scale studies have been supplemented by a number of site-specific studies in the Bristol Channel area, including a PhD on the benthic ecology of Carmarthen Bay (Woolmer, 2003) and a number of historical benthic surveys discussed in the Marine Nature Conservation Review (MNCR) Sector 9 (Moore *et al*., 1998). Environmental Statements (ESs) obtained and reviewed include Scarweather Sands Wind Farm ES and marine ecology technical report (Titan Environmental Surveys Ltd, 2002, United Utilities, 2003), and ESs for various aggregate extraction licences including Helwick Bank Area 373 (Environmental Resources Management, 2003), Nobel Banks Area 476 (ERM, 2002, ERM, 2009), North Middle Ground Areas 455 and 459 (HR Wallingford, 2003) and Area 486 in the Outer Bristol Channel (EMU, 2007). The Severn Tidal Power marine ecology scoping paper was also reviewed as part of the literature review (Parsons Brinckerhoff Ltd, 2008).

4.54 The Countryside Council for Wales (CCW) has undertaken relatively recent intertidal biotope mapping of the Welsh coastline including the Severn Estuary and Bristol Channel (Wyn *et al*., 2006) and Natural England (NE) commissioned similar intertidal biotope mapping studies for the English side of the Severn Estuary (EMU, 2006), although the NE surveys extended only to the western boundary of Bridgewater Bay.

General Description of Project Area

Introduction

4.55 Consideration of the existing benthic ecology and potential changes to that ecology following construction, operation and decommissioning phases is a standard requirement for an offshore wind farm development. An understanding of the existing environment is valuable for various reasons, including the provision of a broad understanding of the ecology of the site (and hence any species/habitats that may be particularly sensitive) but also as part of the wider ecology, for example substrate type or food sources for more mobile species, particularly fish, birds and marine mammals. The following provides an overview of the current understanding of the benthic ecology of the Bristol Channel, based on the studies identified above (Sections 4.52 to 4.54).

Subtidal benthic ecology

4.56 The subtidal benthic fauna of the Bristol Channel and Severn Estuary are generally impoverished due to scouring bed stresses and the mobility of sediments resulting from its large tidal range (Mettam *et al.*, 1994). Shallow water sandy habitats occur on both the south and north coast and are characterised by a low diversity and abundant mix of bivalves, amphipods and polychaetes.

4.57 Subtidal sandbanks within the Estuary are an Annex I habitat type and, as such, form one of the designation features of the Severn Estuary cSAC (Royal Haskoning, 2008). Sandbanks of the Middle, Welsh and Cardiff Grounds are mobile but permanent features, with more ephemeral sandbanks occurring to the east within the Severn Estuary (Royal Haskoning, 2008), characterised by impoverished benthic communities (Mettam *et al*. (1994) and Warwick *et al.*, (2001). Subtidal muddy gravels, such as those around the south-east of Cardiff, showed more diverse communities, dominated by the polychaetes together with the sipunculid *Golfingia vulgaris* (Moore *et al.*, 1998).

4.58 Areas of *Sabellaria* reef are notable in the general area, and these have been noted as relatively diverse communities, although the communities associated with *Sabellaria* reefs in the Severn Estuary were found to be significantly less diverse than those in other regions of the UK (Mettam *et al.,* 1994, Warwick *et al.*, 2001). The reef-building honeycomb worm *Sabellaria alveolata* forms extensive reefs on the hard substrata in the lower Severn and into the Bristol Channel, between Flat Holm Island and King Road (Warwick *et al.*, 2001). *Sabellaria spinulosa* also forms crusts and sometimes reefs in the region (Barne *et al.,* 1996, Buck, 1993). Reef forming habitats of both species are protected under Annex I of the Habitats Directive as biogenic 'reefs'. Species such as the sea squirt *Dendrodoa grossularia*, mussels (*Mytilus* spp.) and the polychaete *Polydora ciliata* are associated with these reef habitats. Brittlestar *Ophiothrix fragilis* and horse mussel *Modiolous modiolus* were only found in the extreme western area (off Swansea Bay) associated with *Sabellaria* (Mettam *et al.*, 1994).

4.59 In soft sediments, from Swansea Bay westward several different benthic communities have been described (Warwick and Davies, 1977, Warwick and Uncles, 1980). These include two *Venus* sub-communities: a *Tellina* sub-community, associated with fine stable sands in Carmarthen Bay, Barnstaple Bay and the eastern part of Swansea Bay; and a *Spisula* sub-community, associated with the mobile coarser sand wave areas in the central area of the Bristol Channel. Three forms of the *Abra* community were also

identified. These were found to be associated with a) mud or sandy mud substrates in the central part of Swansea Bay and the inner part of Barnstaple Bay, b) the muddy sand off the mouth of Carmarthen Bay, and c) the mixed fine and coarse gravel and sands fringing the mid channel *Venus* communities. *Modiolus* communities were also found to occur on hard substrata (Warwick and Uncles, 1980).

4.60 To the northeast of the development area, within Swansea Bay (JER4290-SR-008), a benthic survey was undertaken in 2002 for the Scarweather OWF (United Utilities, 2003). The survey identified a predominantly coarse substrate, with only small areas of faunally impoverished sandy habitat. Coarse substrate sites were of relatively high species diversity, with communities comprising a range of species groups (polychaetes, crustaceans, molluscs, pycnogonids and bryozoans). None of the species were found in high abundance, although *Sabellaria spinulosa,* again in low numbers, were a notable record.

4.61 BGS and NMW undertook a more recent survey of the Outer Bristol Channel survey (James *et al.,* 2004, Mackie *et al.*, 2006). These survey data have been used to describe the biotope features occurring in the Outer Bristol Channel, with the area split into four physical regions; Carmarthen Bay and Approaches, Outer Bristol Channel Sands (North and South Sectors), Lundy Platform and Morte Platform. The survey area described included coverage of the entire proposed Atlantic Array development area (Figure 4.7). A summary of the regions and associated biotope features is presented in Table 4.2.

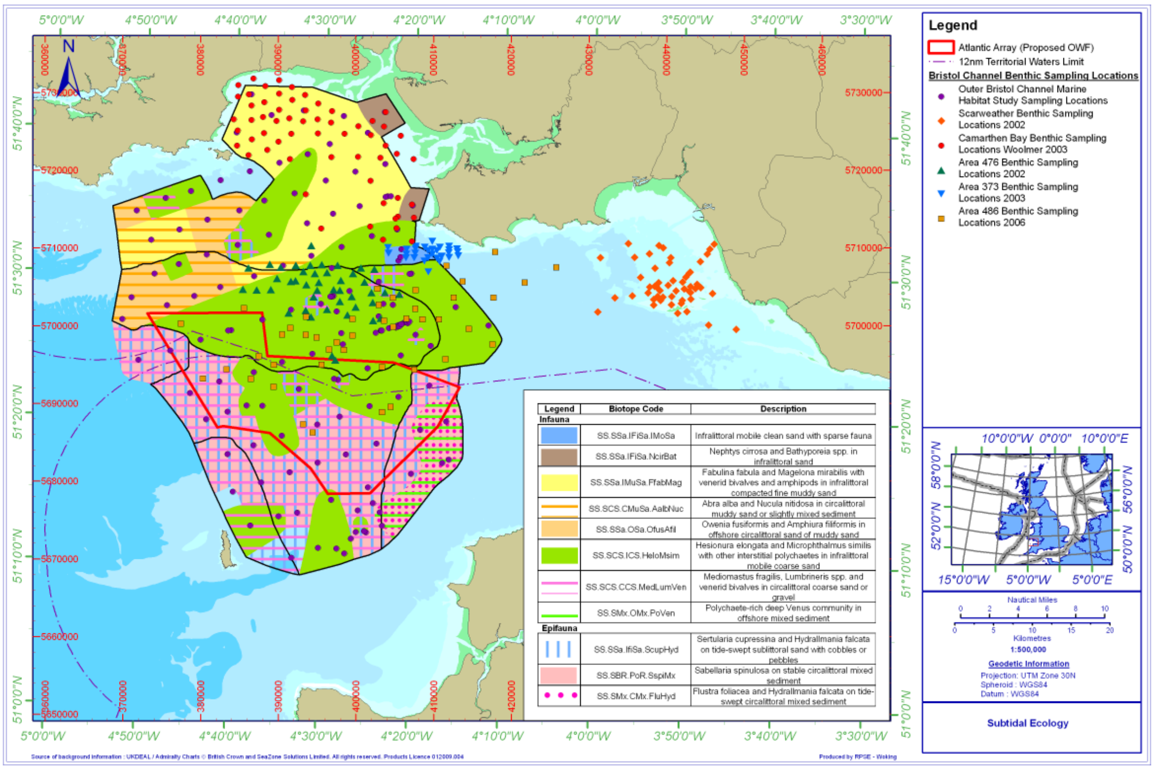


Figure 4.7: Subtidal ecology

Table 4.2: Summary of the regions and associated biotopes (Source: James et al., 2004, Mackie et al., 2006).

Physical region	Physical description	Dominant biotope(s) ascribed	Additional comments
Carmarthen Bay (Region 1)	Predominately smooth seabed of fine to medium sand with some small ripples	SS.SSa.ImuSa.FfabMag Shallower inshore areas off the Gower Peninsula (Helwick Bank) and the mouth of the River Towy comprise SS.SSa.IFiSa.NcirBat and SS.SSa.IFiSa.IMoSa Deeper areas typified by SS.SCS.ICS.HeloMsim and a biotope complex of SS.Ssa.CmuSa.AalbNuc and SS.Ssa.OSa.OfusAfil.	North of the development area. Descriptions agree well with other studies (Woolmer, 2003; ERM, 2003).
North Outer Bristol Channel Sands (Nobel Sands, Region 2a)	Extensive sand wave field in the south (Nobel Sands) and large sand waves in the east (Helwick Bank). Sediments generally comprising medium sand.	SS.SCS.ICS.HeloMsim Isolated areas of the biotope SS.SCS.CCS.MedLumVen occurring in association with the epifaunal biotope SS.Ssa.IfiSa.ScrupHyd.	Low to moderate infaunal diversity ; generally low epifaunal species numbers Similar biotopes identified in other studies at Nobel Sands and Nash Bank (HR Wallingford, 2002; Emu, 2007 respectively).
South Outer Bristol Channel Sands (Sobel Sands, Region 2b)	Sand waves and coarse gravels	SS.SCS.ICS.HeloMsim (associated with sand wave features); SS.SCS.CCS.MedLumVen, with the epifaunal biotope complex SS.Ssa.IfiSa.ScrupHyd and SS.SBR.PoR.SspiMx also occurring on coarser substrata.	Occurs largely within the proposed development area. Relatively high infaunal diversity and moderate to high epifaunal species numbers.
Lundy Platform (Region 3)	Coarse sediment pavement with rocky outcrops (includes Stanley Bank).	No one biotope dominates in this region: Biotope mosaics comprising SS.SBR.PoR.SspiMx and SS.SCS.ICS.HeloMsim, in biotope complexes with SS.SCS.CCS.MedLumVen, with some areas also consisting of the epifaunal biotope SS.Ssa.IfiSa.ScrupHyd	To the south of the proposed development area. Moderate to high infaunal diversity; variable epifaunal species diversity
Morte Platform area (Region 4)	Coarse sediment pavement in the west and north with	SS.Smx.Omx.PoVen; SS.SBR.PoR.SspiMx is also present with the epifaunal biotope	Partially within the proposed development area (eastern margin)

	rocky outcrops to the east	SS.SMx.CMx.FluHyd	

4.62 In summary, two main infaunal biotope complexes dominate across the development area. The area to the north is characterised by the SS.SCS.ICS.HeloMsim biotope while in the southern half of the development area the SS.SCS.CCS.MedLumVen infaunal biotope and the epibenthic biotopes SS.SBR.PoR.SspiMx and SS.Ssa.IfiSa.ScrupHyd characterise the area.

4.63 To the south of the development area, the Devon coast is characterised by a rocky coast, often with deep water over a sandy bottom close inshore, and by many inlets and estuaries along the south coast. In the Clovelly area and off Morte Point mussels (*Mytilus edulis*) dominate the sublittoral communities (Barne *et al.*, 1996). Lundy, designated primarily for its slate and granite reefs which extend well over 1km offshore, has also recently been afforded Marine Conservation Zone (MCZ) status under the Marine and Costal Access Act[9]. It is of particular value for its marine wildlife because of the wide range of conditions for both rock and sediment communities that exist in relation to the varied wave and tidal stream exposure conditions. The variety of habitats and associated species on the reefs includes, for example, a high diversity of seaweeds and many rare or unusual species, including Mediterranean-Atlantic species representing biogeographically distinct communities at, or very close to, their northern limit of distribution.

Intertidal

4.64 Intertidal lifeform mapping of the Welsh coastline including Severn Estuary and Bristol Channel (Wyn *et al.*, 2006) and the English side of the Severn Estuary (EMU, 2006) provide useful information for intertidal areas to the north of the proposed Atlantic Array development (on the South Welsh coast), though the mapping on the English coastal areas dies not extend beyond Bridgewater Bay and thus is of little use in informing any potential cable landfall locations for the project.

4.65 From the Glamorgan coast, at the mouth of the Severn Estuary, to Pembrokeshire, the intertidal zone of south Wales is characterised by areas of both rocky habitats and soft sediments. The Glamorgan coast is dominated by exposed and moderately exposed rocky shores with lichens and algae, algal turf, fucoids (primarily *F. vesiculosus*) and these habitats support nationally important biotopes including *Sabellaria alveolata* reefs and piddock biotopes (MLR.Fser.Pid and MLR.MytPid). To the west, Swansea Bay is characterised by open coast sandy shores, mussel beds and muddy gravel sediments which support a diverse infauna. Swansea Bay also supports significant areas of *Sabellaria alveolata* reef.

4.66 The Gower Peninsula is characterised by similar rocky shore biotopes to those present on the Glamorgan coast and also includes the nationally important piddock biotopes (MLR.Fser.Pid, MIR.Ldig.Pid, MLR.MytPid and MLR.RPid) and the rare overhang

[9] Schedule 12 of the Marine and Coastal Access Act converts any Marine Nature Reserve (MNR) into a Marine Conservation Zone (MCZ):

biotope (LR.SR.Den: Sponges, shade tolerant red seaweeds and *Dendrodoa grossularia* on wave surged overhanging lower eulittoral bedrock).

4.67 The Three Rivers estuaries and Burry Inlet are dominated by sheltered muddy sediments in the upper reaches and estuarine sand and muddy sand closer to the sea, while the rest of Carmarthen Bay is characterised by open coast sandy shore similar to Swansea Bay. The south Pembrokeshire coast is again similar to the Glamorgan and Gower coasts with rocky shores dominating (*F. serratus* is the dominant fucoid here) and piddock and overhang biotopes also recorded (Brazier *et al.,* 2007, Mettam, 1994).

4.68 The Somerset coast is characterised by areas of soft sediment shores, shingle beaches and rocky coastline. The extensive areas of sediment flats within Bridgewater Bay constitute Annex I mudflat and sand flat habitat and represent valuable feeding habitat for internationally significant numbers of avifauna (EMU, 2006). . On the steep rocky shores of Somerset, fucoids (such as *Fucus serratus*) and other macroalgae are confined to the lower shore, except in rockpools. The upper and middle shores are dominated by lichens, barnacles and limpets. On boulder shores winkles and topshells are the dominant herbivores. On low angle, wave cut platforms, the lower shore is usually bare rock bored by piddocks (Crothers and Hayns, 1994). It has been suggested that the shortage of light (due to turbidity and high tidal range) combined with mud being deposited on rock surfaces, prevents germination of algae on these platforms (Crothers and Hayns, 1994, Parsons Brinckerhoff Ltd, 2008).

4.69 To the south of the development site, the Taw-Torridge Estuary supports a range of intertidal biotopes including littoral sand and gravel habitats at the mouth of the estuary, typically supporting communities of burrowing amphipods and polychaetes, often with *Arenicola marina*, in clean sand shores (LS.LGS.S.AP.P) or dense *Lanice conchilega* in tide-swept lower shore sand (LS.LGS.S.Lan).

4.70 Areas of dense rock or littoral mixed substrata with fucoids (e.g. *Ascophyllum nodosum* and *Fucus vesiculosus*) are also present although these occur further along the estuary, interspersed with soft mud habitat with *Hediste diversicolor* and oligochaetes, which continues into the Rivers Taw and Torridge, where conditions become less saline towards the upper reaches of the estuary. Unusually for an estuarine environment, a moderately wave-exposed rocky shore occurs at the confluence of the Taw and the Torridge. The shores here slope gradually over a wave-cut platform and rock fragments, providing a variety of microhabitats (rock pools, overhangs, crevices and boulders) for a diversity of flora and fauna. A detailed description of the intertidal biotopes within the estuary is given in the MNCR review (Moore *et al*., 1998).

Seagrass

4.71 Seagrass (*Zostera marina)* beds occur within the Burry Inlet extending approximately 6 ha; (Brazier *et al*., 2007). The intertidal and subtidal zones of the Taw-Torridge estuary are also historically known to host eelgrass beds (Hughes and Tonkin, 1997). Although the seagrass beds occupy a relatively small area within the Bristol Channel, they are particularly vulnerable to disturbance activities and will therefore be of note should the export cable route lie in proximity to any known location for these species.

Saltmarshes

4.72 The principal areas of saltmarsh within the region lie within the Severn Estuary rather than the Bristol Channel, although there are notable areas present within the Taw Torridge estuary and along the Somerset and North Devon coasts where conditions are suitable. The areas support a typical range of saltmarsh communities and together with the extensive intertidal mudflats and sandbanks provide an important resource habitat for a range of species, most notably perhaps migratory and overwintering birds. Common saltmarsh species include the cord grass, *Spartina anglica*. This species alone occupied over 50% of the total saltmarsh area in the 1980's but is now considered to be in decline. *S. anglica* was introduced into the Severn Estuary this century as a flood defence measure and is now widely distributed within the region.

4.73 Other commonly occurring species include the sea couch grass, *Elymus pycanthus*, and the common saltmarsh grass, *Puccinella maritima*. The sea aster, *Aster tripolium* and *Limonium vulgare* may also be locally abundant whilst the reed, *Phragmites australis*, occurs in brackish water conditions at the upper reaches of marshes. Some Atlantic salt meadows areas are grazed and exhibit a reduced plant diversity (EMU, 2006). In these grazed areas other saltmarsh species may become dominant at various times of the year such as the glasswort, *Salicornia* sp. Higher levels of grazed marsh may form a Festuca saltmarsh containing several nationally scarce species such as *Alopecurus bulbosus*, *Bupleurum tenuissimum*, *Trifolium squamosum*, *Puccinella rupestris* and *Hordeum marinum*.

Summary of surveys/additional studies

4.74 A detailed benthic characterisation survey is proposed across the Atlantic Array OWF site and encompassing one tidal extent from the development area. The survey will also sample additional areas outside any potential zone of influence from the development in order to ascertain the acceptability of other sampling stations for subsequent reference sites, as well as the export cable corridor (1 km width). The specification for this survey will be agreed with CEFAS, NE, CCW and JNCC although it is planned to be preceded by a geophysical (bathymetry and sidescan sonar) survey covering the proposed development site and cable route. The benthic survey will therefore follow as a 'ground truthing' survey to identify the benthic and epibenthic biotopes present, their extent and to assess the presence/likely absence of Annex I reefs. The ground truthing methods to be used include:

- Benthic grab: Following the methodology described in Thomas (2001) a remote operated grab (most likely to be a $0.1m^2$ Hamon grab) will be used to sample the benthic sediment to assess the physical structure of the sediment (PSA) and aid in the identification and determine distribution of the different biotopes or biotope complexes (through infaunal analysis) on the site and surrounding area. Sediment chemistry may also be determined if this is deemed necessary.
- Drop down video: Following the methodologies described in Holt and Sanderson (2001) and Bullimore and Hiscock (2001) seabed photographs and video footage will be acquired using a weighted fresh water camera system. This system will be used instead of the grab sampler to ground truth features identified by the geophysical surveys with potential conservation importance (i.e. Annex I reefs) as it minimises disturbance to these potentially sensitive habitats. This method allows quantitative data on species richness

and biotope composition to be collected. At these potentially sensitive sites, grab sampling will not be used to ground truth the benthos. Drop down video sampling will only be used at sites of potential conservation importance and to ground truth a limited number (~25%) of benthic grab sample sites. This sampling method is particularly difficult in areas of high tidal currents and turbidity, such as the Bristol Channel (Mackie et al., 2006 and EMU, 2007) and data returns have been poor. It is therefore not considered feasible to attempt drop down video at each of the benthic grab sampling sites.

- Epibenthic trawl: Epibenthic sampling, using a standard 2m CEFAS beam trawl fitted with a 5mm cod end, will also be undertaken in the study area. Trawls can be standardised by length or duration. This methodology is primarily designed to collect information on epibenthic invertebrate species, as well as small demersal and juvenile fish. Since this sampling method can be destructive, trawl positions will be informed by data collected during the geophysical survey in order to avoid potentially sensitive habitats (i.e. Annex I reefs).

4.75 The final selection of benthic sampling stations for the project will be based on the results of the geophysical surveys and any other data available prior to the survey being undertaken, however an indicative array has been proposed to MFA and Cefas which will be refined and provided to relevant bodies following completion of the geophysical data review. Ground truthing will be used to identify biotopes and determine extent of biotopes and Annex I reefs. Potentially damaging techniques (i.e. benthic grab and epibenthic trawl sampling) will be avoided in areas identified during the geophysical survey as supporting potentially sensitive habitats (e.g. biogenic reefs).

4.76 Detailed methodologies are presented in Appendix VI.

Identification of Potential Effects and Proposed Assessment Methodology for Marine Ecology

4.77 The key potential environmental effects that may impact upon benthic and epibenthic ecology as a result of the proposed Atlantic Array OWF development are summarised below. The potential effects listed have been developed from (a) relevant guidance notes and (b) ESs published for other Round 1 and Round 2 offshore wind farms.

Potential Impact	Temporary increases in suspended sediment concentrations from trenching, piling, augering, seabed preparation (plume effects) Temporary increases in sediment deposition from plumes
Survey/Study Proposed to Assess Impact	▪ Detailed benthic characterisation survey to enable an assessment of impacts of sediment resuspension and deposition upon the benthic environment to be carried out within the EIA. ▪ Identification of habitats and species with conservation importance (particularly Annex I reefs) will be an important component of this assessment.
Method of Impact Assessment	The benthic environment will be described using standard marine ecological reporting techniques (i.e. bathymetry and sidescan sonar with ground truthing using benthic grab, drop down video and epibenthic trawl; CEFAS *et al.,* 2004, CEFAS,

	2002, Davies *et al.*, 2001). Ground truthing locations, both within the development area and the sphere of likely impact (i.e. tidal excursion), will be selected on the basis of data from the bathymetric and sidescan sonar surveys. The aim of ground truthing methods will be to determine the biotopes present, their extent and relative conservation importance. Annex I reefs will be identified using methodologies compiled by JNCC (e.g. Gubbay, 2007, Irving, 2009). Impact significance will be determined using standard EIA methodologies.

Potential Impact	Release of contaminants bound in sediments during cable laying and turbine installation activities.
Survey/Study Proposed to Assess Impact	Data to be collected during desk study on sediment contamination in the proposed OWF development site and cable route, including possible sources of contamination, both historical and present. This will inform whether there is a requirement for sediment chemistry analysis (e.g. metals and PAH) as part of the benthic characterisation study. This requirement will be discussed with the statutory authorities including CEFAS, MMO, NE, CCW and JNCC.
Method of Impact Assessment	The data obtained during the desk study and benthic survey will be used to assess the likelihood of sediment contamination by comparing data to the levels set out in the Canadian Interim Sediment Quality Guidelines and CEFAS Action Levels In Dredged Materials.

Potential Impact	Loss of seabed habitat through presence of foundations, scour protection and inter-array cables, and temporary loss of habitat due to inter array cables and export cable.
Survey/Study Proposed to Assess Impact	A detailed benthic characterisation survey is proposed across the Atlantic Array OWF site, plus the surrounding area (as described above) to identify the biotopes and habitats present (including Annex I reefs).
Method of Impact Assessment	Potential impacts through direct habitat loss will be assessed via quantifying any losses in terms of % loss of certain biotopes/habitats.

Potential Impact	Alteration of seabed habitats arising from: ▪ Scour effects; ▪ Changes in sediment transport regime (coastal processes); and Spud leg impacts from construction activities (jack up – temporary effects)
Survey/Study Proposed to Assess Impact	A detailed benthic characterisation survey is proposed across the Atlantic Array OWF site, plus the surrounding area (as described above) to identify the biotopes and habitats present (including Annex I reefs).
Method of	Potential impacts on the benthic environment through scour/sediment transport

Impact Assessment	changes will be assessed by applying the findings of the coastal processes assessment to the baseline benthic datasets.

Potential Impact	Colonisation of turbines leading to a change in the benthic ecology and biodiversity
Survey/Study Proposed to Assess Impact	The marine ecology characterisation survey will identify the biotopes present at the development site.
Method of Impact Assessment	This baseline biotope data will be used to assess the impact of increased hard substrates on the surrounding marine ecology. Reference will also be made to the results of monitoring programmes for other OWFs and other relevant literature (e.g. Linley *et al.*, 2007) in order to determine the communities likely to become established on the turbines.

Potential Impact	Potential release of pollutants e.g. from accidental spillage/leakage or sacrificial anodes
Survey/Study Proposed to Assess Impact	To be assessed during the EIA, taking consideration of the likely mitigation measures, which are highlighted below.
Method of Impact Assessment	Potential for accidental spillage or leakage to be mitigated by correct servicing and maintenance of equipment and vessels, together with adherence to best practice and appropriate legislation, including appropriate Pollution Control Plans, Site Environment Management Plans and onsite monitoring/reporting.

Cumulative and In-combination Impact Assessment

4.78 The EIA will assess the potential for both cumulative and in-combination impacts to arise on benthic habitats in the wider study area as a result of the interaction between the proposed Atlantic Array project and other projects and activities, including aggregate extraction at the adjacent Areas 486 and 476 (See Figure 1.2). The potential in-combination effects with the proposed Severn Tidal Power schemes on marine ecology will also need to be considered as part of the EIA process, though as noted in Section 1 of this report, the assessment will be relatively high level unless firm proposals for the Severn tidal power scheme are available within the Atlantic Array EIA timeframe. Potential for in-combination effects through spatial interaction exist for certain impact pathways, such as the creation of sediment plumes from cable-installation activities and the physical loss or alteration of habitats.

Potential Mitigation and monitoring

4.79 Monitoring and mitigation requirements will be identified within the EIA and agreed with the relevant authority, with the degree and type required being dependent on issues including the nature and characteristics of baseline environmental resources and the proposed construction methodology. Although no specific guidance exists for

monitoring the potential impacts of offshore wind on the benthic ecology, the guidance published for marine aggregate dredging sites is of relevance (CEFAS, 2004[10]), although. Experience gained during Round 1 and 2, including the results from site specific monitoring, will also help be drawn upon to inform the proposed mitigation and monitoring package.

4.80 A key principle that will be recognised when developing mitigation and monitoring commitments is that of adaptive management. Adaptive management is a structured, iterative process of decision making, with an overall aim of reducing uncertainty over time. Put more simply, it can be described as "learning by doing".

Further Considerations

4.81 Further literature sources that were not available at the time of the production of this report but will be referred to during the EIA process are summarised below.

- Darbyshire, T, Mackie, ASY, May, SJ and Rostron, D, (2001). A macrofaunal survey of Welsh sandbanks, CCW Contact Report No. 539.
- Jones (2001) SensMap Atlas: sensitivity and mapping of inshore marine biotopes in the southern Irish Sea, Countryside Council for Wales.

Fish and Shellfish Resources

Introduction

4.82 A desk based literature review of existing fish and shellfish ecology data has been undertaken and as with the benthic ecology section above, this has focused on sourcing data collected within or in close proximity to the Bristol Channel, supplemented by information on the fish ecology of the wider sea where available. A range of data sources have been reviewed to inform this scoping exercise, comprising both broad scale studies and site specific assessments and characterisation work in the general area, and these are briefly summarised below.

Background Data/Sources

4.83 A key source of data for fish populations in the wider area (including the Severn Estuary) is the monitoring of fish incidentally captured in cooling water intakes at Hinkley Point B power station. Monthly samples have systematically been taken and recorded since the 1980s and compiled in a database held by Pisces Conservation Ltd, most recently reviewed in Henderson *et al.* (2007). A similar but more infrequent dataset has also been compiled for Oldbury Power Station, in the Severn Estuary (Potter *et al.*, 2001). Whilst providing long-term datasets on fish species in the Bristol Channel and Severn Estuary being from fixed points restricts these datasets, although they do provide useful information on migratory species which will require consideration within the EIA. For information on a broader basis, the oil and gas data and technical reports for area 8 (CEFAS, 2007, DTI, 2004) provide a useful overview of fisheries data and literature for the region.

[10] This guidance is currently under revision and an updated version is due to be published early 2010.

4.84 The Severn Tidal Power marine and estuarine fish scoping paper was also reviewed as part of the literature review (Parsons Brinckerhoff Ltd, 2008). Further information was obtained from Cefas trawl surveys (Cotter *et al.,* 2004, Cotter *et al.*, 2004), which provides information on fisheries resources from trawl data collected in the Bristol Channel and Western Approaches. Pawson *et al*. (2002), updated from Gray, (1995), also provides a useful overview of the types of coastal commercial fisheries around the UK coastline and the target species within these areas.

4.85 The main source of information on fish spawning and nursery grounds within the UK is the Coull *et al.* (1998) report which includes maps of the maximum known extent of such areas for a number of species in UK waters. As part of the proposed Atlantic Array OWF Scoping process, an additional assessment has been undertaken to refine and update the spawning and nursery areas identified by Coull *et al.* in the Bristol Channel. Additional sources of information include species specific information on fish ecology, such as data on the occurrence of basking sharks (Sims *et al.,* 2003, Sims *et al*., 2005, Solandt, 2007, Southall *et al*., 2005), together with ESs undertaken for aggregate, port and wind farm developments (Section 4.53).

General Description of Project Area

4.86 Fish ecology is an important topic for OWF development EIA, both from the perspective of potential direct impacts to fish and that of their role in the ecology of the marine system; for example the importance of different species as a prey resource for birds and marine mammals, and also the potential implications for the commercial fishing industry. Concerns regarding fish ecology tend to relate to issues such as noise (primarily during construction/decommissioning), Electro-Magnetic Field (EMF) effects and artificial reef issues (during operation). Associated issues tend to relate to disturbance to nursery/spawning grounds or benthic food sources.

Fish Populations

4.87 The Severn Estuary and Bristol Channel complex supports diverse and abundant fish communities with 111 fish species recorded (Potts and Swaby, 1993), however, less than 80 of the species are likely to occur in any frequency or abundance throughout the year (Henderson *et al*., 2006). The most common species and those targeted by commercial and recreational fisheries are listed in Table 4.3 below.

4.88 The proposed development site lies between the open seas of the Western Approaches and the Severn Estuary and is thus located in an area through which several important migratory fish species may pass when moving from saline to freshwater habitats (or *vice-versa*). These include river lamprey, sea lamprey and twaite shad. The Severn Estuary also supports a run of migratory salmon. These fish pass through the estuary on their way to and from their spawning grounds in the upper reaches of the rivers and the open sea. The Severn Estuary also has the largest eel run in the country. Most of these migratory species are protected (see Section 4.99).

Table 4.3: Fish species recorded within the Severn Estuary/Bristol Channel* with commercially important species highlighted in bold (Pawson *et al*., 2002)

Common Name	Latin Name		Common Name	Latin Name

Common Name	Latin Name		Common Name	Latin Name
Dab	***Limanda limanda***		**Common skate**	***Dipturus batis***
Plaice	***Pleuronectes platessa***		**Thornback ray**	***Raja clavata***
Lemon sole	***Microstomus kitt***		**Spotted ray**	***Raja montagui***
Sole	***Solea solea***		**Blonde ray**	***Raja brachyura***
Flounder	***Plactichthys flesus***		**Small eyed ray**	***Raja microocellata***
Turbot	***Psetta maxima***		**Spurdog**	***Squalus acanthias***
Brill	***Scophthalmus rhombus***		**Dogfish**	***Scyliorhinus canicula***
Haddock	***Melanogrammus aeglefinus***		Pogge/Hooknose	*Agonus cataphractus*
Pollack	***Pollachius pollachius***		**Mackerel**	***Scomber scombrus***
Whiting	***Merlangius merlangus***		**Mullet**	***Mugilidae***
Cod	***Gadus morhua***		**Bass**	***Dicentrarchus labrax***
Poor cod	*Trisopterus minutus*		**Sprat**	***Sprattus sprattus***
Pout	*Trisopterus luscus*		**Herring**	***Clupea harengus***
Five bearded rockling	*Ciliata mustela*		Gobies	*Pomatoschistus spp. and Aphia spp.*
Hake	***Merluccius merluccus***		Grey Gurnard	*Eutrigla gurnardus*
Lesser weever Fish	*Echiichthys vipera*		Conger eel	*Conger conger*
Sandeels	***Ammodytes spp.***		**Common eel**	***Anguila anguilla***
Sea snail	*Liparis liparis*		River lamprey**	*Lamptera fluviatilis*
Three-spined stickle back	*Gasterosteus aculeatus*		Sea lamprey**	*Petromyzon marinus*
Salmon**	***Salmo salar***		Twaite shad**	*Alosa fallax*
Sea trout**	***Salmo trutta***		Allis shad**	*Alosa alosa*

* Severn Estuary: Based on captures at Hinkley Point B Power Station (Henderson *et al.*, 2006) and Oldbury Power Station (Potter *et al.*, 2001), Bristol Channel: data based on 2m beam trawling undertaken for Scarweather Wind Farm (United Utilities, 2003) and information on commercially important species from CEFAS surveys (Cotter *et al.*, 2004, Cotter *et al.*, 2004, Pawson *et al.*, 2002)

** Migratory fish using the Severn Estuary and Bristol Channel to reach tributary rivers

4.89 Cod, whiting and haddock are known to be a target for commercial trawl fisheries, particularly further out into the approaches to Bristol Channel (offshore of St. Govan's Head and Hartland Point) as are plaice, lemon sole and sole. Further offshore, in the Celtic Sea, the deeper waters support valuable fisheries for anglerfish, conger eel, ling, pollack, megrim, hake and rays (Cotter *et al.,* 2004, Cotter *et al.*, 2004). These offshore

areas also contain some grounds where *Nephrops* spp. (a commercially important crustacean species) may be fished.

4.90 Mackerel are the basis of an important pelagic fishery in the southwest approaches and an area around the south west coast of England has been designated the 'Mackerel Box' under European legislation in order to conserve mackerel stocks by prohibiting trawling for mackerel in these waters (European Union, 1997, Rogers, 1997). Two other fisheries closures are in place in the Bristol Channel: The Trevose Box, a 3600 square mile area off the coast of north Devon, prohibits trawling during the cod spawning period (February and March); and the Ray Box, which covers an area of 300km^2 north of Lundy. This latter provision is a voluntary agreement between north Devon and Belgian fisheries, prohibiting trawling between the beginning of December and the end of May to protect juvenile ray and skate during their nursery period (www.finding-sanctuary.org).

4.91 A study by Ellis *et al*. (2000) characterised the demersal fish assemblages of the Bristol Channel and Irish Sea. This study showed that at many of the sites found throughout the Bristol Channel, including Barnstaple Bay, the demersal fish assemblage was dominated by species such as sole, pout and common spider crab. This assemblage also included species such as thornback and small eyed ray, common starfish, poor cod and hydroids. This assemblage was also found close to the Gower coast and Swansea Bay.

4.92 Other sites sampled, primarily in Carmarthen Bay and its approaches, were dominated by flatfish, including plaice, sole, solenette and dab; with sites south of Carmarthen Bay, close to the proposed OWF development site, typified by thickback sole (*Microchirus variegates*), and the hermit crab (*Pagurus prideaux*), with dominant sole, common starfish and common dragonet (*Callionymus lyra)*. Other demersal fish species commonly recorded in Carmarthen Bay included gurnards, common dragonet, whiting and dogfish.

4.93 A number of vagrant species have been recorded off the coasts of south west Wales. The majority of these species are only likely to be encountered during warm summers. They include four large shark species: mako (*Isurus oxyrincus*), porbeagle (*Lamna nasus*), blue shark (*Prionace glauca*) and thresher (*Alopias vulpinus*), as well as the electric ray (*Torpedo nobiliana*), skate, the European sturgeon (*Acipenser sturio*), pearlsides (*Maurolicus muelleri*), opah (*Lampris guttatus*), and sunfish (*Mola mola*; ERM, 2002). Of these species only the sturgeon has statutory protection under the EU Habitats Directive, the Wildlife and Countryside Act (1981), the Bern Convention, the OSPAR Convention and the Convention on the International Trade in Endangered Species (Barnes, 2008, CITES, 1975).

4.94 Other fish species of non-commercial importance occur in the Bristol Channel, and all species will play a role in the coastal ecosystem as small predators/prey. Such species will include small teleosts such as sand goby, pogge and dragonet which will complete their life-cycles in and around relatively localised areas, living on or in the seabed substrate, spawning and feeding wherever suitable conditions exist. Such species will be important to consider in the EIA given their role astrophic intermediaries in the food chain.

Skate and rays

4.95 Several species of skate and ray occur in the Bristol Channel. All species are commercially important, as well as being important in recreational fisheries.

4.96 The most abundant species ray species in the Bristol Channel is thornback ray (*Raja clavata*), with small-eyed ray, locally know as painted or sandy ray (*Raja microocellata*) and spotted ray (*Raja montagui*) also frequently recorded during CEFAS beam trawl surveys. Blond ray (*Raja brachyura*) are also recorded, though less frequently (Parker-Humphreys, 2004). Other ray species including cuckoo ray (*Leucoraja naevus*) and shegreen ray (*Leucoraja fullonica*) have also been recorded in the Bristol Channel but are more likely to occur in the Celtic and Irish Seas (Parker-Humphreys, 2004, Parker-Humphreys, 2004, Quero and Gueguen, 1981).

4.97 The coast of south Wales, i.e. Carmarthen Bay, Swansea Bay and the Gower coast, were found to be particularly important for rays although these species have also been recorded in Barnstaple Bay and in the Bristol Channel; in proximity to the proposed development area (Parker-Humphreys, 2004). The Ellis *et al.* (2000) study also commonly recorded thornback ray and small eyed ray in demersal assemblages in Barnstaple Bay, Swansea Bay and off the Gower coast.

4.98 Rays are oviparous (egg laying) and breed from April to December, with peak egg laying activity in May to September for thornback ray, June to September for small-eyed ray and February to June for spotted ray (CEFAS, 2009, Ryland and Ajayi, 1984). Whilst thornback and spotted rays are caught over a variety of substrata, small-eyed ray appear to predominately occur over sandy sea beds (United Utilities, 2003), such as in Swansea, Oxwich and Rhossili Bays, as well as over Helwick Sands (off Gower Peninsula) and potentially other sand bank features within Bristol Channel. This species is locally abundant in the Bristol Channel; one of the few areas around the UK it is recorded to be so numerous (CEFAS, 2009).

Migratory Fish

4.99 Information on migratory fish species was obtained from http://www.severnestuary.net/sep/estuary/fish.html and the Marine and Estuarine Fishes of Wales (Potts and Swaby, 1998) which provide an overview of their occurrence and life cycles within the Severn Estuary.

4.100 Sea and river lampreys spend their adult life in the sea or estuaries but spawn and spend the juvenile phase in rivers. They use the Severn Estuary as a migratory passage to and from their spawning and nursery grounds in the rivers. These species are Biodiversity Action Plans (BAP) priority species, as well as Annex II species listed on the Carmarthen Bay and Estuaries SAC, Pembrokeshire Marine SAC, River Usk and River Wye SACs, and the Severn Estuary cSAC.

4.101 Allis and twaite shad enter estuaries in early spring and move up into the rivers. Nocturnal spawning over gravel and stony beds occurs in April to June, before they return to the sea by the end of summer. These species are BAP priority species, as well as Annex II species listed on the Carmarthen Bay and Estuaries SAC, Pembrokeshire Marine SAC, River Usk and River Wye SACs, and twaite shad only is listed on the Severn Estuary cSAC. In the UK, twaite shad spawning is likely to be restricted to the Rivers Severn, Usk, Wye and Twyi. Both allis and twaite shad have also been recorded in the Torridge Estuary (http://www.nbn.org.uk/).

4.102 Salmon migrate through the Severn Estuary and its associated rivers such as the Severn, Wye, and Usk. Key migration periods are reported as being March to June for smolt (moving to the sea from freshwater habitats); June to November (peak Aug-Oct) for adult fish (returning to spawn); and December to April for Kelt (post-spawning adults). Commercial salmon fisheries now take place only on the Rivers Tywi, Taf, Cleddau and Nevern (Pawson *et al.*, 2002), however, the Rivers Torridge and Taw and River Lyn on the north Devon coast, and the Rivers Usk, Wye, Ogmore, Afan, Neath, Taw, Lougher and Gwendraeth Fawr on the Welsh coast are all salmon rivers (CEFAS and Environment Agency, 2006). Salmon is a BAP priority species, as well as Annex II species listed on the Severn Estuary cSAC.

4.103 Sea trout breed in winter, from October to January, and sometimes to February. Spawning always occurs in shallow freshwater gravelly habitats. Sea trout are caught in the Severn Estuary, the Three Rivers and River Lyn. Sea trout are also likely to occur in the Taw-Torridge Estuary (http://www.nbn.org.uk/). Trout is also a priority BAP species but is not afforded protection under the Habitat Directive and is therefore not listed under any of the SAC designations located within the Severn Estuary and Bristol Channel region.

4.104 European eels begin their life as eel larvae, and it is thought that they drift from their birthplace in the Sargasso Sea for three years across the Atlantic Ocean on ocean currents to the Severn Estuary. Here they metamorphose into 'glass eels' and subsequently develop into more pigmented 'elvers'. This freshwater phase is a feeding and growing stage, before they migrate out of the estuary to the open sea. They feed on invertebrates and small fish in the estuary. There are established elver fisheries on the Rivers Parrett, Severn, Wye and Usk, although in recent years the size and value of this fishery has declined (Environment Agency, 2009). European eel has previously also been recorded in the Taw-Torridge Estuary (http://www.nbn.org.uk/). This species is listed as a priority BAP species.

Shellfish Populations

4.105 Shellfish species of commercial interest in the Bristol Channel include lobster (*Homarus gammarus*), brown crab (*Cancer pagurus*), spider crab (*Maja squinado*), prawn (*Crangon crangon*), cockle (*Cerastoderma edule*), whelk (*Buccinum undatum*), mussel (*Mytilus edulis)*, oyster (*Ostrea edulis*), king scallop (*Pecten maximus*) and squid (*Loligo vulgaris*) (Pawson et al., 2002). The following information has been largely sourced from (Pawson *et al.*, 2002).

4.106 On the Welsh coast, lobsters and velvet crabs tend to be caught inshore and around the islands, particularly off the Gower Peninsula and Carmarthen Bay, with brown crabs are caught both inshore and offshore. Pots and nets are used for spider crabs both inshore and offshore, and pots are also set for prawns in north Pembrokeshire. Other crab species such as velvet and green shore crab are exploited in these inshore areas but to a lesser extent. There is also a summer shrimp fishery in Cardiff Bay and squid are taken seasonally (June - August) off the Gower coast and Lundy by pelagic trawls. Cockles and mussels are collected around the Gower Peninsula, Swansea Bay, Burry Inlet and the Three Rivers. Oysters are collected from the Porthcawl area and scallop dredging occurs in Carmarthen Bay and off Mumbles Head. Scallops can be harvested all year, although they spawn in the spring and are then of poor quality. Since the mid

90s, a whelk fishery has developed, mainly in Carmarthen Bay, but also offshore of Gower and Fishguard.

4.107 On the English coast, natural stocks of mussels, oysters and cockles are exploited in the Torridge and Taw Estuaries, with mussels and Pacific oysters cultivated. In the Minehead and Bridgewater area there is a significant brown shrimp fishery and molluscs are also gathered by hand. Potting for lobster and brown crab occurs inshore around the Torridge and Taw Estuaries, Ilfracombe, Combe Martin and Watermouth, as well as further offshore, with potting extending up to 20 miles off Ilfracombe, and including around Lundy.

Spawning and Nursery Grounds

4.108 The Bristol Channel and Severn Estuary are important spawning and nursery areas for a number of fish and crustacean species (Table 4.4). Spawning and nursery areas are reported in Coull *et al.* (1998) and these areas have been refined where possible through reference to a range studies and papers to ensure robust consideration of the key locations for the Atlantic Array EIA. Additional data sources reviewed included ES documents (United Utilities, 2003; Emu, 2007); monitoring programmes at power stations within Bristol Channel and Severn Estuary (e.g. Henderson and Holmes, 1991; Henderson and Seaby, 1994); academic reports (eg Horwood *et al*, 1998); and the Finding Sanctuary website (http://www.finding-sanctuary.org/). The oil and gas SEA for this area (DTI, 2004) and Severn Tidal Power studies (Parsons Brinkerhoff, 2008) were also reviewed for relevant data.

4.109 In addition to determining important locations within the development area, several additional have also been included due to their proximity to the project. It should be noted that these spawning and nursery grounds represent only a small proportion of the overall area utilised in UK waters, and furthermore, that their inclusion does not necessarily identify that significant issues will arise from development as the relative importance of different sites is not clear from the data. Spawning and nursery grounds in the Bristol Channel are summarised in Figure 4.8.

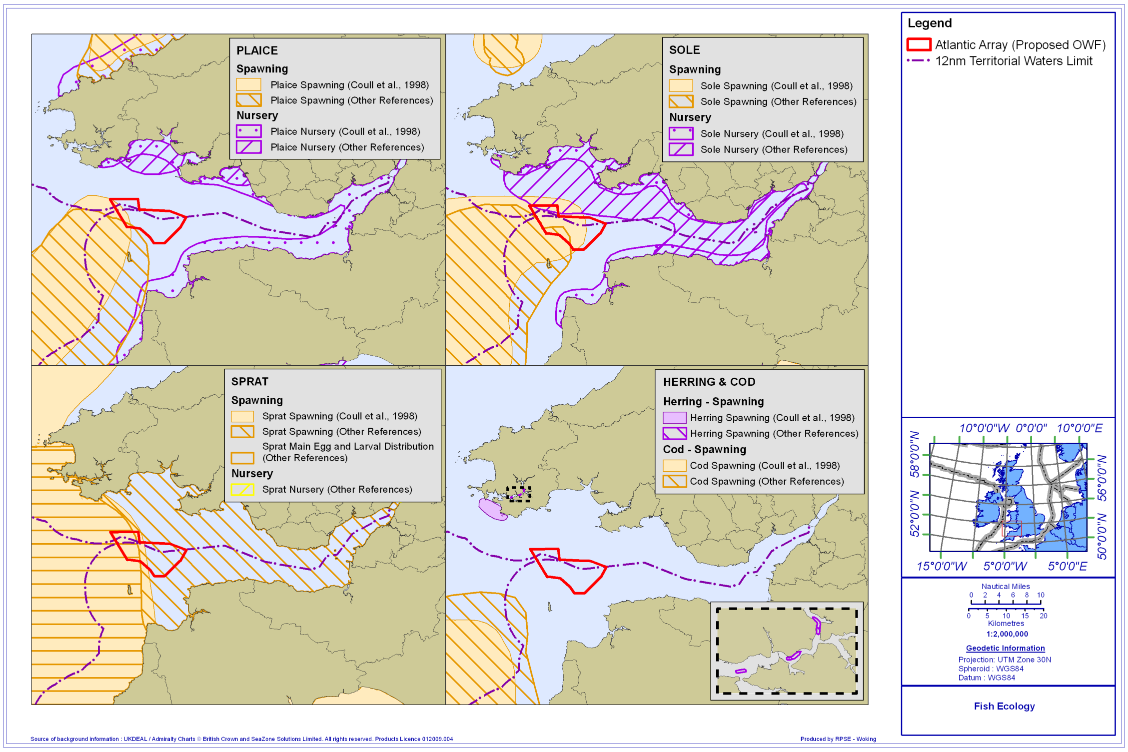


Figure 4.8: Fish populations in the Bristol Channel

Table 4.4: Location of species spawning and nursery grounds within the area of interest from Coull et al. (1998) and RPS assessment (Appendix VII). Information for migratory fish species was obtained from http://www.severnestuary.net/sep/estuary/fish.html.

Species	Spawning	Nursery
Plaice	Discontinuous distribution around UK coast. Large spawning area covering an offshore area from Trevose Head to Hartland Point and north of Lundy. February and March.	Inshore UK coast. Arrives in nurseries in south Wales and south west England in April and May.
Sole	Discontinuous around UK. Large spawning area offshore from Trevose Head to St. Govan's Head. March to May.	Arrives in nurseries in Bristol Channel from May to July. Nurseries identified in Severn Estuary, Bridgewater Bay and inshore waters of south Wales.
Dab	March and April off the coast of Trevose Head, north Cornwall.	Nursery identified in Bridgewater and Swansea Bays
Lemon sole	Spawning occurs wherever adults are recorded. Spawning grounds identified off the coast of Trevose Head, probably stretching into Bristol Channel. April and May.	Continuous from north Scotland, North Sea to mid English Channel, west Celtic Sea. Nursery grounds may be present in Bristol Channel.
Bass	Spawning occurs between March and May over a large area stretching from Trevose Head to Lundy. Some spawning also occurs in Carmarthen and	Juveniles arrive in nurseries in June and July. The River Torridge, River Taw, Burry Inlet, the Three Rivers

Species	Spawning	Nursery
	Swansea Bays.	Taf, Tywi and Gwenaraeth, off the old Aberthaw Power Station site and Milford Haven have all been designated as important bass nurseries. Swansea Bay is also a nursery for bass.
Whiting	Patchy distribution around UK. Small area offshore of Trevose Head and Hartland Point.	Discontinuous around the UK coast. Bridgewater Bay and Severn Estuary have been identified as nurseries with juveniles arriving from July to November
Cod	Significant spawning grounds off Trevose Head and Hartland Point extending to west of Lundy. February to April	-
Herring	Discontinuous distribution around UK. Includes small isolated spawning areas off Angle Peninsula and in Milford Haven (February to April).	Juveniles recorded arriving in Bridgewater Bay and Severn Estuary between July and October although no nurseries confirmed.
Sprat	February to June. Continuous around UK; offshore of major inlets and estuaries including extensive spawning in Bristol Channel.	Arrive in nurseries between June and September. Nursery identified in Severn Estuary.
Rays	Dogfish egg cases identified in CEFAS trawls indicating spawning occurs in the Bristol Channel. South Wales coast (Swansea Bay, Gower coast, Carmarthen Bay) may also be important for a range of ray species.	Swansea Bay, Gower coast and Carmarthen Bays important for a number of ray species. Swansea Bay identified as nursery for thornback ray.
Nephrops	January to December. May be limited spawning in Bristol Channel although more likely to be further offshore in Celtic Sea.	Discontinuous around UK. Not recorded in significant numbers in Bristol Channel but likely to be more abundant further offshore.
Edible crab	May to July. Known to spawn along Cornwall coast to Hartland Point.	-
Sandeel	February to April. Spawn in burrows and likely to be present in sandbanks and sandy sediment of Bristol Channel.	-
Sea and river Lamprey	Annex II species listed on the Carmarthen Bay and Estuaries SAC, Pembrokeshire Marine SAC, River Usk and River Wye SACs, and the Severn Estuary cSAC, therefore these areas assumed to be important spawning and nursery areas.	See spawning section
Allis and twaite shad	Listed on the Carmarthen Bay and Estuaries SAC, Pembrokeshire Marine SAC, River Usk and River Wye SACs, and twaite shad only is listed on the	See spawning section

Species	Spawning	Nursery
	Severn Estuary cSAC. Twaite shad spawning likely to be restricted to these rivers.	
Salmon and sea trout	Salmon rivers: Rivers Tywi, Taf, Cleddau and Nevern (Pawson *et al.*, 2002), the Rivers Torridge and Taw and River Lyn on the north Devon coast, and the Rivers Usk, Wye, Ogmore, Afan, Neath, Taw, Lougher and Gwendraeth Fawr on the Welsh coast are all salmon rivers (CEFAS and Environment Agency, 2003). Sea trout rivers: the Three Rivers and River Lyn.	See spawning section
Common eel	-	Rivers Parrett, Severn, Wye and Usk. This freshwater phase is a feeding and growing stage, before they migrate out of the estuary to the open sea.

The Lundy No Take Zone (NTZ)

4.110 The Lundy No Take Zone (NTZ) was designed to protect marine wildlife while improving local fish stocks. The 42 km zone contains both rocky and soft sediment habitats. Lundy NTZ is protected under a bylaw enforced by Devon Sea Fisheries Committee.

4.111 The main commercial activity that has been banned from the NTZ is potting for crabs and lobsters, though the area prohibits any kind of fishing or sea life collection. A peripheral area to the NTZ is designated as a refuge zone, within which potting and angling is permitted. Outside the NTZ Lundy is still heavily potted from May to August.

4.112 Scallop dredging and beam trawling was also undertaken over the sand banks of the NTZ while the whole east coast was popular with boat anglers. Lundy has also seen a good deal of scallop harvesting by scuba divers, with several clubs frequenting the area solely for this reason. In recent years, this has had a greater impact on local scallop stocks than commercial dredging, particularly in areas close to shore.

Basking Shark and Marine Turtles

Basking Shark

4.113 The basking shark (*Cetorhinus maximus*) is the second largest fish in the world. It occurs in temperate waters worldwide and is thought to migrate between inshore and offshore areas seasonally, often being found near seasonally persistent tidal fronts in the summer to feed on zooplankton, moving offshore in the late summer (www.ukbap.org.uk/UKPlans.aspx?ID=203). In the UK, the basking shark is protected under Schedule 5 of the Wildlife and Countryside Act 1981, listed on Appendix II of CITES and is listed as a priority species on the UK Biodiversity Action Plan. Its global status is assessed as Vulnerable (A1a, d, A2d) in the 1996 IUCN Red List.

4.114 There have been a number of recent studies to determine basking shark distribution and status in UK waters, including tagging studies which track basking shark movements from the west coast of Scotland south through the Irish Sea and into the Western Approaches (Sims *et al.,* 2003, Sims *et al.*, 2005, Solandt, 2007, Southall *et al.*, 2005). The Marine Conservation Society has collated sightings data sent to the charity between 1987 and 2004 (www.mcsuk.org/marineworld/baskingsharks/basking+shark+hotspot+map), which shows the main areas to be the west coast of Scotland, the Isle of Man and the southwest of England. Basking sharks were reported on three occasions from north Cornwall/Devon, and on one occasion just to the south of Swansea – the most easterly record of a basking shark (to date) into the Bristol Channel (Solandt, 2007). The low number of sightings in this latest report indicates that the waters off the Welsh coast of the Bristol Channel do not appear to be a hotspot for the basking shark.

Marine turtles

4.115 Two species of marine turtles are regularly recorded from the southwest: the leatherback (*Dermochelys coriacea*) and the loggerhead (*Caretta caretta*). Most of the leatherbacks have been sighted swimming west of Land's End, although a leatherback turtle was recorded by the Marine Conservation Society near Carmarthen Bay in 2007 (Solandt, 2007), and three loggerheads have been found stranded in Mount's Bay, Cornwall (Jones *et al.*, 2004). Although most turtle species recorded are believed to arrive in UK waters accidentally (with the possible exception of the loggerhead which may be at the extreme limit of its range), the occurrence of the leatherback is almost certainly the result of a deliberate, migratory movement (see the UKBAP web site – www.ukbap.org.uk).

4.116 The leatherback turtle and the loggerhead are listed on Appendix I of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES) 1975. They are also listed on Appendix II of the Bern Convention 1979, Appendices I and II of the Bonn Convention 1979 and Annex IV of the EC Habitats Directive. The loggerhead is also listed as a priority species on Annex II of the EC Habitats Directive, which allows for SACs to be designated in areas identified as essential for life and reproduction. It is unlikely that any SACs will be identified in UK waters for loggerhead turtle. Both species are also protected under schedule 5 of the Wildlife and Countryside Act 1981 and schedule 2 of the Conservation (Natural Habitats &c.) Regulations 1994.

Summary of surveys/additional studies

4.117 The potential impacts of the OWF development on fish and shellfish ecology will be an important aspect for consideration and assessment and is reflected in the specific listing of fisheries assessments within the CEFAS guidance for the assessment of offshore wind farms (CEFAS *et al.*, 2004). Seasonal fisheries surveys, covering the proposed development site, cable route and the sphere of likely impact (i.e. tidal excursion), will be undertaken to establish the presence and distribution of fish and shellfish species in the vicinity. The specification for this survey will be agreed with the relevant statutory organisations (i.e. CEFAS, Natural England, CCW and JNCC) and

will be informed by discussions with the relevant sea fisheries committees and the Fisheries Liaison Representative[11] (FLR) for the project. These discussions are necessary to ensure that the methods used are appropriate for the area being surveyed and mirror those used in local commercial fisheries (CEFAS *et al.*, 2004). The survey methods to be employed are likely to include:

- Otter/beam trawl: Seasonal otter/beam trawls, using a local commercial trawling vessel, will be undertaken in order to help characterise the changing fish assemblages throughout the year in waters of the proposed development site and surrounding area. Trawls can be standardised by length or duration. Trawl locations, duration and other details of the survey methodology will be confirmed following discussions with CEFAS, Natural England, CCW and JNCC.
- Epibenthic trawl: Epibenthic sampling, using a standard 2m or CEFAS beam trawl fitted with a 5mm cod end, will be undertaken in the study area. As with otter trawls, epibenthic trawls can also be standardised by length or duration. This methodology is primarily designed to collect information on epibenthic invertebrate species, including shellfish, but is also used to sample demersal (primarily flatfish species) and juvenile fish assemblages. Since this sampling method is destructive, trawl positions will be informed by data collected during the geophysical survey in order to avoid potentially sensitive habitats (i.e. Annex I reefs).
- Fish larval surveys: The target species for these surveys are plaice, sole, cod, herring and sprat, which were selected following an assessment based on:
    - The location of spawning grounds of each species relative to the development site,
    - The hearing sensitivity of each species,
    - Their relative ecological or conservation importance and
    - Their relative importance to commercial fisheries.

4.118 These species are known to spawn in this region between February and April and as a result, three larvae surveys will be conducted during this period to ensure that sampling is undertaken during the peak spawning periods for each species. Since many other fish species (including whiting, dab and bass) are known to spawn in the Bristol Channel during the same period, the larval surveys will also provide additional information on local spawning grounds of these fish species in the context of the proposed development site. In this manner, additional information on the peak spawning periods for both target and non target fish species close to the proposed development site will be gained for which there is a lack of contemporary data.

Identification of Potential Effects and Proposed Assessment Methodology for Fish Ecology.

[11] The FLR acts as a principal point of contact drawn from within the fishing community who is able to provide the views of the fishing industry to the Developer; and to disseminate information from the Developer to the fishing community.

4.119 The key potential environmental effects that may impact upon fish and shellfish ecology as a result of the proposed Atlantic Array OWF development are summarised below. The potential effects listed have been developed from (a) relevant guidance notes and (b) ESs published for other Round 1 and Round 2 offshore wind farms.

Potential Impact	Loss of spawning/nursery/crab overwintering grounds through presence of turbines and foundations and temporary loss through inter array and export cables.
Survey/Study Proposed to Assess Impact	Fish and shellfish resources in and around the development site will be described via a combination of desk-based studies and site-specific fisheries data obtained via 2m scientific a beam trawl and commercial otter trawl surveys. The details of survey methods to be employed will be confirmed following a desk based assessment and consultation with the relevant sea fisheries committees, fisheries liaison officer (FLO) for the project and the relevant nature conservation organisations to ensure the most appropriate methods are being employed (CEFAS *et al.*, 2004). Data on the distribution of spawning and nursery grounds will also be obtained via specific questions to commercial fishermen during the commercial fisheries consultation exercise. It is proposed to undertake egg/larval surveys during the period February to April 2010.
Method of Impact Assessment	The spatial and temporal nature of spawning/nursery activity and habitats in the study area will be fully described and losses of this habitat through turbine placement quantified. Potential benefits from any fishery exclusion zone will also be estimated.

Potential Impact	Impact upon seabed spawning habitat (e.g. herring) as a result of increases in sediment deposition
Survey/Study Proposed to Assess Impact	Further information on distribution of spawning and nursery grounds in the vicinity of the proposed development OWF will be obtained via larval surveys for sensitive species to more clearly define local spawning areas and specific questions to commercial fishermen during the commercial fisheries consultation exercise. .
Method of Impact Assessment	Potential impacts on spawning habitats through increased sediment loads will be assessed using the outputs of the coastal process assessment and published data on the sensitivity of fish species spawning in this area to high sediment loads.

Potential Impact	Behavioural impacts from construction noise (e.g. piling)
Survey/Study Proposed to Assess Impact	The data collected during the commercial fisheries consultation, desk based review and fisheries surveys will be used to determine the distribution and extents of fish populations, spawning grounds and important migration routes within the development site and surrounding area.
Method of Impact Assessment	Potential noise impacts during the construction phase on those fish species found to be present in the vicinity of the development area will be assessed via a

	review of the relatively large body of data that exists on this topic, including developer-led work and COWRIE projects (Bio/Consult AS, 2001, Nedwell et al., 2007, Wahlberg and Westerberg, 2005). Use of assessment tools including species sensitivity audiograms will be used where appropriate/available.

Potential Impact	Sediment plumes creating localised avoidance
Survey/Study Proposed to Assess Impact	Use of physical impact studies to provide data on potential extent of suspended sediment compared to the background. This will be compared to species distribution data described in the baseline.
Method of Impact Assessment	Potential impacts on behavioural responses, importantly including the potential creation of temporary water quality barriers to migration through increased sediment loads within the water column will be assessed using the outputs of the coastal process assessment and published data on the sensitivity of fish species in this area to high sediment loads.

Potential Impact	Effects due to physical presence of turbines. These may include: ▪ Distributional changes for certain species (e.g. shoaling species attracted to structures or increased prey resource from colonisation of foundations etc.); ▪ changes arising from reduced fishing pressures affecting abundances and distribution of certain species; and ▪ impedance of, or barriers to, migration (e.g. salmon).
Survey/Study Proposed to Assess Impact	The data collected during the commercial fisheries consultation, desk based review and fisheries surveys will be used to determine the distribution and extents of fish populations within the development area and surrounding area. A review of the potential colonisation of new structures (piles, scour protection etc.) and potential benefits afforded by this will also be undertaken, including a consideration of potential benefit from a change/reduction/cessation in commercial fishing and the potential for such consequences to be used as mitigation. This requires an objective assessment of the relative merits of a general increase in biodiversity *per se* over an increase in species that naturally and locally colonise local hard substrata (e.g. Linley *et al.,* 2007).
Method of Impact Assessment	To be based on the findings from developed sites where monitoring has already been instigated, supplemented with site specific information on species and local conditions (e.g. turbidity).

Potential Impact	Behavioural effects resulting from electromagnetic field emissions.
Survey/Study Proposed to Assess Impact	Data on the distribution of EMF sensitive species (particularly elasmobranchs) in and around Atlantic Array will be collated via desk-based studies, site-specific fishery and benthic ecological surveys, and consultation with fishermen and

	fisheries organisations.
Method of Impact Assessment	The findings of recent COWRIE projects (Gill *et al.,* 2005, Gill *et al.*, 2009) investigating the effects of EMF on sensitive fish species will be used to determine the significance of any impacts on fish species from EMF associated with the Atlantic Array OWF and export cables.

Cumulative and In-combination Impact Assessment

4.120 The EIA will assess the potential for both cumulative and in-combination impacts to arise on fish ecology in the wider study area as a result of the interaction between the proposed Atlantic Array project and other activities, including commercial and recreational fishing activity within and in proximity to the Bristol Channel and aggregate extraction at the adjacent Application area 486 and active dredging area 476 (see Figure 4.27). The in-combination effects of the proposed Severn Tidal Power schemes on fish ecology will also be considered as part of the EIA process, though the level of detail available on the tidal power scheme will directly affect the level of assessment detail it is possible to achieve within the EIA. The potential for cumulative and/or in-combination impacts through spatial interaction exist for certain impacts, such as the creation of sediment plumes from turbine and cable installation activities. Potential for cumulative/in-combination impacts also exist via the disturbance of habitats of ecological significance, such as fish and shellfish spawning/nursery/overwintering grounds. Potential cumulative benefits may also be apparent, when taking into consideration the proximity of existing fishery exclusion or no-take zones (e.g. Lundy).

Potential Mitigation and monitoring

4.121 Monitoring and mitigation requirements will be identified in the EIA and agreed with the relevant authority, with the degree and type likely to be required dependent on issues such as the baseline environmental resources and the proposed construction methodology. Experience gained during Round 1 and 2, including the results from site specific monitoring, will also help inform the proposed mitigation and monitoring package.

4.122 A key principle that will be recognised when developing mitigation and monitoring commitments is that of adaptive management. Adaptive management is a structured, iterative process of decision making, with an overall aim of reducing uncertainty over time.

Further Considerations

4.123 Due to the potential impact of the proposed OWF development on migratory routes of Annex II fish species for which a number of SACs (including Carmarthen Bay and Estuaries SAC, Pembrokeshire Marine SAC, River Usk, River Wye and Severn Estuary SACs) have been designated there may be a need for an HRA to be carried out to determine the likely impact of the development on these species and the SACs. The survey programme and data collection proposal is such that it will fulfil the requirement of the EIA and provide robust information in order to inform the Appropriate Assessment (AA). A separate report will be produced to inform the AA (to be undertaken by the competent authority i.e. the IPC for this project).

4.124 As part of the changes brought in by the Marine and Coastal Access Act 2009, the Sea Fisheries Committees in England and Wales will cease to be. In England these will be replaced by Inshore Fisheries and Conservation Authorities who will have many of the same responsibilities as the Sea Fisheries Committees, including management of inshore fisheries. In Wales these responsibilities will be passed to the Welsh Assembly Government. Since the consultation process will involve discussions with the relevant sea fisheries committees, this regulatory change will need to be considered during the EIA process.

Marine Mammals

Introduction

Background Data/Information

4.125 The principal source of cetacean data for this assessment is the Joint Cetacean Database (JCD), now prospectively named the Joint Cetacean Protocol (JCP). The JCP collaboration brings together marine mammal records and their associated meta-data from a diverse range of surveys and monitoring programmes. A most useful first output of the JCD was an atlas of cetacean distribution in north-west European waters (Reid et al 2003). The atlas provides species distribution maps and standardised sighting rates for cetaceans recorded during dedicated surveys. The underlying data were obtained from three sources:

- European Seabirds At Sea database (ESAS).
- Sea Watch Foundation database (SWF) as summarised and discussed in the Status Review of UK Cetaceans (Evans *et al* 2003). The SWF data compliment the JCD with records of less frequently observed species, and by providing information on seasonal occurrence and longer-term trends in abundance.
- A Survey of Cetaceans of the North Sea & Adjacent Waters (SCANS), the first pan-European cetacean survey (Hammond *et al* 1995).

4.126 A regional re-assessment of JCD and new records was published recently by CCW: The Atlas of Marine Mammals in Wales (Baines & Evans 2009). The Welsh Atlas provides maps of species occurrence and relative sighting rates in the Irish Sea, the Celtic Sea and the Bristol Channel and includes several important new record sources. Of particular relevance to Atlantic Array, are data collected during a systematic monitoring at Scarweather Sands OWF over the period 2005-2007 (Pierpoint, 2008) and from surveys conducted by the Gower Marine Mammal Project (GMMP) (Watkins & Colley, 2004).

4.127 On the adjacent English coast to Atlantic Array marine mammal records are collected by Seaquest Southwest a recording scheme run jointly by the Cornwall and Devon Wildlife Trusts. These data are managed by the Devon Biodiversity Records Centre (DBRC) and The Environmental Records Centre for Cornwall & the Isles of Scilly (ERCCIS).

4.128 The principal source of information on pinnipeds in the UK is that reported by the Sea Mammal Research Unit (SMRU) to the National Environmental Research Council's

Special Committee on Seals (e.g. SCOS 2007). SMRU and others also publish the results of behavioural studies including for example, tracks of seal movements using satellite telemetry or photo-identification, which aid the interpretation of seal counts on land. The Grey Seal population is monitored on the Welsh coast by CCW and in England by the Wildlife Trusts of Devon and Cornwall and the Lundy Field Society. Some tracking studies have been carried out using satellite tags (SCOS 2006) and photo-identification (Kiely *et al*. 2000; the Cornish Seal Group: http://www.cornwallsealgroup.co.uk/).

4.129 In addition, useful and recent information on marine mammal occurrence within the area of Atlantic Array are available from observation records made during the boat-based bird transect surveys carried out in 2009 (ongoing survey work).

4.130 Other data utilised in the initial characterisation review comprise:

- Background information supporting Strategic Environmental Assessment 8 (Mackey *et al*. 2004)
- A Status Review of UK Cetaceans (Evans *et al*. 2003)
- UK Cetacean Strandings Investigation Programme (CSIP) (annual reports on stranded cetaceans and seals)
- Seaquest Southwest (a recording scheme run jointly by the Cornwall and Devon Wildlife Trusts, Marine Connection 2007).
- Background reports and occasional papers of regional interest, published by the countryside agencies and others (e.g. Baines *et al*. 1995; Pierpoint 2001).
- Seawatch Foundation (regional newsletters; reports; on-going surveys)
- Sea Trust (sightings from a southern Irish Sea Ferry route; reports; on-going surveys).

General Description of Project Area

4.131 The following discussion focuses on the species that are most likely to be encountered in the vicinity of the site. The most commonly occurring marine mammal species in this region are:

- Harbour Porpoise
- Short-beaked Common Dolphin
- Bottlenose Dolphin
- Risso's Dolphin
- Northern Minke Whale
- Grey Seal.

4.132 The Atlantic Array area consists mainly of inshore waters less than 50 m deep. Western parts however, approach deeper water habitats of the Celtic Sea, which support a more diverse marine mammal community than coastal waters (Hammond *et al.* 1995; (Reid *et al*. 2003; Evans *et al*. 2003; Baines & Evans 2009). As well as the common species of inshore habitats (e.g. Harbour Porpoise *Phocoena phocoena* and Grey Seal *Halichoerus grypus*) therefore, species more usually found further offshore

may also be expected to occur at Atlantic Array (e.g. Northern Minke Whale *Balaenoptera acutorostrata*, Short-beaked Common Dolphin *Delphinus delphis*).

4.133 Recent ongoing seabird surveys at Atlantic Array confirm the presence of at least four species within the area during summer 2009: Harbour Porpoise, Short-beaked Common Dolphin, Northern Minke Whale and Grey Seal. Harbour Porpoise and Short-beaked Common Dolphin were the most frequently encountered species; sightings of these species were widespread, but appeared to show some bias in their distribution towards the eastern and western parts of Atlantic Array respectively.

4.134 Harbour Porpoises are present throughout the year in the Bristol Channel and Outer Severn Estuary. Areas of SW Wales and SW England have been identified as some of the most important regions for Harbour Porpoise in the UK (Evans & Wang 2002). Short-beaked Common Dolphin is relatively abundant throughout the Celtic Sea where school size may number several hundred animals (Goold 1998; Earl *et al.* 2004, 2005; Pierpoint 2005). Sightings of Risso's Dolphin (*Grampus griseus*) are more sporadic but have been reported from the Pembrokeshire Islands, the Gower coast and further offshore. . Bottlenose Dolphins are also present south of Atlantic Array on the coast of SW England (Evans *et al.* 2003). Wood (1998) reports the movements of individually recognisable dolphins between Cornwall and west Wales, but more extensive comparisons show that migration between these regions is unusual (Pesante *et al*. 2008).

4.135 Northern Minke Whale is relatively common offshore in the Celtic Sea where other baleen whale species, Fin Whale (*B. physalis*) and Sei Whale (*B. borealis*) have been recorded. There are also offshore records of White-sided Dolphin (*Lagenorhynchus acutus*), White-beaked Dolphin (*L. albirostris*) and Killer Whale (*Orcinus orca*). There have been rare occurrences of Northern Bottlenose Whale (*Hyperoodon ampullatus*) on the Pembrokeshire coast, and of Humpback Whale (*Megaptera novæangliae*) (Evans *et al*. 2003).

4.136 A 24-month baseline assessment programme at Scarweather Sands OWF recorded 205 groups of Harbour Porpoise, nine sightings of Grey Seal and three groups of Short-beaked Common Dolphin. Acoustic monitoring revealed seasonality in Harbour Porpoise occurrence with activity increasing from late spring through the summer, with a seasonal peak during late-November and December. Neonate calves were common in July and August (Pierpoint 2008). Boat transects recorded 86 Harbour Porpoises and aggregations of porpoise schools were observed on the northern boundary of Atlantic Array (Watkins and Colley, 2004). Recent bird surveys conducted over the site have recorded several species including several sightings of Short-beaked Common Dolphin and Minke Whale within the perimeter of Atlantic Array.

4.137 An analysis of 14 years of sightings and stranding records on the adjacent coast of SW England (Marine Connection 2007) indicates several species have been recorded from south and southwest Devon and Cornwall only (White-sided and White-beaked Dolphin, Long-fined Pilot Whale, Minke Whale) and other species have only infrequently been recorded in North Devon (Risso's Dolphin). Sightings of Killer Whale are also rare in the region, but a group of four were spotted between Ilfracombe and Lundy Island in August 2006 (SWF news archive: http://www.seawatchfoundation.org.uk/newsarchive.php). Reports of three species are relatively common on the coast of the Bristol Channel / Outer Severn Estuary however: Bottlenose Dolphin, Harbour Porpoise and Short-beaked Common Dolphin.

4.138 Approximately 5000 Grey Seals use habitats on the Welsh coast, which is the most important breeding colony for Grey Seal in the southern UK. Approximately 5% of UK Grey Seal pups are born on the coasts of SW Wales and SW England each year (Duck 1995; Baines et al. 1995; SCOS 2007). Pembrokeshire Marine SAC, located to the north of Atlantic Array, was designated primarily to protect this Grey Seal breeding colony. Fewer seal pups are born in Devon and Cornwall, but the species is present in the Outer Severn Estuary throughout the year. There is a regionally important haul-out of Grey Seals at Lundy Island Marine Nature Reserve. Satellite telemetry has identified the use by some grey seals of localised foraging areas in the outer Bristol Channel.

Summary of surveys/additional studies

4.139 A detailed survey across the development area will be undertaken with the aim of documenting the distribution and abundance of marine mammal species prior to the development of Atlantic Array. A suite of methods have been developed and agreed with NE, CCW and JNCC for the project, addressing specific marine mammal characterisation objectives:

- Boat-based sighting surveys. Twelve monthly surveys will be undertaken along pre-determined transects designed to provide unbiased survey coverage, extending over the entire proposed development area. Transect lines will be run with line spacings of 2km during the period April to September 2010 and 4km spacing over the winter months (February –March 2010 and October 2010 to January 2011. Methods will be based on a simplified version of methodology used during the recent SCANS-II and CODA surveys, involving a team of four dedicated observers (two primary observers, one tracker observer and one team member resting off-watch).
- Concurrent passive acoustic (towed hydrophone) surveys will be conducted with the observation survey noted above, providing acoustic detection data along the same transect lines and over the same periods as the sighting survey. Passive acoustic detection is particularly effective for inconspicuous but vociferous species (e.g. harbour porpoises) that become very difficult to spot visually in all be ideal sea conditions. The towed hydrophone survey will provide an independent and standardised record of animal distribution and relative abundance.
- Continuous acoustic monitoring from static moorings (C-PODs) will be conducted. This survey will comprise four C-PODs deployed for a 12 month period from early 2010 to early 2011. Two C-PODs will be deployed within the proposed project development area.

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact	Physiological / behavioural effects on marine mammals resulting from high levels of underwater noise (construction phase). The effects may not be detectable (Nedwell *et al.* 2003), or may range from avoidance / exclusion (e.g. Tougaard *et al.* 2005), change in behaviour (e.g. feeding rate), to temporary or permanent hearing damage and lethal effects.
Survey/Study Proposed to	Using species-specific audiograms, noise modelling of typical pile-driving operations will be undertaken to determine the radii of zones in which there may be

Assess Impact	impacts to marine mammals. Data from existing OWF projects will be sourced and used in the EIA. C-PODs, visual boat-based and towed hydrophone surveys will be used to record detection rates of Harbour Porpoises and dolphin species to inform the EIA.
Method of Impact Assessment	Reference to audiograms and application of these findings via standard EIA methodologies (identification of sensitive receptors, assessment of magnitude of impacts).

Potential Impact	Secondary (indirect) impacts due to effects on prey availability (construction phase). These may include avoidance by marine mammals as a result of the displacement of their preferred prey. Attraction of species such as Grey Seal, into the area may potentially occur, in response to fish disoriented by pile-driving.
Survey/Study Proposed to Assess Impact	The difficulty of predicting the nature of secondary impacts makes designing targeted surveys impossible. However, cross-referencing of marine mammals surveys with the marine ecology and fisheries surveys will be made to determine any potential impacts.
Method of Impact Assessment	Review of baseline marine mammal data and cross-referencing of data from other parameters (marine ecology/marine fisheries). Standard EIA methodologies (identification of sensitive receptors, assessment of magnitude of impacts) will be used to assign significance of impacts.

Potential Impact	Displacement of marine mammals during operational phase Marine mammals may possibly be displaced from the area by number of potentially synergistic factors, the effects of which are difficult to separate e.g. exclusion from habitat occupied by infrastructure, barrier effects, displacement due to operational noise and increased vessel traffic.
Survey/Study Proposed to Assess Impact	The area will be characterised using a 12-month survey programme, which will establish baseline data on species occurrence, abundance and distribution. The programme will use boat-based sightings surveys, towed hydrophone transects and acoustic data-loggers deployed on seabed moorings (C-PODs). Literature relating to the behavioural responses of marine mammals to offshore wind farms (including findings of previous Round 1 & 2 projects and overseas projects) will be assessed in order to predict potential impacts, based on the EIA baseline.
Method of Impact Assessment	Standard EIA methodologies (identification of sensitive receptors, assessment of magnitude of impacts) will be used to assign significance of impacts Discussion of the results in the context of physical data (e.g. sea temperature), benthic and fisheries datasets will likely provide some indication and context for the extent and nature of any changes observed.

Potential Impact	Secondary effects due to changes in long-term prey availability caused by the presence of infrastructure and changes in fishing activity. Reduction in fishing pressure and the creation of sheltered habitat (reef effect) around turbine bases may change marine mammal density, distribution and behaviour by causing a local increase in prey density or availability. Changes in fishing activity may affect rates of marine mammal by-catch, potentially (positively) affecting marine mammals at both a local and population level.
Survey/Study Proposed to Assess Impact	**Presence of infrastructure** Desktop literature review of observations recorded at other wind farms in UK waters and internationally. **Changes in fishing activity** During the EIA stage an assessment of commercial fisheries in the area will be undertaken. This will assess the current types and levels of catch and by-catch, as well as intensity of fishing in certain parts of the area.
Method of Impact Assessment	**Presence of infrastructure** The literature review proposed above will be undertaken to assess if any impacts on marine mammals have occurred elsewhere in UK waters and internationally. From these studies, a prediction of the potential impact of the presence of wind farm infrastructure may be made. **Changes in fishing activity** From the commercial fisheries data gathered, it will be possible to outline, to a degree, the fishing effort within the proposed project area. Using this, along with local fisheries consultation, predictions will be made regarding potential changes in fishing effort and the subsequent effect this will have upon marine mammal prey availability, and hence habitat value for marine mammals. Determination of impact in terms of changes to fishing effort locally will not only take in to account negative factors as above, but also positive factors that may occur. This includes the possibility of increased prey availability in the area due to the potential decreased fishing activity within the immediate wind farm site, as well as potential increase in some species due to the presence of infrastructure such as scour protection around turbines (a 'reef effect').

Cumulative and In-combination Impact Assessment

4.140 As the Scarweather Sands OWF project is not going to be constructed, there are no local offshore wind farms which could present potential for cumulative impacts to occur. However, it is understood that the Crown Estate HRA report highlights the potential interconnectivity of important Natura 2000 sites, even at significant distances within the European Union due to the mobile nature of various Annex II species, including marine mammals. As, within this wider context, there are other offshore wind farms in extant

and, as part of Round 3 a relatively high number of proposed offshore wind farm development, the potential for cumulative effect will theoretically exist. The potential for such effects to occur will therefore be assessed as part of the Atlantic Array EIA.

4.141 Potential in-combination effects may occur in terms of disturbance, habitat or foraging area loss (temporary or long-term), prey species impacts and so on as a result of the interaction of the OWF development with other activities. Any such impacts due to any large-scale changes in local fisheries, sand and gravel extraction, or tidal energy generation for example, will be assessed during the course of this project as informed by both ongoing research and extensive consultation on activities and issues which will need to be considered within the EIA.

Potential Mitigation and monitoring

4.142 Monitoring and mitigation requirements will be identified within the EIA and agreed with the relevant authorities, with the degree and type required being dependent on the outcome of both the survey and EIA process. This follows since a more detailed understanding of the baseline is required for the assessment; only once the sensitivity of marine mammal receptors in the area has been established (based on species characteristics, distribution and abundance) can an appropriate future monitoring and mitigation package be developed.

4.143 Experience gained during Round 1 and 2, including the results from site specific monitoring for Round 1 projects, will also be drawn upon to inform the proposed mitigation and monitoring package. On this basis, and in general terms, current industry best-practice approaches will be employed in mitigating against the risk of injury or disturbance to marine mammals from high levels of underwater noise (JNCC 2009). Other developing mitigation options, for example novel noise reduction methods (e.g. bubble curtains) (COWRIE, 2007a, 2007b) will also be noted and included where appropriate.

Further Considerations

4.144 An Appropriate Assessment may be required because of the proximity of Atlantic Array to areas designated as European Marine Sites for marine mammal, and indeed the consideration required on far-field sites which are designated for marine mammal species as noted above, and the potential effects which might arise from the proposed project (construction, operation and decommissioning). Although the area of Atlantic Array does not overlap an SAC, Pembrokeshire Marine / Sir Benfro Forol SAC is located approximately 8 km north of the perimeter of site. Pembrokeshire Marine / Sir Benfro Forol SAC was established in part for Grey Seal, which is named as a primary reason for SAC selection. The presence of grey seals is also noted as a qualifying feature, but not the primary reason for site selection, of Lundy Island SAC. Lundy Island SAC is located 10 km to the south of Atlantic Array. Clearly, for such mobile species, the small distances separating the project from these sites indicates that marine mammals have the potential to move into or utilise the project area at certain times in addition to the potential (though lower probability) that individuals from distant sites may also visit or use the area on occasion. The assessment of such issues, as informed by the site characterisation survey works, will be undertaken during the EIA to provide sufficient information to support a HRA, should this be required.

Ornithology

Introduction

4.145 The ecological richness of the Bristol Channel is reflected in the ornithological interest of the area, with the non-breeding aggregations of Common Scoter *Melanitta nigra* in the Bae Caerfyrddin/Carmarthen Bay SPA as well as numerous seabird colonies along both the surrounding English (Somerset, Devon and Cornwall) and Welsh (Dyfed and South, Mid and West Glamorgan) coasts and its associated islands, as well as Lundy island in the Channel itself.

4.146 Birds of several island SPAs have the potential to interact with the wind farm zone including Northern Gannets *Morus bassanus* from the Grassholm SPA and Manx Shearwaters *Puffinus puffinus* Lesser Black-backed Gulls *Larus fuscus* and Atlantic Puffins *Fratercula arctica* from the Skokholm and Skomer (and Middleholm) SPA. In accordance with recent population estimates, these SPAs contain a significant proportion of the European populations of Manx Shearwater (44.4%) Gannet (9.7%) and the *graellsii* race of Lesser Black-backed Gull (5.6%). Many smaller colonies of a range of species including auks, gulls and Northern Fulmar *Fulmaris glacialis* are not contained within designated areas, which may partly be a function of the large numbers of nesting seabirds in large colonies in the area.

4.147 As well as wintering and breeding species, a large number of seabirds are likely to disperse or migrate through the Bristol Channel, with some spending some time in the area. The latter includes post-breeding Balaeric Shearwater *Puffinus mauretanicus*, a globally critically endangered species breeding on the Balaeric Islands in the western Mediterranean. Auks, terns, skuas, gulls, and petrels are also likely to be well represented. Moreover, the Bristol Channel is linked at its eastern end to the Severn Estuary - a particularly large (24,701 ha) and significant intertidal Special Protection Area (SPA) supporting over 90,000 waterfowl in winter. At least some of these birds may navigate across the zone to and from the estuary (as well as other important estuaries such as Camarthen Bay and Burry Inlet SPA) depending on their origin or destination.

4.148 In summary, the ornithological interest of the Bristol Channel and the Bristol Channel zone within it will comprise breeding, wintering and dispersing/migrating species and individuals. This, together with the relative proximity of SPAs and the birds contained therein, implies potential for impacts arising from the proposed development on a number of species, for example in a cumulative context as presented in the cumulative effects section below. Of course, it does not necessarily follow that such potential will be realised and the assessment of any impacts will rely on the gathering of a high-quality specific dataset and rigorous assessment of all impacts from collision to disturbance/displacement and indirect effects mediated through any change in habitat and foraging conditions, particularly in the context of potential cumulative impacts especially on wide-ranging species.

Background Data/Information

4.149 Scoping the ornithological interest of the development zone has relied on a combination of desk study of literature sources to generate a series of expectations of the seabird use of the area and specific survey information gathered by boat-based surveys in 2009. The initial literature reviews have formed the basis of the

ornithological survey programmes for the zone, the long lead observation (boat and aerial) work having commenced in Q1 2009.

4.150 Background information for the area has been obtained from a range of sources.

- European Seabirds at Sea (ESAS) team database, in part summarised in *An Atlas of Seabird Distribution in North-West European Waters* by Stone *et al*. (1995). (In this, the English and Bristol Channels are combined as Area 10, with the Celtic Sea in Area 9 also of relevance). The Strategic Environmental Assessment (SEA) process (DECC 2009) data searches of the Round 3 SEA areas 6, 7 and 8 (Barton & Pollock 2007, Mackey *et al*. undated) which incorporates the proposed area of development[12].
- *Seabird 2000 Census 1998-2002* reported by Mitchell *et al*. (2004)[13].The location of a colony coupled with simple foraging radii analysis (see below) provides a useful series of expectations of the use of the Atlantic Array development zone by breeding seabirds. are summarised in BirdLife International (2004), B*aker et al. (2006)* a*nd BirdLi*fe International *et al. (20*07), providing data on population sizes in the breeding season (and in some cases outside the breeding season) as well as species conservation status in a national and international context.

4.151 Other works of reference such *Birds in England* (Brown & Grice 2005) also provide general ecological information of relevance for some species to provide further insight into likely patterns of seasonal and temporal use. For non-breeding species and waterfowl as well as land birds, *The Migration Atlas: movements of the birds of Britain and Ireland* provides useful information on possible dispersion and migration patterns.

4.152 More detailed information on particular species may then be provided by specific research studies. This includes, for example species-specific details of foraging movements (e.g. Ostrand *et al*. 1998, Hamer *et al*. 2000, 2001, Ojowski *et al*. 2001, Daunt *et al*. 2002, Anker-Nilssen & Lorentsen, 2007, Guilford *et al*. 2008) coupled with more indirect observations of birds at sea with deduction of their likely origin (e.g. Camphuysen 1995, 2005). Shore-based counts of Balearic shearwater in UK waters are also being undertaken (Wynn & Brereton, 2008; http://www.seawatch-sw.org). To date, most individuals have been recorded in south Devon and Cornwall in the area although a peak count of 50 birds passing Strumble Head in Pembrokeshire in 2005 suggests that there is some significant movement north through the Irish Sea.

4.153 Valuable local information on both seabirds and land birds is also available for specific local sites (e.g. Lundy) and in county-based bird reports as well as on various websites and the general ornithological literature (i.e. within *British Birds* amongst others).

4.154 As a result of what is thought to be a similar process, Langston (2008) suggested a number of priority species that were of most concern from the RSPB's perspective in each of the Round 3 development zones. In the Bristol Channel these were Manx

[12] Subsequent gap analysis identified the need for further ornithological surveys around the UK in relation to continuing offshore wind farm development. The resulting aerial surveys in 2007/08 commissioned by DECC (WWT Consulting 2009) followed those adopted in previous rounds of development (DTI 2006, BERR 2007): Bristol Channel (blocks SW102-107 inclusive), provide data of direct relevance to the Atlantic Array development.
[13] Details of designated colonies are available at http://www.jncc.gov.uk/

Shearwater, Balearic Shearwater, European Storm-petrel *Hydrobates pelagicus* and auks (no species specified) subject to risk of displacement and Northern Gannet and Lesser Black-backed Gull at risk of collision. It is of note that the feasibility study for the project (Royal Haskoning 2007) identified five of these species – Manx Shearwater, Balearic Shearwater, European Storm-petrel, Gannet and Lesser Black-backed Gull – as being of potential key interest in the area.

4.155 Discussions held to date with Natural England (NE) introduced Common Scoter as an important receptor as well as suggesting a hierarchy of sensitivity of different species with Manx Shearwater and Common Scoter of highest sensitivity followed by European Storm-petrel, Balearic Shearwater, Gannet and Lesser Black-backed Gull with NE noting a distinction between species which had been studied for earlier proposals (e.g. Common Scoter, Lesser Black-backed Gull) and those that had not (e.g. Manx Shearwater, Balearic Shearwater and Gannet).

4.156 Subsequent discussions with NE and the Countryside Council for Wales (CCW) utilised a hierarchy suggested by the SEA process which in turn replicated the analysis of Langston (2008), with Gannet Lesser Black-backed Gull (collision risk) and Manx Shearwater, Balearic Shearwater, European Storm Petrel and auks (displacement risk). Common Scoter was also considered due to the proximity of the Carmarthen Bay SPA. This list of species coupled with an appraisal of their peak use of the area informed the subsequent monitoring proposals (RPS 2009) with a focus of summer boat-based surveys and winter aerial surveys.

General Description of Project Area

Desk study

4.157 A number of internationally important designated areas for and including birds that may interact with the development zone (i.e. excluding species which are not seabirds or highly unlikely to cross the open sea area of the proposed zone) are present at varying distance from the zone.

4.158 For the designated seabird species, foraging radii analysis - whereby the typical known foraging range of the species is overlaid on the location of the colony (and excluding inland areas) - clearly indicates that *all* named species have the potential to interact with the development zone (Figure 4.9 through to Figure 4.18). Table 4.6 presents the species likely to be present within the wind farm zone from the literature reviewed.

Table 4.5: Internationally important sites for birds and their component species with the potential to interact with the proposed Bristol Channel Zone. The sites are ranked in order of importance to the zone.

Protected Site	Designation(s)	Minimum distance (and direction) from development zone (km)	Ornithological Interest (from Natura 2000 UK SPA data forms)
Skokholm & Skomer	SPA	42km (NW)	Internationally important population of **Manx Shearwater** (150,986 pairs – 51.3% of World population as in late 1990s), **Razorbill** (4,260 individuals – 0.5% of the European population in 1997), **Atlantic**

			Puffin (9,500 pairs - 0.5% of the European population in mid 1980s), **Lesser Black-backed Gull** (20,300 pairs – 16.4% of the West European/ Mediterranean / West African population mean 1993-1997)*, nationally important population of **European Storm-petrel** (>3,100 pairs – 3.6% of GB population in 1995), internationally important seabird assemblage of >20,000 individuals of **Razorbill**, **Guillemot**, **Kittiwake**, **Puffin**, **Lesser Black-backed Gull**, **Manx Shearwater** and **European Storm-petrel***
Grassholm	SPA	53km (NW)	Internationally important population of breeding **Northern Gannet** (33,000 pairs - 12.5% of European population as in 1994/95)
Carmarthen Bay	SPA, SAC	12km (N) (7.7 to SAC boundary)	Internationally important numbers of wintering **Common Scoter** (16,946 individuals - >1% of European population mean 1997/8-2001/2).
Burry Inlet	SPA, Ramsar site, SAC, SSSI	26km (NE)	Internationally important numbers of wintering **Pintail**, **Knot**, **Redshank** and **Oystercatcher**, with nationally important numbers of **Shoveler**, **Teal**, **Wigeon**, **Dunlin**, **Curlew**, **Grey Plover** and **Shelduck**. Annually supports an assemblage of 34,962 wintering waterfowl (5 year peak mean to 1999).
Severn Estuary	SPA Ramsar	>85 km (ENE)	Internationally important for wintering **Bewick's Swan** with internationally important numbers of **Dunlin**, **Shelduck**, **Redshank**, **Ringed Plover***, **Curlew*** and **Pintail***, and nationally important numbers of **Gadwall** and **White-fronted Goose**. Annually supports an assemblage of 84,317 wintering waterfowl (5 year peak mean to 1998)

* As listed in the SPA review document only

Table 4.6: Status of Seabird species identified as having potential to occur within the Bristol Channel development zone (from Royal Haskoning 2007).

Species	Status	Seasonal occurrence in Bristol Channel	UK Population	Estimated Regional Population / Status	Known Sites

Species	Status	Seasonal occurrence in Bristol Channel	UK Population	Estimated Regional Population / Status	Known Sites
Common Eider		Winter	Winter: 23,390	Scarce to rare on both coasts	
Long-tailed Duck	Schedule 1	Winter	Winter: 3,015	Scarce to rare on both coasts	
Common Scoter	Schedule 1	Winter	Winter: 11,425	>20,000	Carmarthen Bay holds vast majority of birds in the region.
Red-throated Diver	Annex 1	Passage / Winter	Winter: >456	Scarce on both coasts	
Black-throated Diver	Annex 1 Schedule 1	Winter	Winter: 66	Very scarce off both coasts	
Great Northern Diver	Annex 1 Schedule 1	Winter	Winter: 111	Very scarce off both coasts	
Northern Fulmar		Breeding	Breeding: 537,991	>2,000	Breeds in all seabird colonies
Manx Shearwater		Breeding / Passage	Breeding: 332,267	>151,000	Breeds on Skomer, Skokholm, Ramsay with small numbers on Lundy after eradication of rats
Balearic Shearwater	Annex1 IUCN Red List Category: Critically Endangered	Passage			Annual in small but variable numbers past Pembrokeshire coast
European Storm-petrel	Annex 1	Breeding	Breeding: 124,775	9,500	Breeds on Ramsay, Skokholm and Skomer
Northern Gannet		Breeding	Breeding: 260,607	33,000	Breeds on Grassholm
Great Cormorant		Resident	Breeding: 13,681	<300	Scarce breeder. More common in winter
European Shag		Breeding / Passage			Regular but uncommon breeder in welsh seabird colonies.

Species	Status	Seasonal occurrence in Bristol Channel	UK Population	Estimated Regional Population / Status	Known Sites
					Passage/winter visitor to North Devon coast
Arctic Skua		Passage			Scarce though more numerous in spring and Autumn primarily off Pembrokeshire coast.
Great Skua		Passage			Scarce though more numerous in spring and Autumn primarily off Pembrokeshire coast.
Black-headed Gull		Winter / Passage	Winter: .250,000		Locally common resident in south Wales. Numerous winter visitor to Devon
Common Gull		Winter / Passage	Winter: >65,000		Fairly numerous winter visitor to both coasts.
Lesser Black-backed gull		Year round	Breeding: 116,684 Winter: >40,000	>21,000	Breeds on Skomer, Skokholm, Ramsey and Lundy
Herring Gull		Year round	Breeding: 149,177 Winter: >52,000	>8,000	Breeds on Skomer, Skokholm, Ramsey and Lundy
Great Black-backed gull		Year round	Breeding: 19,713 Winter: 12,948	>322	Breeds on Skomer, Skokholm, Ramsey and Lundy
Kittiwake		Breeding	Breeding: 415,995	>4000	Breeds in substantial numbers on Skomer, Skokholm, Grassholm, Ramsay, Lundy & Stackpole
Terns		Passage		Small numbers on passage only	
Common Guillemot		Breeding	Breeding: 1,559,484	> 30,000	Breeds in substantial numbers on Skomer, Skokholm, Grassholm, Ramsay, Lundy & Stackpole

Species	Status	Seasonal occurrence in Bristol Channel	UK Population	Estimated Regional Population / Status	Known Sites
Razorbill		Breeding	Breeding: 216,087	>9,000	Breeds on Skomer, Skokholm, Grassholm, Ramsay, Lundy & Stackpole
Puffin		Breeding	Breeding: 600,751	>9,500	Breeds on Skomer, Skokholm, Ramsay with small numbers on Lundy

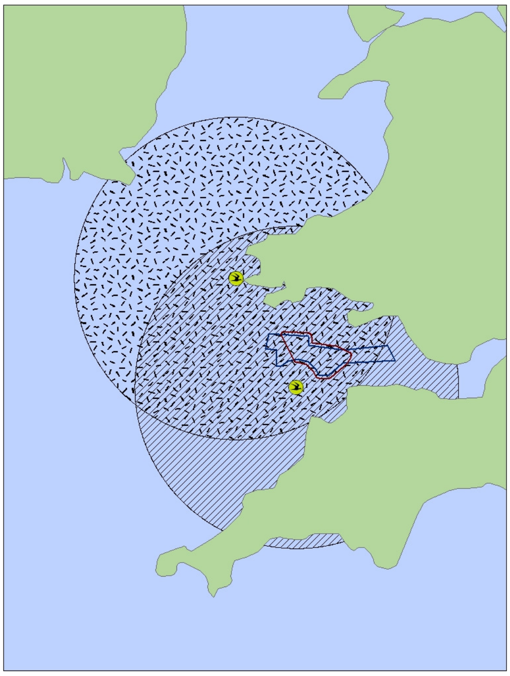


Figure 4.9: Prospective minimum foraging radii (100km – Langston 2008) of Manx Shearwater from colonies (bird symbol) at Skomer/Skokholm and the small population on Lundy).

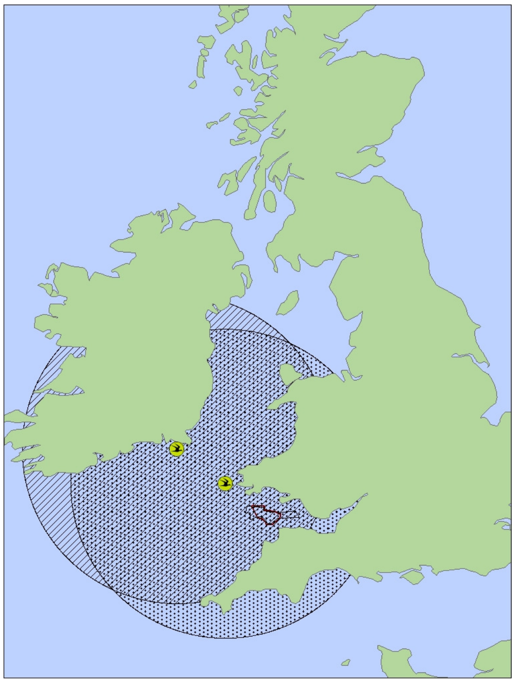


Figure 4.10: Prospective foraging radii (232km – Hamer et al. 2000) of Gannet from known large colonies (bird symbol) at Grassholm in Wales (30,688 pairs) and Great Saltee in Ireland (1930 pairs).

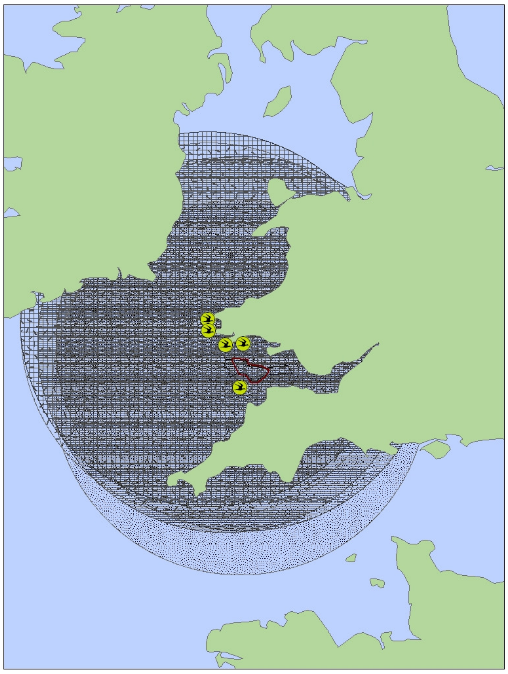


Figure 4.11: Prospective foraging radii (222km – Ojowski et al. 2001) of Fulmar from known larger (101-1000 pairs) colonies (bird symbol).

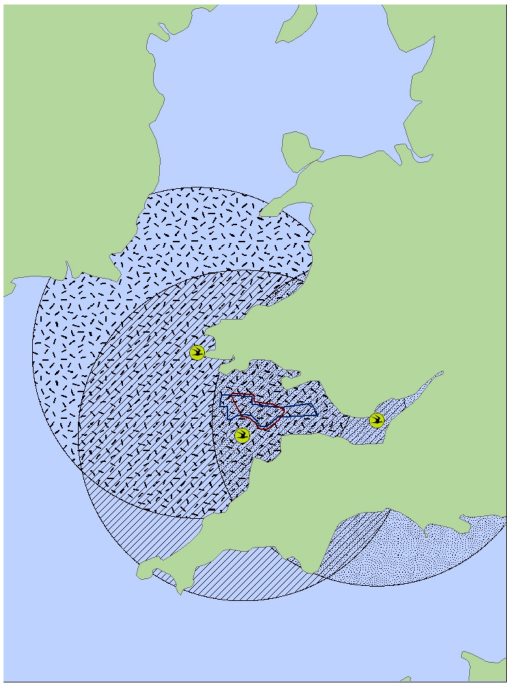


Figure 4.12: Prospective foraging radii (135 km – Camphuysen 1995) of Lesser Black-backed Gull from known large colonies (bird symbol) at Skomer & Skokholm

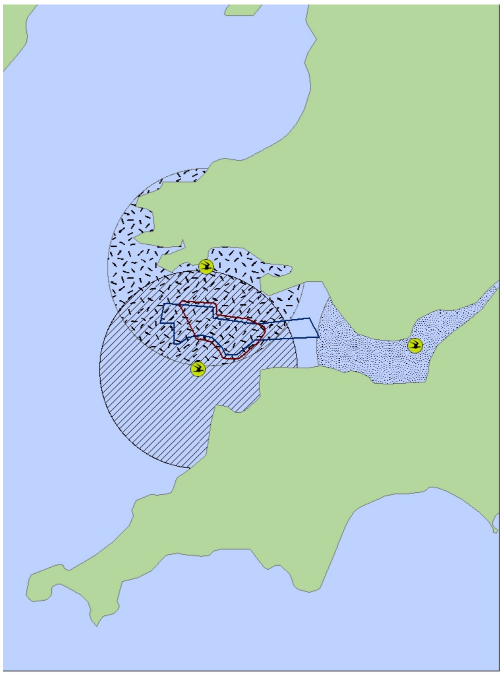


Figure 4.13: Prospective foraging radii (54km – Camphuysen 1995) of Herring Gull from known large (>500 pairs) colonies (bird symbol) at Lundy, Caldey Island and Flat Holm.

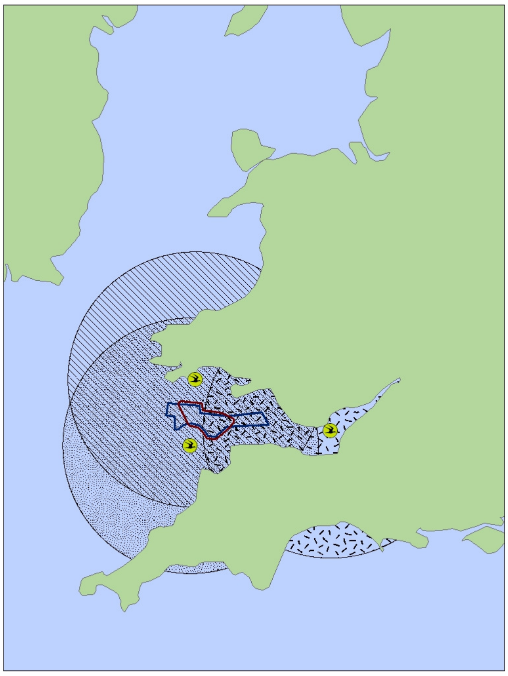


Figure 4.14: Prospective foraging radii (100 km – Langston 2008) of Great Black-backed Gull from known large (>500 pairs) colonies (bird symbol) at Lundy, Caldey Island and Flatholm.

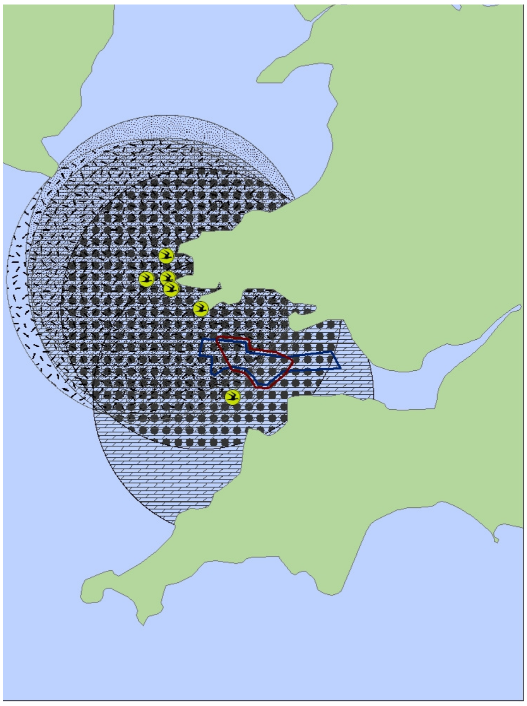


Figure 4.15: Prospective foraging radii (80 km – Camphuysen 2005) of Guillemot from known large (>1000 individuals) colonies (bird symbol) including Lundy, Skomer, Skokholm, Grassholm and Ramsey.

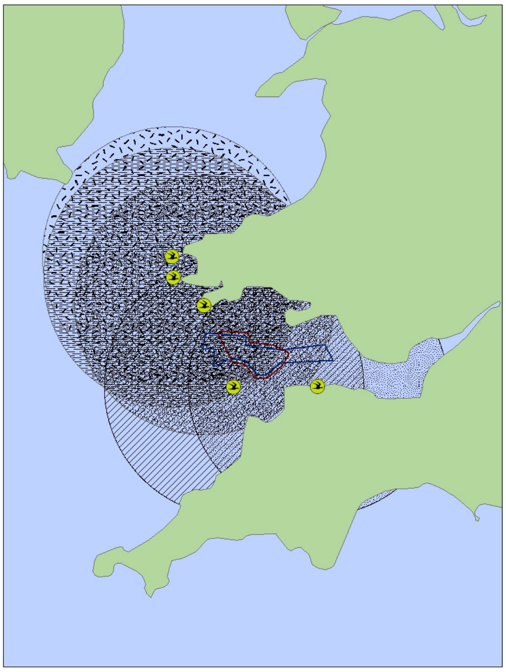


Figure 4.16: Prospective foraging radii (80km - Camphuysen 2005) of Razorbill from known larger (>1000 individuals) colonies (bird symbol), with the largest at Skomer (3,898 individuals).

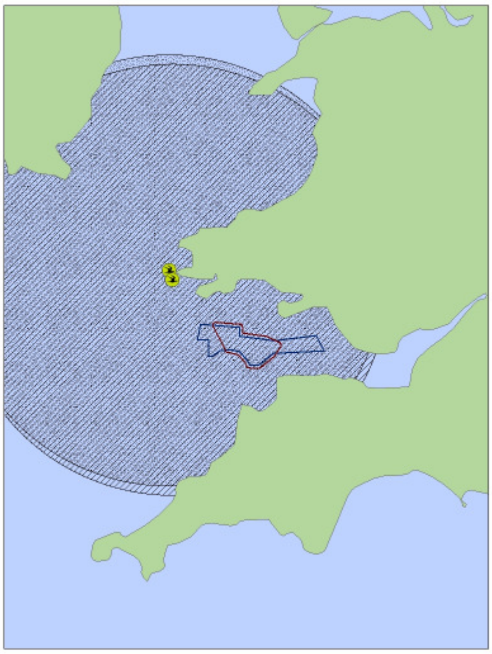


Figure 4.17: Prospective foraging radii (137km of Puffin - Anker-Nilssen & Lorentsen 2007) from known large (>100 pairs) colonies (bird symbol) at Skomer (7,076) and Skokholm (2,055 pairs pairs).

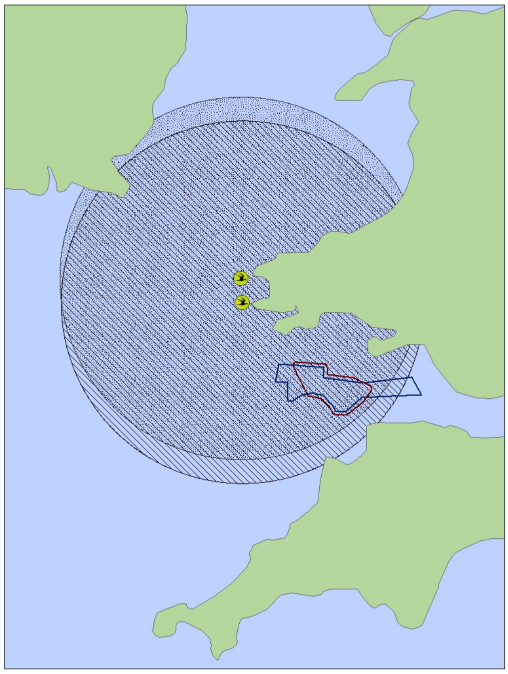


Figure 4.18: Prospective foraging radii (100km – Langston 2008) of European Storm-petrel from known large colonies (bird symbol) at Skokholm/Skomer (2,560 pairs) & Ramsey (102 pairs).

4.159 Desk study

4.160 A number of internationally important designated areas for and including birds that may interact with the development zone (i.e. excluding species which are not seabirds or highly unlikely to cross the open sea area of the proposed zone) are present at varying distance from the zone.

4.161 For the designated seabird species, foraging radii analysis - whereby the typical known foraging range of the species is overlaid on the location of the colony (and excluding inland areas) - clearly indicates that all named species have the potential to interact with the development zone (Figure 4.9 through to Figure 4.18). Table 4.6 presents the species likely to be present within the wind farm zone from the literature reviewed.

4.162 Table 4.5 (and indeed other wetlands away from the coast). However, many of the flightlines of the species involved are thought unlikely to actually cross the site. For example, Bewick's Swan *Cygnus columbianus bewickii* originating from western Siberia are thought likely to enter the UK via East Anglia (Wernham *et al*. 2002) and are therefore highly unlikely to cross the Bristol Channel. However, many other species may re-orientate during the winter and move between estuaries on the west coast of the UK, with potential to undertake direct routes across the Bristol Channel.

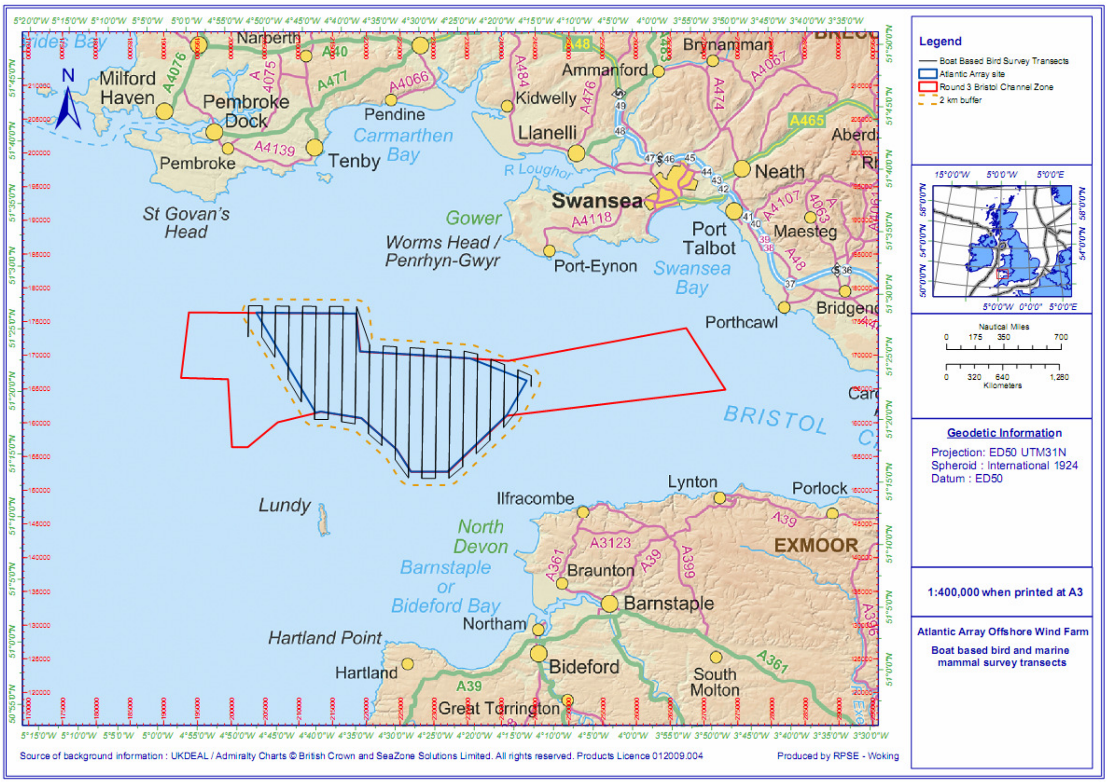
Survey programme

4.163 As a result of the need for two years of ornithological survey data to inform offshore wind farm development EIA (see for example Maclean *et al*, 2009) and the lead-in times for consent application, boat and aerial surveys have been initiated already for

the Atlantic Array project. The survey work, which commenced in January 2009, has been developed in consultation with NE, CCW and JNCC. The overall approach to the survey programme has been to carry out a year of survey and analysis and to review the results with the statutory agencies in order to decide on the need (scope) of a second year of complete or targeted surveys. Boat-based surveys, following techniques outlined in Camphuysen et al (2004)[14], were specifically focused on the main potential development area - Atlantic Array (Figure 4.19) with targeted surveys of one per month in the summer months (April to September) aimed at breeding species. In the event, the lack of a suitable weather window led to omission of a survey in June and extension of the programme into October. Discussions have also been held with RSPB regarding data capture approaches and survey programme.

4.164 In contrast, the aerial surveys were intended to provide information on the distribution of species during the winter months and it was felt that extending the surveys to cover the whole Bristol Channel zone would provide valuable context for certain species in terms of their distribution, particularly those with graduated distributions according to distance from shore. In particular, aerial surveys have been demonstrated to have particular value in determining the distribution of species such as Common Scoter and divers (DTI, 2006; BERR, 2007), which can be disturbed by vessels.

4.165 Additional aerial surveys, contracted by COWRIE Ltd were carried out by WWT/HiDef Aerial Surveying Ltd using a high definition video recording technique in the breeding season of 2009 across the BCZ (Hexter 2009), providing information on the wider Zone through the breeding season.



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14 Camphuysen et al suggest snapshots at 5min intervals; for these surveys, snapshots are being undertaken at distance intervals of 500m (about every 2 minutes).

Figure 4.19: Boat transect lines across the Atlantic Array project area. Transects provide for 2km buffer from outer turbine boundaries.

4.166 To date, four aerial surveys have been flown this winter (2009/10); a table summarising the ornithological survey work undertaken for the Atlantic Array project is presented below (Table 4.7).

Table 4.7: Ornithological survey programme

			Season/Month											
			Winter		Spring			Summer			Autumn			Winter
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Year	2009	Boat				✓	✓	*	✓	✓	✓	✓		
	2009	Aerial	✓	✓	✓		✓	✓		✓		✓	✓	✓
	2010	Boat			✓	**P**	**P(n)**	**P**	**P(n)**	**P**	**P(n)**	**P**	**P**	**P**
	2010	Aerial	✓	✓	✓		**P**	**P**		**P**	**P**	**P**	**P**	**P**

KEY:

'**P**' denotes 'proposed' as surveys are yet to be undertaken.

* denotes survey unable to be undertaken due to weather

(n) denotes potential additional Nocturnal survey – see Section 4.174

Preliminary overview of data collection to date

4.167 The aerial surveys conducted by WWT Consulting (early 2009) recorded high number of birds in the south-west region (58,539 individuals) including the development zone. West Wales and the South West produced more auks than the other regions of the UK (48.7% of the 79,124 encountered). From a total of 33,971 Manx Shearwaters, the West Wales supplied 52% of records, although the largest colonies do fall within this survey area. However, this indicates that a large number of birds were recorded away from these colonies in the south-west and north-west. In the south-west area itself by far the largest number of birds (24,980 birds) were encountered in early winter (25th October – 24th November) due to large numbers of auks, Common Scoters and gulls.

4.168 In summer, the South West Area was dominated by Manx Shearwaters, Gannets and gulls, with the highest numbers in periods six (5^{th} May – 11^{th} July) and seven (11^{th} July – 22^{nd} August) (with 16,506 and 13,681 individuals respectively). Areas of high numbers of observations and high densities were around the Pembrokeshire Islands of Skomer and Skokholm, primarily due to Manx Shearwaters and Gannets; along Pembrey Sands (due to gulls); outer parts of the mid-Bristol Channel; as well as at other locations across the wider South West Area including North Cornwall between Land's End and Boscastle; Whitsand Bay, South Cornwall; and Poole Bay, Dorset (WWT Consulting). Significant change was noted in some of the survey blocks further south than the Bristol Channel between surveys indicating birds were exploiting patchy food resources.

4.169 Total combined counts from the six boat-based transect line surveys completed to date, with maximum count in any one survey, estimated densities and actual population size and the month in which maxima occurred and the possible conservation status of those counts is shown in Table 4.8.

4.170 A total of 35,428 birds were seen over the survey period with Manx Shearwater by far the most abundant species (57% of records) followed by Guillemot (26% of records) with Gannet at ~5% of records.

4.171 Boat-based surveys also showed large differences in estimated population size between surveys from a minimum of 507 in April to a maximum of 20,154 in July/August. High numbers were however maintained into September (13,546) after the breeding season. It may be that as well as stage of the breeding cycle, use of the Bristol Channel by Manx Shearwaters varies according to a range of environmental factors including the distribution of prey fish. It is of note that shearwaters were strongly associated with feeding auks (Guillemots) in multi-species foraging associations (MSFAs), particularly in September. Auks driving prey to the surface where they become accessible to other species is a typical feature in many other productive areas for seabirds (Camphuysen 2005).

4.172 Auks also varied considerably in abundance with a peak population of Razorbills in April around the time of egg-laying, with Puffins slightly later in May and peaks of Guillemot in October after the breeding season (Table 4.8). The numbers present at this time exceeds the regional population and indicates aggregation of dispersing birds from colonies further north. It seems likely that aggregations of prey fish drive this pattern, which also led to the generation of large foraging groups of mature Gannets immediately after the breeding season.

Table 4.8: Total counts and maximum density and population size of all species recorded in boat-based surveys (n=6) from April-October 2009. The possible conservation importance of maximum estimated population size relative to 1% criteria is also indicated.

Species	Total Count	Maximum count	Maximum Density	Maximum Population size	Month	Conservation Importance**
Pintail	3	3		6	Oct	
Common Scoter	49	38	0.032	22	Sep	
Unidentified duck	1	1		2	May	
Fulmar	347	100	0.280	192	Jul/Aug	Regional 1% limit – 51[1]
Cory's Shearwater	1			2	May	
Sooty Shearwater	3	2		4	Oct	
Manx Shearwater	20234	6298	29.292	20154	Jul/Aug	International 1% limit – 7400[1]
Balearic Shearwater	4	2	0.008	6	Sep	Critically Endangered
European Storm Petrel	371	221	0.337	232	May	Local 1% limit – 28[2]
Wilson's Petrel	1	1		2	Jul/Aug	
Gannet	1652	542	1.835	1263	Sep	Regional 1% limit – 307[2]
Cormorant	13	9	0.016	11	Sep	
Shag	10	8		16	Apr	
Oystercatcher	2	2		4	Jul/Aug	
Golden Plover	15	15	0.120	83	Aug	
Dunlin	5	4		8	Jul/Aug	
Bar-tailed Godwit	2	2	0.016	11	Jul/Aug	
Whimbrel	1	1		2	Aug	
Curlew	1	1		2	Oct	
Turnstone	3	2		4	Jul/Aug	
Pomarine Skua	2	1	0.008	6	Oct	
Arctic Skua	19	13	0.034	23	Oct	
Long-tailed Skua	1	1		2	Oct	
Great Skua	39	28	0.209	144	Jul/Aug	
Unidentified skua	4	2		4	Apr	
Kittiwake	891	373	0.888	611	Oct	Regional 1% limit – 45[1]
Black-headed Gull	1	1	0.008	6	Oct	

Little Gull	1	1		2	Oct	
Mediterranean Gull	2	2		4	Oct	
Common Gull	24	23	0.069	48	Oct	
Lesser Black-backed Gull	410	165	0.315	217	Aug	
Herring Gull	435	175	0.506	348	Oct	
Great Black-backed Gull	160	107	0.312	214	Sep	Regional 1% limit – 16[2]
Unidentified gull	2	1	0.008	6	Aug	
Unidentified small gull	4	3	0.01	7	Apr	
Unidentified large gull	242	216	1.116	768	Oct	
Black Tern	2	2	0.016	11	Aug	
Sandwich Tern	4	4	0.008	6	Aug	
Common Tern	80	57	0.24	166	May	
Arctic Tern	46	16	0.208	143	May	
Unidentified tern	43	35		70	May	
Guillemot	9095	3366	15.586	10724	Oct	Regional 1% limit – 930[1]
			132.132†	90913†	Jul/Aug	International 1% limit – 43000[1]
Razorbill	472	214	0.842	579	Apr	Regional 1% limit – 112[1]
			3.897†	2681†	Apr	National 1% limit – 2161[2]
Black Guillemot	1	1	0.008	6	Jul/Aug	
Puffin	45	21	0.091	63	May	
Unidentified auk	525	375	0.810	557	Aug	
Feral Pigeon	3	2		4	May	
Sand Martin	1	1		2	Apr	
Unidentified martin	4	4	0.008	6	May	
Swallow	134	117	0.233	160	Sep	
Meadow Pipit	6			8	Oct	
Pied Wagtail	1	1	0.008	6	Sep	
Starling	1			2	Oct	
Unidentified passerine	8	6	0.048	33	Sep	

4.173 The October surveys indicated that, as well as Guillemots, 37% of the seabird species recorded achieved peak numbers in October. Although not recorded at peak in

October, the estimated population of Great Skua *Stercorarius skua* on slightly earlier, perhaps protracted passage was also considerable. Although currently secure (BirdLife International 2004, BirdLife International *et al*. 2007), this species has a small global breeding population (<16,000 pairs) concentrated entirely in northern Europe, 60% of which are within the UK. Although most birds appear to undertake southbound passage along the east coast of the UK there is increasing evidence of overland interchange following the line of the Wash to the Severn and into the Bristol Channel (Brown & Grice 2005). The relatively high flight height of *S. skua* makes this species potentially vulnerable to collision.

Summary of Surveys/Additional Studies

4.174 Following consultation with CCW, NE and JNCC, the survey strategy has been updated to capture specific information requested by these bodies. The current survey strategy will include detailed survey of the site with the objective of documenting the abundance, distribution and where possible, movements, of seabirds, waders and wildfowl and migratory passerines. The following range of methods have been developed to address specific characterisation objectives:

- Summer season boat based bird survey. Thirteen monthly boat based surveys undertaken over 2 years (2009 and 2010) on 22 transects running north-south across the proposed Atlantic Array development area. Transects lines are spaced at 2 km intervals and use three observers, with two observers covering a 180° forward arc, each simultaneously recording a separate 90° arc from mid-ship to bow on each side of the vessel. A third person is present on the observation platform to record the sightings and other parameters. Observations are made along the line transect within a strip width of 300 m with surveyors categorising sightings with bands perpendicular to the ship of 0-50m, 50-100m, 100-200m, 200-300m and 300+m. Flight heights are recorded in three bands: <20m, 20-200m and >200m. The summer boat based surveys have been/will be surveyed over the following months:
    - Monthly between April and October 2009 (6 surveys)
    - Monthly between March and September 2010 (7 surveys)
- Summer aerial survey. Over the survey period 2009-2010 a total of six summer aerial surveys will be undertaken. This will include three surveys undertaken per year in May, June and August. In 2009 these surveys were conducted by WWT on behalf of The Crown Estate using standard aerial survey techniques (observers flying in a light aircraft along transects across the Zone). Due to the discontinuation of this method of survey by WWT the 2010 summer aerial surveys will be undertaken using the high definition (HD) aerial survey technique, involving the use of HD video equipment to record the birds under the aircraft. This is then played back at a slower rate in a laboratory where individual birds are identified and counted. The surveys proposed for 2010 will be conducted over the same transects as in 2009, thus including the entire Bristol Channel Zone.
- Winter aerial survey. Winter aerial surveys of the site were commissioned by The Crown Estate and covered the period of January to March 2009 and

October to March 2009/10. These surveys covered the entire Bristol Channel Zone using the observers in light aircraft method discussed above. For the period of September to December 2010 these surveys will be continued, though as with the summer survey the methodology used at this time will be the HD technique. These surveys will cover the full Bristol Channel Zone as per previous TCE commissioned surveys.

- Potential winter boat based survey late 2010. Three surveys are provisionally proposed for October to December 2010 pending review of the 2009/10 winter aerial survey data, which is yet to be received. The necessity for this survey arises out of the poor species discrimination of auks during standard aerial survey. If the 2009/10 winter aerial survey data shows a large number of auks then it is proposed that the boat based survey programme be extended in order to adequately identify actual species present (rather than 'auk sp.', and their numbers in the project area over the second early Winter period (i.e. Oct/Nov/Dec 2010).
- Nocturnal thermal imaging with image intensifier. After consultation with NE, CCW and JNCC it is proposed that a trial of thermal imaging and image intensifier survey is undertaken in order to characterise the species present and their abundances and behaviour at night. The initial trial is scheduled for May 2010 with a view to undertaking additional surveys in July and September, subject to agreement with NE, CCW JNCC and RSPB that the method is effective. The nocturnal surveys will utilise imaging equipment and will be carried out in a similar manner to that of the diurnal boat based surveys. The nocturnal surveys will follow, wherever possible within the limitations of the imaging technology, the recommendations of Camphuysen *et al* (2004) for a line transect survey with distance sampling and 'snapshot' counts of birds in flight. Carrying out the surveys on a vessel of the same specification (if not the actual vessel) as that used for the diurnal survey programme will mean that many of the recommendations of Camphuysen *et al* (2004) are automatically met.

Identification of Potential Effects and Proposed Assessment Methodology

4.175 Experience from wind farm development indicates three main risks to birds:

- Collision with turbine blades whilst in flight.
- Disturbance by vessels, construction activity or the turbines themselves leading to displacement resulting in loss of habitat/food resources.
- Indirect effects on habitat and food within and around the wind farm.

4.176 The latter is largely focused upon construction activity, particularly pile-driving, arising through potential effects on prey item distribution or availability.

4.177 A number of other potential effects may also be identified which have not to date proved to be significant (see for example Pettersson 2005, Petersen *et al*. 2006):

- Creation of a barrier to movement resulting in longer flight routes and increased energy expenditure; and
- Release of sediments or pollutants during construction and maintenance.

- Direct habitat loss from turbine bases.

4.178 The possibility also remains that some beneficial impacts may occur, particularly the reef effect of turbine bases (see Linley *et al*. 2007) leading to aggregation of marine invertebrates and fish, which may then attract birds. The exclusion of certain types of fishing activity within the wind farm area may also lead to potential increase in prey availability, hence also attracting more birds. This may however be at cost of increased risk of collision for susceptible species.

4.179 From desk-based review and particularly from the boat-based survey programme, the likely sensitive receptors and the potential risks they may face are suggested to be:

i)	Manx Shearwater	displacement & indirect effects
ii)	Balearic Shearwater	displacement & indirect effects
iii)	Gannet	collision risk & indirect effects
iv)	Guillemot	displacement & indirect effects
v)	Lesser Black-backed Gull	collision risk & indirect effects
vi)	Great Skua	collision risk
vii)	Razorbill	displacement & indirect effects
viii)	Puffin	displacement indirect effects
ix)	European Storm-Petrel	displacement & indirect effects

4.180 The principal potential impacts outlined are to be assessed in manner summarised in the following tables:

Potential Impact	Collision risk with turbines whilst in flight (seasonal migration and diurnal or nocturnal movement).
Survey/Study Proposed to Assess Impact	Boat-based ornithological survey
Method of Impact Assessment	Calculation of monthly density and passage rates summed to produce annual estimates for use in species-specific collision risk modelling (Band *et al*. 2000, Chamberlain *et al*. 2007), should this be warranted from survey data.

Potential Impact	Disturbance leading to displacement of birds (construction and decommissioning) Disturbance may be initiated both by vessels (especially of swimming and diving species) and by noisy construction activity such as pile-driving that may affect all species
Survey/Study Proposed to Assess Impact	Boat-based ornithological survey
Method of Impact Assessment	Determination of the relative importance of the development area and the proportion of the population of the species potentially affected with the use of

	both quantitative matrix analysis and rigorous qualitative evaluation

Potential Impact	Risk of indirect effects, comprising: Indirect disturbance of prey resources (e.g. fish) thereby changing bird distribution (construction phase); and Positive and/or and negative changes to habitat conditions (presence of turbine bases and changes to the seabed) inducing changes in the distribution of bird prey resources and thus the birds themselves (operational phase)
Survey/Study Proposed to Assess Impact	Following characterisation of the ornithological interest of the site by detailed boat-based surveys and review of the aerial data, a broad assessment of the nature of the sensitive receptors and their use of the proposed site will be undertaken. The likely response of species to the presence of the project may then be broadly determined in part using previously documented evidence in the literature. Details of habitat changes will be determined from the marine ecology survey.
Method of Impact Assessment	Determination of the relative importance of the development area for the species concerned, likelihood of impact upon important food resources/habitats and the proportion of the population potentially affected, with the use of both quantitative matrix analysis and rigorous qualitative evaluation

Potential Impact	Displacement and barrier effects (especially to flying birds) (operational phase)
Survey/Study Proposed to Assess Impact	Boat-based ornithological survey
Method of Impact Assessment	Determination of the relative importance of the development area and the proportion of the population of the species potentially affected with the use of both quantitative matrix analysis and rigorous qualitative evaluation

Potential Impact	Displacement, collision and barrier effects at night (especially to flying birds) (operational phase)
Survey/Study Proposed to Assess Impact	Boat-based ornithological survey undertaken at night using a thermal imager and image intensifier. The survey methodology is based on that utilised for the diurnal surveys, based on Camphuysen *et al* (2004).
Method of Impact Assessment	Determination of the relative importance of the development area at night and the proportion of the population of the species potentially affected at night with the use of both quantitative matrix analysis and rigorous qualitative evaluation.

4.181 Other potential impacts (see above) will be assessed in sections dealing specifically with construction (e.g. release of sediments and pollutants), maintenance (e.g. vessel activity leading to disturbance) and operation (e.g. barrier effects)

Cumulative and In-combination Impact Assessment

4.182 Considerable effort has recently been directed at the means of assessing cumulative impacts (King *et al.* 2009). In simple terms, assessment of cumulative impacts may be achieved through a similar process of rigorous matrix analysis supplemented by equally rigorous qualitative evaluation as is undertaken for a single site. This does however require that links between different sites can be established for different species (e.g. sites along a flyway or foraging route). Foraging radii analysis from breeding colonies may again prove useful in this respect to at least reveal the potential for overlap. In the absence of specific information, a precautionary approach of including possible links between sites must then be adopted. Similarly, the likely origin of birds on passage or in winter may be evaluated using a variety of clues on the age of individuals, timing of appearance, direction of travel etc.

4.183 At this stage, it is relatively clear that for several wide-ranging species (e.g. Gannet, Manx Shearwater and Fulmar) all wind farms in all rounds of development (1, 2 and 3) may interact in a cumulative manner with the proposed Atlantic Array site. Although species such as auks exhibit more restricted flight ranges during the breeding season, and are thus less likely to represent a significant issue during such times, dispersing and migrating individuals may travel more widely and thus require consideration. In the case of Great Skua for example, sites along flyways along the east coast may also have to be considered with evidence of overland crossing.

Potential Mitigation and monitoring

4.184 Mitigation of potential impacts is specific to the impact involved. Such measures may include:

- Avoidance of sensitive periods for birds or important prey resources for potentially significant impacting activities (e.g. pile driving);
- Careful design of turbine layouts within the project area, or avoidance of turbine placement in areas of high sensitivity or importance to bird species to reduce significance or likelihood of impact;
- Selection of appropriate spacing of turbines within the array to accommodate regular transit routes for risk species.

Further Considerations

4.185 The boat-based strategy in the Atlantic Array has focused on the simultaneous determination of ornithological interest in both the zone *and* the potential sites with the use of a high-resolution survey design utilising line transects spaced at 2km intervals, typically employed at much smaller sites. A 2km buffer has then been superimposed around the potential development zone to allow for additional characterisation of near-site effects. Therefore the deployment of a high resolution system of transect lines provides for both zonal and site-based assessment.

4.186 This approach will provide the data required to underpin any Appropriate Assessment that may be triggered following EIA, in relation to potential impacts on SPA populations of birds. Such sites include candidate SPAs at Skomer and Skokholm and Grassholm, with specific reference to Manx Shearwater and Gannet respectively within these colonies. Several species of auk including Guillemot, Razorbill and Puffin (depending on determination of the features within the SPA) as well as Lesser Black-backed Gull may also be included if impacts are suggested to be significant in EIA.

4.187 Cumulative impacts may also arise for Gannet, Manx Shearwater, Lesser Black-backed Gull, Great Skua, possibly Great Black-backed Gull and several species of auks.

Nature Conservation

Introduction

4.188 A review of designated sites occurring within or in proximity to the Bristol Channel (and into the Severn Estuary) has been undertaken and a summary of the areas of importance, and the reasons for designation are presented below. The types of designation included are as follows:

- Marine Conservation Zone (MCZ) (Lundy);
- Special Areas of Conservation (SAC);
- Special Protection Area (SPA);
- Ramsar Site;
- Site of Special Scientific Interest (SSSI);
- National Nature Reserve (NNR);
- Marine Nature Reserve;
- Marine Conservation Zone; and
- Local Nature Reserve.

4.189 Details on the Severn Estuary are included since the Severn/Bristol Channel complex is important to consider together with respect to nature conservation issues and the interconnectivity of many of the designated sites and their associated features. The 'study area' for this aspect therefore, in common with the sections on marine mammals and ornithology, is necessarily broader than for the majority of the topics considered in this scoping document and, ultimately, in the EIA.

4.190 The sites listed represent all those designated within 1km from the coast between St David's Head and Bude on the north Cornwall coast (see Figure 4.20). Since these sites are coastal and/or shallow subtidal in nature, they would be primarily of interest for issues connected to the cable route corridor and potentially wider ranging coastal processes issues. There may also be issues for designated sites for which mobile species (e.g. birds or fish) are listed in the citation. In addition, some (notably the Lundy SAC/SSSI/MNR/MCZ, the Pembrokeshire Marine SAC, the Carmarthen Bay and Estuaries SAC/SPA and Severn Estuary cSAC/SPA/Ramsar) include areas further offshore, which would potentially be of greater significance for the offshore aspects of the wind farm.

4.191 Even where coastal sites are limited in their extent offshore, the potential development area lies in relative proximity to both the north and south coastlines, and as such it is considered possible that the offshore components associated with the construction, operation and decommissioning of an OWF located within the identified zone could impact upon current coastal designated sites. It should be noted, that in addition, issues may arise in connection to the cable route corridor, its landfall and any associated infrastructure required onshore. The nature conservation issue considered here solely relates to potential marine components of designated sites, with terrestrial sites considered within the onshore chapter of this document.

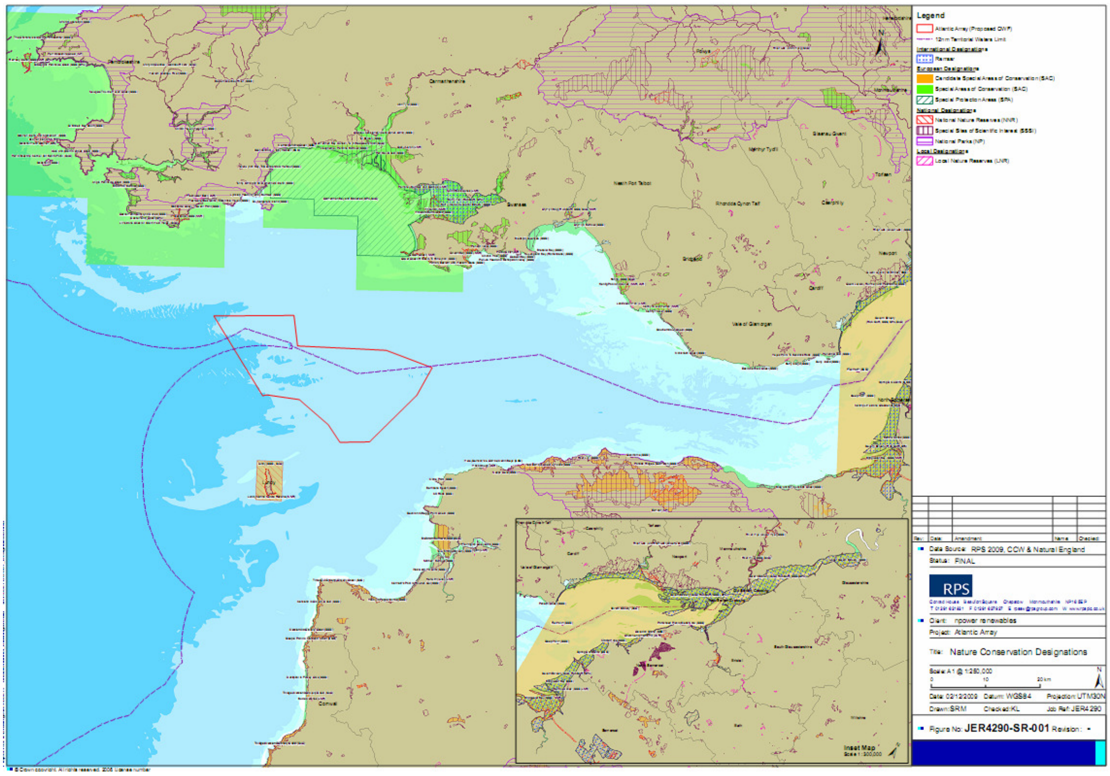

Figure 4.20: Nature conservation designations in the Bristol Channel

Background Data/Sources

4.192 Information on nature conservation has been sourced through data provided by the conservation agencies, disseminated through the Magic website (http://www.magic.gov.uk/). Individual citations for designated sites have been reviewed in order to summarise the features and species for which the areas hold importance (www.ccw.gov.uk, www.naturalengland.org.uk and www.jncc.gov.uk). Further information on species and habitats of conservation concern was also sourced from the Atlas of Marine Biodiversity Action Plan Species and Habitats of Species and Conservation Concern in Wales (Moore, 2002).

General Description of Project Area

4.193 The location of the Severn Estuary on the north Atlantic flyway for migratory birds means that its mudflats and saltmarshes provide feeding grounds for very high numbers of wildfowl and waders throughout the winter period, making the estuary important for migratory waterfowl.

4.194 The estuary is also notable as a migration route for a number of diadromous fish species including salmon and sea trout as they pass through the estuary into the Rivers Torridge and Taw and River Lyn on the north Devon coast, and the Rivers Usk, Wye, Ogmore, Afan, Neath, Taw, Lougher and Gwendraeth Fawr, Tywi, Taf, Cleddau and Nevern on the Welsh coast. Shad and lamprey also migrate through the Severn Estuary and are BAP priority species, as well as Annex II species listed on the Carmarthen Bay and Estuaries SAC, Pembrokeshire Marine SAC, River Usk and River Wye SACs, with twaite shad only listed on the Severn Estuary cSAC.

4.195 The Severn Estuary is designated as a Ramsar site, SPA, and cSAC. There are an additional ten marine and coastal areas designated as SACs, two SPA and one Ramsar site in the Bristol Channel between St. David's Head and Bude. The SAC, SPA and Ramsar designations are summarised in Appendix VII. These form part of the Natura 2000 network of protected areas in the European Union. SPAs and SACs are established under the Birds Directive and Habitats Directive respectively and together, SPAs and SACs make up the Natura 2000 network of protected areas. The Natura 2000 network contributes to the "Emerald network" of Areas of Special Conservation Interest (ASCIs) set up under the Bern Convention on the conservation of European wildlife and natural habitats.

4.196 The Wild Birds Directive (79/409/EC) and the Habitats Directive (92/43/EC), as transposed into UK legislation, both apply to the land and out to the limit of territorial waters in the UK. These directives are put into practice through the Natura 2000 programme which has led to the establishment of SPAs under the Birds Directive and SACs under the Habitats Directive.

4.197 The potential effects of any proposed OWF upon protected sites and their interest features in the Bristol Channel need to be considered carefully. Where sites of international (Ramsar site) or European (SPA, SAC) importance are potentially affected, then the advice of the Statutory Nature Conservation Organisations (in this case Natural England, CCW and JNCC) will be required. If there is any indication of a likely significant effect (LSE) on any of these sites then these organisations may advise the Competent Authority that an Appropriate Assessment is required. It should be noted that the JNCC is investigating potential sites, both wholly offshore but also extensions to existing coastal sites, for Habitat Directive Annex II species, as well as potential SPAs under the Birds Directive.

4.198 The project team are not aware of any current interest in designating new Natura 2000 sites, or extensions to existing sites, in the Severn Estuary or the Bristol Channel, however the Lundy SAC has also recently been designated as a Marine Conservation Zone under the Marine and Coastal Access Act (2009). Additionally, the Finding Sanctuary project (www.finding-sanctuary.org/page/get-involved), aims to identify other potential Marine Conservation Zones in the south west region of England, which may include sites within the Bristol Channel area.

Sites of Special Scientific Interest (SSSI)

4.199 A number of SSSIs (Appendix VIII) are located along the northern (CCW) and southern (Natural England) shores of Bristol Channel (Figure 4.20). There are 56 coastal/marine SSSI located within Bristol Channel and the Severn Estuary. The SSSI designation is the main national nature conservation designation in the UK. Sites in Wales and England are established by CCW and Natural England respectively under the provisions of the *Wildlife and Countryside Act, 1981* (and amendments) for their nature conservation or geological importance.

National Nature Reserves (NNRs)

4.200 NNRs are established by CCW and Natural England under the *Wildlife and Countryside Act 1981* (and amendments) and the *National Parks and Access to the Countryside Act 1949*. These areas represent the best of the UK's SSSIs and the objectives of this statutory designation are to protect nationally important areas of wildlife habitat and

geological interest. Reserves are managed by CCW/Natural England, the wildlife trusts or the National Trust, and access restrictions are often applied. The overriding priority of NNRs is nature conservation and they are offered the same protection as SSSIs.

4.201 There are eight NNRs between St. David's Head and mouth of the Severn Estuary on the Welsh coast:

- Ramsey Island NNR;
- Skomer Island NNR;
- the Gower Coast NNR;
- the Oxwich NNR located in Oxwich Bay;
- Stackpole NNR;
- Kenfig Pool and Dunes;
- Whiteford;
- Merthyr Mawr Warren

4.202 There is one NNR between Bude and the mouth of the Severn Estuary on the English coast:

- Bridgewater Bay

Marine Nature Reserves

4.203 Marine Nature Reserve (MNR) is a UK designation officially made by the government. It has similar status and protection to a National Nature Reserve (NNR), but is particularly concerned with the marine environment. MNRs are created by statute (under the Wildlife and Countryside Act 1981) to conserve marine flora and fauna and geological or physiographical features of special interest, while providing opportunities for study of the systems involved. MNRs may be established within 3 nautical miles of the coast under the Territorial Seas Act 1987 or, by an Order in Council, to the limits of UK territorial waters; they include both the sea and the seabed. MNRs can also be protected by bylaws.

4.204 Relatively few MNRs have been designated. Probably the best known is Lundy Island, which was designated as a MNR in 1986. This site is located ~12km south of the proposed development area and the area is also designated as an SAC (Figure 4.20).

Local Nature Reserves (LNRs)

4.205 LNRs are designated by local authorities, under the *National Parks and Access to the Countryside Act 1949,* for their local natural interest or educational value. Sites are afforded protection through Structure and Local Plans.

4.206 There are eight LNRs between St. David's Head and the mouth of the Severn on the Welsh coast:

- Pwlldu Cliffs;
- Flat Holm;
- Freshwater East;
- Glan-yr-afon;

- Kenfig Pool And Dunes;
- Lock's Common;
- North Rock Dunes;
- Pembrey Burrows and Saltings

4.207 There are four LNRs between Bude and mouth of the Severn Estuary on the English coast:

- Hillsborough;
- Wains & Church Hill
- Kenwith Valley;
- Berrow Dunes

UK Biodiversity Action Plan (BAP)

4.208 The Convention of Biological Diversity was signed in Rio de Janeiro in 1992 (and hence is also referred to as the Rio Convention), entering into force in 1993. It was the first treaty to provide a legal framework for biodiversity conservation, including calls for national strategies and action plans to 'conserve, protect and enhance biological diversity'. The UK's response was the UK Biodiversity Action Plan (BAP), which was launched in 1994. The plan includes the identification of a number of habitats and species, together with a series of local Action Plans. The following Plans are applicable to the current project:

- Action for biodiversity in the South-West BAP Devon BAP
- Exmoor Local BAP
- West Somerset BAP
- Sedgemoor District, Somerset BAP
- North Somerset *'Action for Nature'* Local BAP
- Bristol Biodiversity Action Project
- Newport Local BAP
- Cardiff 'Wild About Cardiff' Local BAP
- Vale of Glamorgan Local BAP
- Bridgend County Borough Council Local BAP
- Neath-Port Talbot Local BAP
- Swansea Local BAP
- Carmarthenshire Local BAP
- Pembrokeshire Local BAP

4.209 The plans identify a number of habitats and species that are highlighted as being 'coastal', which include the following:

Habitats

Estuaries (Local)	Coastal sand dunes (Priority)	Seagrass beds (Priority)	Rocky seabed (Local)
Coastal and floodplain grazing marsh (Priority)	Coastal vegetated shingle (Priority)	*Sabellaria alveolata* reefs (Priority	Intertidal mudflats (Priority)
Coastal saltmarsh (Priority)	Maritime cliff and slopes (Priority)	Offshore shelf rock (Broad/Local	Saline lagoons (Priority)
Reedbeds (Priority)			

Species

Allis Shad (*Alosa alosa*) (fish)	Pink sea-fan (*Eunicella verrucosa*) (coral)	A polychaete worm (*Ophelia bicornis*)	Fen orchid (*Liparis loeselii*) (vascular plant)
Twaite Shad (*Alosa fallax*) (fish)	Native oyster (*Ostrea edulis*) (mollusc	Shore dock (*Rumex rupestris)* (vascular plant)	Rock sea lavender (*Limonium binervosum*) (vascular plant)
Atlantic salmon (*Salmo salar*) (fish)	Otter (*Lutra lutra*) (mammal)	Dune gentian (*Gentianella uliqinosa*) (vascular plant)	Lapwing (*Vanellus vanellus*) (bird)
Basking shark (*Ceterohinus maximus*) (fish)	Harbour porpoise (*Phocena phocena*) (mammal)	Early gentian (*Gentianella anglica*) (vascular plant)	Curlew (*Numenius arquata*) (bird)
Common scoter (*Melanitta nigra*) (bird)	Kingfisher (*Alcedo althis*) (bird)		

Other Features of Note

4.210 As described in earlier sections, there are reported occurrences of *S. alveolata* and *S. spinulosa* within the area, including some forming biogenic reefs. Where such features have been found offshore, there have been moves to designate some such sites under the Habitats Directive (e.g. Inner Dowsing, Race Bank and North Ridge pSAC). There is currently no indication of new sites being designated in the Severn Estuary or the Bristol Channel.

Summary of surveys/additional studies

4.211 Characterisation surveys of the benthic, fish and shellfish ecology (As described above) are to be conducted on the proposed development site and sphere of likely impact (i.e. tidal excursion). The results of these surveys, along with consultation with the relevant statutory nature conservation organisations, will be used to address any data gaps and properly inform the impact assessment on nature conservation sites in the region.

Identification of Potential Effects and Proposed Assessment Methodology

4.212 The proposed development of a wind farm within the Bristol Channel has the potential to create a range of physical and biological effects which could impact upon features of nature conservation interest. A summary of the potential impacts of the proposed development upon nature conservation and the methods to assess these impacts is presented below.

Potential Impacts:	Changes to the physical and biological environment could adversely impact upon currently designated sites (international, national and/or regional level) or their designated features. Changes to the physical and biological environment could adversely impact upon habitat/species that are not currently covered by any specific designation but which may potentially be designated as part of the on-going process of designating offshore SACs, currently being undertaken by NE and the JNCC. Physical and biological effects caused by the proposed development may adversely impact habitats and/or species listed on the UK BAP
Survey/Study Proposed to Assess Impacts	Although the main proposed development site does not currently lie within the boundaries of an SAC, there is the potential that Annex I habitats (e.g. *Sabellaria* reefs) and/or Annex II species (e.g. salmon or shad migrating to Severn Estuary or marine mammals) may exist within, or utilise the sites. The proposed benthic and fish ecology characterisation surveys, have been designed in order to describe the status and distribution of Annex I habitat. This survey will include the use of non-destructive methods including drop-down video. Data from the geophysical survey of the site, in particular hi-resolution sidescan data, will also be used to describe the distribution of potential Annex I habitats. The presence/absence of Annex II species within the site will be recorded via a combination of desk-based review of existing datasets and data from the on-going monthly boat-based bird surveys (which also record marine mammal sightings). The method of determining the presence/absence of UK BAP habitats and species will be determined via the type of habitat/species in question. A combination of desk-based review and analysis of site-specific survey data will be used.
Method of Impact Assessment	Potential impacts upon Annex I habitats, Annex II species and/or UK BAP habitat/species will be assessed via standard EIA methodologies, using significance criteria outlined in the relevant guidance documents (CEFAS *et al.,* 2004, English Nature *et al.*, 2001) and agreed with the relevant statutory nature conservation agency (CCW, Natural England or JNCC). Where potential impacts may arise on species/habitats listed under the Habitats Directive, there may be a requirement to provide information as a separate report that enables the competent authority to undertake an HRA. It is intended that any such report will look at the potential effects of the project with reference to the conservation objectives for the site.

Cumulative and In-combination Impact Assessment

4.213 The EIA will assess the potential for in-combination impacts to arise on sites of nature conservation significance in the wider study area as a result of the interaction between the proposed Atlantic Array project and other activities, such as aggregate extraction at the adjacent Areas 486 and 476 (see Figure 1.2). The in combination effects of the proposed OWF with the Severn Tidal Power schemes on designated sites within the Bristol Channel will also need to be assessed as part of the EIA process. Potential for cumulative and/or in-combination impacts through spatial interaction exist for certain impacts, such as the creation of sediment plumes from activities associated with installation of turbines and cables. Potential for cumulative/in-combination impacts also exist via the disturbance of habitats of conservation significance, such as migratory routes or important locations for Annex II species or Annex I reef habitats.

Potential Mitigation and monitoring

4.214 Examination of Round 1 and Round 2 OWF mitigation and monitoring programmes as part of the Atlantic Array EIA process will help to develop a good understanding of how previous mitigation and monitoring measures proposed in these earlier projects have been transposed into licence conditions. This will assist in setting out clear, well-defined mitigation and monitoring commitments for the Atlantic Array OWF project.

4.215 A key principle that will be recognised when developing mitigation and monitoring commitments is that of adaptive management. Adaptive management is a structured, iterative process of decision making, with an overall aim of reducing uncertainty over time.

Further Considerations

4.216 Given that the marine export cable route is likely to pass through or in close proximity to a number of sites of conservation significance, it is possible that the cable route will be subject to an HRA, though this will be determined by the route selected for the export cable and the installation method selected.

The Human Environment

Landscape and Seascape

Introduction

4.217 The Landscape, Seascape and Visual Impact Assessment (LSVIA) will identify and assess potential effects from the proposed cable route and substation on landscape resources and visual receptors, as well as the setting of historic landscapes and monuments, with reference to established methodology and guidance.

Background Data/Information

4.218 Prior to this scoping report the following work has been undertaken:

- An initial analysis of the Department of Energy and Climate Change document, UK Offshore Energy Strategic Environmental Assessment: Future Leasing for Offshore Wind Farms and Licensing for Offshore Oil and Gas Storage, Environmental Report (January 2009) and the subsequent Crown Estate response note.
- A series of twelve wirelines were undertaken from various locations along the south Welsh and north Devon coast, including from Lundy Island. These were produced to investigate a number of different development scenarios. An overview of the visual assessment was reported on.
- An initial meeting with the Countryside Council for Wales (CCW) was held to introduce the scheme to CCW and seek his initial thoughts on the proposals. Prior to the meeting CCW had provided a copy of CCW Policy Research Report No. 08/5, Welsh Seascapes and their sensitivity to offshore developments, (January 2009). There was agreement that further meetings would take place between the two parties.

General Description of Project Area

4.219 Paragraph 4 of the DECC publication, UK Offshore Energy Strategic Environmental Assessment: Future Leasing for Offshore Wind Farms and Licensing for Offshore Oil and Gas Storage, Environmental Report (January 2009) gives an outline description of the landscape of the coasts on either side of the Bristol Channel:

> *The Bristol Channel has surrounding coasts in England and Wales. Landscape value here is recognised in the: Hartland, Lundy, North Devon, Exmoor, Glamorgan, Gower and South Pembrokeshire Heritage Coasts: North Devon and Gower AONBs and the Exmoor and Pembrokeshire Coast National Parks. Unlike most areas the Bristol Channel is viewable from almost all sides from high cliffed coasts.*

4.220 For the initial report on views from the various coastal areas (that accompanied the wirelines) the following observations on views were made.

Western part of the South Wales Coast (Pembrokeshire):

4.221 For the most part, this coastal area lies within the Pembrokeshire Coast National Park. It is a landscape of gently undulating pastoral fields, and the coast itself has a variety of landscapes formed either of the red sandstone, or limestone.

4.222 The views are primarily along the coast and out to sea. There are theoretical views of Lundy, from St. Govan's Head (47.59km) Lydstep Point (49.77km) and Caldey Island (48.05km). However, due to the distance, Lundy Island is barely perceptible from this coast.

Central part of the South Wales Coast (Camarthenshire):

4.223 Carmarthen Bay is a part of the Welsh coast that does not face predominantly south, many of the views from the coastline are east/west, and some north, along the several estuaries.

Central part of the South Wales Coast (The Gower):

4.224 This part of the coast is lies within the Gower AONB. Much of the Gower has views over the Carmarthen Bay. The views from the Pembrokeshire Coast National Park are similarly east/west at this point. However, southerly views to Devon are available and at its closest point the Gower is 36.77km from the North Devon Coast.

Eastern part of the South Wales coast (Swansea Bay):

4.225 It has been assumed that this landscape will contain the consented Scarweather Sands offshore wind farm (Round 1). Much of the coast is industrial, or contains large urban areas.

Lundy Island:

4.226 Historically inhabited by hermits/monks, the island was chosen for its isolation and lack of links to the mainland. It is located 18.19km from the North Devon coast and 47.59km from the South Wales coast. At present views to the island are theoretically available from both coasts.

Western part of North Devon (Torridge DC):

4.227 Hartland Point lies approximately 18.19km from Lundy Island, and as such is the closest part of the mainland to the island.

Central section of the North Devon coast (North Devon DC):

4.228 This area is more accessible and the towns of Bideford and Barnstaple lie on the Taw Torridge Estuary. Ilfracombe is the largest of the coastal towns situated on the north-facing section of the coastline. Views north to South Wales are possible, The Gower being the closest area of land to this part of the North Devon coast.

Identification of Potential Effects and Proposed Assessment Methodology

4.229 Using industry guidance contained within the relevant documents referred to below, the LSVIA will undertake the following:

- A scoping exercise and consultation with statutory and non-statutory consultees to establish valued county and local landscape and seascape resources and viewpoints;
- Baseline studies of existing landscape resources and visual receptors incorporating national level conclusions;
- Assess the sensitivity of those resources and receptors to the proposals;
- Provide advice on any mitigation that may be possible (e.g. layout) and incorporate agreed mitigation into the scheme description;

- Propose and agree monitoring;
- Identify the potential effects of the proposal on the landscape and seascape resources and visual receptors during the construction, operation and decommissioning phases of the project;
- A cumulative assessment on the combined effects of the proposed development in combination with any other major developments that lie within the agreed study area. A list of such developments would be agreed with the relevant authorities;
- Assess the significance of those effects; and,
- Present the finding in the Environmental Statement (ES) and Non-technical Summary (NTS).

Construction Phase

Potential Impact	Construction Phase: Effects on Landscape Character ▪ Indirect effects on nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Indirect effects on locally designated landscapes. ▪ Indirect effects on undesignated landscapes. ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.
Survey/Study Proposed to Assess Impact	Desk study and field survey
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Countryside Council for Wales, Brady Shipman Martin, University College Dublin, *Guide to Best Practice in Seascape Assessment* (2001) Maritime Ireland / Wales INTERREG Report No. 5; ▪ Department of Trade and Industry, *Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report* (November 2005); ▪ Horner and MacLennan and Envision, *Visual Representation of Wind farms: Good Practice Guidance* (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning; and, ▪ Landscape Institute and Institute of Environmental Management and Assessment *Guidelines for Landscape and Visual Impact Assessment': Second Edition* (2002).

4.230

Potential Impact	Construction Phase: Effects on Visual Resources ▪ Views from nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Views from locally designated landscapes. ▪ Views from Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Views from National Trails: Pembrokeshire Coast Path and South West Coast Path. ▪ Views from promoted paths ▪ Views from other public rights of way. ▪ Views from other publicly accessible land e.g. Access Land (under CRoW Act). ▪ Views from residential properties.
Survey/Study Proposed to Assess Impact	Desk study and field survey.
Method of Impact Assessment	▪ The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Countryside Council for Wales, Brady Shipman Martin, University College Dublin, *Guide to Best Practice in Seascape Assessment* (2001) Maritime Ireland / Wales INTERREG Report No. 5; ▪ Department of Trade and Industry, *Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report* (November 2005); ▪ Horner and MacLennan and Envision, *Visual Representation of Wind farms: Good Practice Guidance* (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning; ▪ Landscape Institute and Institute of Environmental Management and Assessment *Guidelines for Landscape and Visual Impact Assessment': Second Edition* (2002); ▪ Scottish Natural Heritage, *Visual Analysis of Wind farms – Good Practice Guidance* (2005); and, ▪ University of Newcastle, *Visual Assessment of Wind farms: Best Practice* (2002) Scottish Natural Heritage Commissioned Report F01AA303A.

Potential Impact	Construction Phase: Effects on Settings of Historic Landscapes and Historic Monuments ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Indirect effects on settings of Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Historic Parks and Gardens, Protected Wreck Sites, Areas of Archaeological Importance.
Survey/Study Proposed to Assess Impact	Desk study and field survey
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Cadw, Guide to Good Practice on Using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process (2007); and, ▪ Wessex Archaeology for COWRIE, Historic Environment Guidance for the Offshore Renewable Sector (2007).

Operational Phase

Potential Impact	Operational Phase: Effects on Landscape Character ▪ Indirect effects on nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Indirect effects on locally designated landscapes. ▪ Indirect effects on undesignated landscapes. ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.
Survey/Study Proposed to Assess Impact	Desk study and field survey (as above).
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Countryside Council for Wales, Brady Shipman Martin, University College Dublin, *Guide to Best Practice in Seascape Assessment* (2001) Maritime Ireland / Wales INTERREG Report No. 5; ▪ Department of Trade and Industry, *Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report* (November 2005); ▪ Horner and MacLennan and Envision, *Visual Representation of Wind farms: Good Practice Guidance* (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of

<table>
<tr><td></td><td>Planning; and,
Landscape Institute and Institute of Environmental Management and Assessment Guidelines for Landscape and Visual Impact Assessment': Second Edition (2002).</td></tr>
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<tr><td>Potential Impact</td><td>Operational Phase: Effects on Visual Resources
Views from nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty.
Views from locally designated landscapes.
Views from Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.
Views from National Trails: Pembrokeshire Coast Path and South West Coast Path.
Views from promoted paths.
Views from other public rights of way.
Views from other publicly accessible land e.g. Access Land (under CRoW Act).
Views from residential properties.</td></tr>
<tr><td>Survey/Study Proposed to Assess Impact</td><td>Desk study and field survey (as above).</td></tr>
<tr><td>Method of Impact Assessment</td><td>The SVIA will be undertaken with due regard to best practice guidance set out in:
Countryside Council for Wales, Brady Shipman Martin, University College Dublin, Guide to Best Practice in Seascape Assessment (2001) Maritime Ireland / Wales INTERREG Report No. 5;
Department of Trade and Industry, Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report (November 2005);
Horner and MacLennan and Envision, Visual Representation of Wind farms: Good Practice Guidance (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning;
Landscape Institute and Institute of Environmental Management and Assessment Guidelines for Landscape and Visual Impact Assessment': Second Edition (2002);
Scottish Natural Heritage, Visual Analysis of Wind farms – Good Practice Guidance (2005); and,
University of Newcastle, Visual Assessment of Wind farms: Best Practice</td></tr>
</table>

	(2002) Scottish Natural Heritage Commissioned Report F01AA303A.

Potential Impact	Operational Phase: Effects on Setting of Historic Monuments ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Indirect effects on settings of Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Historic Parks and Gardens, Protected Wreck Sites, Areas of Archaeological Importance.
Survey/Study Proposed to Assess Impact	Desk study and field survey (as above).
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Cadw, Guide to Good Practice on Using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process (2007); and, ▪ Wessex Archaeology for COWRIE, Historic Environment Guidance for the Offshore Renewable Sector (2007).

Decommissioning Phase

Potential Impact	Decommissioning Phase: Effects on Landscape Character ▪ Indirect effects on nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Indirect effects on locally designated landscapes. ▪ Indirect effects on undesignated landscapes. ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.
Survey/Study Proposed to Assess Impact	Desk study and field survey (as above).
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Countryside Council for Wales, Brady Shipman Martin, University College Dublin, *Guide to Best Practice in Seascape Assessment* (2001) Maritime Ireland / Wales INTERREG Report No. 5; ▪ Department of Trade and Industry, *Guidance on the Assessment of*

	Impact of Offshore Wind Farms: Seascape and Visual Impact Report (November 2005); ▪ Horner and MacLennan and Envision, *Visual Representation of Wind farms: Good Practice Guidance* (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning; and, ▪ Landscape Institute and Institute of Environmental Management and Assessment *Guidelines for Landscape and Visual Impact Assessment': Second Edition* (2002).

Potential Impact	Decommissioning Phase: Effects on Visual Resources ▪ Views from nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Views from locally designated landscapes. ▪ Views from Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Views from National Trails: Pembrokeshire Coast Path and South West Coast Path. ▪ Views from promoted paths ▪ Views from other public rights of way. ▪ Views from other publicly accessible land e.g. Access Land (under CRoW Act). ▪ Views from residential properties.
Survey/Study Proposed to Assess Impact	Desk study and field survey (as above).
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Countryside Council for Wales, Brady Shipman Martin, University College Dublin, *Guide to Best Practice in Seascape Assessment* (2001) Maritime Ireland / Wales INTERREG Report No. 5; ▪ Department of Trade and Industry, *Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report* (November 2005); ▪ Horner and MacLennan and Envision, *Visual Representation of Wind farms: Good Practice Guidance* (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning; ▪ Landscape Institute and Institute of Environmental Management and

	Assessment *Guidelines for Landscape and Visual Impact Assessment': Second Edition* (2002); ▪ Scottish Natural Heritage, *Visual Analysis of Wind farms – Good Practice Guidance* (2005); and, ▪ University of Newcastle, *Visual Assessment of Wind farms: Best Practice* (2002) Scottish Natural Heritage Commissioned Report F01AA303A.

Potential Impact	Decommissioning Phase: Effects on the Setting of Historic Monuments ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Indirect effects on settings of Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Historic Parks and Gardens, Protected Wreck Sites, Areas of Archaeological Importance.
Survey/Study Proposed to Assess Impact	Desk study and field survey (as above).
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Cadw, Guide to Good Practice on Using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process (2007); and, ▪ Wessex Archaeology for COWRIE, Historic Environment Guidance for the Offshore Renewable Sector (2007).

Cumulative and In-combination Impact Assessment

Potential Impact	Cumulative Landscape Effects ▪ Indirect effects on nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Indirect effects on locally designated landscapes. ▪ Indirect effects on undesignated landscapes. ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.
Survey/Study Proposed to Assess Impact	Desk study and field survey (as above).

Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Department of Trade and Industry, Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report (November 2005); ▪ Horner and MacLennan and Envision, Visual Representation of Wind farms: Good Practice Guidance (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of Planning; ▪ Landscape Institute and Institute of Environmental Management and Assessment Guidelines for Landscape and Visual Impact Assessment': Second Edition (2002); and, ▪ Scottish Natural Heritage, Cumulative Effects of Wind Farms: Version 2 (2005).

Potential Impact	Cumulative Visual Effects ▪ Views from nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Views from locally designated landscapes. ▪ Views from Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Views from National Trails: Pembrokeshire Coast Path and South West Coast Path. ▪ Views from promoted paths ▪ Views from other public rights of way. ▪ Views from other publicly accessible land e.g. Access Land (under CRoW Act). ▪ Views from residential properties.
Survey/Study Proposed to Assess Impact	Desk study and field survey (as above).
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Department of Trade and Industry, Guidance on the Assessment of Impact of Offshore Wind Farms: Seascape and Visual Impact Report (November 2005); ▪ Horner and MacLennan and Envision, Visual Representation of Wind farms: Good Practice Guidance (2006), for Scottish Natural Heritage, The Scottish Renewables Forum and the Scottish Society of Directors of

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Potential Impact	Cumulative Effects on the Setting of Historic Monuments ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Indirect effects on settings of Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Historic Parks and Gardens, Protected Wreck Sites, Areas of Archaeological Importance.
Survey/Study Proposed to Assess Impact	Desk study and field survey (as above).
Method of Impact Assessment	The SVIA will be undertaken with due regard to best practice guidance set out in: ▪ Cadw, Guide to Good Practice on Using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process (2007); and, ▪ Oxford Archaeology for COWRIE, Guidance of Assessment of Cumulative Impacts on the Historic Environment Guidance from Offshore Renewable Energy (2008).

4.231 A list of the known wind farms together with their current status, within a 70km radius of the outer turbines of the Atlantic Array scheme is presented in Appendix IX and illustrated in Figure 4.21. The status of the wind farms listed here will be checked prior to submission of the ES. Any additional developments that are also operational, in construction, consented or formerly within the planning system will also form part of the cumulative assessment. Other major projects would also be assessed as part of the cumulative study. The significance of any cumulative effects will be assessed. The types of cumulative effects assessed would include the following:

- Simultaneous (or combined) visibility – where two or more sites are visible from a fixed viewpoint in the same arc of view;
- Successive visibility – where two or more sites are visible from a fixed viewpoint, but the observer is required to turn to see the different sites; and,

- Sequential visibility – where two or more sites are not visible at one location, but would be seen as the observer moves along a linear route, for example, a road or public right of way, such as the two National Trails, the Pembrokeshire Coast Path and the South West Coast Path.

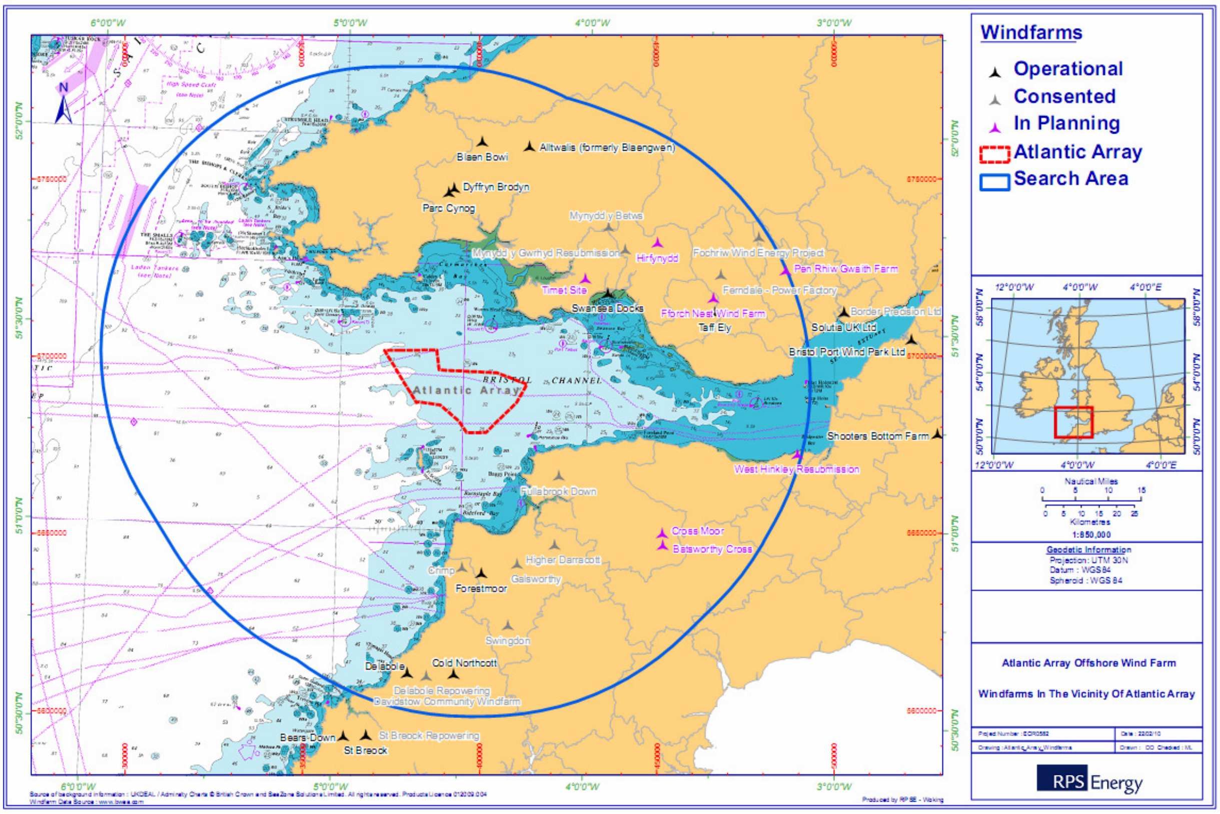

Figure 4.21: Wind Farms in 70 km radius of Atlantic Array.

Potential Mitigation and monitoring

4.232 The most significant area of potential mitigation for the effects of the wind farm on seascape and visual resources is during the design of the layout of the wind farm and the location of individual turbines. Input into this iterative process will ensure that the potential effects on the most sensitive seascape and visual resources are mitigated as fully as possible.

Further Considerations

4.233 Additional survey material would include the following:

- The most recent ten years meteorological data from the closest land-based weather stations and from any 'pilot' records would be analysed to indicate likely degrees of visibility from the coast and further inland.
- Follow up work from consultation with statutory and non-statutory consultees, such as confirmation/addition of viewpoints.
- An update and assessment of any relevant wind farms within 70km of the proposed scheme, prior to publication.

Commercial Fisheries

Background

4.234 A review of fishing activity in and around the proposed development area has been undertaken. This has aimed to make an initial assessment of the importance of the area for the fishing sector and to establish in general terms the potential for conflict with existing use which might accrue from the development. A range of data sources have been reviewed to inform this preliminary appraisal, comprising both vessel activity and landings data for the general area, together with site specific information provided in assessments for other activities and proposed developments in adjacent waters. These are briefly summarised below.

Background Data/Information

4.235 Information utilised in this initial study have been drawn from published data from the Department for Environment, Food and Rural Affairs (DEFRA) and the Marine and Fisheries Agency (MFA), including MFA landings data, MFA surveillance and VMS data. Additional information from local Sea Fishery Committee reports, relevant technical reports, scientific papers, Government Departmental and NGO publications and reports, commercial fisheries press reports and existing Environmental Statements for adjacent projects has also been used

4.236 As part of the main EIA for this site, a detailed commercial fisheries consultation exercise will be undertaken by specialist fisheries consultants. This exercise will involve a series of field-based interviews with individual fishermen, processors and fisheries regulators, as well as port visits to build up a picture of the fishing communities/fleets in this area.

General Description of Project Area (Fishery Overview)

Fishery Overview

Introduction

4.237 The site for the proposed Atlantic Array wind farm lies in the Bristol Channel within Statistical Rectangle 31E5 in ICES Area VIIf (Figure 4.22). The main site is located in close proximity, and the export cable corridor passes through, three sea fisheries committee districts: the Devon Sea Fisheries Committee (SFC), The Cornwall SFC and the South Wales SFC[15]. This section presents an overview appraisal of the importance of this statistical rectangle to the regional fishing industry and of the activity going on inside it, and is based primarily on MFA landings data for 2004-2008 and surveillance data for 2000-2008. These data-sets will be used to develop an overview of fishing activity in this area which will be presented in the ES.

4.238 These data sources will be complemented by information gathered through the commercial fisheries consultation exercise.

[15] The SFCs will be wound up under the Marine & Coastal Access Bill (Act), being replaced by Inshore Fisheries and Conservation Agencies (IFCAs) from April 2011. These will include Cornwall IFCA, Devon & Severn IFCA. At the same time the South Wales SFC will also cease to operate, with fisheries management & enforcement responsibilities being taken on by WAG.

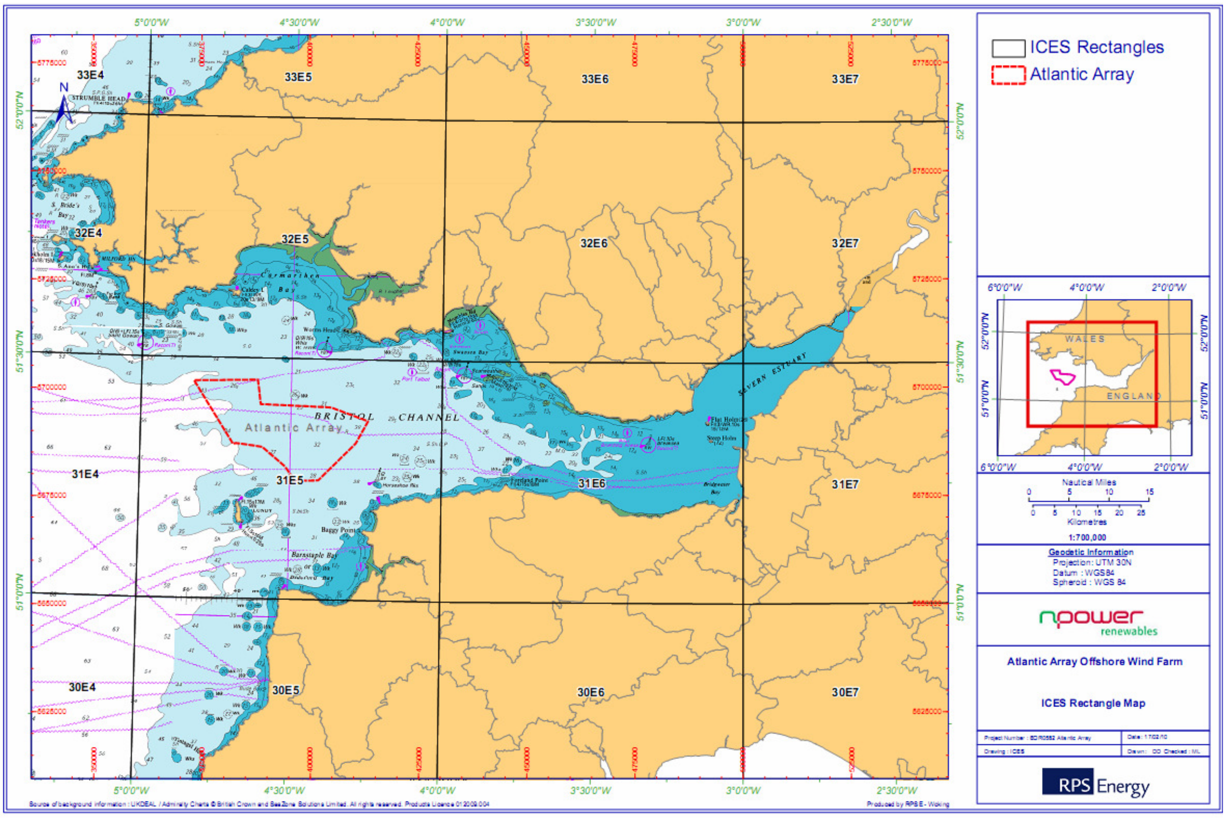

Figure 4.22: ICES rectangles in the Bristol Channel

The Bristol Channel fishery overview

4.239 There are three main fisheries operating in the overall Bristol Channel area; otter trawling, primarily for demersal fish; beam trawling for sole; and potting for lobsters and whelks. Most vessels operating in this fishery work from the ports of Milford Haven and Swansea in Wales (South Wales SFC); Ilfracombe and Appledore in north Devon (Devon SFC); and Padstow and Newlyn in Cornwall (Cornwall SFC), which between them account for around 90% of fish landed into UK ports from this area. Belgian and French vessels also operate in the area.

Important Species

4.240 The most important species economically in the overall Bristol Channel fishery are Dover Sole (22% of total value), Lobsters (11%), Skates and Rays (10%), Whelks (7%), Monkfish (7%), Edible Crabs (5%), Bass (4%), Lemon Sole (4%) and Turbot (4%), together accounting for around 75% of the value of landings from the area. Relative values as a proportion of the entire fishery are presented in Fig 3.3 below.

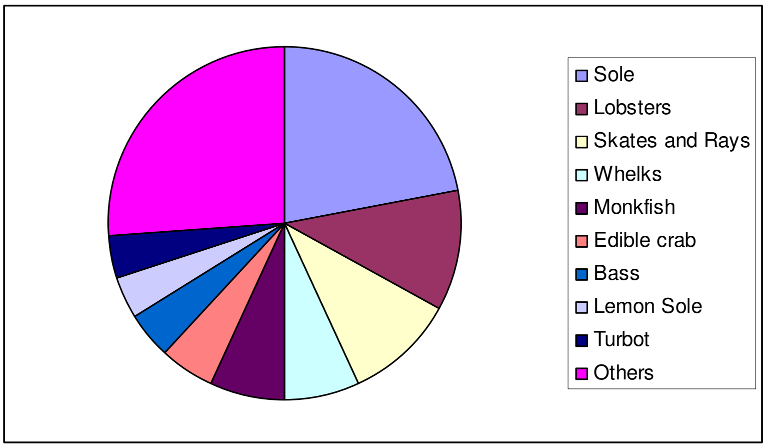

Figure 4.23: Relative value of landings of the major commercial fish species in Bristol Channel area. Source: MFA landings data

Rectangle 31E5

4.241 From 2004 – 2008, rectangle 31E5 produced on average 22% of fish (average £2.4 million per year) caught in the wider Bristol Channel area. In common with the regional pattern, around 90% of the catch from 31E5 landed into UK ports is taken by UK vessels. The remainder of the catch is taken by Belgian boats. The most important ports for fish caught in 31E5 are Ilfracombe (36%), Appledore (28%) and Milford Haven (14%).

4.242 From an economic perspective, the most important species in the landings from 31E5 are Skates and Rays (22.5%), Lobsters (14.2%), Whelks (13.7%), Sole (10.2%), Bass (10%) and Squid (9.6%), accounting for approximately 80% of overall value of fish caught in the area. The fisheries and recent trends for these species are briefly examined below.

- The fishery for skates and rays is carried out largely by UK registered, >10 m, otter trawlers working from Appledore and Ilfracombe in North Devon. The main months for the fishery are April to June, with catches declining towards the end of the year. December to March is the period when catches are lowest. Landings showed a marked increase in 2005 and no clear trend since then.
- The fishery for lobsters is carried out largely by UK registered, >10 m potters. Ilfracombe in North Devon accounts for around 50% of the landings from 31E5, with Padstow in North Cornwall being the next most important port. The fishery is highly seasonal, with approximately 75% of the annual catch being landed between May and September. Landings have showed a steady increase since 2005.
- The vast majority of the whelk catch is taken by UK registered potters of greater than 10m in length. The bulk of the catch is taken between February and June. The primary port for whelk landings is Ilfracombe, with Appledore and Milford Haven between them landing a similar quantity. Landings of whelks from Area 31E5 have fluctuated widely from year to year over the study period, with 2005 and 2008 being productive years.
- There is a clear seasonal trend in the sole fishery, with approximately 63% of the total catch being taken in 5 months from May to September. Around 65% of the sole catches are taken by UK vessels, with Belgian boats taking the remainder. Around 30% of sole from 31E5 is landed into Milford Haven, with Ilfracombe, Swansea and Appledore also taking significant quantities. Most sole is caught by beam trawl and otter trawl by boats

of over 10m in length. There is no visible trend in annual landings of sole – 2006 was the best year during the study period.

- There is a strong seasonality in the bass fishery, with over 45% of annual catches being taken in July, August and September. Almost all bass from 31E5 is taken by UK otter trawlers of over 10m in length operating out of Appledore and Ilfracombe. Landings of bass from 31E5 a steady increase from 2004 to 2007, flattening out somewhat in 2008.
- The vast majority of squid caught in this area is taken by UK over 10m otter trawlers working from Appledore, Ilfracombe and Bideford, mostly during a 3 month period from June to August. Landings of squid from area 31E5 show high year on year variability.

Fishing activity within the Project Area (PA)

MFA surveillance data suggests that the PA is not the most important part of rectangle 31E5. Figure 4.24 below shows a plot of the positions of all vessels seen actively fishing in rectangle 31E5 between 2000 and 2008 relative to the PA (outlined in red)

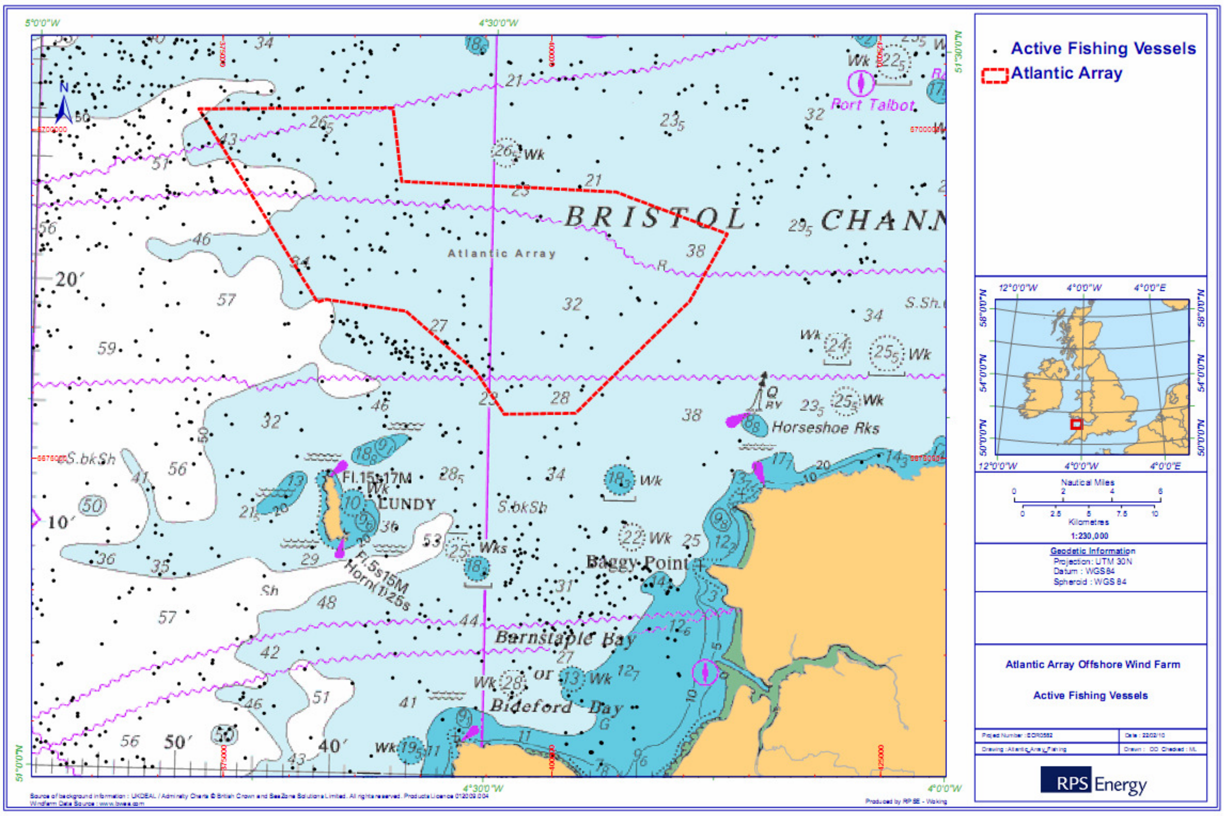

Figure 4.24: Scatter plot of sightings of active fishing vessels in rectangle 31E5, 2000 – 2008. Source: MFA surveillance data.

4.243 A total of 115 active vessels were seen in the area between 2000 and 2008, out of a total of 979 for the whole of 31E5; this equated to approximately 12% of sightings. Out of the 115 sightings inside the PDS, 88 were of UK vessels, 19 of Belgians and 8 of French.

4.244 The surveillance data suggests that much of the activity inside the area is at the western end, comprising primarily UK otter trawler and Belgian beam trawler effort. There is relatively little potting activity, and the area subject to such effort is relatively restricted occurring mostly at the

eastern end of the area. The distribution of sightings by gear type comprises otter trawl (67 vessels recorded), beam trawl (28 vessels) and potting (20 vessels).

Summary of surveys/additional studies

- Literature review of relevant reports/studies, including MFA landings data, MFA surveillance and VMS data, local Sea Fishery Committee reports, relevant technical reports, scientific papers, Government Departmental and NGO publications and reports, commercial fisheries press reports and existing Environmental Statements for adjacent projects.
- Acquisition of landings data from Belgian and French Fishery Bodies
- Consultations with fishing industry with fishermen and fishermen's representatives, fish processors, merchants and fleet owners and the local regulatory bodies (the South Wales Sea Fisheries Committee, Devon Sea Fisheries Committee and the MFA at Milford Haven, Plymouth and Brixham), and French and Belgian interests.
- Comprehensive fisheries assessment as part of the EIA Analysis of data listed above.
- Review of seabed morphology and hydrodynamic studies of project.
- Liaison with conservation bodies and appropriate authorities regarding proposed SACs, MCZs and HPMRs (Highly Protected Marine Reserves).

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact	**Loss of Access to Fishing Grounds and subsequent displacement of fishing effort – Construction phase**. During construction fishers will have no access to the area within the 500 m exclusion zones around each turbine installation position. The post -construction access arrangements have yet to be determined. Vessels excluded from fishing grounds within the proposed site will be displaced to nearby grounds. This may interfere with existing fisheries and increase fishing intensity in surrounding area
Survey/Study proposed to Assess Impact	▪ Comprehensive fisheries assessment from published data (MFA) to determine the extent and nature of fishing activity in the area. ▪ Detailed consultations with fishing industry, fishermen and fishermen's representatives, fish processors, merchants and fleet owners and the local regulatory bodies (South Wales Sea Fisheries Committee, Devon Sea Fisheries Committee, Cornwall SFC, and the MFA at Milford Haven, Plymouth and Brixham). ▪ Observations and interviews at local ports ▪ Work with Fisheries Liaison Representative
Method of Impact Assessment	Standard EIA methodologies will be used to assess the significance of any area-loss impacts upon commercial fishing activity in the context of the EIA process, following recommendations in offshore wind farm EIA guidance documents CEFAS 2004 and DTI 2009 and Mackinson et al. 2006

Potential Impact	**Displacement of fishing activity due to indirect effects of construction disturbance affecting target species distribution – Construction Phase.** During construction, target species distribution may be altered temporarily, particularly during activities which generate significant noise underwater (e.g. piling). This, in tandem with the potential displacement of effort from the construction site due to exclusion zones to provide for safety during this phase of the development, may result in additional impact with respect to existing fisheries and fishing intensity in the surrounding area.
Survey/Study proposed to Assess Impact	▪ Comprehensive fisheries assessment from published data (MFA) to determine the extent and nature of fishing activity in the area. ▪ Use of the findings of the fish ecology assessment in respect of the potential for avoidance effects on relevant species in the area affected. ▪ Detailed consultations with fishing industry, fishermen and fishermen's representatives, fish processors, merchants and fleet owners and the local regulatory bodies (South Wales Sea Fisheries Committee, Devon Sea Fisheries Committee, Cornwall SFC, and the MFA at Milford Haven, Plymouth and Brixham). ▪ Observations and interviews at local ports ▪ Work with Fisheries Liaison Representative
Method of Impact Assessment	Standard EIA methodologies will be used to assess the significance of any area-loss impacts upon commercial fishing activity in the context of the EIA process, following recommendations in offshore wind farm EIA guidance documents CEFAS 2004 and DTI 2009 and Mackinson et al. 2006

Potential Impact	**Disruption of fishing by cable operations.** The trenching and cable-laying operations will impede fishing operations, and there is a risk that objects and obstructions left on the sea-bed after construction operations may restrict trawling.
Survey/Study proposed to Assess Impact	Consultations with fishery interests. Review of sightings and VMS data. Collation of fishing industry's existing information on seabed obstructions.
Method of Impact Assessment	Consultations with fishery interests

Potential Impact	**Decommissioning.** At this stage the decommissioning strategy has yet to be decided. The potential impact on fishing will depend on the option chosen, which will be determined by the final design parameters of the wind farm.
Survey/Study proposed to Assess Impact	'Rochdale envelope' approach to provide for assessment of the realistic 'worst case'.

Method of Impact Assessment	Potential impact a to be assessed by reference to local literature, consultations, surveys and existing wind farm studies, inc. Forward (2005)

Cumulative and In-combination Impact Assessment

4.245 Cumulative impacts to be studied following requirements in CEFAS 2004.

4.246 There are two sites of interest for aggregate dredging immediately to the north of the proposed site (Licence area 476 and application area 486) with an existing aggregate dredging site at Nash Bank to the east. The Lundy Island SAC contains a no-take zone, and a potting and angling only zone. Future possible restrictions include the possible establishment of local Marine Conservation Zones (as laid out in the Marine Bill), and proposed developments at Hinkley Point. Developments will be monitored and the cumulative/in combination impacts assessed as proposals arise during the EIA studies and consultation exercise.

Potential Mitigation and monitoring

4.247 Mitigation and monitoring measures for this project will be assessed and proposed in light of recommendations in CEFAS 2004 and DTI 2004 and Blyth-Skyrme (2009)

4.248 For monitoring purposes the fishery can be usefully monitored using future landing records and effort data, as well as through comparison with fish ecology results.

Further Considerations

Extra data requirements

4.249 Landings data from Belgian and French Fishery Authorities will be obtained to evaluate landings made by Belgian and French vessels into non-UK ports.

4.250 The Marine Bill allows the setting up of Marine Conservation Zones (MCZs), and in the case of Welsh inshore waters, Highly Protected Marine Reserves (HPMRs), in which certain activities can be prohibited. These restrictions may have a cumulative impact on fisheries in the region, so liaison with the appropriate authorities is required.

Shipping and Navigation

Introduction

4.251 The Bristol Channel encompasses a number of shipping activities, including the transportation of cargo and passengers and marine aggregate extraction. Commercial fishing and recreational sailing also take place in the area. The characteristics of vessel traffic in and around the proposed Atlantic Array site are mainly determined by the trades supported by surrounding ports.

Ports

4.252 The Bristol Channel is bounded by the South Wales coastline and contains the commercial ports of Swansea, Neath and Port Talbot handling general cargo and containers. On the

opposite side of the channel lies the North Devon coast which hosts the smaller ports of Bideford, Barnstaple, Ilfracombe, Lynmouth and Porlock, which are home to fishing fleets and house recreational craft. Further East into the Bristol Channel lies the Welsh ports of Cardiff, Newport and Barry, which are all commercial ports handling cargo and liquid bulk and on the English side, the large commercial English ports of Avonmouth, Bristol, as well the smaller harbours of Watchet and Bridgewater used mainly for pleasure craft and finally the port of Sharpness giving access to Gloucester to cargo vessels.

4.253 The large port of Milford Haven lies some 25 nautical miles steaming distance from the area to the west and north around Saint Govan's head on the West coast of Wales. This port contains several oil and gas refineries and coastal tankers leaving Milford Haven head to the Bristol Channel and pass through or close to the proposed development area.

4.254 The number, types and characteristics of the vessels visiting these ports will be determined during stakeholder consultation as part of the EIA process.

Shipping routes

4.255 In terms of shipping routes, current information on shipping routes in the vicinity of the proposed development is based on a 28-day Automatic Identification System (AIS) survey conducted in September 2008. AIS is a system for electronically exchanging ship data, allowing ship movements to be tracked, and the data on vessel tracks was analysed to identify shipping lanes in which 90% of the traffic using the lane was located so as to define the main routes in the area. The boundaries of the proposed site were defined on the basis of the main routes identified, with a due allowance for separation between the routes and the wind farm in accordance with the Maritime and Coastguard Agency's Wind farm Shipping Route Template (Marine Guidance Note 371 (M+F) – Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues).

4.256 .The main routes identified around the proposed site are as follows:

- The Swansea Bay Route
- The Severn Estuary North Route
- The Severn Estuary South Route

4.257 These routes are shown below in Figure 4.25.

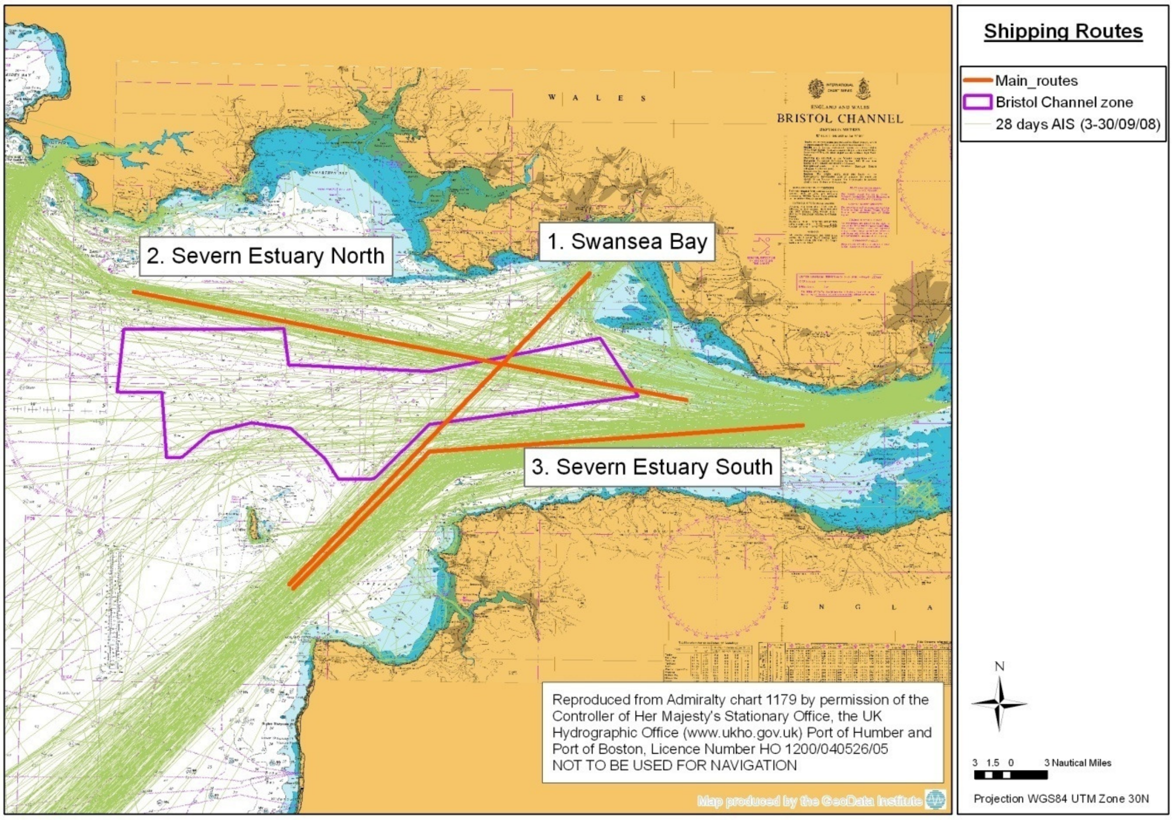

Figure 4.25: Shipping routes of the Bristol Channel

4.258 The survey indicated some vessel tracks in and around the proposed site which are outside the 90% shipping lanes, and further analysis of these tracks will be undertaken as part of the EIA.

Other marine activities

4.259 A number of other activities that occur in the area may have an impact on shipping and navigation in the vicinity of the proposed Atlantic Array site, and will be appropriately taken into account during the EIA process. The nature of commercial fishing activity is relatively well understood, as described above. Marine recreation activities are known to take place in the Bristol Channel region, including sea angling, diving and wind surfing. In particular, the Atlantic Array wind farm site is a heavy use sailing area and recreational sailing routes intersect the wind farm site. Offshore oil and gas exploration does not currently take place in the Bristol Channel. The presence of communications cables on the seabed passing through the development site is also a relevant issue. Marine aggregate extraction occurs in the Bristol Chanel. Of relevance is licensed aggregate extraction area 476, which lies just north of the Bristol Channel Zone. Potential effects on search and rescue and emergency response activities will also be investigated.

4.260 A prospective tidal barrage scheme has been mooted for the Severn Estuary for some time now and if built will have an impact on shipping in the area. A shortlist of 5 possible locations was announced by the Secretary of State for Energy and Climate Change in January 2009. The schemes are expected to go to full public consultation in 2010 although recent comments by Lord Hunt, the Minister of State at the Department of Energy and Climate Change, suggest that

the scheme is not likely to come to fruition until after 2020, if at all. The impact of any barrage scheme will be assessed in the ES.

Further surveys and studies

4.261 In support of the Marine Navigation Assessment that will be conducted as part of the EIA process, the following further surveys / studies are proposed:

- An up-to-date traffic survey including all vessel types, totalling at least four weeks duration and taking account of the factors listed in Annex 1 of MCA publication *MGN 371 (M+F) –Offshore Renewable Energy Installations (OREI) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues.*
- Hydrographic surveys
- Modelling of traffic patterns to examine the effects on vessels displaced by the wind farm.
- Simulation of specific traffic situations where necessary (to examine, for example, whether engine failure could cause a vessel to drift into danger).
- Traffic forecasting.
- Ongoing stakeholder consultation.

4.262 Empirical data that is emerging on the navigation of commercial vessels in the vicinity of Rd1 wind farms may also be considered.

Potential Environmental Effects, Proposed Surveys and Impact Assessment Methodology

4.263 The potential effects listed have been developed from (a) relevant guidance notes, (b) experience gleaned from writing ESs for other wind farms and (c) knowledge of issues on the navigation environment in and around the proposed Atlantic Array development area. For each potential impact identified, details are provided with respect to any surveys that are planned to investigate this potential impact, plus the proposed method of impact assessment.

4.264 In assessing the potential impacts of the Atlantic Array Wind Farm on shipping and navigation, full account will be taken of Maritime and Coastguard Agency (MCA) publication *MGN 371 (M+F) –Offshore Renewable Energy Installations (OREI) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues*. The Marine Navigation Assessment to be conducted as part of the EIA will be carried out in the spirit of the recommended methodology described in the DTI publication *Guidance on the Assessment of the Impact of Offshore Wind Farms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms* (known as 'BERR). It is currently envisaged that the risk assessment will be based on a formal safety assessment process centering on a risk register and using a criticality matrix. Prior to the commencement of the Marine Navigation Assessment a consultation will be entered into with key navigational stakeholders, and an ongoing dialogue will be maintained as the risk assessment process progresses.

4.265 In accordance with the methodology, the risk assessment will be performed in two distinct phases. First, a submission to the MCA is prepared, which will include a preliminary hazard analysis, propose an appropriate programme of work, and define the tools and techniques to be used for assessing the marine navigational risks in a manner proportionate to the specific case of the Atlantic Array Wind Farm. The submission will also include preliminary search and rescue and emergency response overviews. Once the programme and techniques have been

agreed with the MCA, the full Marine Navigation Assessment will proceed by carrying out the following five overarching tasks:

- Estimate the base case level of risk (with present day traffic levels and no wind farm).
- Predict the future case level of risk (with future traffic levels and no wind farm).
- Predict base case with wind farm under construction level of risk (with present day traffic levels and with the wind farm under construction).
- Predict base case with wind farm level of risk (with present day traffic levels and with the wind farm operational).
- Predict future case with wind farm level of risk (with future traffic levels and with the wind farm).

4.266 Consultation with key stakeholders will continue as this process unfolds.

Potential Impact(s)	Displacement, navigation and collision avoidance impacts on shipping and navigation (construction, operational and decommissioning phases)
Survey/Study Proposed to Assess Impact	Some displacement impacts on shipping and navigation may include but not be limited to: ▪ Additional voyage distances. ▪ An increase in vessel encounters and the creation of 'choke points'. ▪ A reduction in the available depth and width of navigable water. Navigation and collision avoidance impacts may arise from, for example: ▪ Structures hindering the view of navigational features and other vessels. ▪ Interference with electronic navigation and communication equipment. These issues would be assessed on the basis of a traffic survey, consultations with key stakeholders and if necessary traffic modelling (which may include area traffic assessment and specific traffic assessment). Where modelling is required, information on weather, visibility, tides and bathymetry would be assembled as an input to the model. Future case traffic projections would be based on desk studies and consultation with stakeholders. Published studies into effects on marine radio navigation and communications systems would be consulted (for example the 2004 QinetiQ/MCA report into investigations undertaken at North Hoyle Wind Farm and the 2007 BWEA report into effects on radar at Kentish Flats).
Method of Impact Assessment	The level of impact would be assessed in accordance with the relevant guidelines from the BERR Methodology as agreed with the MCA.

Potential Impact (s)	Marine casualty, search and rescue and emergency response impacts on shipping and navigation (construction, operational and decommissioning phases)
Survey/Study Proposed to	Some of the main categories of potential hazardous event listed in Appendix G1 of the

Assess Impact	BERR Methodology are as follows: ▪ Collision between vessels. ▪ Contact with wind farm structures. ▪ Grounding and stranding. ▪ Fire and explosion. ▪ Flooding and sinking. ▪ Inhibited search and rescue operation. ▪ Inhibited pollution clean-up. These issues would be assessed on the basis of a traffic survey, consultations with key stakeholders and if necessary traffic modelling (which may include area traffic assessment and specific traffic assessment). Where modelling is required, information on weather, visibility, tides and bathymetry would be assembled as an input to the model. Future case traffic projections would be based on desk studies and consultation with stakeholders. Information on historic casualty rates would be sought from the Marine Accident Investigation Branch and other organisations holding such data.
Method of Impact Assessment	The level of impact would be assessed in accordance with the relevant guidelines from the BERR Methodology as agreed with the MCA following submission of the proposed program of work

Mitigation & Monitoring

4.267 There are a range of measures that can be applied to mitigate the impacts of a wind farm development. MCA publication MGN 371 (M+F) – Offshore Renewable Energy Installations (OREI) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues lists the following measures, to be applied to a particular development as appropriate to the level and type of risk determined during the EIA:

i) Promulgation of information and warnings through notices to mariners and other appropriate media.

ii) Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).

iii) Safety zones of appropriate configuration, extent and application to specified vessels.

iv) Designation of the site as an area to be avoided (ATBA).

v) Implementation of routeing measures within or near to the development.

vi) Monitoring by radar, AIS and / closed circuit television (CCTV) or other agreed means.

vii) Appropriate means to notify and provide evidence of the infringement of safety zones or ATBAs.

viii) Any other measures and procedures considered appropriate in consultation with other stakeholders.

ix) Creation of an Emergency Response Co-operation plan with the relevant Maritime Rescue Co-ordination Centre from construction phase onwards.

4.268 Other mandatory control measures include:

- Marking and lighting the site in accordance with General Lighthouse Authority requirements (which will include a system of routine inspection and maintenance of lights and marks).
- MCA standards and procedures for wind turbine generator shut-down in the event of a search and rescue, counter pollution or salvage incident in or around a wind farm.

4.269 Proposed mitigations for the Atlantic Array Wind Farm will be identified during the formal Marine Navigation Assessment, and may include, in addition to the points listed above, measures such as an IMO adopted traffic routeing system (e.g. a traffic separation scheme) and changes to presently charted anchorages.

In-combination Impacts

4.270 The development of Atlantic Array will result in increased vessel traffic, particularly during construction. There is the possibility the trips made will add to the existing vessel traffic from other activities such as marine aggregate extraction or tourism.

4.271 In assessing the impact of any increased level of shipping in the area and in-combination assessment will be made with regard to other marine users.

4.272 Cumulative impact assessment is not required for this site as there no longer any other planned offshore wind farms in the region.

Marine Archaeology

Introduction

4.273 The area assessed comprises the proposed wind farm site (the Wind Farm Area in Figure 4.26), a broad corridor encompassing the potential routes for the export cables (the Cable Route Area in Figure 4.26) and the coastal zone adjacent to the cable route (the Cable Landfall Area in Figure 4.26). An Archaeological Study Area (ASA) was created by placing a 1km buffer around the wind farm site and the cable route corridor. The buffer also extended inland from the high water mark for 1km in order to allow for the collection of terrestrial archaeological records relating to the cable landfall.

4.274 The ASA was used to define the boundary for the collection of information on archaeological remains and seabed features. The inclusion of the buffer area will ensure that any archaeological trends are adequately identified and understood. The ASA is illustrated in Figure 4.26.

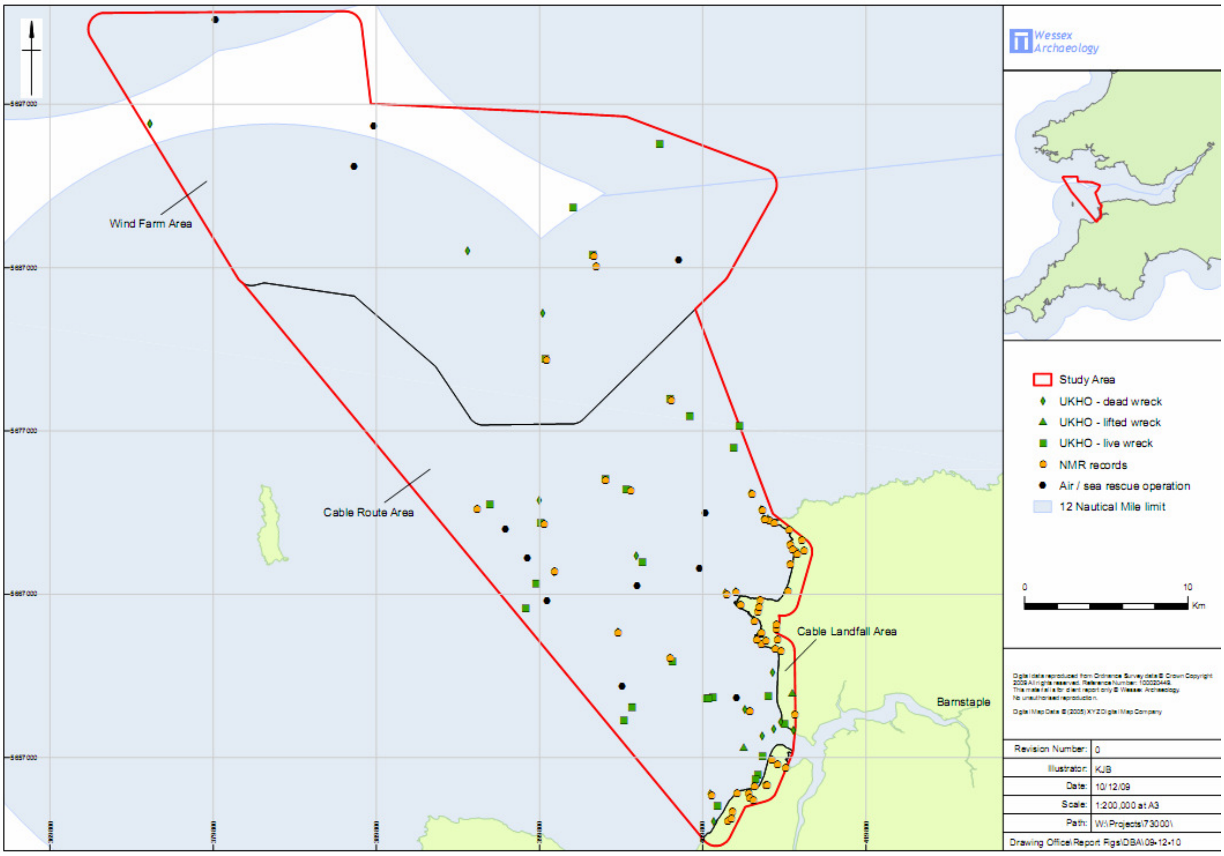

Figure 4.26: Archaeological study area

Background Data/Information

4.275 The principal sources consulted in drafting this scoping report comprised:

- United Kingdom Hydrographic Office (UKHO) wreck record;
- National Monuments Record (NMR);
- secondary sources related to historic shipping patterns and potential wreck sites and casualties, specifically the ALSF England's Shipping (Wessex Archaeology 2004) and ALSF Navigational Hazards projects (Bournemouth University 2007);
- secondary sources relating to historic aviation patterns and the potential for aircraft crash sites, specifically the ALSF Aircraft Crash Sites at Sea project (Wessex Archaeology 2008): records of WWII Air/Sea Rescue operations provided an understanding of the potential density and general distribution of wartime aircraft activity across the Atlantic Array site;
- secondary sources relating to the palaeoenvironment of the Atlantic Array site, with specific reference to submerged palaeolandscapes and coastal change; and
- previous archaeological studies in the area.

4.276 These data sources will be used within the main ES and will be complemented by the review of site-specific geophysical data that will be collected over the entire Atlantic Array project area as part of the proposed engineering/EIA studies. These surveys will include the acquisition of data from hi-resolution side scan sonar, sub-bottom profiler and magnetometer equipment. All of

these data will provide important information on potential maritime archaeological features within the ASA.

Legislation and Guidance

UK Territorial Waters

4.277 There are two principal pieces of legislation under which wrecks in UK waters may be protected:

- Protection of Wrecks Act (PWA) 1973; and
- Protection of Military Remains Act (PMRA) 1986.

4.278 It is important to note that the PMRA is also applicable beyond UK Territorial Waters.

4.279 In addition, there are UK-wide provisions that apply to the recovery and possession of wreck – including wreck of archaeological interest – under the Merchant Shipping Act (MSA) 1995.

4.280 English Terrestrial Legislation

- Ancient Monuments and Archaeological Areas Act 1979 (as amended)
- PPG16 Archaeology and Planning

4.281 Welsh Legislation

- Welsh Office Circular 60/96 Planning and Historic Environment: Archaeology
- Seas, Shores and Coastal Areas: Maritime Policy (Countryside Council for Wales 1996)

The UK Continental Shelf

4.282 Continental Shelf activities are subject to EIA under European Directives. The effects of those activities on the archaeological heritage have to be addressed and mitigation proposed.

4.283 As noted, archaeological material from beyond territorial waters may also be subject to the provisions of the MSA, as wreck found or taken into possession outside UK waters but brought into UK waters must be reported to the RoW.

Archaeological Guidance

4.284 There are various guidance documents applicable to the historic environment and offshore wind farm developments. Of particular interest are:

- The Code of Practice for Seabed Developers, Joint Nautical Archaeology Policy Committee 1998 (JNAPC);
- Historic Environment Guidance for the Offshore Renewable Energy Sector, COWRIE 2007 (Wessex 2007);
- Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy, COWRIE 2008 (Oxford Archaeology & George Lambrick Archaeology & Heritage 2008);
- Guidance on the Assessment of the Impact of Offshore Wind Farms: Seascape and Visual Impact Report (Department of Trade and Industry 2005).

4.285 Other relevant guidance provided by EH includes:

- Identifying and Protecting Palaeolithic Remains: Archaeological Guidance for Planning Authorities and Developers (English Heritage 1998);
- Military Aircraft Crash Sites: archaeological guidance on their significance and future management (English Heritage 2002);
- EH has also published, in conjunction with the British Marine Aggregate Producers Association (BMAPA), a Guidance Note on assessing, evaluating, mitigating and monitoring the archaeological effects of marine aggregate dredging (Wessex Archaeology 2003). Whilst the Guidance Note is concerned with aggregates, many of its details are relevant to offshore wind farm developments.

Baseline

General Description of Project Area

4.286 The Atlantic Array site can be split into three separate areas of differing archaeological potential. These include:

- Area 1, the Wind farm Area, (A1) is the area proposed for the turbines and lies in the middle of the Bristol Channel approaches;
- Area 2, the Cable route Area, (A2) is the area proposed for the export cable route and lies from the southern section of A1 to the North Devon coastline by the River Torridge;
- Area 3, the Cable Landfall Area, (A3) is the section of the coastal land above the high water mark that lies adjacent to the export cable route.

Submerged Prehistoric Archaeology and Landscapes

4.287 This section presents a brief overview of the potential for submerged prehistory on the Atlantic Array site, based on the local geology and the effects of glaciation and sea level change, particularly during the last c.120,000 years. The three areas A1, A2 and A3 all possess differing levels of potential for the survival of submerged prehistoric archaeology and landscapes. As a result of this, each area will be assessed individually.

Glaciation and Sea Level Change

4.288 For long periods of time since the first recorded human activity in the UK, approximately 700,000 BP (Parfitt et al. 2005), much of the Atlantic Array site would have been exposed as dry land. During these dry periods the flat terrain of the Atlantic Array site would have been open to exploitation and even possible occupation by early hominids.

4.289 The different areas of the Atlantic Array site would have seen differing conditions throughout the differing glacial periods. Much of A1 and the northern sections of A2 have sea level depths of 40 m or more, and therefore would have become completely inundated at an earlier date than the southern sections of A2 and the entirety of A3. These differences greatly affect the potential within each area.

Prehistoric Archaeological Potential: Offshore

4.290 The low level of Pleistocene deposits within A1 and the northern sections of A2 suggest it is unlikely for any *in situ* archaeological remains prior to the Devensian glacial maximum to

survive. A limited potential for artefacts from a secondary context is still present as can be seen by the Middle and Upper Palaeolithic flint recovered from the foreshore in Wales (Murphy 2002).

4.291 The likelihood of any archaeological material surviving from the Mesolithic period *in situ* is very low. As with the early Mesolithic period, the potential for archaeological material from a secondary context still remains, although it is again unlikely.

4.292 In contrast, the Mesolithic sites within A3 at Westwood Ho! show the level of activity within the area and the high potential for the survival of archaeological material. The shallower sections of A2, although not as prolific in recovered material from this period, do offer a higher potential than the remainder of the Atlantic Array site to the north, due to the higher sediment levels within this area.

4.293 The end of the Mesolithic period saw the inundation of A1 and much of A2, leaving only the shallower coastal sections of A2 and the entirety of A3 still as dry land.

Maritime Archaeology

Known Maritime losses

4.294 The UKHO search has produced a total of 85 wrecks within the Atlantic Array site. Of these, 47 are charted and 38 are uncharted. The UKHO classifies the wrecks as follows:

Record Type	Number within the ASA
Live wrecks	49
Lifted wrecks	3
Dead wrecks	33
Total	85

4.295 The UKHO defines ‘live’ as sites where repeated geophysical survey has identified a wreck and ‘lift’ as sites where a wreck has been subject to salvage. ‘Dead’ wrecks are site where a geophysical anomaly was initially found, but where repeat surveys could not subsequently confirm the presence of a wreck.

Recorded Losses

4.296 The NMR search produced 18 recorded losses attributed to named locations within the Atlantic Array site. These represent documented losses for which there are currently no known seabed remains. There is still the potential for vessels to have been lost within the Atlantic Array site that were not recorded or to have been falsely recorded in another position.

Navigational Hazards

4.297 The project ‘Enhancing our understanding of the marine historic environment: navigational hazards project’ by Bournemouth University identified a number of hazards in the estuary between Lundy and the entrance to Minehead. In addition, the report notes that the seabed is not conducive to the burial and subsequent preservation of archaeological material (ibid.). This would suggest that there are no major hazards in A1 and much of A2. The southern-most sections of A2, at the coastline, are rocky in this area, however. This would have presented a hazard to shipping, especially in heavy seas, when vessels tend to hug the coastline.

4.298 The mouth of the River Taw has shallow banks which would have been a hazard to any shipping trying to reach Barnstaple, Appledore and Bideford. The location of these banks is likely to have changed over time, possibly covering over stricken vessels with sediment. If these banks are impacted during the development, this should be considered an area of higher potential for wooden remains to survive.

Aircraft Crash Sites

4.299 The NMR holds records of two aircraft crash sites within the Atlantic Array site. These positions are not exact locations of aircraft remains as they are the last recorded locations prior to crashing. They do however highlight the potential for aircraft remains to be recovered from within the Atlantic Array site.

4.300 A brief analysis of maps showing the location of WWII Air/Sea Rescue operations indicates that only four recorded operations took place within A1. This low number is not unexpected due to the distance from the shore. The number of operations may not however be indicative of the amount of aircraft lost in the area, as the distances involved mean it is likely that many of those wrecked this far from the shore would not have been seen or recorded. Within A2 the number of operations increases greatly as the distance from shore decreases, with a further eight being recorded. This indicates that there is considerable potential for aircraft remains to be discovered during construction of the wind farm, which would automatically become a constraint to the development.

4.301 Further desk-based work and other investigations, such as geophysical survey, will be required to more accurately determine the potential for aircraft remains in this area.

Potential Maritime Archaeology

4.302 Archaeological finds from the medieval period and earlier will be of national interest and will hold special significance, as so little survives in the current record. Any post medieval finds would also be of special interest but such finds are more common than those of earlier dates. More examples of boats and ships exist from the modern period, therefore more discrimination would be required to determine the importance of any remains discovered. Due to the considerable changes in ship/boat building during this period, any remains discovered showing evidence of this could be considered as being of particular interest. The losses attributed to the two World Wars should be considered as significant due to the magnitude of the loss endured by all countries involved.

Terrestrial Archaeology at Cable Landfall

4.303 The landfall search area of the cable route corridor is split in two by the mouth of the Taw estuary. To the south of the estuary there are c.15 sites within 1km of the shore, and a further c.40 sites to the north.

4.304 The archaeological records for the area to the south of the estuary are dominated by 20th century military sites and prehistoric archaeology. The latter is dominated by the nationally important Mesolithic site of Westward Ho!. The presence of this site is likely to mean that the whole stretch of the coast within the proposed landfall area (with the possible exception of the rocky cliffs to the south) is of high archaeological importance and should be considered a constraint to development.

4.305 On Saunton Sands, to the north of the estuary, there is a possible medieval chapel and village site to the south, and a general scatter of 20th century military sites. The proximity of this area to the Westward Ho! Mesolithic site, and the generally similar topography and environment, means that this area should be considered to be of high archaeological potential, but with little known archaeology.

4.306 To the north of Saunton Sands the rocky headlands of Croyde and Morte Point lie on either side of Woolacombe Sands. The whole of this area is dominated by prehistoric archaeology, with important sites at Croyde Hoe, on Woolacombe Sands and at Mortehoe. There are additional Neolithic and Bronze Age sites within the area, and the whole area is of high archaeological importance.

4.307 To summarise, the potential landfall sites may be split into sandy beaches and rocky headlands, all of which are rich in prehistoric (principally Mesolithic) archaeology, all of which may be categorised as of high regional or national importance. Of the beaches, Saunton Sands appears to have the least known archaeology, however this may be a product of the level of research in that area, rather than relating to an actual absence of archaeology.

4.308 These records along with the local Sites and Monuments Record (SMR) and secondary sources will need to be assessed further at EIA stage and with a confirmed cable route.

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact	Potential damage may occur during pre-construction seabed preparation, wind farm construction, cable laying and intrusive geotechnical survey to wrecks that could potentially date from the Mesolithic through to the present day.
Survey/Study Proposed to Assess Impact	A desk-based assessment will collate information on known wrecks and recorded losses using the UKHO wreck record, NMR recorded losses and historic and contemporary documentary sources. Side scan sonar and magnetometer data will be subject to archaeological assessment in order to confirm the presence of previously located wreck sites and comment on their character; and to identify, locate and characterise any unrecorded wrecks. The study will consider the importance of each site and the potential level of impact.
Method of Impact Assessment	The potential impact to wreck remains in the area will be assessed using standard EIA methodologies. Cowrie's Historic Environment Guidance for the Offshore Renewable Energy Sector (2007) will be closely adhered to during the assessment of the impacts.

Potential Impact	Potential damage may occur during pre-construction seabed preparation, wind farm construction, cable laying and to aircraft, in particular military aircraft lost during WWII.
Survey/Study Proposed to Assess Impact	A desk-based assessment will collate information on recorded aircraft losses and known remains using the UKHO wreck record, NMR and documentary sources (including air-sea rescue records). Side scan sonar and magnetometer data will be subject to archaeological assessment in order to confirm the presence of previously located aircraft remains and comment on their character; and to identify, locate and characterise any unrecorded aircraft. The study will consider the importance of each site and the potential level of impact.
Method of Impact	The potential impact to aircraft remains in the area will be assessed using standard EIA methodologies. Cowrie's Historic Environment Guidance for the Offshore Renewable

Assessment	Energy Sector (2007) will be closely adhered to during the assessment of the impacts.

Potential Impact	Potential damage may occur during pre-construction seabed preparation, wind farm construction, cable laying and to submerged prehistoric sites and finds and submerged topographic features and deposits that contain palaeo-environmental evidence.
Survey/Study Proposed to Assess Impact	A desk-based study will assess the potential for the presence of submerged prehistoric archaeology by considering finds recorded in the NMR and local SMR, and secondary sources, in particular those relating to sea-level changes within the area. Geotechnical and marine geophysical (sub-bottom and bathymetric) data will be used to identify and map any topographic features and/or deposits with palaeo-environmental and archaeological potential. The study will consider the importance of the archaeology and the potential level of impact.
Method of Impact Assessment	The potential impact to prehistoric archaeology in the area will be assessed using standard EIA methodologies. Cowrie's Historic Environment Guidance for the Offshore Renewable Energy Sector (2007) will be closely adhered to during the assessment of the impacts.

Potential Impact	Potential damage will occur during pre-construction seabed preparation, wind farm construction, cable laying and to other archaeological sites and finds on the seabed.
Survey/Study Proposed to Assess Impact	A desk-based assessment will collate information on known sites. Side scan sonar and magnetometer data will be subject to archaeological assessment in order to identify anomalies that potentially have an anthropogenic origin and to comment on their character. The study will consider the importance of each site and the potential level of impact.
Method of Impact Assessment	The potential impact will be assessed using standard EIA methodologies. Cowrie's Historic Environment Guidance for the Offshore Renewable Energy Sector (2007) will be closely adhered to during the assessment of the impacts.

Potential Impact	Potential impact will occur pre-construction clearance, cable laying and grid connection works within the inter-tidal zone and on land to terrestrial archaeological sites potentially ranging in date from the Palaeolithic to the present day.
Survey/Study Proposed to Assess Impact	A desk-based assessment will collate information on known sites and finds using the local SMR, the NMR, aerial photographs, historic mapping and documentary sources. This will be supported by a visual inspection of the area. The study will consider the importance of each site and the potential level of impact.
Method of Impact Assessment	The potential impact will be assessed using standard EIA methodologies. COWRIE's Historic Environment Guidance for the Offshore Renewable Energy Sector (2007) and IFA guidance for desk-based assessment (2008) will be closely adhered to during the assessment of the impacts.

Cumulative and In-Combination Impact Assessment

4.309 Activities that will potentially have to be considered in relation to the cumulative and in-combination impact assessment are:

- subsea cables and pipelines;
- marine waste disposals;
- marine aggregate extraction;
- Severn Tidal Power Scheme;
- other offshore wind farm schemes.

Potential Mitigation and Monitoring

4.310 Without mitigation, there is the potential that a number of wreck sites and deposits of palaeoenvironmental potential may be affected, and that some of those sites prove to be archaeologically important. However, the general density of known sites is low, and the same density probably applies to currently unknown archaeology. Therefore, if appropriate mitigation is applied, archaeology should prove to be a low risk and should not spatially restrict development within the area to any great extent.

4.311 It is proposed that the following standard methodology for undertaking an offshore development EIA is undertaken in order to ensure that the correct level of mitigation is implemented to avoid significant impact on archaeological resources:

- full Environmental Impact Assessment (EIA) including archaeological analysis of marine geophysical data and preferably archaeological assessment of geotechnical data;
- a mitigation strategy that places Exclusion Zones (EZs) around all wrecks and geophysical anomalies with archaeological potential;
- the archaeological review of additional geophysical data when it becomes available;
- a methodology for conducting diver assessment of any EZs that prove to be a constraint that is hindering development and which for those reasons need to be removed/altered;
- an agreed methodology for conducting recording to a level appropriate to the importance of any sites that would be damaged by development;
- the staged analysis of marine geotechnical data in areas where an initial assessment (preferably conducted during EIA) has indicated that deposits with palaeoenvironmental potential are present and will be impacted;
- a Written Scheme of Investigation (WSI) covering all mitigation strategies and curator contact/liaison details and a Protocol for Unexpected Discoveries.

Further Considerations

4.312 To further enhance the study into the proposed development area during EIA the data consulted during this assessment will be considered in greater detail along with new survey data. The latter will include high resolution side scan sonar, sub-bottom profiler and magnetometer data.

Summary of Surveys/Additional Studies

- Full assessment of UKHO wreck data
- Full assessment of NMR data
- Full assessment of SMR data
- Assessment of geophysical survey data
- Assessment of geotechnical data
- Assessment of the primary and secondary historic and contemporary sources

Military Practice Areas

Background

4.313 The Bristol Channel has several military practice areas. The full list of these is included in Table 4.9 below.

Table 4.9: Military practice areas in the vicinity of the proposed Atlantic Array site.

Name	Type	Distance from site (nearest point)
Manorbier	Firing danger area	Overlaps northern edge of site
Castlemartin	Firing danger area	~10.1 km
Pendine	Firing danger area	~16.5 km
Braunton Burrows	Amphibious activities	~20.7 km
Pembrey	Ordnance demolition	~27.8 km
D064C	Unknown	~33.4 km
Bridgwater Bay	Naval bombing range	~66.4 km
Trevose head	Helicopter exercises	~77.9 km

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact	Risk of shipping lanes being moved into the northern part of the Atlantic Array site leading to reduction in potentially available wind farm development area.
Survey/Study Proposed to Assess Impact	Shipping study to be undertaken to inform the potential need for moving shipping lanes.
Method of Impact Assessment	Desktop study and shipping VMS data analysis.

Potential Mitigation and Monitoring

4.314 Consultation will take place with the MOD throughout the project. If detailed shipping analysis identifies conflict between military and commercial shipping movements into and out of the Bristol Channel then this will be addressed in consultation with the MoD and MCA.

Munitions

Background

4.315 As with many parts of the UK coastline there remains the possibility of unexploded ordinance (UXO) being present within the project area. Indeed there is direct evidence of recent deposition of UXO in the Bristol Channel. The uxoinfo.com website notes that in February 2003:

The United Kingdom (U.K.) Military lost a pallet of explosives from a military ship traversing in the Bristol Channel. The pallet contained 20 live British-made Swing Fire missile warheads, eight mines, plastic explosive charges, rolls of detonating cord and boosters. A team of six Royal Navy divers spent four days looking for the lost pallet using various metal detectors without luck. Instead, the divers recovered two tons of scrap and eight other unexploded bombs.

According to a letter from U.K.'s Minister, "The search concluded that the missing pallet is no longer within the area of the range that was searched. Surveying and clearance conditions throughout the range are particularly difficult due to the extensive areas of very soft mud and sand, rocky outcrops, heavily covered areas of seaweed patches and the tidal streams." …Reportedly, there are no current plans for the diving group to return to continue the search in the future.

4.316 Given the obvious risks such as those above, and those arising from military campaigns in the area it will be appropriate for a full UXO study of the site to be conducted prior to construction.

4.317 There is a known munitions disposal sites approximately 14.7km from the north-western tip of the Atlantic Array site. This site is also overlain by a ‘spoil ground’, which may also be military in nature.

4.318 Additionally, the northern edge of the Atlantic Array site is bounded by the Manorbier land based missile firing range – the only firing range of this type in the UK. This raises the possibility of UXO from this area being present within the site.

Identification of Potential Effects and Proposed Assessment Methodology

4.319 The risk of unexploded ordnance within the main array site or within the export cable route will be monitored and reviewed on a regular basis.

Potential Impact	Risk of danger to project staff, construction and the marine environment through an unexpected detonation of UXO.
Survey/Study Proposed to Assess Impact	Desk based UXO study to be carried out as part of the Environmental Statement.
Method of Impact Assessment	Geophysical data collected for engineering and EIA purposes to be analysed by specialist UXO personnel for potential presence of UXO and appropriate risk assessment undertaken.

Potential Mitigation and Monitoring

4.320 Upon review of geophysical data, ROV, diving surveys and possible recovery operations may be undertaken prior to construction to confirm details of any suspected UXO. Construction staff

will be briefed on the potential presence of UXO prior to deployment and will remain alert for any further unidentified ordnance.

Socioeconomics and Tourism

Background

North Devon

4.321 North Devon has a relatively diverse and well balanced economic base. Between 1991 and 2001, the economy of North Devon increased by 5.2% although the growth rate was faster during the first half of the period. Service sector employment has increased steadily since 1981 and now accounts for 67% of all employment in the area. Until recently manufacturing in North Devon had steadily grown in contrast to the rest of the UK and accounted for around 17% of all North Devon employment in 2001 (North Devon Local Plan, 2009).

4.322 Employment in agriculture and forestry has continued to decline in line with national trends whilst fishing has grown significantly since 1991. All of these three sectors also create and support jobs in ancillary industries such as servicing and processing. Distribution, hotel and catering sectors are stronger than the national average and have experienced significant growth in recent years. Within the tourism sector, self-catering accommodation including caravans and camping is currently growing faster than serviced accommodation. As a result there are strong development pressures in the protected coastal countryside outside the main resorts. Improvements in the quality of tourist accommodation have also led to a cascade effect of expenditure throughout the local economy.

4.323 Tourism is of significant importance to the economy of North Devon and the area is the second most popular holiday destination in the county after Torbay. Tourism is estimated to be worth approximately 25% of the gross domestic product (GDP) of the district. The tourism industry within the region relies on long stay holidays in traditional resorts and in serviced accommodation. However, there has been a marked decline in long stay holidays recently and instead self catering, countryside and off season short break holidays are increasing in popularity. This has resulted in more day visitors both into and within North Devon (North Devon Local Plan, 2009).

4.324 The economy of North Devon is dominated by small businesses with 87% of firms employing less than 10 people. However, small businesses only account for about 25% of all employees. Additionally, 22% of the economically active working population are self-employed as compared to the national average of 11.5%.

4.325 North Devon has a low GDP per capita, particularly in the rural areas, arising largely due to low wages. In 2006, 61.2% of the workforce in North Devon was employed full time compared to a UK average of 68.9%. In 2009, the average weekly income for full-time workers in North Devon was £367.40, compared to £491.00 for the UK (Office for National Statistics, 2010).

South Wales

4.326 South Wales, including the counties of Pembrokeshire, Carmarthenshire, Swansea and Neath Port Talbot, comprises 22.4% of the population of Wales. This region however, creates only 20.1% of the value added in Wales, employs only 20.6% of those employed in Wales and includes 24.9% of those unemployed in Wales (South West Wales Economic Forum, 2010).

4.327 The natural resources on which the economy of the region was largely built (coal in the east and a deep-water haven in the west) are no longer sufficient to overcome the region's remoteness from markets and a lack of transport infrastructure.

4.328 The natural scenic value of much of the region makes tourism an important industry. According to the South West Wales recreational audit, which covers the coastal region of South Wales to include Pembrokeshire, Carmarthenshire, Swansea, Neath Port-Talbot and Bridgend, UK residents took 2.4 million tourism trips and overseas residents took 188,000 of tourism trips to South Wales in 2003, with a total of 12.7 million nights and £433 million of spending, which supports approximately one third of all tourism jobs in Wales. For nine out of ten visitors to Pembrokeshire, beaches and the coast were the most commonly quoted factors attracting visitors to the county (Pembrokeshire Coastal Forum, 2005).

Identification of Potential Effects and Proposed Assessment Methodology

4.329 Given the importance of tourism to the local economies of North Devon and South Wales, it will be necessary to assess the potential impact of the proposed Atlantic Array wind farm on tourism in the area. There has been no specific research carried out on in England and Wales on the impacts of offshore wind farms on tourism. However, research commissioned by the Scottish government shows wind farms to have little or no impact on the tourism industry (Scottish Renewables Forum, 2007).

4.330 There are relatively few known direct socio-economic effects on tourism arising out of offshore wind farm development. However, there are examples of boat operators offering tours of wind farms, such as at Kentish Flats off the coast of Kent, which indicates that there may be minor beneficial effects.

4.331 There are likely to be direct and indirect benefits to the local and regional economies, through the creation of jobs within the supply chain. Some of the potential effects are listed below:

- Direct and indirect creation of jobs through economic multiplier effects during construction operation and decommissioning phases of the project;
- The use of local contractors during construction of onshore infrastructure;
- Potential requirement for improved infrastructure within local ports can allow expansion and diversification of local industry;
- The use of local services or manufactured products can boost the local economy; and
- Increased long-term security and reliability of supply and more evenly distributed energy generation, decreases the cost of energy bills and reduces energy wasted in transmission over long distances.

4.332 A socio-economic impact assessment will be carried out to assess the potential positive or negative impacts the proposed wind farm could have for the local communities of North Devon and South Wales. During this process, the proposed development will be assessed with regard to relevant local, regional and national policies on planning, economic development and tourism.

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact	Potential impact on local and regional economies, including tourism during the construction, operation and decommissioning phases of the development.

Survey/Study Proposed to Assess Impact	A desk-based study will be carried out to determine the socio-economic background of the region. This will include identification of local port infrastructure and any supporting infrastructure that may be of relevance to the offshore wind farm development.
Method of Impact Assessment	A socio-economic assessment will be carried out of data compiled in the desk-based study to determine any positive or negative impacts associated with the development on the local economies of both North Devon and South Wales. There is currently no specific UK guidance for assessing the socio-economic impacts of offshore wind farms, however the following resources will be used in the desk-based assessment: ▪ The Crown Estate (2008) Socio-economic indicators of marine-related activities in the UK economy; ▪ Energy for Sustainable Development Ltd (2004) Offshore wind, onshore jobs, - A new industry for Britain; ▪ Glasgow Caledonian University (2007). Economic Impact of Wind Farms on Scottish Tourism (commissioned by the Tourism Unit of the Scottish Government); ▪ Scottish Renewables Economic Impact Report (2007); ▪ Tourist Attitudes Towards Wind Farms, Scottish Renewables and British Wind Energy Association; and ▪ Sociological Investigation of The Reception of Horns Rev and Nysted Offshore Wind Farms In the Local Communities (2005).

Potential Mitigation and Monitoring

4.333 Consultation will take place with key local industries and ports, local authorities and organisations and interest groups throughout the project, to ensure their concerns are addressed through the EIA process. Consultation with regional groups such as the South West Wales Economic Forum and the Pembrokeshire Coastal Forum will also form an important part of the process.

4.334 If the EIA assessment identifies any adverse impacts on the socio-economic environment of the area mitigation measures will be proposed. The assessment will also highlight any positive effects that the proposed wind farm may have on the local community.

Recreation

Background

North Devon

4.335 The countryside and coastal regions of North Devon support a wide array of recreational activities. Popular countryside activities include walking, cycling, fishing, horse riding, clay shooting, golf and motor sport activities. North Devon contains an extensive network of footpaths and bridleways that are supplemented by national and regional routes such as the South West Coast Path National Trail, the Tarka Trail, the Two Moors Way and the National

Cycle Network which incorporates some of these other routes. Some parts of coastal footpaths will have views of the proposed Atlantic Array site.

4.336 The coast, estuary and rivers of North Devon also offer a range of recreational opportunities including swimming, fishing, angling, surfing and boating and sailing activities. In recognition of their importance to the local community and economy, the North Devon Council is 'committed to protecting and improving water based recreational facilities whilst ensuring the natural environment, including nature conservation interests, are not harmed'.

South Wales

4.337 The coastline of South Wales is also home to an extensive array of outdoor activities and recreation. Popular activities include swimming, walking, cycling, surfing, wind surfing, kite surfing, fishing and angling, canoeing and kayaking, horse-riding and boating. The region is also popular for adventure sports such as coasteering, climbing, abseiling and sky diving.

4.338 An extensive network of footpath and cycle ways line the coastline of south west Wales. National and regional routes include the Pembrokeshire Coast Path National Trail, the Celtic Trail, the Lon Teifi, the Carmarthen Bay Coast Path, the Gower Way, Valeways Millenium Heritage Trail, Ogwr Ridgeway Walk, Bridgend Circular Walk, Garw Valley Walk and Ogmore Valley. The National Cycle Network includes The Tramway, Brunel Trail, Cardi Bach and Llys y Fran, which incorporate some of the walking trails mentioned above.

4.339 The proposed Atlantic Array site is crossed by 11 recognised RYA sailing routes. The southern edge of the site also slightly overlaps an RYA sailing area around the North Devon coast and is approximately 17.5 km from another RYA sailing and racing area around Tenby and Caldey Island. Recreational diving also occurs in the Lundy Marine Conservation Zone, approximately 12 km to the south-west of the site. The region also supports a range of other recreational and amenity uses including bird watching, seal watching, boat trips, rambling, cycling and National Trust sites onshore.

Identification of Potential Effects and Proposed Assessment Methodology

4.340 A desk study of the recreational amenity value of the Atlantic Array site and its vicinity will be undertaken. Consultation will be undertaken in conjunction with the local community and other interest groups. Consultation on future plans for recreation in the area will also be conducted.

Potential Impact	Risk of negative impact upon recreational amenity in and around the Atlantic Array site.
Survey/Study Proposed to Assess Impact	Study of recreational amenity value of the Atlantic Array site and associated cable route. This will include consideration of disruption and potential alterations to RYA sailing routes. No site specific surveys are anticipated.
Method of Impact Assessment	Analysis of data complied in desk-based study to assess the level of impact on recreational amenity.

Potential Mitigation and Monitoring

4.341 During construction, safety exclusion zones will be imposed to ensure other marine users are not placed in danger by construction activities. Effective communication of survey and

construction activities through Notices to Mariners and directly to local ports will ensure impacts are minimised throughout the life of the project.

4.342 Marine spatial planning techniques have already been implemented in the preliminary site selection for the Atlantic Array OWF site in order to minimise impacts on recreational users wherever possible. BCZL will continue to consult with relevant bodies representing recreational interests in order to minimise any further impacts.

Noise

Background

4.343 There is a wide array of anthropogenic activities in and around the Bristol Channel and surrounds that will contribute to background marine noise levels. Commercial fishing activity, general commercial shipping traffic, marine aggregate extraction and a range of recreational motor boating all occur in this region. Table 4.10 provides indicative noise levels for a selection of offshore activities that are likely to take place in this area, including estimated values for piling and trenching related to offshore wind farm construction works.

Table 4.10: Indicative noise levels for a selection of offshore activities.

Activity	Estimated Source Pressure Level dB	Dominant Frequency (and/or Indicative frequency range)	Reference
Pile Driving of a 6.5m diameter pile (estimated)	271	130 – 150Hz	Centrica, 2006
Air-gun (seismic survey)	219 – 259	10 – 10,000Hz	Centrica, 2006
Cable trenching plough	178	-	Centrica, 2006
Zodiac (5 m) with outboard motor	152	6,300Hz	Centrica, 2006
Tug or barge travelling at 16 km p/h	162	630Hz	Centrica, 2006
Large Tanker vessel	177	100Hz	Centrica, 2006
Fishing vessel	150 - 160	-	Centrica, 2006
Cutter Suction Dredger	160-180	10-1000Hz	Malme 1989, cited in Richardson et al, 1995
Clamshell Dredge	150-162		Miles et al, cited in Richardson et al, 1995

4.344 Although no data has been sourced to date for background noise levels in this offshore area, ambient levels in open coastal waters are typically in the range of 60 to 100dB over a frequency range of 10 to 2000Hz (SEAS, 2000; 2000a; Vella et al, 2001). Although the Atlantic Array project is some distance offshore, the sea area is subject to a high level of use regionally, and as such it would be expected that the Zone would be characterised by noise levels in this general range.

4.345 Offshore construction operations, particularly piling activities, will generate noise and vibration which may have the potential to be audible at the coastline (South Wales or North Devon)

although it would be anticipated that due to the distance offshore such airborne noise will be of low intensity. However, pending initial assessments it may be necessary to establish the level and duration of construction noise which will be experienced at the coast. This will be particularly important at sites of importance for tourism and recreational activities.

4.346 The assessment, should it be deemed necessary, will include consideration of worst-case conditions for noise transmission (i.e. onshore winds conditions; at night (when onshore noise would be expected to be at its lowest level); and all turbines requiring piling). The actual noise produced will also be directly related to the ground conditions into which the piles are driven (hard substrata producing significantly higher source pressures than soft sediments). Reference to guideline levels of acceptability will be made to ensure that the assessment is acceptable and robust.

4.347 Operational noise assessment (in air) will also be considered within the context of the region, being subject to, for example, commercial fishing activity, general commercial shipping traffic, marine aggregate extraction and a range of recreational motor boating. Again, reference to guideline values for acceptable noise levels at the coast will be made within the EIA should the assessment be required.

Identification of Potential Effects and Proposed Assessment Methodology

4.348 The potential effects of noise generated by the development and operation of the Atlantic Array OWF will be assessed for all identified sensitive receptors.

4.349 The two receptors known to have particular sensitivity to noise are fish and marine mammals. As documented in the fish and shellfish ecology section of this report potential noise impacts will be assessed via a review of the relatively large body of data that exists on this topic, including developer-led work and COWRIE projects (Bio/Consult AS, 2001, Nedwell et al., 2007, Wahlberg and Westerberg, 2005). The assessment will employ the use of assessment tools such as audiograms and species-metrics, where appropriate.

4.350 For marine mammals the effect of increased noise in the marine environment may be undetectable or may range from avoidance/exclusion to changes in behaviour, to permanent hearing damage and lethal effects. In order to asses the impact of noise upon marine mammals it is proposed that using species-specific audiograms, noise modelling of typical pile-driving operations will be undertaken to determine the radii of zones in which there may be impacts to marine mammals. Data from existing OWF projects will be sourced and used in the EIA.

4.351 C-PODs, visual boat-based and towed hydrophone surveys will be used to record detection rates of Harbour Porpoises and dolphin species to inform the EIA population baseline. The potential impact of noise upon marine mammals will be assessed via reference to audiograms and application of these findings via standard EIA methodologies (identification of sensitive receptors, assessment of magnitude of impacts).

Potential Mitigation and Monitoring

4.352 Any mitigation or monitoring which might be required by the findings of the EIA process will be developed specifically in relation to the receptor identified.

4.353 For marine mammals this may include the use of Marine Mammal Observers (MMOs) to ensure that no animals are present within a 500 m radius before pile-driving commences. Pile-diving would then begin at low power and increase gradually following a soft start procedure. Passive acoustic monitoring solutions are available should pile-driving take place during the night. Other

mitigation options including the use of acoustic deterrent devices that encourage marine mammals to leave the area prior to pile-driving operations, and noise reduction methods (e.g. bubble curtains) for the pile-driver itself (COWRIE, 2007a, 2007b) will be investigated in the ES.

4.354 Some marine mammals are expected to leave the immediate vicinity of the wind farm temporarily during the construction phase. C-PODs will be deployed throughout this period to monitor whether a displacement of animals does occur, and how long it takes before site use by marine mammals returns to levels recorded prior to construction.

4.355 Mitigation measures for ameliorating impacts upon fish may include the use of bubble curtains or *in-situ* muffling devices. These will be further investigated in the ES for their efficacy and suitability for the proposed project.

4.356 The necessity for ongoing monitoring of fish stocks will be assessed within the ES.

Marine Aggregate Extraction and Waste Disposal

Background

4.357 There are several marine aggregate extraction areas, either licensed or applied for, in the vicinity of the Atlantic Array site. These sites are all to the north of site and one in particular, Area 486, is directly adjacent to the northern limits of the Atlantic Array site boundary. Table 4.11 provides details of all marine aggregate extraction sites located within 50km of the proposed Atlantic Array offshore wind farm. The location of these sites is also shown in Figure 4.27.

Table 4.11: Aggregate extraction areas within 50 km radius of the proposed Atlantic Array site

Area ID	Name	Type	Distance from site (nearest point)
486	Resource Management Association	Application	Adjacent to site
476	Llanelli Sand Dredging	Licensed/active	~4.2 km
373	Llanelli Sand Dredging	Licensed/active	~14.8 km

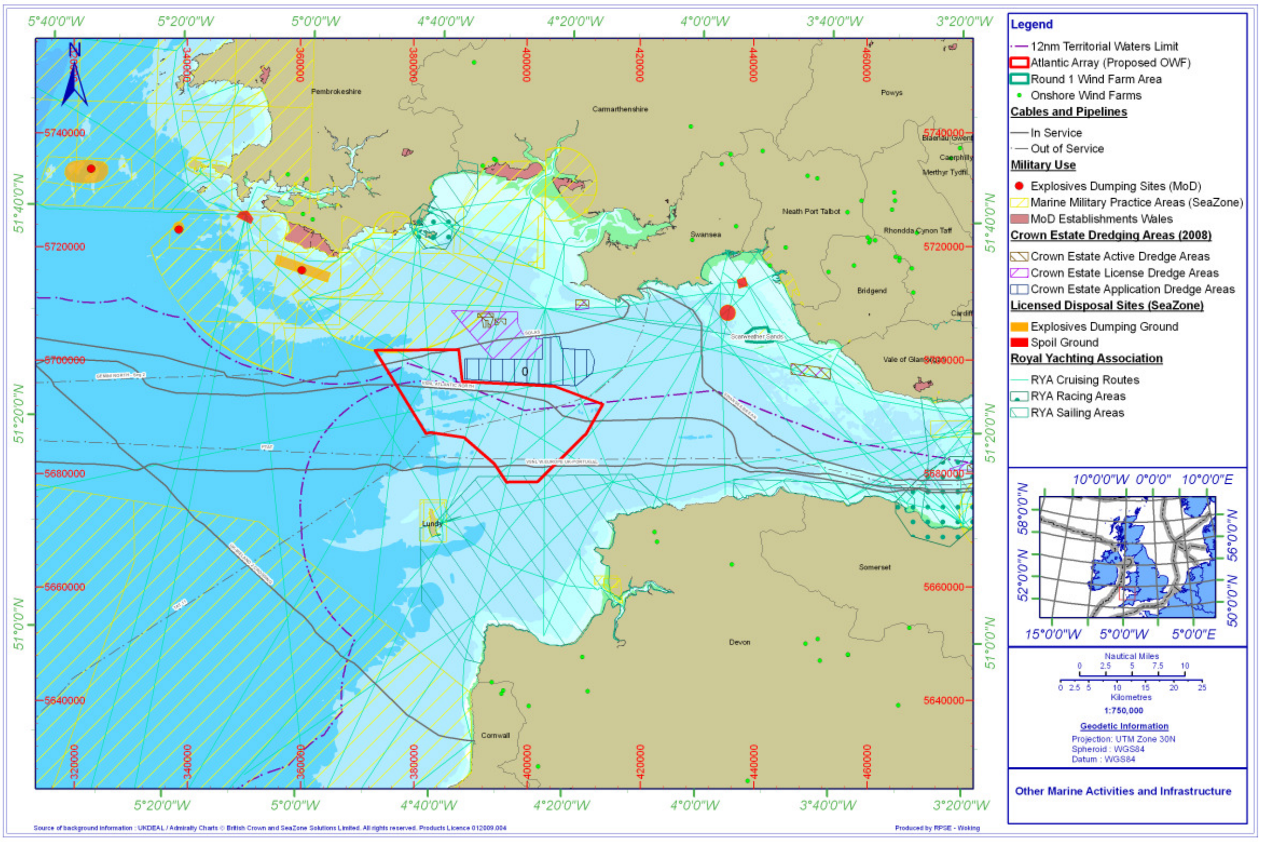

Figure 4.27: Marine aggregate extraction and dumping grounds in the Bristol Channel.

4.358 Three spoil dumping grounds and one explosives dumping ground are present within a 50km radius of the Atlantic Array site. These sites are listed in Table 4.12 and their locations are shown in Figure 4.27 (note: the western most sites outside Milford Haven have been omitted due to being outside 50km radius from the development site).

Table 4.12: Dumping grounds within 50 km radius of the proposed Atlantic Array site

Name	Type	Distance from site (nearest point)
Castlemartin (St Govan's Head)	Explosives	14.5 km
Swansea Bay (inner)	Spoil	31.5 km
Swansea Bay (outer)	Spoil	25.9 km
Unknown (St Govan's Head)	Spoil	18.5 km

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact	Indirect impacts upon coastal processes (changes to tidal regime, sedimentation rates etc) affecting nearby aggregate extraction areas.
Survey/Study Proposed to	Coastal processes study to identify sediment mobilisation and deposition rates arising from the construction and operation of the Atlantic Array wind farm.

Assess Impact	
Method of Impact Assessment	Desktop modelling of coastal processes in and around the project area.

Potential Impact	Indirect impacts upon aggregate extraction through the alteration of large shipping routes in the Bristol Channel.
Survey/Study Proposed to Assess Impact	Shipping study will be employed to investigate the potential requirement for aggregate vessels to make longer or indirect trips to dredging grounds.
Method of Impact Assessment	Desktop modelling of shipping movements in relation to potential changes in large shipping routes.

4.359 There are no expected impacts upon dumping grounds in the Bristol Channel arising from this proposal. This aspect is therefore **scoped out**.

Potential Mitigation and Monitoring

4.360 Mitigation measures for marine aggregate extraction will be developed during the ES process in consultation with the Crown Estates and other relevant aggregate industry stakeholders.

Offshore Wind Developments

4.361 There are no other active offshore wind developments projects within the Bristol Channel. As of December 2009 work on Scarweather Sands was halted by E.ON Climate and Renewables Ltd. There are no other known projects in the Bristol Channel in planning or at the project concept stage and as such the potential for impacts on other wind licences areas is **scoped out**.

Subsea Cables and Pipelines

Background

4.362 The proposed Atlantic Array site is crossed by five kingfisher telecommunication cables. There are no known pipelines in the vicinity of the site and the nearest known exploration well is over 65km from the centre of the site. There is no other subsea or surface infrastructure known within or near the site.

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact	Potential Impacts on existing subsea telecommunications infrastructure (construction and operational phases)
Survey/Study Proposed to Assess Impact	Further investigation into the location and operational status of cables in the area will be conducted using GIS techniques, as well as through consultation with operators. As the exact export cable route is not yet decided there remains the potential for impacts on existing telecommunication cables. This aspect of the project will be

	included in all GIS investigations outlined above.
Method of Impact Assessment	Impacts on existing subsea cable/pipeline infrastructure will be minimised via sympathetic route selection for the export cable. If a situation arises whereby existing infrastructure needs to be crossed, discussions will be held with operators/owners of cables to agree crossing method, based on standard UKCPC methods. The significance of any impacts will be assessed using standard EIA methodologies.

4.363 No pipelines are present in the project area and as such any impacts on this aspect are **scoped out**.

Potential Mitigation and Monitoring

4.364 Where conflicts between surface and subsea infrastructure are identified owners and/or operators will be consulted and agreements will be put in place concerning buffer distances and crossing arrangements. These arrangements will be determined and implemented so as to avoid disruption to existing infrastructure.

Offshore Oil and Gas Exploration

4.365 No oil and gas infrastructure, including wells or pipelines, is present within the Atlantic Array site. The nearest oil and gas infrastructure, well 103/18-1, was drilled in 1976 by Shell UK Exploration and Production Ltd and is located approximately 65 km west of the centre of the proposed Atlantic Array site. This well is plugged and abandoned.

4.366 There are currently no known active leases over the Atlantic Array site or within the Bristol Channel generally.

4.367 It is concluded that due to the large distance of oil and gas infrastructure from the site, and the lack of active oil and gas licences, that there will be no significant impact upon oil and gas exploration and therefore **this aspect is scoped out**.

Military and Civil Aviation

Background

4.368 The Atlantic Array OWF is located in the vicinity of a number of airports and is within the operational range of primary and secondary radar systems, serving both civil and military aviation. Wind turbines can appear as targets to radars and have the potential to induce clutter upon radar displays.

4.369 The following section is based on an initial review of aviation activity and line-of-sight (LOS) assessments and outlines the potential effects of the proposed Atlantic Array OWF on civil and military aviation (Cyrrus Ltd, 2009). These potential effects are based upon technical analysis, derived from desk-top research and subject matter expertise including: LOS assessments from the identified radars to the project area, using the industry standard package ATDI HerTZ Mapper; identification of relevant airspace features and air traffic flows from the UK Aeronautical Information Publication; typical military operations outlined in UK Military Aeronautical Information Publication; and relevant NATS reports.

General Description of Airspace Arrangements in the Project Area

4.370 Atlantic Array is located below 2 types of airspace. The lower volume which is uncontrolled (Class G) from sea level up to 19,500 feet and immediately above that (in common with airspace classification across Europe) Class C controlled airspace.

4.371 There are a number of Air Navigation Service Providers (ANSP) operating in the Project area. Lower Airspace Radar Service (LARS) in the airspace around the Bristol Channel is provided by a number of ANSP, although an initial review indicates that only the Cardiff and Hartland Point LARS operational areas would overlie the Atlantic Array OWF. The two principle sensors providing NATS En-Route coverage over the Bristol Channel area in middle and upper airspace (FL100 and above and FL250 and above respectively) are the Burrington and Clee Hill radars. In upper airspace, above FL250, the centrelines of Upper Air Routes UL180 and UM140 cross the proposed Atlantic Array OWF site.

4.372 Military aviation activity also takes place in the airspace in the vicinity of Atlantic Array. This includes the MoD Air Defence Range at Manorbier, where manoeuvres up to 40,000 feet are undertaken prior to conducting weapons training and low flying exercises inside the Range. Military helicopters operating from RAF Chivenor and RNAS Yeovilton routinely fly in the local area and are also involved in low level search and rescue and occasional military exercises.

Summary of surveys/additional studies

4.373 Where required, a thorough assessment of aviation and radar issues will be undertaken based on the following methodology:

- Technical assessment of air navigation and radar systems and their operational requirements;
- Gathering of operational ATC knowledge (civil and military);
- Consultation with relevant ANSP;
- Analysis of radar LOS using specialised software modelling tools;
- Detailed technical investigation (if required, for example to design specific mitigation solutions);
- Undertaking an aviation traffic study (if required);
- Undertaking flight trials (if required, for example to gather specific on-site data to inform mitigation design).

Identification of Potential Effects and Proposed Assessment Methodology

Potential Impact:	Adverse effects on Controlled Airspace (CAS) and Lower Airspace Radar Services (LARS) (operational phase)
Survey/Study Proposed to Assess Impact	Determination of CAS operational requirements, and LOS to potential Atlantic Array OWF turbines from Cardiff Airport, Newquay Airport, Bristol International Airport, Filton Airport and Swansea Airport.
Method of Impact Assessment	Impact will be assessed by analysing the extent of any radar visibility of the turbines. Identification of potential operational and technical mitigations will be explored.

Potential	Adverse effects on Primary Service Radar (PSR) and Secondary Service Radar (SSR)

Impact:	(operational phase)
Survey/Study Proposed to Assess Impact	LOS analysis of radar coverage for potential Atlantic Array OWF turbines from Cardiff Airport, Newquay Airport, Bristol International Airport, Filton Airport, Portreath ASACS, Hartland Point, Culdrose, Yeovilton and Manorbier PEXA.
Method of Impact Assessment	Impact will be assessed by analysing the extent of any radar visibility of the turbines. Means of technical mitigation will be explored with the relevant ANSP which might include radar equipment re-optimisation and use of infill solutions from suitably sited established radars and from alternative radars.

Potential Impact:	Generation of adverse effects on air traffic control En Route radar (operational phase)
Survey/Study Proposed to Assess Impact	LOS analysis for a range of different size turbines to NATS sensor at Clee Hill and Burrington.
Method of Impact Assessment	Impact will be assessed by analysing the extent of any radar visibility of the turbines followed by an operational assessment of the type and density of air traffic operating over and close to the wind farm and the nature of the air traffic service provided to those aircraft. Means of mitigation will be explored with the ANSP including: the development of an upgrade package for NATS En Route radars; the expansion of SSR to control offshore air traffic and the potential for use of overlapping cover from other existing radars.

Potential Impact:	Creation of additional obstacles which create adverse affects on military air traffic at Manorbier and St. Athan (construction and operation phase).
Survey/Study Proposed to Assess Impact	Determination of operational requirements of Manorbier PEXA airspace and St.Athan airbase.
Method of Impact Assessment	Assessment of the impact on the Manorbier PEXA and St. Athan airbase will be conducted by analysing the existing and planned low level flying operations of the bases and the potential interaction with parts of the planned OWF.

Potential Impact:	Creation of additional obstacles which create adverse affects on military helicopter traffic at Culdrose, Yeovilton and Chivenor (construction and operation phase).
Survey/Study Proposed to Assess Impact	Determination of operational requirements of Culdrose, Yeovilton and Chivenor activities.
Method of Impact Assessment	Assessment of the impact on the Culdrose, Chivenor and Yeovilton helicopter bases will be conducted by analysing the existing and planned low level flying operations of the bases, and the potential interaction with parts of the planned OWF.

Potential Mitigation and Monitoring

4.374 Experience has shown that there are a number of mitigation options that have been used successfully in other wind energy developments in the UK. These can be split into technical, operational and regulatory mitigations. The potential technical options range from adjustments to the radar configuration to installation of new PSR to provide an in-fill solution. Operational solutions include change to airspace arrangements (e.g. conduct LARS from a different unit) and re-routing around the OWF, although ANSPs are increasingly reluctant to initiate such changes due to the perceived reduction in the level of service provision. There is also potential for conducting an airspace change (e.g. establish a Transponder Mandatory Zone) using the Civil Aviation Authority change process.

SCOPING OF ENVIRONMENTAL EFFECTS – ONSHORE DEVELOPMENT

Introduction

5.1 As set out in the previous sections, it is anticipated that there will be a single ES for the Atlantic Array project. This would have separate onshore and offshore volumes for ease of reference.

5.2 The onshore volume of the ES will be structured to allow all relevant environmental information to be readily accessible. The initial part of the onshore ES will contain the introductory chapters relating to the project as a whole, including the description of the onshore parts of the project, an outline of the main alternatives considered during the evolution of the project and the methodology adopted for the EIA. The remainder of this volume of the ES will contain the topic by topic environmental information. A table of contents of the onshore part of the ES is listed in Appendix I.

5.3 The approach to the assessment of the main environmental effects of the onshore connection from mean low water and the landfall options at Cornborough Range, Saunton Sands and Woolacombe are described below on a topic by topic basis. These landfall options, together with potential substation locations and cable corridor options are shown in Figure 2.3, Figure 2.4 and Figure 2.5.

Onshore EIA Methodology

5.4 The onshore EIA and the onshore volume of the ES would take into account relevant government guidance, including:

- Department of the Environment, Transport and the Regions (DETR) (1999) Circular 02/99: Environmental Assessment. HMSO.
- Department of the Environment (1995) Preparation of Environmental Statements for Planning Projects that Require Environmental Assessment: A Good Practice Guide. HMSO.
- Department of the Environment, Transport and the Regions (DETR) (1997) Mitigation Measures in Environmental Statements. HMSO.
- Department of the Environment, Transport and the Regions (DETR) and the National Assembly for Wales (2000) Environmental Impact Assessment: A Guide to the Procedures. HMSO.
- Guidance on the Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2000, Urn 01/789, September 2000.

5.5 In addition to the above, the Department for Communities and Local Government has consulted on proposed amendments to Circular 02/99 and on new EIA guidance. This would also be considered where relevant.

5.6 Further guidance may be forthcoming on the Infrastructure Planning (Environmental Impact Assessment) Regulations (2009).

5.7 Other topic specific specialist methodologies and good practice guidelines would be drawn on as necessary and details of these can be found in the relevant topic sections below.

Approach

5.8 The assessment of each environmental topic will form a separate section of the onshore volume of the ES. For each environmental topic, the following will be addressed:

- Methodology and assessment criteria;
- Description of the environmental baseline (existing conditions);
- Identification of likely effects;
- Evaluation and assessment of the significance of identified effects, taking into account any measures designed to reduce or avoid environmental effects which form part of the project and to which the developer is committed;
- Identification of any further mitigation measures envisaged to avoid, reduce and, if possible, remedy adverse effects (in addition to those measures that form part of the project).

Baseline

5.9 The environmental baseline for the landfall and substation sites, cable route corridors and their environs form the basis of the assessment for the EIA, enabling the likely significant effects to be identified and assessed. This baseline for the assessment should represent the conditions that will exist in the absence of the project at the time that the project is likely to be implemented. For the purposes of this report, it is assumed that the application will be submitted in 2012 and that the onshore works would be constructed mainly over the period 2014 to 2019.

5.10 The baseline for the assessment of environmental effects will mostly be drawn from existing conditions during the main period of the EIA work in 2010-2012 but these will be examined to identify any likely changes between the time of survey and the future baseline for the implementation of the project in 2014. This would take account of any other major schemes that have been granted planning permission but not yet built or operational. Agreement on a list of such schemes would be sought with the relevant local authorities.

Assessment of Effects

5.11 The EIA Regulations require the identification of the likely significant environmental effects of the Project. The process by which effects will be identified and their significance evaluated is set out below.

Sensitivity or Importance of Receptors

5.12 Receptors are defined as the physical resource or user group that would be affected. The baseline studies identify potential environmental receptors for each topic. Some receptors will be more sensitive to certain environmental effects than others. The sensitivity or importance of a receptor may depend, for example, on its frequency or extent of occurrence at an international, national, regional or local level.

Description of Effect

5.13 Effects are defined as the physical changes to the environment attributable to the project. For each topic, the likely environmental effects will be identified and taken into account, including their magnitude and other dimensions of identified change in the environment with the project by comparison with the situation without the project.

5.14 Effects will defined as either adverse or beneficial and will be divided into those occurring during the construction phase, operational and decommissioning phases.

Significance of Effects

5.15 The significance of an effect differs according to the topic under assessment. The magnitude of an effect does not directly translate into its significance. For example, a significant effect may arise as a result of a relatively modest effect on a resource of national value, or a large effect on a resource of local value. In broad terms, therefore, the significance of the effect can depend on both its magnitude and the sensitivity or importance of the receptor.

5.16 The significance of an effect will take account of the following criteria:

- Extent and magnitude;
- Duration (short-term and long-term);
- Reversibility and irreversibility;
- Performance against environmental quality standards;
- Sensitivity of the receptor.

5.17 Significance levels will be defined separately for each topic, taking into account relevant topic specific guidance.

Mitigation Measures

5.18 As the process of project development and EIA is iterative, the project will include a range of measures that have been designed to reduce or prevent significant adverse environmental effects arising. In some cases these measures result in enhancement of environmental conditions. The assessment of effects will therefore take into account all measures that form part of the project and to which the applicant is committed.

5.19 In a few cases it has may be considered desirable to identify what have been described as ‘further mitigation’ measures. These are measures that could also prevent, reduce and where possible offset any adverse effects on the environment but are not part of the assessed project.

Cumulative Effects

5.20 The cumulative effects of the onshore electrical grid connection for the proposed Atlantic Array offshore wind farm, in conjunction with other major schemes used for the future baseline, will be considered within each topic chapter of the Environmental Statement. The relevant local authorities will be consulted on other development types that might have an effect in combination with the onshore grid connection project. The EIA assessments will consider cumulative effects assessment study areas as relevant to each particular specialism.

5.21 The following sections set out the approach for each of the specialist topics to be covered in the onshore volume of the ES.

Landscape

Introduction

5.22 The landscape in the area within which the potential landfall, cable route and substation options are located is shaped by underlying geology, the action of the sea, historic patterns of habitation and more modern land uses. The coastline is nationally designated for its landscape importance and these designations overlap with ecological and nature conservation designations as well as areas of particular historic and geological interest.

5.23 The Landscape and Visual Impact Assessment (LVIA) will identify and assess potential effects from the proposed landfall, cable route and substation options on landscape resources and visual receptors, with reference to established methodology and guidance.

Background Data/Information

5.24 A review of the main landscape designations, landscape character assessments and public rights of way has been undertaken as part of the initial landfall and cable route studies. In addition, a site visit has been undertaken by a landscape architect to the potential landfall options, cable routes and substation sites identified in this scoping report.

General Description of Project Area: Cornborough Range to Alverdiscott

Designated Sites

5.25 The coastline in North Devon forms part of the North Devon Area of Outstanding Natural Beauty (AONB). The landfall option at Cornborough Range falls within this designated area, as does the initial part of the cable route as far as the A39.

5.26 The AONB is the subject of a management strategy, published by the North Devon AONB Partnership, which identifies landscape character types. The Cornborough Range landfall lies within the landscape character type 1B: Open Coastal Plateaux.

5.27 In addition to the AONB designation, the coastline is also subject to a non-statutory Heritage Coast designation, defined by Natural England.

National Character Assessment

5.28 As part of a national mapping exercise the Countryside Agency (now Natural England) produced a series of Countryside Character reports, including Volume 8: South West. This report locates this route option within The Culm character area (Area 149).

5.29 Key characteristics of this area are recorded as:

- Rolling, locally steep-undulating open, pasture separated by many small valleys.
- Heavy, poorly-drained soil supporting rushy pastures of low agricultural quality but high nature conservation interest.
- Wide views across a remote landscape.

- Little tree cover except occasional wind-shaped hedgerow and farmstead trees, conifer blocks and valley woodlands.
- Patches of heathland commons.
- Scattered hamlets and farms in cob and whitewashed stone, connected by winding sunken lanes.
- Occasional hilltop villages.
- Spectacular coastline of high cliffs and a few fishing villages in sheltered coves.
- Contrasting enclosed wooded valleys of Taw and Torridge cutting through the ridges.

County Level Character Assessment

5.30 Devon County Council (DCC) published a landscape character assessment in 2002. This document identified 32 individual landscape character zones over six geographical regions within the county.

5.31 The Cornborough Range landfall lies within character area 18: Clovelly Coast. In addition to this area, the cable route option passes through character areas 13: Taw and Torridge River Systems and 12: High Culm Ridges.

General Description of Project Area: Saunton Sands to Alverdiscott

North Devon Area of Outstanding Natural Beauty (AONB)

5.32 As for the Cornborough Range option, this landfall and the initial part of the cable route would fall within the North Devon AONB and Heritage Coast.

5.33 The Saunton Sands landfall lies within or adjacent to the landscape character types 4E: Extensive Intertidal Sands and 4F: Coastal Dunes within the AONB management plan.

National Character Assessment

5.34 The Countryside Agency (now Natural England) Countryside Character report locates this route option within character areas 145: Exmoor and 149: The Culm.

5.35 Key characteristics of character area 149 are described above for Cornborough Range. Those for area 145 are recorded as:

- A diverse upland landscape, rising abruptly out of the surrounding lowlands and ending in a high and spectacular cliffed coastline with coastal heath at the edge of the Bristol Channel.
- Central high, treeless heather and grass moorlands used for rough grazing.
- Extensive 19th century moorland-edge enclosures and farms with beech-topped hedgebanks and beech windbreaks.
- Steep wooded inland valleys and steep, coastal combes.
- Regular, straight-sided fields usually enclosed by earth banks and stone walls.
- Villages and farmsteads nestle in sheltered valley bottoms.
- Wooded lower slopes in places, some with former deer parks.

- Slates and sandstones used in older buildings.
- Complex and visually outstanding coastline of headlands, steep cliffs and coves.
- High archaeological interest of Bronze Age monuments and hill forts.

County Level Character Assessment

5.36 The DCC landscape character assessment identifies the Saunton Sands landfall as located within character area 19: Taw-Torridge Estuary. In addition to this area, the cable route option passes through character area 12: High Culm Ridges.

General Description of Project Area: Woolacombe to Alverdiscott

North Devon Area of Outstanding Natural Beauty (AONB)

5.37 As for the other options, this landfall and the initial part of the cable route would fall within the North Devon AONB and Heritage Coast.

5.38 The Woolacombe landfall lies within landscape character types 4E: Extensive Intertidal Sands, 4F: Coastal Dunes and 2G: Steep Open Slopes within the AONB management plan.

National Character Assessment

5.39 The Countryside Agency (now Natural England) Countryside Character report locates this route option within character areas 145: Exmoor and 149: The Culm as described above for the Saunton Sands option.

County Level Character Assessment

5.40 The DCC landscape character assessment identifies the Woolacombe landfall as located within character area 20: North Devon Downs near the border with area 21: Exmoor and North Devon High Coast. In addition to this area, the cable route option passes through character areas 19: Taw and Torridge Estuary and 12: High Culm Ridges.

Identification of Potential Effects and Proposed Assessment Methodology

Scope and Methodology

5.41 The LVIA will include the following:

- Scoping and consultation with statutory and non-statutory consultees to establish valued landscape resources and viewpoints;
- Baseline studies of existing landscape resources and visual receptors;
- Assess the sensitivity of those resources and receptors to the project;
- Provide advice on any mitigation that may be possible, e.g. layout, ground modelling or planting;
- Identify the potential effects of the project on the landscape resources and visual receptors during the construction and operation and decommissioning (if relevant) phases of the project;
- Assess the significance of those effects;

- Propose monitoring e.g. of any planting proposals; and
- Present the findings in the chapter for the onshore volume of the ES.

5.42 Current LVIA methodology in the UK is founded on guidance and techniques published by the Landscape Institute and the Institute of Environmental Management and Assessment the Countryside Agency and Scottish Natural Heritage, and the Countryside Council for Wales (CCW).

5.43 The LVIA will be undertaken with reference to best practice outlined in published guidance, including:

- Guidelines for Landscape and Visual Impact Assessment, Second Edition (2002) Landscape Institute and the Institute for Environmental Management and Assessment; and,
- Landscape Character Assessment: Guidance for England and Scotland (2002) Countryside Agency and Scottish Natural Heritage, and
- Guide to Best Practice in Seascape Assessment (2001) CCW.

5.44 The significance of effects on landscape resources and those on visual receptors will be assessed separately through a closely linked procedure. However, a clear distinction will be drawn between the two, as described below:

- Landscape effects relate to the effects of the proposals on the physical and other characteristics of the landscape and its resulting character, quality and value.
- Visual effects relate to the effects on views experienced by visual receptors (for example people engaged in recreational activities, footpath users or tourists).

5.45 The LVIA will assess both the permanent effects relating to the operational lifetime of the substation and also the short-term effects associated with the construction of the onshore infrastructure including the laying of cables. It will also consider any effects during decommissioning of the substation (if relevant), many of which may be similar to the effects during construction.

5.46 The LVIA will consider not only the effects associated with the landfall, substation and cable routes but also related effects resulting from any associated infrastructure.

5.47 The cumulative impact with other major development proposals, including wind farms, will also be assessed where appropriate. A list of such proposals will be agreed with the relevant local authorities.

Baseline Landscape Assessment Methodology

5.48 Baseline information on the landscape resource will be gathered through a combination of desk studies, consultation and field surveys. Key documents including County or local landscape character assessments will be reviewed as part of the desk study.

5.49 The baseline assessment will include an appraisal of the landscape resource within the study area. This will generally extend up to a 5km radius of the substation locations depending on local topography and 500m either side of the cable route corridors. The baseline studies will identify the wider landscape context of the project, identify more localised landscape resources and examine how the project might affect individual features, elements and key characteristics, as well as the wider landscape character.

5.50 In addition, information relating to the following will be collected as part of the wider assessment and analysed with reference to potential effects on the landscape resource and visual receptors:

- Local geology and soils;
- Topography;
- Land use;
- Areas of habitation that may potentially be affected;
- Public Rights of Way (PRoW) and Access Land;
- Cultural aspects of the landscape; and
- National, regional and local landscape designations.

5.51 Where there is public access to historic monuments, such as Scheduled Monuments and historic parks and gardens, reference will be made to the effects on the visual (human) receptors at these locations. The effects on the setting of these historic monuments will be examined in the cultural heritage section of the ES. Where relevant, the LVIA will also link to other chapters in the onshore volume of the ES, for example those on heritage and ecology and to the offshore landscape assessment.

Baseline Visual Assessment Methodology

5.52 The geographical extent of potential visibility will be established for the tallest elements of the onshore development by production of Zone of Theoretical Visibility (ZTV) plans.

5.53 Due to the possible extent of the ZTV, it would be impossible to assess the visual impact on every individual visual receptor identified within it. Consequently, key viewpoints looking towards the substation will be agreed with statutory consultees as part of the baseline assessment. The viewpoints would be representative of potentially sensitive receptors situated within the study area at varying distances and directions. These representative viewpoints will be used to assess the potential visual effects of the project on the different range of views towards the site.

5.54 Wireline diagrams of the substation and associated infrastructure (such as sealing end compounds and access tracks) will be produced and set alongside baseline photographs of the landscape to illustrate the location and potential appearance of the onshore elements of the project from each of the agreed viewpoints. A number will be developed further into photomontages of the project in agreement with the relevant local authorities.

Mitigation Measures

5.55 The development of the project and the EIA is an iterative process and every effort will be made to ensure that appropriate mitigation is incorporated as part of the project, where possible. Baseline information relating to those landscape elements and visual receptors considered to be sensitive to the proposed substation development will be used to refine its final layout as appropriate. Mitigation measures will be developed in tandem with the layout to minimise potential adverse effects.

Assessment of Likely Effects

5.56 The LVIA will follow established procedures for determining the significance of effects. The attributes of the baseline landscape resource (features, elements, characteristics and overall

character) and visual amenity will be determined and these attributes and the magnitude of the effect will be taken into account in considering the significance of effect.

5.57 The proposed onshore works will be assessed within the context of the character and attributes of the local landscape. The extent and significance of character change resulting from the onshore elements of the project will be established and also evaluated as to its importance.

5.58 Attention will be paid to the potential effects on valued visual receptors, chiefly sensitive residential and recreational receptors with the findings of the individual viewpoint assessments being extrapolated as appropriate. Recreational amenity will mainly be addressed via PRoW, roads and promoted recreational assets. The latter will include valued landscape resources for example designated landscapes.

5.59 The principal objectives of the assessment will be:

- To describe, classify and evaluate the existing landscape likely to be affected by the onshore elements of the project during the construction and operational phases;
- To identify visual receptors with views of the onshore elements of the project; and
- To assess the significance of the effects on landscape character and visual resources, taking into account the measures proposed to mitigate any of the effects identified.

Likely Significant Effects Anticipated during Construction, Operation and Decommissioning

5.60 Each of the landfall and cable route options would require a cable landing and an onshore cable corridor through the North Devon AONB and measures would be required to ensure that any temporary effects during construction are minimised through careful routing to avoid, where feasible, woodland and significant river corridor vegetation.

5.61 The new substation, either close to the existing one at Alverdiscott or elsewhere would be sited to minimise landscape and visual effects, using where possible existing vegetation cover to screen sensitive receptors. Consideration will be given to the means of accessing the substation location by the underground cable corridor in order to minimise the loss of vegetation during the construction phase and recommendations for strengthening the existing planting or for new planting will be proposed, as necessary.

Summary of Approach

Potential Impact	The Landscape and Visual Impact Assessment (LVIA) will identify and assess likely significant effects on landscape resources and visual receptors. These are likely to include temporary loss of vegetation arising from cable landing and laying operations and the visual effects arising from a new substation.
Survey/Study Proposed to Assess Impact	Baseline information on the landscape resource will be gathered through a combination of desk studies, consultation and field surveys. Key documents such as any county or local landscape character assessments will be reviewed as part of the desk study. The geographical extent of potential visibility will be established for the tallest elements of the onshore proposals by production of a Zone of Theoretical Visibility (ZTV) plans. Key viewpoints will be agreed with statutory consultees. Wireline diagrams of the substation and associated infrastructure will be produced to illustrate the location and potential appearance of the onshore elements of the project from each of the agreed viewpoints. A number will be developed further into photomontages of the proposed development in agreement

	with the local authorities.
Method of Impact Assessment	The LVIA will be undertaken with reference to best practice outlined in published guidance, including 'Guidelines for Landscape and Visual Impact Assessment, Second Edition (2002) Landscape Institute and the Institute for Environmental Management and Assessment'.

Potential Mitigation and Monitoring

5.62 Mitigation proposals may include the replanting of vegetation, including translocated hedgerows, over the top of constructed cables, in order to minimise the effects of the development in landscape terms. Reference will be made to the 'Holford Rules' which provide guidance on the restricted planting of tree species over a cable.

5.63 With reference to a new substation, strengthening of any existing hedgerow planting, tree belts or woodland may be required or there may be a need for additional planting. Ground modelling could also be undertaken in the form of a reduction in levels at the substation site or the provision of earth mounding to merge with surrounding levels.

Summary of Required Studies

5.64 The studies necessary to undertake the landscape and visual impact assessment of all onshore elements of the project include:

- Review of policies and plans;
- Landscape baseline study;
- Visual baseline study; and
- Route evaluation and assessment in respect of potential effects on elements within the landscape and views.

Ecology and Nature Conservation

Introduction

5.65 The area within which the potential landfall, cable route and substation options are located comprises a wide range of habitat types, including the Rivers Taw and Torridge and their tributaries, the estuary and associated saltmarsh, sand dunes, mudflats and sandflats. Coastal cliffs and sandy and pebble beaches are present along the coastline with areas of scrub, woodland, hedges, grassland, ponds and reservoirs throughout the area.

5.66 This section describes the methodology proposed to assess the effects of the onshore elements of the project on ecology and nature conservation interests.

Background Data/Information

5.67 An initial review of the main ecological and nature conservation designations and the local Biodiversity Action Plans has been undertaken, together with a study of the Taw-Torridge estuary. In addition, a site visit has been undertaken by an ecologist to the potential landfall options, cable routes and substation sites identified in this scoping report.

General Description of Project Area: Cornborough Range to Alverdiscott

Designations

5.68 The cliffs either side of, and including, the proposed landfall are designated as the Mermaid's Pool to Rowden Gut SSSI for geological reasons. The landfall and cable route would not directly affect any sites designated for their nature conservation value at either a national or international level.

5.69 The landfall site lies in a gap between the Cornborough Cliff County Wildlife Site (CWS) to the north, designated for its maritime grassland and heath, unimproved acidic grassland, scrub and bracken, and Abbotsham Cliff CWS to the south, designated for similar habitats, with the addition of wet flushes.

5.70 The cable route would cross the River Torridge to the south of the SSSI designation but within the (proposed) Seven Oaks Local Nature Reserve, which forms part of the Torridge Estuary CWS, designated for its estuarine and saltmarsh habitats. It is proposed that effects on this site would be minimised through the use of a tunnelling technique (such as HDD) beneath the river.

5.71 The cable route would seek to avoid woodland and parkland CWSs in the vicinity of the River Torridge.

Species and Habitats

5.72 The landfall location and cable route would pass through a range of habitat types, including:

- Sea cliffs and slopes;
- Rivers and streams (including the River Torridge to the south east of the Taw-Torridge estuary);
- Improved, semi-improved and possibly unimproved pasture;
- Arable land; and
- Hedgerows.

5.73 Habitats affected by the proposed route are likely to provide an opportunity for a number of protected or otherwise notable species to exist, which may include bats, dormice, breeding birds, badgers and possibly reptiles.

- Bat foraging would be primarily focussed on the woodland and hedgerows interlinking them, with mature trees and other structures likely to provide opportunities for bat roosting.
- Dormice are now recognised to make much more use of hedgerows and other habitats than was previously recognised, although core areas are still likely to be woodland and interlinking hedgerows.
- Breeding farmland birds would be primarily associated with the same habitats, although open grasslands and possibly arable fields may also be of value to ground-nesting birds.
- Badgers would again be most likely found in woodland or hedgerows, but their territories would also include areas of grassland and arable fields.
- Reptiles are most likely to occur in south-facing areas of hedge margins or woodland/scrub-edge locations, offering potential basking sites and nearby cover. It is

unlikely that specially protected amphibians such as great crested newts would be present, as the North Devon coast lies outside the natural ranges for this species.

General Description of Project Area: Saunton Sands to Alverdiscott

Designations

5.74 The beach and burrows behind this area form the northern edge of the Braunton Burrows Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) and the Core Area of the North Devon Biosphere Reserve, designated by the UN (UNESCO). This area comprises one of the largest dune systems in the country. It is designated for its important structural range of dunes ranging from the freshly-formed shifting "white dunes", through the more stable "grey dunes" with herbaceous vegetation to the more heavily vegetated dunes with creeping willow (*Salix repens*) habitats, along with transitional habitats between all of these. The dune matrix is largely held together by the vegetation assemblages inhabiting them, making it a particularly fragile and interesting site. It supports around 500 flowering plant species and is one of only two places supporting water germander (*Teucrium scordium*). Rare orchids also occur and the site is particularly rich in lower plants, being one of two sites in the south west designated for its population of the liverwort: petalwort (*Petalophyllum ralfsii*). It also has a good assemblage of lichens. The site is also of great value to invertebrates, with species such as red poplar leaf beetle (*Chrysomela populi*) and marbled white, grayling, ringlet and skipper butterflies also abundant. The amber sandbowl snail is also present.

5.75 Cliffs along the northern edge of the Saunton Sands beach form part of the Saunton to Baggy Point Coast SSSI, designated for its geological exposures and botanical features including maritime heathland, grassland and lichens.

5.76 No Local Nature Reserves or County Wildlife Sites are present within the area of the proposed landfall site.

5.77 The proposed cable route avoids any further designated sites for ecology and nature conservation until it reaches the Taw-Torridge estuary from Horsey Island. At this point a river crossing would be required towards land at Yelland. The river at this location forms part of the Taw-Torridge Estuary SSSI, designated for its importance for overwintering and migratory populations of wading birds and rare plants. It is proposed that effects on this site would be minimised through the use of a tunnelling technique (such as HDD) beneath the river.

Species and Habitats

5.78 The landfall location and cable route would pass through a range of habitat types, including:

- Sand dune habitats, including "white" and "grey" vegetated sand dunes, beach and associated sand/mudflats;
- Braunton Marshes, including pasture fields and a matrix of boundary ditches, often including common reeds;
- Rivers and streams (including the Taw-Torridge estuary);
- Improved, semi-improved and possibly unimproved pasture;
- Arable land; and
- Hedgerows.

5.79 As for the Cornborough Range option, habitats affected by the proposed route are likely to provide an opportunity for a number of protected or otherwise notable species to exist, including bats, dormice and badgers. In addition to those species to be expected in the broader landscape, this area is also likely to support species associated with sand dune habitats at Braunton Burrows including:

- Rare plants and lower plants, invertebrates and reptiles possibly including sand lizard (*Lacerta agilis*);
- Breeding farmland birds would be primarily associated with the same habitats, although open grasslands and possibly arable fields may also be of value to ground-nesting birds. The route at Braunton may also affect nesting birds associated with the more scrub-covered areas, and those associated with Braunton Marshes, which may support species which favour reedy habitats; and
- Reptiles which are most likely to occur in south-facing areas of hedge margins or woodland/scrub-edge locations, but are also likely to occur on inland areas of the Burrows (possibly including the European Protected Species sand lizard, which may have been reintroduced into this area). As at Cornborough it is unlikely that specially protected amphibians such as great crested newts would be present.

General Description of Project Area: Woolacombe to Alverdiscott

Designations

5.80 The beach and immediate area surrounding the landfall option for Woolacombe is not subject to any national or international nature conservation designation. No Local Nature Reserves or County Wildlife Sites would be directly affected.

5.81 The potential cable route options would avoid any designated sites for ecology or nature conservation until reaching the Taw-Torridge estuary, where the river crossing would fall within the Taw-Torridge Estuary SSSI. As for the Saunton Sands option, it is proposed that effects on this site would be minimised through the use of a tunnelling technique (such as HDD) beneath the river.

5.82 For an east of Braunton option, the cable route could continue along the southern edge of the river towards Yelland close to the SSSI and other ecological designations such as County Wildlife Sites and RSPB Reserves alongside the river.

Species and Habitats

5.83 The landfall location and cable route would pass through a range of habitat types, including:

- Beach;
- Braunton Marshes, including pasture fields and a matrix of boundary ditches, often including common reeds;
- Rivers and streams (including the Taw-Torridge estuary);
- Improved, semi-improved and possibly unimproved pasture;
- Arable land; and
- Hedgerows.

5.84 As for the Cornborough Range and Saunton Sands options, habitats affected by the proposed route are likely to provide an opportunity for a number of protected or otherwise notable species to exist, particularly bats, dormice, breeding farmland birds, badgers and reptiles.

Identification of Potential Effects and Proposed Assessment Methodology

Scope and Methodology

5.85 A desk study, together with relevant site and species surveys will be carried out to establish the existing ecology and nature conservation interest of the areas covered by the different elements of the onshore development. The desk study area will extend to approximately 2km from the landfall, substation and cable route options and will include:

- Review of existing records of plants, animals and habitats held by relevant biological record centres and local interest groups as well as information presented in published and unpublished literature, to the extent that these are available;
- Consultation with key groups including Natural England, Devon Wildlife Trust and local wildlife groups;
- Mapping of the locations of statutory and non-statutory sites of importance for nature conservation, e.g. SPA, SAC, SSSI and County Wildlife Sites;
- Review of relevant Local Biodiversity Action Plans;
- Identification of habitats and features of value or those with potential to support protected or otherwise notable species (including habitats and species of principal importance – priority UK Biodiversity Action Plan habitats and species) and those identified in Local Biodiversity Action Plans.

5.86 To supplement and update the desk-based study and to obtain detailed information on plant communities present and the potential habitats for key species groups, an extended Phase 1 Habitat survey will be carried out. This will follow the standard method (JNCC 2003) and will be undertaken at the landfall and substation sites and along the cable corridors and on land adjacent to these elements. It will involve an assessment of potential habitat for, but not limited to, the following:

- Bats;
- Otters/Water vole;
- Badgers;
- Birds;
- Reptiles (Specially protected amphibians unlikely to be encountered in the broader routes, but may be necessary if desk-study shows potential present in areas such as Braunton Burrows, where sand lizard may have been re-introduced); and
- Invertebrates.

5.87 During this survey attention will particularly focus on identifying species rich hedgerows and mature trees of intrinsic value, trees likely to support bat roosts, and rivers and ditches of potential interest, including those likely to support important plant species and aquatic fauna (e.g. otter and water vole). The results of the Phase 1 survey will be used to identify the need for additional detailed species or habitat surveys.

5.88 Targeted surveys could potentially include:

- Detailed habitat surveys, including hedgerow surveys to be undertaken in accordance with the Hedgerows Regulations 1997. Targeted areas of habitat may also require detailed floristic surveys and National Vegetation Classification (if appropriate). Complex habitat areas such as dunes will require detailed micro-habitat assessment, which would include elements of species assemblage, but also structure and substrate stability, to refine the potential impact assessment;
- Invertebrate survey, initially based on a walkover habitat survey or initial aquatic habitat survey by an appropriate invertebrate specialist. Further detailed work may be required following the initial assessment;
- Breeding bird surveys for insensitive habitat areas, particularly any areas with records of particularly vulnerable or protected species. Wintering bird surveys for sensitive areas such as the Taw/Torridge Estuary, which are known to be important for wildfowl;
- Reptile survey conducted in accordance with the JNCC "Herpetofauna Workers Manual" 1998 to be undertaken from April-May or August-September. This may include licensed survey for sand lizard, if conducted in Braunton Burrows areas;
- Mammal survey along suitable water courses to search for signs of mammal activity such as feeding stages, burrows and runs (Water Voles), and holts, couches and spraints (Otters);
- Badger survey to conform to good current practice and informed by guidance such as that in the Design Manual for Roads and Bridges and produced by Creswell *et al.* (1990);
- Dormouse survey, conforming to the good practice recommendations in the Dormouse Conservation Handbook (2nd Ed. 2006) Natural England; and
- Bat surveys to conform to current guidance (Bat Surveys - Good Practice Guidelines 2007, Bat Conservation Trust).

5.89 The scope of all surveys will be agreed with Natural England, as appropriate, prior to being undertaken.

5.90 The data gathered during the desk study and field surveys will be used to undertake the ecological impact assessment for the project, which will be based on guidance issued by the Institute of Ecology and Environmental Management (IEEM, 2006). The method involves five key stages:

- Consultation;
- Baseline studies and evaluation of ecological receptors;
- Identification of Valued Ecological Receptors;
- Identification and characterisation of potential effects; and
- Assessment of the significance of effects.

5.91 Statutory and non-statutory nature conservation organisations that will be consulted include Natural England, the Environment Agency, the County Ecologist for Devon, the Devon Wildlife Trust, the RSPB, British Trust for Ornithology (BTO), Devon Biodiversity Record Centre, local badger, mammal, bat and amphibian and reptile groups, County bird and butterfly recorders and the Botanical Society for the British Isles (BSBI). A summary of the relevant planning policy, legislative context and key ecological legislation will be provided.

5.92 The ecological assessment will include an evaluation of habitats and species present on site including an assessment of their importance at local, regional, national and international level. The potential effects on the habitats and species present will be assessed including direct loss of habitats, effects during construction including damage to valuable habitats, impacts during operation, and cumulative effects with other potential developments in the area.

Likely Significant Effects Anticipated during Construction, Operation and Decommissioning

5.93 The following effects during the construction, operational and decommissioning phases of the project would be considered within the assessment:

- Direct loss of any existing habitats, or species at the landfall or along the cable route corridor;
- Disturbance or damage to any habitat or species on or adjacent to the route corridor due to construction or maintenance of the cables;
- Habitat fragmentation or species isolation and the potential for severance of aerial migration routes to/from more distant receptors; and
- Discharge/pollution.

5.94 Protection of species afforded by relevant legislation including the Wildlife and Countryside Act 1981 (and amendments), the Countryside and Rights of Way Act 2000, and the Conservation (Natural Habitats & etc) Regulations 1994 (as amended) will be taken into account, as will relevant non-statutory guidance.

5.95 For the Saunton Sands option (if selected), the effects on the Braunton Burrows European designated site will be assessed, including the provision of information towards an Appropriate Assessment.

Summary of Approach

Potential Impact	Likely significant effects on ecological and nature conservation including: ▪ Direct loss of any existing habitats, or species at the landfall or along the cable route corridor; ▪ Disturbance or damage to any habitat or species within or adjacent to the route corridor due to construction or maintenance of the cables; ▪ Habitat fragmentation or species isolation; and ▪ Discharge/pollution.
Survey/Study Proposed to Assess Impact	A desk study, together with relevant site and species surveys will be carried out to establish the existing ecology and nature conservation interest of the areas covered by the onshore elements of the project. To supplement and update the desk-based study and to obtain detailed information on habitats present, an extended Phase 1 Habitat survey will be undertaken. This will follow the standard method (JNCC 2003) and will also involve an assessment of potential habitat for protected species. The results of the Phase 1 survey will be used to identify the need for additional detailed species or habitat surveys, which may include surveys for invertebrates,

	reptiles, badgers, water voles, otters and bats as well as surveys of habitats, including hedgerows. Survey methodologies will take into account the most recent species/habitat specific guidance.
Method of Impact Assessment	The impact assessment will be based on guidance issued by the Institute of Ecology and Environmental Management (IEEM, 2006).

Potential Mitigation and Monitoring

5.96 Mitigation measures that can be incorporated into the project design to avoid or reduce the potential for adverse effects on biodiversity will be identified.

5.97 In the event that the Saunton Sands option is taken forward, a construction design will be developed to minimise effects on the SAC. This is likely to include HDD beneath the dunes to minimise any surface effects on the designated site. In addition, a programme of mitigation for effects on specific habitats and species will be developed for this option.

5.98 The Taw-Torridge Estuary SSSI is of national nature conservation importance with large numbers of wintering birds using it. The route options shown would generally avoid direct effects on the SSSI, except for the river crossings associated with the Saunton Sands and Woolacombe potential landfalls. For these options, consideration would have to be given to the timing of the construction work in order to avoid potential disturbance to wintering and breeding birds and appropriate methods of drilling beneath the river to minimise any effects on hydrology and the nearby habitat. Given the local importance of the River Torridge in the vicinity of the proposed river crossing for the potential Cornborough Range landfall, these factors would also be considered for this option.

5.99 Where the cables pass through woodland, tree clearance is often carried out, so cable routing would seek to avoid woodland where possible.

5.100 Detailed surveys will determine a scheme of mitigation for the protection of terrestrial species.

Summary of Required Studies

5.101 The studies undertaken to inform the assessment of effects on ecology and nature conservation would comprise:

- Desk based study;
- Phase 1 survey of route followed by detailed ecological surveys of terrestrial habitats and species, as required; and
- Assessment of effects on ecology and conservation

Historic Environment

Introduction

5.102 The area within which the potential landfall, cable route and substation options are located has a long history of human habitation. This is demonstrated by the historic landscape features, such as enclosed fields defined by ancient hedge-banks, field patterns, historic farmsteads, hamlets and villages. This is recognised through a range of designated sites, together with areas of recognised local significance for their historic character.

5.103 The historic environment assessment will comprise an assessment of the known and potential cultural heritage resources that may be affected by the onshore elements of the project. This will include an assessment of the likely significant effects on archaeology.

Background Data/Information

5.104 An initial review of the main heritage designations, including nationally designated sites, listed buildings and Conservation Areas has been undertaken as part of the initial landfall and cable route studies. In addition, locally important historic sites have been identified, such as those at Braunton Great Field and Braunton Marshes.

General Description of Project Area: Cornborough Range to Alverdiscott

5.105 No major cultural heritage constraints have been identified at this landfall location.

5.106 An extensive scheduled monument lies to the west of the Alverdiscott substation at Higher Kingdon. This is the site of an Iron Age enclosure and a subsequent Roman marching camp. The proposed cable route would avoid this monument.

5.107 A scheduled monument is also present on the banks of the River Torridge to the south of Hallsannery. This lime kiln would be avoided by the proposed river crossing.

General Description of Project Area: Saunton Sands to Alverdiscott

5.108 No major cultural heritage constraints have been identified at this landfall location.

5.109 The cable route would avoid designated features of national or international heritage value. It would, however, pass along the edge of both the Braunton Great Field and Braunton Marshes.

5.110 Braunton Great Field is one of few remaining medieval strip field systems in Britain. This area is protected within the Local Plan from any development that would harm the integrity of its archaeological landscape. The Great Field has been subject to a management study which identifies objectives for the management of the historical features, primarily reinstatement, maintenance and preservation of boundaries.

5.111 Braunton Marshes lie directly to the south of the Great Field and to the east of the sand dune system at Braunton Burrows. The history of this area of marshland is directly linked to the dunes to the east, which provide a sheltered area for the accumulation of river sediments.

5.112 The saltmarsh was enclosed in 1811 for cattle grazing and is now managed by the marsh landowners, the Braunton Marsh Internal Drainage Board and the Marsh Inspectors. The marsh drainage system is managed by the Internal Drainage Board while the management of the communal lands belonging to the marsh landowners is undertaken by the Marsh Inspectors.

5.113 There are a number of listed buildings and structures within the marshes area. In addition, buried archaeology may also be present.

5.114 As described for the Cornborough Range option, an extensive scheduled monument lies to the west of the Alverdiscott substation at Higher Kingdon. The proposed cable route would avoid this monument.

General Description of Project Area: Woolacombe to Alverdiscott

5.115 No major cultural heritage constraints have been identified at this landfall location, subject to avoiding the Woolacombe Conservation Area, which would appear to be feasible.

5.116 Each of the cable route options would avoid designated features of national or international heritage value. There are a number of listed buildings and structures throughout the area, which are likely to be able to be avoided by the cable routing. In addition, buried archaeology may well be present.

5.117 A cable route west of Braunton would, however, pass along the edge of both the Braunton Great Field and Braunton Marshes as described above.

5.118 All cable options would require a connection to Alverdiscott. As described above, an extensive scheduled monument lies to the west of the Alverdiscott substation at Higher Kingdon but the proposed cable route would avoid this monument.

Identification of Potential Effects and Proposed Assessment Methodology

Scope and Methodology

5.119 The assessment of the likely significant effects on archaeology and cultural heritage resources arising from all onshore elements of the project will consist, in the first instance, of the preparation of a desk based assessment. This will collate and describe the known archaeological and cultural heritage resources as follows:

- buried archaeological sites, whether designated or not, within a circle of 1 km radius centred on the substation site, and 500m from the centre of each cable route corridor;
- designated historic environment resources of international and national significance (World Heritage Sites, Scheduled Monuments, Listed Buildings Grade I and II*, Registered Parks and Gardens of Special Historic Interest Grade I and II*, Registered Battlefields) within a circle of 5 km radius centred on the substation site and within the identified Zone of Theoretical Visibility (ZTV), and 500m from the centre of each cable route corridor; and
- designated historic environment resources of regional and local significance (Conservation Areas, Listed Buildings Grade II, Registered Parks and Gardens of Special Historic Interest Grade II, locally designated Parks and Gardens, locally listed buildings, locally identified historic landscape areas) within a circle of 3 km radius centred on the substation site and within the identified ZTV, and 500m from the centre of each cable route corridor.

5.120 This desk based assessment will be conducted with reference to the appropriate national, regional and local plans as well as the following legislation and guidance:

- English Heritage ‘Wind Energy and the Historic Environment’ (2005);
- Ancient Monuments and Archaeological Areas Act (1979);
- Planning (Listed Buildings and Conservation Areas) Act (1990);
- Planning Policy Guidance 16: Archaeology and Planning (1991);
- Planning Policy Guidance 15: Archaeology and the Historic Environment (1994);
- Institute of Field Archaeologists ‘Standards and Guidance for Archaeological Desk Based Assessment’ (1994, revised 2001); and
- Highways Agency Guidance Note 208/07 within DMRB Volume 11, section 3, part 2.

5.121 In addition, consideration will be given to any specific cultural associations that the area may have, for example, in terms of literature or paintings.

5.122 Supplementary data will be gathered through a walkover field survey from the landfall sites to the Alverdiscott substation site in order to provide information on the archaeological potential of the affected areas. This survey will be conducted to:

- Assess and validate data collected as part of the desk based assessment;
- Identify the extent and condition of any visible archaeological monuments that might be affected, including any not previously recorded;
- Assess the topography and geomorphology of the landfall and substation sites and cable routes; and
- Inform an assessment of the context of these sites and routes as part of the wider historic landscape.

5.123 Previously unrecorded sites will be plotted accurately using GPS, local landmarks and tapes as appropriate, onto base plans. Written descriptions, scale sketch plans and photographic records will be made of all previously unrecorded sites located within the study area.

5.124 Key resources will be visited, or inspected as closely as is possible from vantage points given access constraints, to assess potential effects on settings and on the wider historic landscape and any associated features. Work will be carried out by appropriately qualified and experienced archaeologists working alongside the project landscape architects.

5.125 The results of the desk-based assessment and site walkover will be discussed with the archaeological advisor to the local planning authorities and English Heritage (if appropriate). Such discussions would appraise the quality of available information and determine whether further evaluation in the form of intrusive or non-intrusive archaeological fieldwork is required. If necessary, archaeological surveys would be undertaken in order to identify the nature and significance of any buried remains that may be affected by the onshore elements of the project.

5.126 Any archaeological fieldwork would be undertaken in accordance with a methodology agreed with the archaeological advisor to the local planning authorities and English Heritage (if appropriate).

5.127 The magnitude of any impact that the project may have on identified historic environment resources, including the settings of those resources where appropriate, will be described. Other proposed developments in the vicinity will be examined in order to identify any potential cumulative impacts. Any likely significant effects of the project on the overall historic landscape will also be assessed.

5.128 Appropriate mitigation measures will be described and the assessment of effects will take account of any mitigation measures proposed as part of the project.

Likely Significant Effects Anticipated during Construction, Operation and Decommissioning

5.129 The following effects during the construction and operational phases of the proposed development are anticipated.

Cornborough Range to Alverdiscott

5.130 The main archaeological issue for the Cornborough Range to Alverdiscott corridor option would be the known archaeology near Alverdiscott at Higher Kingdon. The route would avoid this designated feature.

5.131 Although the route corridors avoid scheduled monuments and known archaeological sites, there remains a risk of encountering other significant archaeological remains.

Saunton Sands to Alverdiscott

5.132 In addition to the effects described for the Cornborough Range to Alverdiscott route, the corridor from Saunton Sands would require archaeological investigation of the land affected at Braunton Great Field and Braunton Marshes.

Woolacombe to Alverdiscott

5.133 In addition to the effects described for the Cornborough Range to Alverdiscott route, a west of Braunton corridor from Woolacombe would also require archaeological investigation of the land affected at Braunton Great Field and Braunton Marshes.

Summary of Approach

Potential Impact	The assessment will consider the likely significant effects of the onshore elements of the project on cultural heritage resources, including the significant archaeological remains near Alverdiscott, and land at Braunton Great Field and Braunton Marshes.
Survey/Study Proposed to Assess Impact	The assessment of likely significant effects on heritage resources arising from all elements of the onshore development will consist of: - Desk based assessment to collate and describe the known archaeological and cultural heritage resources. - Walkover field survey from the landfall sites to the substation site(s) to provide information on the archaeological potential of the affected areas. - Site visit or inspection of key resources to assess potential effects on settings and on the wider historic landscape and any associated features. The results of the desk-based assessment and site walkover will be discussed with the archaeological advisor to the local planning authorities and English Heritage (if appropriate) to appraise the quality of available information and determine whether further evaluation in the form of intrusive or non-intrusive archaeological fieldwork is required. Any archaeological fieldwork would be undertaken in accordance with a methodology agreed with the archaeological advisor to the local planning authorities and English Heritage (if appropriate).
Method of Impact Assessment	The effect that the project may have on identified historic environment resources, including the settings of those resources where appropriate, will be described. Any likely significant effects of the proposed scheme on the overall historic landscape will also be assessed. Relevant guidance will be taken into account in assessing the likely effects of the project, including published EH guidance, PPG15 and 16, and Highways Agency guidance.

Potential Mitigation and Monitoring

5.134 The cable corridor may require some pre-construction evaluation and/or other on-going monitoring and investigation during construction. Pre-construction work would include detailed

desk-based assessment leading to corridor amendments where necessary and/or the adoption of construction techniques that minimise the width of disturbance or avoid surface disturbance altogether.

5.135 Where archaeological remains cannot be avoided, detailed investigations may be needed prior to construction, although this may be able to take place within the construction period.

5.136 Direct effects on the scheduled monument at Higher Kingdon should be avoided in detailing the cable route, although the effects on the setting of the monument should also be considered.

Summary of Required Studies

5.137 The studies undertaken to inform the assessment of effects on archaeology and cultural heritage resources would comprise:

- Desk based assessment;
- reconnaissance field survey;
- assessment of likely effects for EIA;
- pre-construction evaluation; and
- on-going monitoring and investigation during construction, as required.

Ground Conditions and Water Resources

Introduction

5.138 The area within which the potential landfall, cable route and substation options are located includes a number of key hydrological features, including the Rivers Taw and Torridge and the Taw-Torridge estuary. The Rivers Taw (from the north east) and Torridge (from the south) converge near Appledore between Braunton Burrows to the north and Northam Burrows to the south.

5.139 The coastal landscape has been shaped by its underlying geology and the action of the sea. In many parts of the study area, the coastline remains undefended and has been allowed to evolve naturally, creating imposing cliff structures and exposing geological strata.

5.140 This section describes the methodology proposed to assess the effects of the onshore parts of the project on hydrology and flood risk, ground conditions and geology.

Background Data/Information

5.141 An initial review of the main hydrological features of the area, including flood risk, has been undertaken. In addition, the key geological designations and conditions have been identified.

General Description of Project Area: Cornborough Range to Alverdiscott

Landfall

5.142 The landfall location is not at risk of flooding inland of the beach. There are no major watercourses in the immediate area.

5.143 The cliff line in the vicinity of, and including, the cliff line that would be crossed by the HDD for this landfall option is designated as the Mermaid's Pool to Rowden Gut SSSI for geological reasons. This SSSI includes outcrops of the Bideford Formation which comprises strata of broad and slightly asymmetric folds of alternating mudstones, siltstones and sandstones.

5.144 At this location, HDD would be necessary to minimise any effect on the surface exposed strata. The proposed HDD construction compound and landing site for the cables would be outside the SSSI at the cliff top.

Corridor

5.145 The cable route crosses several water courses with floodplains, the largest of note being the River Torridge.

5.146 The route would avoid but would pass within 1km of Jennets reservoir south of Bideford and Gammerton reservoir near Gammerton Barton. Both reservoirs are stocked for fishing.

5.147 The cable route option would not cross any geological SSSIs once beyond the landfall at Cornborough.

Substation

5.148 The existing Alverdiscott substation and surrounding land is bounded by small watercourses to the south and east but is not at significant risk of flooding. Potential alternative landfall locations near Atlantic Village are not at risk of flooding.

General Description of Project Area: Saunton Sands to Alverdiscott

Landfall

5.149 The landfall at this location may be located on the beach, with HDD undertaken from either side of the sand dunes.

5.150 The cliffs along the northern edge of the Saunton Sands beach form part of the Saunton to Baggy Point Coast SSSI, designated for its geological exposures as well as nature conservation interest. It is likely to be possible to avoid effects on this SSSI.

Corridor

5.151 The cable route crosses several water courses with floodplains, the largest of note being a river crossing of the River Taw near the Taw-Torridge estuary from Horsey Island to Yelland. It is assumed that this river would be crossed by HDD.

5.152 Braunton Marshes lie within the 1 in 100 year floodplain for the estuary. The cable route option would not cross any geological SSSIs.

Substation

5.153 Options for a substation adjacent to the existing Alverdiscott substation are discussed above. The potential substation site at Yelland is located adjacent to the Taw-Torridge estuary and lies within the 1 in 100 year floodplain.

General Description of Project Area: Woolacombe to Alverdiscott

Landfall

5.154 The landfall at this location would be located outside the floodplain at Woolacombe. The nearest watercourses are the Taw-Torridge estuary, River Caen and Knowl Water.

5.155 No geological SSSIs are present in the immediate area of this landfall option.

Corridor

5.156 The cable routes would cross several water courses with floodplains, the largest of note being a river crossing of the River Taw. The cable route options would not cross any geological SSSIs.

Substation

5.157 The substation options at Alverdiscott and Yelland would be as discussed above for the Saunton Sands option.

Identification of Potential Effects and Proposed Assessment Methodology

Scope and Methodology

Ground Conditions

5.158 The assessment will involve a preliminary desk study, and initial liaison with the Environment Agency (EA), the local planning authorities and other regulatory bodies to establish potential hydrogeological and ground contamination constraints to the proposed cable routes.

5.159 During this first phase, the following sources would be reviewed:

- Ordnance Survey maps;
- Geological maps;
- Hydrogeological maps;
- Groundwater Sensitivity Maps;
- Local Authority contaminated land records; and
- Maps on the MAGIC (Multi-Agency-Geographic-Information for the Countryside) website for locations of sensitive sites such as Sites of Special Scientific Interest, Special Areas of Conservation etc.

5.160 To identify the potential sources of contamination, pathways by which the source may be affected and receptors (such as watercourses and ecologically important sites) the desk study will review available information to allow an assessment of:

- Historical land uses to assess the potential for ground contamination;
- Areas of contaminated land; and
- Environmental setting to assess the sensitivity of the surrounding environment to contamination and pollution.

5.161 In the case of Yelland, information about the previous land uses and data presented in previous site assessments will be taken into account.

5.162 This will enable any necessary further data collection to be highly targeted, e.g. where potentially contaminated land is in close proximity to sensitive sites.

5.163 An assessment will be made of the likely significant effects of the project on ground and surface water quality and flows and all sensitive sites. The assessment will include the construction, operation and decommissioning phases, and mitigation recommendations will be made.

5.164 The methodology used to identify likely effects on ground conditions would comprise:

- Review of the legislative and policy context;
- Desktop baseline study to identify ground conditions prevailing across all elements of the project and, in particular, the potential for contaminated land;
- Assessment of risk posed by ground and groundwater conditions; and
- Identification of remedial measures to mitigate any potential effects.

Geology

5.165 For all cable route options, effects on any sites designated for their geological interest will be considered. This will include identification and consideration of locally or regionally designated sites (such as Regionally Important Geological Sites) as well as SSSIs.

5.166 For the proposed landfall option at Cornborough Range, consideration will need to be given to the likely effects on the geological SSSI. This will include further engineering assessment to identify the exact location of the landfall and cable routes relative to the existing outfall and local characteristics and the suitability of the geology in this area for HDD. Early consultation will be undertaken to discuss the proposed methodology and any scope for effects on the SSSI.

Hydrology and Flood Risk

5.167 The assessment of likely effects on water resources would include the effects on the prevailing hydrological, surface water drainage, flooding and water quality environments at the landfall sites, along the cable corridors and at the substation site.

5.168 The initial phase of the assessment would comprise baseline data collection. This will involve a preliminary desk study, and initial liaison with the EA, the local water authority and other regulatory authorities to establish key hydrological constraints to the development.

5.169 The desk study will include reference to maps and published information regarding the topography, geology and hydrology of the areas covered by all elements of the project and any previous published reports (e.g., at Yelland). A walkover survey would be undertaken to ascertain the current site conditions.

5.170 Main sources of publicly available information used in the assessment would include:

- Ordnance Survey maps;
- 1:250,000 Soil Map of the UK;
- Hydrogeology map of England and Wales;
- Environment Agency flood maps;
- Previous assessments or reports;
- Natural England website for SSSI boundaries, assessments and designations; and
- MAGIC (Multi-Agency-Geographic-Information for the Countryside) website.

5.171 The desk study and site walkover survey would determine the likely requirements for further site investigation.

5.172 Likely effects associated with the project would be identified as follows:

- Potential for flooding during the operation of the project;
- Potential for the operation of the project to cause flooding;
- Risk of contaminated water run-off from the construction corridor; and
- Subsequent effects of that run-off on water quality.

5.173 The assessment is likely to require some or all of the following:

- Consideration of likely effects arising during construction, including potential for pollution and run off;
- Confirmation of modelled flood level for the substation site, including potential impacts of climate change, and comparison of these flood levels against topographic levels over the site and surrounds;
- Identification of any hydrological constraints to the proposed development (landfall, substation and cable route);
- Assessment of the existing surface-water runoff regime at the substation site, and determination of the potential impacts of the development on peak runoff rates and flow directions;
- Development of a conceptual mitigation strategy for the proposed development, including an outline for appropriate surface-water drainage (SUDS);
- Consideration of flood storage compensation measures (if required);
- Assessment of effects within the ES chapter.

5.174 There will be a need for completion of a Flood Risk Assessment (FRA) for the onshore elements of the project, notably the proposed substation. At Alverdiscott or land near Atlantic Village, a new/extended substation is likely to be in Flood Zone 1, and hence the risk of fluvial and tidal flooding is considered to be low. However, due to the size of the site (in excess of 0.5ha), under the guidelines in Planning Policy Statement 25 (PPS25) there is a need to consider the potential alteration of the surface water runoff regime, and assess the adverse impacts on the local and catchment-wide risk of flooding. At Yelland, any new substation would be located adjacent to the Taw-Torridge estuary within the 1 in 100 year floodplain. This would require further consideration and assessment of the opportunities to minimise effects on the floodplain and to provide defence of the substation itself.

Likely Significant Effects Anticipated during Construction, Operation and Decommissioning

Ground Conditions

5.175 The presence of contaminated soils may have an adverse effect on the construction phase as there may be an increased risk to construction workers from contact with contaminants. Any off-site removal of contaminated soils may also have an effect during construction due to increased vehicle movements and use of landfill void.

5.176 The operation of the cable corridors is not likely to have any significant interaction with sources of potential contamination.

Geology

5.177 Effects on features of geological interest may arise. In particular, for the option at Cornborough Range, effects on the geological SSSI would be considered.

Hydrology and Flood Risk

5.178 As outlined above the potential effects during construction relate to the potential risk of contaminated water run-off from the construction area and subsequent effects on water quality. Operational effects are likely to relate to the potential for flooding on, and arising from, the project. A Flood Risk Assessment (FRA) will be undertaken.

Summary of Approach

Potential Impact	The assessment will consider the likely significant effects of the onshore elements of the project on hydrology and flood risk, ground conditions and geology. These are anticipated to include the presence of contaminated soils (notably for the Yelland substation option), effects on the geological SSSI for the Cornborough option and the potential risk of contaminated water run-off and effects on water quality.
Survey/Study Proposed to Assess Impact	5.179 The assessment of likely significant effects on ground conditions would comprise: ▪ Review of the legislative and policy context; ▪ Desktop baseline study to identify ground conditions prevailing across all elements of the project and, in particular, the potential for contaminated land; ▪ Assessment of risk posed by ground and groundwater conditions; ▪ Identification of remedial measures to mitigate any potential effects. For all route options, effects on any sites designated for their geological interest will be considered. The assessment of effects on water resources would include those on the prevailing hydrological, surface water drainage, flooding and water quality environments at the landfall sites, along the cable corridors and at the substation site. This would include: ▪ Baseline data collection. ▪ Site walkover survey would determine the likely requirements for further site investigation. ▪ Identification of potential effects. including flood risk and contaminated water run-off, ▪ Development of a mitigation strategy. ▪ Consideration of flood compensation measures (if required). ▪ Flood Risk Assessment (FRA) for the project, notably the proposed substation(s).
Method of Impact Assessment	The effect that the onshore elements of the project may have on identified hydrological features, flood risk, ground conditions (including contamination) and geology will be

	described. Any likely significant effects of the proposed scheme will be assessed. Relevant guidance will be taken into account in assessing the likely effects of the scheme. This may include the most recent guidance from the Highways Agency expressed in Guidance Note 208/07 (August 2007) that now forms part of the Design Manual for Roads and Bridges (DMRB, Volume II, section 3, part 2).

Potential Opportunities for Mitigation and Monitoring

5.180 Appropriate measures would be proposed to mitigate potential adverse effects arising from the excavation of contaminated material, with the implementation of management and occupational hygiene measures as necessary.

5.181 In addition, measures to protect features of geological importance and water resources would be implemented, including pollution control measures.

Summary of Required Studies

5.182 The following studies would be undertaken:

- Desk Study including a contaminative uses (historic) search;
- Site/route walkover survey;
- Constraints mapping;
- Characterisation of project risks to water environment;
- Consultation, desk study and further site investigations as required in the vicinity of geological SSSI at Cornborough Range;
- Conceptual model and Phase 1 risk assessment (contamination);
- Development of mitigation measures for entry into Environmental Management Plan;
- Flood Risk Assessment; and
- Impacts assessment taking into account mitigation proposed as part of the project.

Soils, Agriculture and Land Use

Introduction

5.183 Soils within Devon are varied and dependent on the underlying geology and topography as well as historic use. Soils in the UK are classified in agricultural terms using the Agricultural Land Classification (ALC) system. This system grades agricultural land from Grade 1 (best quality) through to Grade 5 (poorest quality) based on factors including climate, nature of the soil and site-based factors.

5.184 This section describes the methodology proposed to assess the effects of the onshore elements of the project on soils, agriculture and land use.

Background Data/Information

5.185 An initial review of existing ALC information for the area has been undertaken. In addition, a site visit has been undertaken by an experienced land use consultant to the potential landfall options, cable route and potential substation sites identified in this scoping report.

General Description of Project Area: Cornborough Range to Alverdiscott

Landfall

5.186 Land at the cliff top at the proposed landfall site is currently in agricultural use and is classified as ALC Grade 3.

Cable Route Option

5.187 The route runs through areas of primarily Grade 3 agricultural land, with areas of Grade 4 land also present, particularly along the river valleys.

Substation

5.188 The existing substation at Alverdiscott is located in an area of Grade 4 land. The nearby fields identified as potentially suitable for an additional substation are in agricultural use and are of ALC Grades 3 and 4. Land near Atlantic Village is primarily Grade 3 agricultural land.

General Description of Project Area: Saunton Sands to Alverdiscott

Landfall

5.189 The landfall site comprises beach and sand dunes not in agricultural use.

Cable Route Option

5.190 Land to the east of the burrows is primarily ALC Grades 3 and 4, although pockets of Grade 2 land are present and include Braunton Great Field.

Substation

5.191 The existing substation at Alverdiscott is located in an area of Grade 4 land as discussed above. Land at Yelland is not in agricultural use, having previously been used as a power station site.

General Description of Project Area: Woolacombe to Alverdiscott

Landfall

5.192 The landfall site comprises car parks not in agricultural use.

Cable Route Option

5.193 Land to the east of the landfall is primarily ALC Grades 3 and 4, although pockets of Grade 2 land are present. For a west of Braunton option, land at Braunton Great Field is ALC Grade 2.

Substation

5.194 Land at Alverdiscott and Yelland is as set out above.

Identification of Potential Effects and Proposed Assessment Methodology

Scope and Methodology

5.195 The assessment would consider the likely significant effects of the onshore elements of the project on the existing soils, agricultural and land use framework. The framework of agricultural land use includes both the physical agricultural resource in terms of the soils materials being used for agricultural production and also the nature and operation of the types of farming enterprises. The assessment of effects in relation to agriculture would therefore include the assessment of:

- Soil resources affected by construction activities;
- Agricultural land quality of the soils affected;
- Likely effects on farm holdings during the construction phase.

5.196 The methodology for the assessment of the effects on land use, agriculture and soils arising would be informed by the following current guidance:

- DMRB Volume 11, Section 3, Part 6 (Land Use);
- EIA Guidance;
- DEFRA guidance including the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009)

5.197 The assessment would, in particular need to address the requirements of DEFRA guidance on the sustainable use of soils on construction sites.

5.198 The assessment work would be carried out in the following stages.

Desk Study

5.199 A desk top assessment will include a review of the following information:

- Published Soils Information from the Soil Survey of England and Wales (1:63,360 and 1:250,000);
- MAFF Published 1 inch to 1 mile ALC Sheets;
- British Geological Sheet at 1:50,000;
- Detailed DEFRA survey information; and
- Published Climatic Information from the Soil Survey LANDIS database. This information is relevant to the assessment of key criteria within the Agricultural Land Classification system.

5.200 In addition, the desk study will include consideration of the farm holdings. This will draw on the following published information to identify patterns of farming and land use along the proposed route:

- Aerial photography;
- DEFRA farming statistics; and
- Land Registry information, if available.

Field Survey: Soil Resource and Agricultural Land Classification

5.201 This survey would be carried out as a verification of the published information collected, based on reconnaissance survey work, to identify the characteristics of the main soil types along the route and their limitations. This would be undertaken using a 1m Dutch hand auger to examine soil profiles along the route corridors.

5.202 This information would be used to draw together a soil management strategy for the construction process, in line with DEFRA guidance.

Field Survey: Farm Holdings

5.203 The effects on farm holdings would consider information provided by the projects land agents and/or directly from the farmers at the potential landfall and substation sites and along the cable route.

Assessment of Effects

5.204 The assessment of effects on soils, agriculture and land use would include:

- Assessment of effects on soils and agricultural land quality;
- Assessment of effects on farm holdings ;and
- Provision of Soil Management Strategy for construction in line with DEFRA guidance.

Likely Significant Effects Anticipated during Construction, Operation and Decommissioning

5.205 The main effects on agricultural and soil resources will be in the areas covered by the cable route corridors arising from trenching activities during the construction phase.

5.206 It would be assumed that landowners would specify any special land access arrangements during way leave negotiations and that significant effects on land holdings as a result of the temporary works could be avoided and would cease on reinstatement.

Summary of Approach

Potential Impact	The assessment will consider the likely significant effects of the onshore elements of the project on agriculture, soils and land use, which are anticipated to include effects on agricultural and soil resources during cable trenching and temporary effects on farm holdings.
Survey/Study Proposed to Assess Impact	The work would include a desk study to consider existing information in relation to agricultural land quality and farm holdings. A field survey would be undertaken as a verification of the published information collected, based on reconnaissance survey work, to identify the characteristics of the main soil types along the route and their limitations. The effects on farm holdings would consider information provided by the projects land agents and/or directly from the farmers along the route.
Method of Impact Assessment	The effect that the project may have on agriculture and land use will be described. Any likely significant effects of the project will be assessed. Relevant guidance will be taken into account in assessing the likely effects of the project. This would include the DEFRA Code for the Sustainable Use of Soils on

	Construction Sites.

Potential Mitigation and Monitoring

5.207 The incorporation of good practice in soil handling and restoration, wherever possible, from the following documents can assist in minimising any damage to soil materials during the construction process:

- MAFF 2000 Soil Handling Guide;
- DEFRA Code of Practice for the Sustainable Use of Soils on Construction Sites (2009).

5.208 Important principles to be considered in the construction process include:

- The identification and management of the soil materials on the site. These have been identified during the soil survey on site;
- Careful planning of haul routes and construction compounds to minimise soil disturbance;
- Timing of soil handling operations;
- Choice of soil handling machinery;
- Separate stripping, storage and reinstatement of topsoil and subsoil resources; and
- Careful supervision of soil handling operations on site.

5.209 These measures would be incorporated into a soil management strategy for the working and restoration of the soils.

Summary of Required Studies

5.210 The studies undertaken to inform the assessment of effects on soils, agriculture and land use would comprise:

- A desk top assessment of relevant published information, including data on soils and farm holdings;
- A field survey to characterise the soils and soil depths, inform a soil management strategy and identify likely effects on farm holdings; and
- Assessment of the likely effects as part of the ES.

Traffic and Transport

Introduction

5.211 The Devon Local Transport Plan 2006 to 2011 has been drawn up in accordance with the requirements of the Transport Act 2000. The Transport Plan identifies the A39 and A361 as principal road corridors in the area.

5.212 This section describes the methodology proposed to assess the effects of the onshore elements of the project on traffic and transport, including those arising during the construction of the landfall and substation and cable laying.

Background Data/Information

5.213 An initial review of the Transport Plan documents has been undertaken, together with a site visit to potential landfall sites and substation locations.

General Description of Project Area: Cornborough Range to Alverdiscott

Landfall

5.214 The area is accessible on foot from the South West Coastal Path which runs along the cliff top. There is currently no vehicular access to the beach but it may be possible to access the landfall location at the cliff top utilising existing agricultural access. In addition, there is a disused railway track leading from the road to the east, which may provide an opportunity for access to the area.

Cable Route Option

5.215 The proposed route would cross two main highway corridors, the A39 between Knotty Corner and Abbotsham Cross and the A338 adjacent to the River Torridge. It is anticipated that major roads would be crossed with ducts pre-installed by HDD.

5.216 A number of minor roads would also be within the cable route corridor.

Substation

5.217 The Alverdiscott substation site is constrained with respect to the existing road infrastructure and includes a number of pinchpoints where there may be width restrictions.

5.218 The route to the site from the north would be via the A39 and southbound along the B3232. This is unlikely to accommodate large vehicles with abnormal roads for construction of the substation due to a narrow pinch point at St Johns Chapel, where properties front directly onto the carriageway, and a tight bend at Newton Tracey.

5.219 It is understood that the route from the south, via the A30, A386 to Great Torrington and northbound along the B3232 to Alverdiscott, has been used previously for vehicles to access the site. An abnormal load approaching from the south via the A386 would need to access the site from Alverdiscott, along the road to Webbery which was upgraded prior to the operation of the existing sub-station to enable vehicles to access the site. Vehicles would then access the site via a left turn approximately 450 metres south of Webbery.

5.220 Alternative site locations near Atlantic Village would have good accessibility from the A39. Access routes would need to be assessed for suitability for abnormal loads.

General Description of Project Area: Saunton Sands to Alverdiscott

Landfall

5.221 There is existing access to the beach from the B3231 via an access road and car park. The car park provides parking for beach users, including surfers, bathers and visitors.

Cable Route Option

5.222 The main highway corridor for the proposed cable route would be the A39, which it would cross east of Tapeley Park. A number of minor roads would also be crossed within the cable route corridor, including the Instow-Yelland road.

Substation

5.223 The site at Alverdiscott would be as discussed above. An alternative site at Yelland is accessible from the north east along the M5 motorway and the A361. The A361 is a good standard dual carriageway which becomes single carriageway at several locations to the west of Tiverton. The route would join the A39 at Barnstaple and travel westwards to the junction with the B3233 at Westleigh. Traffic could then head north along the B3233 former trunk road to Instow which is suitable for the passage of abnormal loads before heading left onto the site access road at West Yelland. Based on an initial desk study, it is not therefore anticipated that there would be difficulties in accessing this location for construction of a substation. However, this should be confirmed in the event that this option is taken forward through a detailed abnormal loads study.

General Description of Project Area: Woolacombe to Alverdiscott

Landfall

5.224 There is existing access to the beach from Challacombe Hill Road and car parks. The car parks provide parking for beach users, including surfers, bathers and visitors.

Cable Route Option

5.225 The main highway corridors for the proposed cable route would be the A361 and the A39. It is anticipated that major roads would be crossed with ducts pre-installed by HDD.

5.226 A number of minor roads would also be crossed within the cable route corridor.

Substation

5.227 The sites at Alverdiscott and Yelland would be as discussed above.

Identification of Potential Effects and Proposed Assessment Methodology

Scope and Methodology

5.228 The scope of the traffic and transport assessment would consider the potential environmental effects on the local highway and transport network at, and in the vicinity of, the potential landfall locations, substation sites and cable corridors, arising from predicted travel demand associated with the project. The main traffic effects would occur during the construction period and include the transport of construction materials and abnormal loads to the landfall and substation sites and cable routes.

Collation of Data

5.229 The following items of work will provide important baseline data to inform the environmental traffic and transport assessment:

- Identification of transport movements associated with landfall works, cable laying and sub-station construction;

- A desktop review of the proposed sites and routes to identify the key locations where transport issues may be raised;
- A site visit to review the sites and routes and access to and from the compound areas;
- Initial consultation with the relevant Highway Authorities;
- The identification of constraints associated with existing transport infrastructure, vehicle or pedestrian movements or other committed developments;
- The identification of areas where traffic management or route diversions may be necessary.

Impact Assessment

5.230 An impact assessment would be undertaken, based on the following items of work:

- A review of available traffic flow data;
- The commissioning of further traffic surveys in areas where no data currently exist;
- The calculation of traffic flows for use in assessments;
- The calculation of the percentage impact of new traffic flows on key parts of the highway network;
- The possible operational assessment of junctions affected by development traffic flows;
- The review of personal injury road traffic accident records on the parts of the network affected by the project;
- The consideration of possible driver delay resulting from traffic management required by the scheme;
- The identification of measures to mitigate adverse transport impacts;
- The preparation of an ES chapter.

5.231 The construction transport assessment will concentrate on road traffic associated with the construction of the onshore elements of the project i.e. it excludes the supply of personnel and materials to ports elsewhere serving the offshore construction project.

5.232 The environmental effects of traffic and transport will be assessed in accordance with guidance contained in the following principal sources:

- Guidance for Transport Assessment, Department for Transport (2007);
- The Design Manual for Roads and Bridges (various volumes);
- The Manual of Streets, Department of Transport/Department for Communities and Local Government (2007);
- Circular 02/07: Planning and the Strategic Road Network;
- Guidelines for the Assessment of Road Traffic, The Institute of Environmental Management (2003); and
- Department of Transport – Transport Analysis.

5.233 The 'Guidelines for the Environmental Assessment of Road Traffic' suggest two broad rules can be used as a screening process to identify the appropriate extent of the assessment area. These are:

> *"Rule 1 - Include highway links where traffic flows would increase by more than 30% (or the number of HGVs would increase by more than 30%); and*
>
> *Rule 2 - Include any other specifically sensitive areas where traffic flows would increase by 10% or more."*

5.234 Where the predicted increase in traffic flow is lower than the thresholds, the guidelines suggest the significance of the effects can be stated to be low or insignificant and further detailed assessments are not warranted.

5.235 A formal Transport Assessment (TA) should not be required to accompany the Development Consent Order application for the proposed onshore elements of the project, as TAs principally relate to developments that generate significant permanent increases in travel as a direct consequence of their function, for example, retail parks and residential developments. Information to be included in the EIA will address the local transport impacts of the development during construction and operation and suggest mitigation measures to deal with any identified effects.

Abnormal Loads Study

5.236 In addition to general HGVs accessing the landfall sites and cable corridors, abnormal loads carrying substation construction components would be transported on vehicles that are longer, wider and heavier than standard HGVs.

5.237 An abnormal loads study associated with construction and maintenance at the landfall and substation sites and any associated infrastructure, would be undertaken which would include the following:

- The identification of a detailed schedule of abnormal load movements;
- Consultation with relevant Highway Authority or Authorities;
- A review of all available practical routes connecting with the national strategic highway route network;
- A further site visit to review sensitive parts of the highway network;
- Identification of mitigation measures where appropriate; and
- The preparation of a report summarising and setting out the conclusions of the work.

5.238 A Route Access Study to identify the most suitable route for transporting the construction components to the various locations between landfall and substation from the nearest suitable port of entry will be undertaken. This report will assess the suitability of the route to accommodate the manoeuvrability and loading requirements of the transportation vehicles and components associated with the onshore elements of the project. The study will include vehicular swept path analysis to identify areas where road modifications or improvements would be required.

5.239 The study will include consultation with the relevant authorities regarding the suitability of the proposed access route.

Likely Significant Effects Anticipated during Construction, Operation and Decommissioning

5.240 During the construction phase, traffic is likely to be generated by a range of activities including:

- Construction workers arriving and leaving site areas;
- Supply of construction materials and plant including cable and substation components;
- Movement of plant;
- Removal of soil resources, spoil or waste; and
- Service vehicles and visitors.

5.241 Once construction at the landfall and the substation sites and the cable laying operations are complete, the effect on the local road system will be minimal. There will be no permanent staffing needed at the substation, but access will be required from time to time for routine maintenance. Effects related to decommissioning will be considered, where details of these are known.

Summary of Approach

Potential Impact	The assessment will consider the likely significant effects of the onshore elements of the project on traffic and transport, primarily during the construction phase arising from, *inter alia*, the construction workforce and materials, movement of plant and the removal of soil resources, spoil or waste.
Survey/Study Proposed to Assess Impact	The work would include a desk study and site visits to review the sensitive parts of the road network. The work will include an abnormal loads study.
Method of Impact Assessment	The effect that the proposed development may have on traffic and transport will be described. This will take into account relevant guidance, including: ▪ Guidance for Transport Assessment, Department for Transport (2007); ▪ The Design Manual for Roads and Bridges (various volumes); ▪ The Manual of Streets, Department of Transport/Department for Communities and Local Government (2007); ▪ Circular 02/07: Planning and the Strategic Road Network; ▪ Guidelines for the Assessment of Road Traffic, The Institute of Environmental Management (2003); and ▪ Department of Transport – Transport Analysis.

Potential Mitigation and Monitoring

5.242 Appropriate mitigation measures will be identified for the construction phase of the project, including hours of construction operations.

Summary of Required Studies

5.243 The following studies would be undertaken:

- Collection of baseline traffic data (likely to be a combination of existing data supplemented with survey information);

- Characterisation of construction traffic requirements including weights and dimensions of abnormal loads;
- Site access study to sensitively locate marshalling areas and main corridor access points (incl. design of junctions) taking traffic levels and road widths into account;
- Route access study for abnormal loads;
- Development of draft construction travel plan; and
- Impact assessment taking into account mitigation forming part of the project.

Air Quality

Introduction

5.244 This assessment would consider the effects of the proposed onshore elements of the project on air quality, in relation to existing air quality conditions and standards/targets.

Background Data/Information

5.245 The UK Air Quality Strategy (AQS) updates previous UK strategies, providing objectives for local authorities for a wide range of pollutants. Under the AQS, local authorities have a duty to review and assess local air quality to determine whether the national objectives will be met. The Review and Assessment process requires local authorities to undertake a phased assessment to identify any areas likely to experience exceedances of the air quality objectives. Any location likely to exceed the objectives must be declared an Air Quality Management Area (AQMA) and an action plan must be prepared and implemented. A review of the local air quality management documents has been undertaken.

General Description of Project Area

5.246 North Devon Council have undertaken air quality assessments and progress reports on a regular basis for several years. These identify that the risk of exceeding the air quality objectives for carbon monoxide, benzene, 1,3 butadiene, lead, sulphur dioxide and PM_{10} (particulates) are negligible. Consideration has been give to the potential for exceedances of the threshold limit for nitrogen dioxide in Barnstaple. The potential for issues associate with traffic flow and traffic emissions in Barnstaple have been reduced by the construction of the additional river crossing and bypass. The 2008 progress report identified that 3 of the 16 sites monitored in 2007 exceeded the threshold limit for nitrogen dioxide, including one site in Barnstaple and two in Braunton. A detailed assessment is currently being undertaken for these sites. Results for 2008 indicate only two sites with exceedances.

5.247 At the current time no Air Quality Management Areas have been designated within North Devon.

5.248 Torridge District Council also undertake air quality monitoring and have prepared monitoring and update reports for the district. The 2007 update report concludes that there are not predicted to be any exceedence of air quality objectives within the district.

5.249 At the current time no Air Quality Management Areas have been designated within Torridge District.

5.250 There are no Air Quality Management Areas within the vicinity of the landfall/substation options or the cable route corridors.

Identification of Potential Effects and Proposed Assessment Methodology

5.251 The onshore elements of the project are unlikely to give rise to significant effects on local or regional air quality. The project will not affect targets for ambient air (NO_x or PM_{10}) either in the short term or on an annual basis. Air quality effects are most likely to arise during the construction phase of the project as a result of the generation of dust. The assessment of effects would therefore identify those construction activities that might generate dust and propose mitigation measures to control the effects on local receptors through the development of control measures.

5.252 No likely significant operational air quality effects are anticipated.

Scope and Methodology

5.253 The approach to the assessment will have regard to:

- The UK Air Quality Strategy (AQS), Defra (2007);
- The Air Quality Standards Regulations, Defra (2007); and
- The Highways Agency's (HA's) Design Manual for Roads and Bridges (DMRB) Part 1 HA207/07 Air Quality;
- Local Air Quality Management. Policy Guidance LAQM.PG(09); and
- Technical Guidance LAQM.TG(09), Defra (2009).

5.254 The current air quality in the area would be established with specific regard to the findings of the Review and Assessment process of Local Authorities, the results of available local monitoring and data available at the National Air Quality Information Archive.

5.255 The Highways Agency's Design Manual for Roads and Bridges (DMRB) methodology provides criteria for determining those roads affected by a project and, therefore, requiring a local air quality assessment. The results of the traffic and transport environmental assessment will be reviewed in the context of these criteria to determine whether an assessment of construction-related vehicle emissions is required. It is envisaged that this will scope out the necessity for quantitative modelling.

5.256 A risk assessment of dust and emissions during construction would be undertaken, using the London Best Practice Guide (LBPG) on Construction Dust formulated by the Air Pollution Planning and the Local Environment (APPLE) working group. Although the project is not located within London, the LBPG provides a useful framework within which to evaluate air quality risks during the construction phase.

5.257 Appropriate mitigation measures would be recommended to control dust nuisance effects and emissions during construction, consistent with the level of risk.

Summary of Required Studies

5.258 The assessment of construction air quality effects would include:

- Identification of dust generating activities;
- Review of the Transport Study;

- Identification of appropriate mitigation measures to be adopted as part of the project; and
- Assessment of likely effects.

Noise and Vibration

Introduction

5.259 This assessment would consider the effects of the proposed onshore elements of the project on noise and vibration, including effects on sensitive receptors.

Background Data/Information

5.260 A review of the Campaign for the Protection of Rural England (CPRE) tranquillity maps has been carried out and a site visit undertaken to identify key groups of sensitive receptors in the areas around the proposed landfall, substation and cable route options.

General Description of Project Area

5.261 The CPRE county map for Devon indicates the presence of a range of tranquillity categories. Stretches of the coastline, such as those from the estuary north towards Morte Point and between Hartland Point and Clovelly, fall largely within the 'most tranquil' categories. However, settlements and major road corridors fall within the 'least tranquil' categories, notably in the areas around Bideford, Northam and Westward Ho!, Braunton, Barnstaple and Ilfracombe.

5.262 In the county rankings produced by CPRE, Devon ranks 5th most tranquil of 87 areas considered with a mean tranquillity score of +7.00 compared to +28.6 for Northumberland (most tranquil) and -79.5 for Slough (least tranquil).

Identification of Potential Effects and Proposed Assessment Methodology

5.263 From available mapping and site visits, noise sensitive receptors (NSRs) in the area surrounding landfall, cable corridor and substation options would be identified and consultation undertaken with the relevant environmental health officer (EHO) to agree the extent of the baseline noise monitoring and to agree construction noise criteria for the project.

Scope and Methodology

5.264 Noise and vibration issues associated with the onshore elements of the Atlantic Array offshore wind farm construction including cabling, substations and access roads would be assessed using the guidance contained in BS 5228: 2009, which defines prediction methods and source data for various construction plant and activities. Construction noise effects would be based on the likely construction programme and associated activities, including cable laying and directional drilling works, construction traffic and access routes. Operational effects would include noise impacts associated with the substation and operational/maintenance traffic.

5.265 The guidance and methodology contained in BS 4142:1997 would be used to assess impacts arising from the substation where the measured background is within the recommended limits. A different methodology would be discussed with the relevant EHO in the event that prevailing

conditions are outside of the recommended limits for BS4142. Vibration will only be considered as an issue where significant piling works are required.

5.266 The spatial scope of the construction noise assessment would include the following geographic coverage:

- 300m from the cable corridor routes where significant activities could affect noise sensitive receptors; and
- Traffic routes and routes subject to significant changes in traffic flows (and / or percentage HGV) associated with the construction of the project.

5.267 The tasks required will include:

- Undertake initial liaison with the local authorities to agree approach, methodology and criteria to be used for the noise assessment;
- Carry out short-term, baseline noise surveys along the route of the cable corridor;
- Carry out long-term, baseline surveys in the area of the sub-station;
- Carry out construction noise assessment for the cable burying activity and the sub-station. The latter to be broad brush as impacts will be of limited duration;
- Consider construction vibration impacts for any specific areas where piling may be required;
- Assess construction effects on any nature conservation areas which may be close to the route;
- Assess construction traffic effects;
- Assess operational effects of the substation; and
- Provide assessment of likely construction and operational effects as chapter within ES.

Likely Significant Effects Anticipated during Construction, Operation and Decommissioning

5.268 The potential temporary effects of construction noise may arise from:

- Activities carried out on the surface along the proposed cable corridors (mainly earth moving and excavation);
- Construction activities at the substation site including landscaping;
- Directional drilling activities; and
- Heavy goods vehicles servicing the proposed cable corridors and substation, delivering or removing materials (including spoil and fill) and plant.

5.269 There are unlikely to be any noise and vibration effects relating to operational or maintenance traffic but operational noise effects may arise from the operation of the substation. Should the substation site be proximate to residential property, an assessment would be required to determine whether operational noise emissions would be likely to have significant environmental effects.

5.270 Where possible, effects likely to arise during decommissioning will also be considered.

Summary of Approach

Potential Impact	The assessment will consider the likely significant effects of the onshore elements of the project on noise and vibration. These are anticipated to include construction effects associated with earth moving, excavation, construction activities at substation, HDD and heavy goods vehicles. Operational effects may arise from the operation of the substation.
Survey/Study Proposed to Assess Impact	The work would include short term baseline noise surveys along the route of the cable corridor and long-term baseline noise surveys in the area of the substation. This will inform a construction noise assessment for the cable burying activity and the sub-station and construction vibration impacts for any specific areas where piling may be required. In addition, the operational effects will be considered for substation site.
Method of Impact Assessment	The assessment of effects will take into account relevant guidance including BS 5228: 2009 and BS 4142:1997. A different methodology would be discussed with the relevant EHO in the event that prevailing conditions are outside of the recommended limits for BS4142. Vibration will only be considered as an issue where significant piling works are required.

Potential Mitigation and Monitoring

5.271 The construction works would use Best Practicable Means (BPM) to limit the effects of noise at sensitive receptors. Those measures will be set out in the Code of Construction Practice. Where appropriate, construction and/or operational mitigation measures would be proposed.

Summary of Required Studies

5.272 The following studies would be undertaken:

- Identification of receptors at greatest risk of noise impacts along construction corridor i.e. in close proximity to earth works, marshalling areas, HDD works or piling;
- Identification of noise sensitive receptors at greatest risk of operational noise effects;
- Consultation with the relevant EHO to reach agreement on which receptors should be the subject of baseline noise monitoring;
- Further consultation with the relevant EHO on the results of the surveys and the criteria used for impact assessment;
- Prediction of effects and identification of mitigation measures as required; and
- Assessment of short and long term impact significance.

Recreation, Tourism and Socio-Economics

Introduction

5.273 The area within which the onshore elements of the project are located has a broad economic base. Tourism and recreation is important within the study area, which includes beaches, the South West Coastal Path, the Tarka Trail and other public rights of way (PRoW), hotel and other tourist accommodation, camp sites and caravan parks, country parks, historic gardens, fishing facilities and visitor attractions. An extensive stretch of the coast between Croyde and Ilfracombe comprises the National Trust property known as Morte. Many beaches in the area are well used

by locals and tourists and provide facilities for surfing, in particular at Saunton, Woolacombe, Croyde and Westward Ho!

5.274 The Taw-Torridge estuary in particular is currently subject to a range of uses, including use by Appledore shipyard, the local lifeboat station, the summer ferry and vessel moorings.

5.275 Income in the area is below the national average, with North Devon and Torridge districts ranking 392 and 407 respectively of 408 administrative areas in terms of earning from income.

Background Data/Information

5.276 An initial desk study review of existing available information has been undertaken, together with a site visit to possible substation locations and landfall sites.

General Description of Project Area: Cornborough Range to Alverdiscott

5.277 The beach is publicly accessible via the coastal path from Westward Ho! to the north or from the south. Land at Kipling Tors to the north and at Abbotsham Cliff to the south is under the ownership of the National Trust. However, the proposed landfall falls outside of these areas. Further north, Westward Ho! itself is a busy coastal resort.

Cable Route Option

5.278 The North Devon area is popular for tourism. The proposed cable route would cross a number of minor roads but public rights of way are generally avoided for this option. The key areas of recreational interest are likely to include Westward Ho! to the north, the Big Sheep at Abbotsham to the east and the River Torridge and Tarka Trail, which runs alongside the river in this location. Westward Ho! and the Big Sheep have been avoided by the proposed route.

General Description of Project Area: Saunton Sands to Alverdiscott

Landfall

5.279 Saunton Sands beach is well used and serviced with a range of facilities, including a café, surfing shop, surf school, equipment hire facilities and beach huts. The beach is overlooked by the Saunton Sands hotel and is divided into activity zones. The car park is very well used.

5.280 Braunton Burrows are also a key tourist feature within the area forming the Core Area of the Biosphere Reserve and accessible from a range of points including Saunton and Crow Point.

Cable Route Option

5.281 At the eastern edge of the dunes, the golf club is another important feature of this area. It is possible that an HDD operation could drill beneath the golf course, avoiding the club house, and the dunes, which would minimise disturbance to the golf club.

5.282 This option would require a river crossing. The river and estuary is an important part of the local tourist industry as well as being well used by boat traffic.

5.283 The South West Coastal Path runs along the edge of the estuary through Instow and Yelland. The Tarka Trail also runs through this area.

General Description of Project Area: Woolacombe to Alverdiscott

Landfall

5.284 Woolacombe Sands beach is well used and serviced with a range of facilities. The beach is overlooked by the Woolacombe Bay hotel. The car parks are reasonably well used.

Cable Route Option

5.285 At the eastern edge of the beach, Woolacombe Down is an important local feature. The South West Coastal Path runs along the edge of the beach to the west of Woolacombe Down.

5.286 For all options, the cable routes would pass across land to the south and east of Woolacombe that is indicated by MAGIC as being owned by the National Trust.

5.287 Further south, each of the options would require a river crossing. The river and estuary is an important part of the local tourist industry as well as being well used by boat traffic.

5.288 For a west of Braunton option, land at Braunton Marshes would be affected. This area is of local tourism value.

Identification of Potential Effects and Proposed Assessment Methodology

Scope and Methodology

5.289 The assessment of the recreational, tourism and socio-economic onshore effects of the project would be undertaken in close liaison with the assessment work relating to the offshore socio-economic, tourism and recreational elements and would include:

- Review of policy and plans - the project is located in the administrative areas of Devon County Council, North Devon Council and Torridge District Council. Data will be collected and analysis carried out for these districts, the County of Devon, as well as England and Wales where appropriate.
- Desk top study to identify recreational and tourist resources, including parks, leisure facilities, visitor attractions, areas of access land and the public right of way network in proximity to the project, including any long distance recreational routes;
- Collection of data on existing and proposed public rights of way (PRoW), their purposes and indicative levels of use from existing sources, including Ordnance Survey mapping, relevant Definitive Maps, details of long distance and strategic routes, information provided by the County Council and relevant rights of way user groups.
- Site visit to establish the nature and use of the recreational and tourist resources identified, including the main PRoW that may be affected within or adjacent to the project area. Targeted user surveys of some PRoW routes may also be required
- Desk top socio-economic study to collate baseline information from sources such as the Census and other local socio-economic data (e.g. from the local authorities), information about local tourist amenities, relevant planning policy and other relevant strategies;
- Consultation with the relevant local authorities, recreational and tourist bodies and other interest groups as appropriate;

- Assessment of effects on the recreational and tourist resources and socio-economics identified during the construction period and arising from the existence and operation of the project.

5.290 The likely effects on recreation, tourism and socio-economics will include those arising during the construction and operational phases of the project. During construction, effects are anticipated to include:

- Direct and indirect effects on employment;
- Effects on recreational and tourist resources arising from, for example, land take and/or severance;
- Effects on PRoW, including any temporary diversions; and
- The effects on recreational and tourist resources in relation to changes in amenity. This will draw on the assessments regarding the generation of dust and noise, and views from/to sensitive receptors that would be addressed in the relevant ES chapters, with qualitative comment provided within this topic.

5.291 Once operational, the onshore works will be largely un-manned except during routine maintenance periods and therefore a relatively low number of operational jobs would be anticipated. Effects on recreational and tourist resources during operation may include permanent changes to the PRoW network both at the landfall locations and arising from the siting of the sub-station.

Likely Significant Effects Anticipated during Construction, Operation and Decommissioning

Cornborough Range to Alverdiscott

5.292 The landfall at this location lies close to the South West Coastal Path. An HDD construction would have no long term visible effect on the coastal path. However, temporary construction activity would be in relatively close proximity to the network of footpaths used by the public.

5.293 Construction effects along the cable corridors in the countryside may include the temporary diversion of PRoW and temporary disruption to the recreational use of small areas of access land. In addition, river crossings will be required. The river crossing for the Cornborough Range option lies adjacent to the Tarka Trail and therefore effects on the river and associated recreational activity would be considered. A river crossing by HDD would minimise construction disturbance to the river and Tarka Trail although the HDD construction compound many be visible from the Trail during the construction phase.

Saunton Sands to Alverdiscott

5.294 The Saunton Sands option would require works at or near the beach, which are likely to include use of the beach car park on a temporary basis as a construction compound. This has the potential to cause disruption to the existing car park and beach users, including those using the beach for surfing and businesses based at the beach/car park.

5.295 In addition, use of the car park and the potential for further construction areas within or close to the dunes may affect access to and the amenity of the Braunton Burrows area, which forms the Core Area of the Biosphere Reserve.

5.296 It is proposed that works (such as an HDD compound to allow drilling beneath the dunes) in the vicinity of the golf course be considered in order to minimise effects on the dunes. It is possible

that an HDD operation could drill beneath much of Braunton Burrows and the golf course, avoiding the club house and the dunes, which would minimise disturbance to recreation and tourism. This would require further evaluation if this option were to be taken forward.

5.297 Further south, this option would pass through Braunton Marshes and Braunton Great Field. Effects on these features and on the local community would be considered.

5.298 As for the Cornborough Range option, the route through the countryside may include the temporary diversion of PRoW and temporary disruption to the recreational use of small areas of access land. In addition, a river crossing will be required close to the Taw-Torridge estuary, although the use of HDD would minimise construction disturbance to the river.

Woolacombe to Alverdiscott

5.299 The Woolacombe option would require works at or near the beach, which are likely to include use of a local car park on a temporary basis as a construction compound. This has the potential to cause disruption to the existing car park and beach users, although in this case alternative access to the beach is likely to remain possible.

5.300 As for the above options, the route through the countryside may include the temporary diversion of PRoW and temporary disruption to the recreational use of small areas of access land. The river crossing for a cable route option to the east of Braunton would be located outside the main area used for moorings, the shipyard and docks and would not have a direct effect on the estuary mouth and constrained areas such as the Neck or Appledore Pool. The river crossing for an option to the west of Braunton would also be outside of the main navigational area but would be in closer proximity to the estuary. Effects on recreation would be minimised if an HDD beneath the river could be achieved at this point.

5.301 As for the Saunton Sands option, a west of Braunton option would require consideration of the effects on Braunton Marshes and Braunton Great Field.

Summary of Approach

Potential Impact	The assessment will consider the likely significant effects of the onshore elements of the project on recreation, tourism and socio-economic factors. These are anticipated to include temporary effects on PRoW, recreational and tourist resources during the construction phase.
Survey/Study Proposed to Assess Impact	Baseline information would be complied based on a desk study, to inform an assessment of effects on recreational resources, tourism and socio-economics will include those arising during the construction and operation of the project, such as effects on employment, effects on recreational and tourism amenities and effects of PRoW. Information regarding existing and proposed PRoW, their purposes and indicative levels of use would initially be collated from existing sources. An initial site visit to establish the nature and use of recreational resources, including PRoW will be undertaken. Targeted user surveys of some PRoW may also to be required.
Method of Impact Assessment	The assessment of effects will take into account relevant guidance and professional judgement.

Potential Mitigation and Monitoring

5.302 The adoption of directional drilling of cables may be required to reduce disruption to existing recreational land uses and areas of particular recreational or tourist value, such as Braunton Burrows, the river crossings (including the Tarka Trail where appropriate) and major road corridors.

5.303 The works could also be timed to avoid peak seasons. A Code of Construction Practice would include measures to reduce the effects on the beach facilities, PRoW and important tourist or recreational features such as Braunton Burrows, Braunton Marshes and Braunton Great Field, where these are affected.

Summary of Required Studies

5.304 The following studies would be undertaken:

- Review of policy and plans;
- Desk top study to identify recreational and tourist resources and the socio-economic baseline; and
- Site reconnaissance visits.

Electric and Magnetic Fields

5.305 The strength of power frequency magnetic fields directly over high voltage underground cables can be of similar order of magnitude to those found directly under high voltage overhead lines which, under maximum load, can approach the guideline levels for public exposure issued by the International Commission on Non-Ionising Radiation Protection (ICNIRP, 1998). From buried cables, however, the distribution of the magnetic fields has been found to be concentrated in a relatively narrow band and no restriction is likely to apply further than about 10 metres from any cables.

5.306 The strength of magnetic fields likely to be generated by the proposed connection options has not been determined for the cable current flows and/or maximum loads that might be used in the connections being considered in this study. However, the possibility that magnetic fields might be at or approaching guideline levels should not be discounted and an assessment would be completed where the cables run in close proximity to dwellings. No dwellings would be located directly over cables.

ENVIRONMENTAL IMPACT MATRIX

6.1 The proposed Atlantic Array OWF development has the potential to result in a range of environmental impacts. The likely environmental effects are collated and summarised in the table below. Impacts listed here are organised into stages of the proposed development (construction, operation and decommissioning). The level of significance of each potential effect would be determined in the ES. This table is not intended to be exhaustive and should be used as a guide to the likely environmental effects only.

Summary of potential environmental effects

Parameter		Potential Impact Requiring Assessment
Offshore Scoping		
Physical Environment	**Tidal Regime**	Changes to erosional / depositional processes along the adjacent coastline impacting on morphology and consequently habitats, infrastructure and recreational surfing resource. Changes will be most likely along the coastline in the lee of the wind farm site during the prevailing wave direction (The Gower Peninsular and Carmarthen Bay) and along the coast in closest proximity (Bideford Bay) although the distance of the development from the coast means impacts are unlikely.
	Wave Regime	Impacts on swell (wave period height and direction) in lee of development leading to impacts on surfing resource in the lee of the development. Changes will be most likely along the coastline in the lee of the wind farm site during the prevailing wave direction (The Gower Peninsular) although the distance of the development from the coast means impacts are unlikely.
	Sediment Transport	Increase in suspended sediment concentration during installation of foundations / cables or during operation following scour around foundations resulting in elevated suspended sediment concentrations and deposition of suspended sediment on sensitive receptors.
		Changes to sediment transport pathways (suspended or bedload) resulting in changes to the local sediment regime.
	Seabed Morphology	Scour around foundations leading to changes to seabed morphology.
		Changes in seabed morphology leading to the exposure of the cables (inter-array and export cable) and undermining of foundations.
	In-combination effects	The interaction between plumes of sediment created by dredging in Area 476 or 373 (and potential future extraction in Area 486) and the installation of turbines or the burial of cables as part of Atlantic array.
Biological Environment	**Benthic ecology**	▪ Temporary increases in suspended sediment concentrations from trenching, augering, seabed preparation (plume effects) ▪ Temporary increases in sediment deposition from plumes
		Release of contaminants bound in sediments
		Loss of seabed habitat through presence of foundations, scour protection and inter-array cables, and temporary loss of habitat due to inter array cables and export cable.

Parameter		Potential Impact Requiring Assessment
		▪ Scour leading to change on seabed habitats ▪ Change in sediment transport leading to changes in habitats ▪ Temporary effects of construction vessels and jack up rigs
		Colonisation of turbines leading to a change in the benthic ecology and biodiversity
		Potential release of pollutants e.g. from accidental spillage/leakage or sacrificial anodes
	Fish and shellfish resources	Loss of spawning/nursery/crab overwintering grounds through presence of turbines and foundations and temporary loss through inter array and export cables.
		Impact upon seabed spawning habitat (e.g. herring) as a result of increases in sediment deposition
		Behavioural impacts from construction noise (e.g. piling)
		Sediment plumes creating localised avoidance
		▪ Effect upon shoaling due to presence of turbines ▪ Increased habitat complexity due to presence of turbines ▪ Reduced fishing pressure within wind farm site
		Behavioural effects of electromagnetic field emissions
	Marine Mammals	Physiological / behavioural effects on marine mammals resulting from high levels of underwater noise (construction phase). The effects may not be detectable (Nedwell *et al.* 2003), or may range from avoidance / exclusion (e.g. Tougaard *et al.* 2005), change in behaviour (e.g. feeding rate), to temporary or permanent hearing damage and lethal effects.
		Secondary (indirect) impacts due to effects on prey availability (construction phase). These may include avoidance by marine mammals as a result of the displacement of their preferred prey. Attraction of species such as Grey Seal, into the area may potentially occur, in response to fish disoriented by pile-driving.

Parameter		Potential Impact Requiring Assessment
		Displacement of marine mammals during operational phase Marine mammals may possibly be displaced from the area by number of potentially synergistic factors, the effects of which are difficult to separate e.g. exclusion from habitat occupied by infrastructure, barrier effects, displacement due to operational noise and increased vessel traffic.
		▪ Secondary effects due to changes in long-term prey availability caused by the presence of infrastructure and changes in fishing activity. ▪ Reduction in fishing pressure and the creation of sheltered habitat (reef effect) around turbine bases may change marine mammal density, distribution and behaviour by causing a local increase in prey density or availability. ▪ Changes in fishing activity may affect rates of marine mammal by-catch, potentially (positively) affecting marine mammals at both a local and population level.
	Ornithology	Collision risk
		Risk of displacement
		Risk of indirect effects (prey displacement etc)
	Nature Conservation	▪ Changes to the physical and biological environment could adversely impact upon currently designated sites (international, national and/or regional level) ▪ Changes to the physical and biological environment could adversely impact upon habitat/species that are not currently covered by any specific designation but which may potentially be designated as part of the on-going process of designating offshore SACs, currently being undertaken by NE and the JNCC. ▪ Physical and biological effects caused by the proposed development may adversely impact habitats and/or species listed on the UK BAP

Parameter		Potential Impact Requiring Assessment
Human Environment	**Landscape and Seascape**	Construction Phase: Effects on Landscape Character ▪ Indirect effects on nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Indirect effects on locally designated landscapes. ▪ Indirect effects on undesignated landscapes. ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.
		Construction Phase: Effects on Visual Resources ▪ Views from nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Views from locally designated landscapes. ▪ Views from Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Views from National Trails: Pembrokeshire Coast Path and South West Coast Path. ▪ Views from promoted paths ▪ Views from other public rights of way. ▪ Views from other publicly accessible land e.g. Access Land (under CRoW Act). ▪ Views from residential properties.

Parameter		Potential Impact Requiring Assessment
		Construction Phase: Effects on Settings of Historic Landscapes and Historic Monuments ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Indirect effects on settings of Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Historic Parks and Gardens, Protected Wreck Sites, Areas of Archaeological Importance.
		Operational Phase: Effects on Landscape Character ▪ Indirect effects on nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Indirect effects on locally designated landscapes. ▪ Indirect effects on undesignated landscapes. ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.

Parameter		Potential Impact Requiring Assessment
		Operational Phase: Effects on Visual Resources ▪ Views from nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Views from locally designated landscapes. ▪ Views from Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Views from National Trails: Pembrokeshire Coast Path and South West Coast Path. ▪ Views from promoted paths. ▪ Views from other public rights of way. ▪ Views from other publicly accessible land e.g. Access Land (under CRoW Act). ▪ Views from residential properties.
		Operational Phase: Effects on Setting of Historic Monuments ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Indirect effects on settings of Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Historic Parks and Gardens, Protected Wreck Sites, Areas of Archaeological Importance.

Parameter		Potential Impact Requiring Assessment
		Decommissioning Phase: Effects on Landscape Character ▪ Indirect effects on nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Indirect effects on locally designated landscapes. ▪ Indirect effects on undesignated landscapes. ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.
		Decommissioning Phase: Effects on Visual Resources ▪ Views from nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Views from locally designated landscapes. ▪ Views from Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Views from National Trails: Pembrokeshire Coast Path and South West Coast Path. ▪ Views from promoted paths ▪ Views from other public rights of way. ▪ Views from other publicly accessible land e.g. Access Land (under CRoW Act). ▪ Views from residential properties.

Parameter		Potential Impact Requiring Assessment
		Decommissioning Phase: Effects on the Setting of Historic Monuments ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Indirect effects on settings of Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Historic Parks and Gardens, Protected Wreck Sites, Areas of Archaeological Importance.
		Cumulative Landscape Effects ▪ Indirect effects on nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Indirect effects on locally designated landscapes. ▪ Indirect effects on undesignated landscapes. ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows.

Parameter		Potential Impact Requiring Assessment
		Cumulative Visual Effects ▪ Views from nationally designated landscapes: Pembrokeshire Coast National Park; Exmoor National Park; Gower Area of Outstanding Natural Beauty; North Devon Area of Outstanding Natural Beauty. ▪ Views from locally designated landscapes. ▪ Views from Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Views from National Trails: Pembrokeshire Coast Path and South West Coast Path. ▪ Views from promoted paths ▪ Views from other public rights of way. ▪ Views from other publicly accessible land e.g. Access Land (under CRoW Act). ▪ Views from residential properties.
		Cumulative Effects on the Setting of Historic Monuments ▪ Indirect effects on Welsh Landscapes of Outstanding Historic Interest: No. 44 Stackpole Warren; no. 45 Manorbier; no. 11 Taf and Twyi Estuary; no. 15 Gower; no. 51 Margam Mountain; no. 12 Merthyr Mawr, Kenfig and Margam Burrows. ▪ Indirect effects on settings of Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Historic Parks and Gardens, Protected Wreck Sites, Areas of Archaeological Importance.
	Commercial Fisheries	**Loss of Access to Fishing Grounds and subsequent displacement of fishing effort – Construction phase.** During construction fishers will have no access to the site including a 500m exclusion zone around the boundary. The post - construction access arrangements have yet to be determined. Vessels excluded from fishing grounds within the proposed site will be displaced to nearby grounds. This may interfere with existing fisheries and increase fishing intensity in surrounding area

Parameter		Potential Impact Requiring Assessment
		Displacement of fishing activity due to indirect effects of construction disturbance affecting target species distribution – Construction Phase.
		Obstruction of passage to other fishing grounds – Construction and operational phases. The site may fall between a vessel's port and fishing grounds. Any exclusion of vessels from the site may obstruct their passage causing longer steaming time, increased fuel consumption. and added collision risk at site boundaries.
		Disruption of fishing by cable operations. The trenching and cable-laying operations will impede fishing operations, and there is a risk that objects and obstructions left on the sea-bed after construction operations may restrict trawling.
		Decommissioning. Decommissioning strategy has yet to be decided The potential impact on fishing will depend on the option chosen. If, for example, pylons are left in place or cut off near the surface, then effective exclusion for mobile gear fisheries will remain. Similarly, if rock armour bases are left, then trawling will be impacted, but enhancement of static fisheries will continue.
	Shipping and Navigation	Displacement, navigation and collision avoidance impacts on shipping and navigation (construction, operational and decommissioning phases)
		Marine casualty, search and rescue and emergency response impacts on shipping and navigation (construction, operational and decommissioning phases)
	Maritime Archaeology	Potential damage will occur during pre-construction seabed preparation, wind farm construction, cable laying and intrusive geotechnical survey to wrecks that could potentially date from the Mesolithic through to the present day.
		Potential damage will occur during pre-construction seabed preparation, wind farm construction, cable laying and intrusive geotechnical survey to aircraft, in particular military aircraft lost during WWII.
		Potential damage will occur during pre-construction seabed preparation, wind farm construction, cable laying and intrusive geotechnical survey to submerged prehistoric sites and finds and submerged topographic features and deposits that contain palaeo-environmental evidence.
		Potential damage will occur during pre-construction seabed preparation, wind farm construction, cable laying and intrusive geotechnical survey to other archaeological sites and finds on the seabed.

Parameter		Potential Impact Requiring Assessment
		Potential impact will occur pre-construction clearance, cable laying and grid connection works within the inter-tidal zone and on land to terrestrial archaeological sites potentially ranging in date from the Palaeolithic to the present day.
	Military Practice Areas	Risk of shipping lanes being moved into the northern part of the Atlantic Array site leading to reduction in potentially available wind farm development area.
	Munitions	Risk of danger to project staff and construction and the nearby seabed environment through the unexpected discovery of UXO.
	Socioeconomics and Tourism	Potential impact on local and regional economies, including tourism during the construction, operation and decommissioning phases of the development.
	Recreation	Risk of negative impact upon recreational amenity in and around the Atlantic Array site.
	Marine aggregates	Indirect impacts upon coastal processes affecting nearby aggregate extraction areas.
	Subsea cables and pipelines	Impacts on existing subsea cable/pipeline infrastructure (construction and operational phases)
	Military and Civil Aviation	Adverse effects on Controlled Airspace (CAS) and Lower Airspace Radar Services (LARS) (operational phase).
		Adverse effects on Primary Service Radar (PSR) and Secondary Service Radar (SSR) (operational phase)
		Generation of adverse effects on air traffic control En Route radar (operational phase)
		Creation of additional obstacles which create adverse affects on military air traffic at Manorbier and St. Athan (construction and operation phase).
		Creation of additional obstacles which create adverse affects on military helicopter traffic at Culdrose, Yeovilton and Chivenor (construction and operation phase).
Onshore scoping		
	Landscape	Potential effects on landscape resources and visual receptors. Likely to include temporary loss of vegetation arising from cable landing and laying operations and the visual effects arising from a new substation.
	Terrestrial Ecology and Nature Conservation	Direct loss of any existing habitats, or species at the landfall or along the cable route corridor
		Disturbance or damage to any habitat or species on or adjacent the route corridor due to construction or maintenance of the cables

Parameter		Potential Impact Requiring Assessment
		Habitat fragmentation or species isolation
		Discharge/pollution effects
	Historic Environment	Potential effects on cultural heritage resources, including: ▪ buried archaeological remains; ▪ historic buildings; and ▪ historic landscapes.
	Ground Conditions and Water Resources	Potential effects of the onshore elements of the project on hydrology and flood risk, ground conditions and geology. These are anticipated to include the presence of contaminated soils (notably for the Yelland substation option), effects on the geological SSSI for the Cornborough option and the potential risk of contaminated water run-off and effects on water quality.
	Soils, Agriculture and Land Use	Potential effects of the onshore elements of the project on agriculture, soils and land use, including effects on agricultural land quality, soil resources and farm holdings
	Traffic and Transport	Potential effects of the onshore elements of the project on traffic and transport, including the environmental effects of traffic.
	Air Quality	Potential effects of construction activities (e.g. generation of dust) The results of the traffic and transport environmental assessment will be reviewed in the context of these criteria to determine whether an assessment of construction-related vehicle emissions is required. It is envisaged that there would not be significant effects associated with vehicle emissions.

<table>
<tr><th colspan="2">Parameter</th><th>Potential Impact Requiring Assessment</th></tr>
<tr><td></td><td>Noise and Vibration</td><td>Potential noise and vibration emissions from the construction phase of the onshore elements of the project, including:
▪ Activities carried out on the surface along the proposed cable corridors (mainly earth moving and excavation);
▪ Construction activities at the substation site including landscaping;
▪ Directional drilling activities; and
▪ Heavy goods vehicles servicing the proposed cable corridors and substation, delivering or removing materials (including spoil and fill) and plant
Should the substation site be proximate to residential property, an assessment would be undertaken to determine whether operational noise emissions would be likely to have significant environmental effects.
Where possible, effects likely to arise during decommissioning will also be considered.</td></tr>
<tr><td></td><td>Community Effects</td><td>Potential effects on:
▪ Tourism;
▪ Socio-economic factors; and
▪ Public rights of way.</td></tr>
<tr><td></td><td>Electric and Magnetic Fields</td><td>Assessment of potential effects if the cable run is in close proximity to dwellings</td></tr>
</table>

Summary of Mitigation and Monitoring

Parameter		Mitigation and Monitoring proposed
Offshore Scoping		
Physical Environment	**Coastal Processes**	Potential mitigation options will be considered as part of the man EIA and the details are pending the outcomes of the assessments recommended here. However, it is likely that mitigation methods will involve the use of some form of scour protection.
Biological Environment	**Benthic ecology**	Monitoring and mitigation requirements will be identified in the EIA and agreed with the relevant authority, with the degree and type likely to be required dependent on issues such as the baseline environmental resources and the proposed construction methodology. Although no specific guidance exists for monitoring the potential impacts of offshore wind on the benthic ecology, the guidance published for marine aggregate dredging sites is of relevance (CEFAS 2004), although these are currently under revision and an updated version is due to be published early 2010. Experience gained during Round 1 and 2, including the results from site specific monitoring, will also help be useful to inform the proposed mitigation and monitoring package. A key principle that will be recognised when developing mitigation and monitoring commitments is that of adaptive management. Adaptive management is a structured, iterative process of decision making, with an overall aim of reducing uncertainty over time. The Atlantic Array EIA will ensure that any mitigation measures set out in the ES are achievable, realistic, practical and proven on previous projects. With respect to monitoring commitments, any monitoring proposed within the ES will have the objectives of the monitoring clearly defined. In cases where colonisation of turbines and scour protection by encrusting organisms leads to an increase in biodiversity at the site, this could be used as mitigation for the loss of seabed habitat as a result of construction activities. In evaluating the potential for mitigation of habitat loss using artificial reefs, consideration has to be given to the communities that are likely to develop on the artificial substrata, as these can be quite different from those communities present on the site prior to construction of the OWF. This requires an objective assessment of the relative merits of a general increase in biodiversity *per se* over an increase in species that naturally and locally colonise local hard substrata (Linley *et al.*, 2007). However whether such "artificial reefs" increase productivity in the long-term is controversial, and such structures should not automatically be assumed to be beneficial (CEFAS *et al.*, 2004)

Parameter		Mitigation and Monitoring proposed
	Fish and shellfish resources	Monitoring and mitigation requirements will be identified in the EIA and agreed with the relevant authority, with the degree and type likely to be required dependent on issues such as the baseline environmental resources and the proposed construction methodology. Experience gained during Round 1 and 2, including the results from site specific monitoring, will also help inform the proposed mitigation and monitoring package. This will help the proposed Atlantic Array OWF to set out clear, well-defined mitigation and monitoring commitments. A key principle that will be recognised when developing mitigation and monitoring commitments is that of adaptive management. Adaptive management is a structured, iterative process of decision making, with an overall aim of reducing uncertainty over time. Put more simply, it can be described as “learning by doing”. The Atlantic Array EIA will ensure that any mitigation measures set out in the ES are achievable, realistic, practical and proven on previous projects. With respect to monitoring commitments, any monitoring proposed within the ES will have the objectives of the monitoring clearly defined
	Marine Mammals	Monitoring: We aim to document the distribution and abundance of marine mammal species prior to the development of Atlantic Array. A suite of methods have been selected that address specific monitoring objectives: ▪ Boat-based sighting surveys ▪ Concurrent passive acoustic (towed hydrophone) surveys ▪ Continuous acoustic monitoring from static moorings (C-PODs).
		Mitigation: We will employ standard precautions during the construction phase to mitigate against the risk of injury or disturbance to marine mammals from high levels of underwater noise (JNCC 2009). These include the use of Marine Mammal Observers (MMOs) to ensure that no animals are present within a 500 m radius before pile-driving commences. Pile-diving would then begin at low power and increase gradually following a soft start procedure. Passive acoustic monitoring solutions are available should pile-driving take place during the night. We will review other mitigation options including the use of acoustic deterrent devices that encourage marine mammals to leave the area prior to pile-driving operations, and noise reduction methods (e.g. bubble curtains) for the pile-driver itself (COWRIE, 2007a, 2007b).

Parameter		Mitigation and Monitoring proposed
	Ornithology	Mitigation of potential impacts is specific to the impact involved. In simple terms, effective mitigation of construction related effects can be achieved by use of specific construction methods. For activities with high impact such a s pile driving, restrictions on timing to avoid sensitive periods may be employed. This is likely to be complex in the Bristol Channel with a range of species with protracted periods of occurrence. It may be possible however to determine and avoid key periods for important prey species (e.g. spawning fish). Mitigation of collision impacts may be achieved in a number of ways with perhaps the most effective being careful consideration of location of turbines. The distribution of birds may be particularly patchy and this may often be relatively predictable if it is associated with a particular habitat feature or perhaps proximity to a breeding colony. Good data, especially if this is specifically linked to environmental variables in a predictable way may allow ‘hotspots’ to be established and subsequently easily avoided which is likely to have a disproportionate effect on collision risk as well as risk of displacement. Other means of reducing collision relate to the numbers and size of turbines, particularly as turbine capacity increases without increasing rotor swept area in a proportional way. In other words, fewer turbines with less risk of collision for vulnerable species may achieve site capacity. Through simple modelling, it should be possible to determine precautionary thresholds of the number of turbines that may avoid significant or unacceptable impacts upon sensitive species. Where individual birds tend to take predictable routes, perhaps back to colonies, ‘flyways’ created of wider-spaced turbines through wind farms have the potential to both reduce collision risk and minimise barrier effects. Colour or decoration of turbines may also be considered, particularly for birds flying at night.

Parameter		Mitigation and Monitoring proposed
	Nature Conservation	Examination of Round 1 and Round 2 OWF mitigation and monitoring programmes as part of the Atlantic Array EIA process will help to develop a good understanding of how previous mitigation and monitoring measures proposed in these earlier projects have been transposed into licence conditions. This will assist in setting out clear, well-defined mitigation and monitoring commitments for the Atlantic Array OWF project. Many of the issues identified via scoping in the Round 1 projects have now been explored in detail and monitored for actual operational projects. As a result of this growing knowledge base of the effects of both the construction and operational phase of offshore wind farms, it is possible that some of the mitigation and monitoring commitments set out within the Atlantic Array ES will be different to those set out in earlier projects. A key principle that will be recognised when developing mitigation and monitoring commitments is that of adaptive management. Adaptive management is a structured, iterative process of decision making, with an overall aim of reducing uncertainty over time. Put more simply, it can be described as “learning by doing”. The Atlantic Array EIA will ensure that any mitigation measures set out in the ES are achievable, realistic, practical and proven on previous projects. With respect to monitoring commitments, any monitoring proposed within the ES will have the objectives of the monitoring clearly defined.
Human Environment	**Landscape and Seascape**	The most significant area of potential mitigation for the effects of the wind farm on seascape and visual resources is during the design of the layout of the wind farm and the location of individual turbines. Input into this iterative process will ensure that the potential effects on the most sensitive seascape and visual resources are mitigated as fully as possible.

Parameter		Mitigation and Monitoring proposed
	Commercial Fisheries	Mitigation Access Exclusion policy will have a pronounced affect on the impact of the scheme to the fishery. Allowing complete or partial access will mitigate impacts. Partial exclusion (e.g. allowing static gear only) would have a positive impact to those sectors. Displacement and related issues Possible reductions in catch, increased competition for fish in remaining areas and added steaming time and fuel costs could be ameliorated by a number of options: ▪ Decommissioning of some vessels. ▪ Leasing of extra quota. ▪ Promotion/Sponsoring of beneficial fisheries research / projects (hatcheries, marketing, improved handling facilities etc.) These options will be investigated in consultation with the industry.
		Monitoring Following guidance in CEFAS 2004 and CEFAS 2009. Following baseline surveys of fish populations, future monitoring will depend on site plan and access. For example, post-construction trawl surveys within the site might be impossible. The fishery can be usefully monitored using future landing records and effort data.

Parameter		Mitigation and Monitoring proposed
	Shipping and Navigation	This section of the scoping report provides initial details of some of the proposed mitigation and monitoring measures that are likely to be required / recommended, in order to reduce the significance of the impacts on the human environment described in the preceding section. Many of these measures have been established on existing Rd1 and Rd2 offshore wind farms and have been successfully implemented. There are a range of measures that can be applied to mitigate the impacts of a wind farm development. MCA publication MGN 371 (M+F) –Offshore Renewable Energy Installations (OREI) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues lists the following measures, to be applied to a particular development as appropriate to the level and type of risk determined during the EIA: ▪ Promulgation of information and warnings through notices to mariners and other appropriate media. ▪ Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC). ▪ Safety zones of appropriate configuration, extent and application to specified vessels. ▪ Designation of the site as an area to be avoided (ATBA). ▪ Implementation of routeing measures within or near to the development. ▪ Monitoring by radar, AIS and / closed circuit television (CCTV) or other agreed means. ▪ Appropriate means to notify and provide evidence of the infringement of safety zones or ATBAs. ▪ Any other measures and procedures considered appropriate in consultation with other stakeholders. ▪ Creation of an Emergency Response Co-operation plan with the relevant Maritime Rescue Co-ordination Centre from construction phase onwards. Other mandatory control measures include: ▪ Marking and lighting the site in accordance with General Lighthouse Authority requirements (which will include a system of routine inspection and maintenance of lights and marks). ▪ MCA standards and procedures for wind turbine generator shut-down in the event of a search and rescue, counter pollution or salvage incident in or around a wind farm. Proposed mitigations for the Atlantic Array Wind Farm will be identified during the formal Marine Navigation Assessment described in above, and may include, in addition to the points listed above, measures such as an IMO adopted traffic routeing system (e.g. a traffic separation scheme) and changes to presently charted anchorages.

<table>
<tr><th colspan="2">Parameter</th><th>Mitigation and Monitoring proposed</th></tr>
<tr><td rowspan="3"></td><td>Maritime Archaeology</td><td>Without mitigation, a number of wreck sites and deposits of palaeoenvironmental potential will be affected, and that some of those sites will prove to be archaeologically important. However, the general density of known sites is low, and the same density probably applies to currently unknown archaeology. Therefore, if appropriate mitigation is applied, archaeology should prove to be a low risk and should not spatially restrict development within the area to any great extent.
Based on WA's involvement in over 25 offshore wind farm schemes and many other offshore developments, it is concluded that the offshore archaeology of the Atlantic Array site should not prove to be a barrier to consent for the scheme if the following standard methodology is applied:
▪ full Environmental Impact Assessment (EIA) including archaeological analysis of marine geophysical data and preferably archaeological assessment of geotechnical data;
▪ a mitigation strategy that places Exclusion Zones (EZs) around all wrecks and geophysical anomalies with archaeological potential;
▪ the archaeological review of additional geophysical data when it becomes available;
▪ a methodology for conducting diver assessment of any EZs that prove to be a constraint that is hindering development and which for those reasons need to be removed/altered;
▪ an agreed methodology for conducting recording to a level appropriate to the importance of any sites that would be damaged by development;
▪ the staged analysis of marine geotechnical data in areas where an initial assessment (preferably conducted during EIA) has indicated that deposits with palaeoenvironmental potential are present and will be impacted;
▪ a Written Scheme of Investigation (WSI) covering all mitigation strategies and curator contact/liaison details and a Protocol for Unexpected Discoveries.</td></tr>
<tr><td>Military Practice Areas</td><td>Consultation will take place with the MOD throughout the project. If detailed shipping analysis identifies a conflict between military use and shipping movements into and out of the Bristol Channel then this will be addressed specifically at the time.</td></tr>
<tr><td>Munitions</td><td>Upon review of geophysical data ROV, diving surveys and possible recovery operations may be undertaken prior to construction. Construction staff will be briefed on the potential presence of UXO prior to deployment and will remain alert for any further unidentified ordnance.</td></tr>
</table>

Parameter		Mitigation and Monitoring proposed
	Socioeconomics and Tourism	Consultation will take place with key local industries and ports, local authorities and organisations and interest groups throughout the project, to ensure their concerns are addressed through the EIA process. Consultation with regional groups such as the South West Wales Economic Forum and the Pembrokeshire Coastal Forum will also form an important part of the consultation process. The socio-economic assessment will identify measures to mitigate any potential negative impacts that may occur as a result of the proposed development and will also highlight any potential positive impacts for the local community which this development may bring.
	Recreation	During construction, safety exclusion zones will be necessary to ensure other users are not adversely affected. Effective communication of survey and construction activities through Notices to Mariners and directly to local ports will ensure impacts are minimised throughout the life of the project. Marine spatial planning techniques have been implemented in the preliminary design and site selection for the Atlantic Array OWF, however continued engagement with relevant parties will be undertaken in order to avoid or minimise overlaps with, and effects upon, recreation and other users.
	Noise (offshore)	Any required monitoring or mitigation which might be required following the assessment of effects potentially arising from noise emissions from the project will be developed specifically in relation to the receptor identified. All such potential measures are thus presented in relevant sections of this document (see marine mammals, benthic ecology, ornithology etc).
	Marine aggregates	Mitigation measures for marine aggregate extraction will be developed during the ES process in consultation with the Crown Estates and other relevant aggregate industry stakeholders.
	Subsea cables and pipelines	Where conflicts between surface and subsea infrastructure are identified owners and/or operators will be consulted and agreements will be put in place concerning buffer distances and crossing arrangements. These arrangements will be determined and implemented so as to avoid disruption to existing infrastructure.
	Military and Civil Aviation	Technical mitigation options range from radar configuration adjustments through to the installation of new PSR to provide in-fill solutions. Operational options include changes to airspace arrangements (e.g. conduct LARS from a different unit) and re-routing around the OWF. Regulatory options include conducting an airspace change (e.g. establish a Transponder Mandatory Zone) using the Civil Aviation Authority change process.
Onshore scoping		

Parameter		Mitigation and Monitoring proposed
	Landscape	Mitigation proposals may include the replanting of vegetation, including translocated hedgerows, over the top of constructed cables, if required, in order to minimise the effects of the development in landscape terms. Reference will be made to the 'Holford Rules' which provide guidance on the restricted planting of tree species over a cable. With reference to the extension to the Alverdiscott substation strengthening of the existing hedgerow planting may be required or there may be a need for additional planting. Ground modelling could also be undertaken in the form of a reduction in levels at the substation site or the provision of earth mounding to merge with surrounding levels.
	Terrestrial Ecology and Nature Conservation	Mitigation measures that can be incorporated into the scheme design to avoid or reduce the potential for adverse effects on biodiversity will be identified. In the event that the Saunton Sands option is taken forward, a construction design will be developed to minimise effects on the SAC. This is likely to include HDD beneath the dunes to minimise any surface effects on the designated site. In addition, a programme of mitigation for effects on specific habitats and species will be developed for this option. The Taw-Torridge Estuary SSSI is of national nature conservation importance. Large numbers of wintering birds use the SSSI. The route options shown would avoid direct effects on the SSSI. The river crossings for the Saunton Sands and Woolacombe options would be located within this SSSI. For these options, consideration would have to be given to the timing of the construction work in order to avoid potential disturbance to wintering and breeding birds. Consideration should be given to appropriate methods of drilling beneath the river to minimise any effects on hydrology and the nearby habitat. Given the local importance of the River Torridge in the vicinity if the proposed river crossing for the Cornborough Range option, these factors would also be considered for this option. Where the cable passes through woodland, tree clearance is often carried out. Routing of the cable would seek to avoid woodland were possible. Detailed surveys will determine a scheme of mitigation for the protection of terrestrial species.
	Historic Environment	The cable corridor may require some pre-construction evaluation and/or other on-going monitoring and investigation during construction. Pre-construction work would include detailed desk-based assessment leading to corridor amendments where necessary and/or the adoption of construction techniques that minimise the width of disturbance or avoid surface disturbance altogether. Where archaeological remains cannot be avoided, detailed investigations may be needed prior to construction, although this may be able to take place within the construction period if properly planned. Direct effects on the scheduled monument at Higher Kingdon should be avoided in detailing the cable route, although the effects on the setting of the monument should also be considered.

Parameter		Mitigation and Monitoring proposed
	Hydrology and Flood Risk	Appropriate measures would be proposed to mitigate potential adverse effects arising from the excavation of contaminated material, with the implementation of management and occupational hygiene measures as necessary. In addition, measures to protect features of geological importance and water resources would be implemented, including pollution control measures.
	Soils, Agriculture and Land Use	The incorporation of good practice in soil handling and restoration, wherever possible, from the following documents can assist in minimising any damage to soil materials during the construction process: ▪ MAFF 2000 Soil Handling Guide. ▪ DEFRA 2008 Consultation on Draft Code of Practice for the Sustainable use of Soils on Construction Sites. Important principles to be considered in the construction process include: ▪ The identification and management of the soil materials on the site. These have been identified during the soil survey on site; ▪ Careful planning of haul routes and construction compounds to minimise soil disturbance; ▪ Timing of soil handling operations; ▪ Choice of soil handling machinery; ▪ Separate stripping, storage and reinstatement of topsoil and subsoil resources; and ▪ Careful supervision of soil handling operations on site. ▪ These measures would be incorporated into a soil management strategy for the working and restoration of the soils.
	Traffic and Transport	Appropriate mitigation measures will be identified as required during the construction phase of the project, including hours of construction operations.
	Air Quality	A risk assessment of dust and emissions during construction would be undertaken. Appropriate mitigation measures would be recommended to control dust nuisance effects and emissions during construction, consistent with the level of risk.
	Noise and Vibration	A risk assessment of dust and emissions during construction would be undertaken. Appropriate mitigation measures would be recommended to control dust nuisance effects and emissions during construction, consistent with the level of risk.

Parameter		Mitigation and Monitoring proposed
	Recreation, Tourism and Socio-economics	The adoption of directional drilling of cables may be required to reduce disruption to existing recreational land uses and areas of particular recreational or tourist value, such as Braunton Burrows, the river crossings (including the Tarka Trail where appropriate) and major road corridors. The works could also be timed to avoid peak seasons. A Code of Construction Practice would include measures to reduce the effects on the beach facilities, public rights of way and important tourist or recreational features such as Braunton Burrows, Braunton Marshes and Braunton Great Field, where these are affected.

Conclusions

9.1 This scoping report has outlined the main issues concerning the proposed development of the Atlantic Array offshore wind farm. In doing so a preliminary analysis of the potential issues and impacts has been established and mitigation and monitoring procedures proposed. The surveys and studies proposed in this report are summarised in the table below.

Parameter		Survey/Study Proposed to Assess Impact
		Offshore Scoping
Physical Environment	**Tidal Regime**	▪ Grab sampling (to include drop down videos and / or sample photos). ▪ Boreholes to characterise sediment variability with depth below the seabed surface ▪ Field measurements of background (pre-construction) suspended sediment concentrations. ▪ Geophysical survey. ▪ Numerical modelling
	Wave Regime	▪ Wave data ▪ Wave modelling
	Sediment Transport	▪ Geophysical survey ▪ Grab samples ▪ Conceptual understanding of sediment transport regime ▪ Hydrodynamic / sediment transport modelling

<table>
<tr><th colspan="2">Parameter</th><th>Survey/Study Proposed to Assess Impact</th></tr>
<tr><td rowspan="2"></td><td rowspan="2">Seabed Morphology</td><td>Grab sampling (to include drop down videos and / or sample photos).
Boreholes to characterise sediment variability with depth under the seabed surface
Field measurements of background (pre-construction) suspended sediment concentration.
Geophysical survey.
Empirical calculations / numerical modelling</td></tr>
<tr><td>Quantitative analysis of historic bathymetric variation
Conceptual understanding of sediment regime</td></tr>
<tr><td rowspan="5">Biological Environment</td><td rowspan="5">Benthic ecology</td><td>A detailed benthic characterisation survey is proposed across the Atlantic Array OWF site, plus the surrounding area. The specification for this survey will be agreed with CEFAS, Natural England, CCW and JNCC and will involve surveys to characterise the benthic ecology of the site and surrounding area in order to enable an assessment of impacts of sediment re-suspension and deposition upon the benthic environment to be carried out within the EIA.
Identification of habitats and species with conservation importance (particularly Annex I reefs) will be an important component of this assessment.</td></tr>
<tr><td>Data to be collected during desk study on sediment contamination in the proposed OWF development site and cable route, including possible sources of contamination, both historical and present. This will inform whether there is a requirement for sediment chemistry analysis (e.g. metals and PAH) as part of the benthic characterisation study. This requirement will be discussed with the statutory authorities including CEFAS, MMO, Natural England, CCW and JNCC</td></tr>
<tr><td>A detailed benthic characterisation survey is proposed across the Atlantic Array OWF site, plus the surrounding area (as described above) to identify the biotopes and habitats present (including Annex I reefs).</td></tr>
<tr><td>The marine ecology characterisation survey will identify the biotopes present at the development site.</td></tr>
<tr><td>Desktop assessment of potential for accidental release of pollutants.</td></tr>
</table>

Parameter		Survey/Study Proposed to Assess Impact
	Fish and shellfish resources	Fish and shellfish resources in and around the development site will be described via a combination of desk-based studies and site-specific fisheries data obtained via 2m scientific a beam trawl and commercial otter trawl surveys. The details of survey methods to be employed will be confirmed following a desk based assessment and consultation with the relevant sea fisheries committees, fisheries liaison officer (FLO) for the project and the relevant nature conservation organisations to ensure the most appropriate methods are being employed (CEFAS *et al*., 2004). Data on the distribution of spawning and nursery grounds will also be obtained via specific questions to commercial fishermen during the commercial fisheries consultation exercise. It may also be necessary to conduct fish egg/larvae surveys to more clearly define fish spawning areas in the vicinity.
		A desk based study has already been completed for the Atlantic Array proposed OWF. Details of this desk study can be found in Appendix VI. Further information on distribution of spawning and nursery grounds in the vicinity of the proposed development OWF will be obtained via specific questions to commercial fishermen during the commercial fisheries consultation exercise. There may also be a need to conduct egg/larvae surveys for sensitive species (i.e. herring) to more clearly define local spawning areas.
		The data collected during the commercial fisheries consultation, desk based review and fisheries surveys will be used to determine the distribution and extents of fish populations and spawning grounds within the development area and surrounding area.
		Use of physical impact studies to provide data on potential extent of suspended sediment compared to the background. This will be compared to species distribution data described in the baseline.
		The data collected during the commercial fisheries consultation, desk based review and fisheries surveys will be used to determine the distribution and extents of fish populations within the development area and surrounding area. A review of the potential colonisation of new structures (piles, scour protection etc.) and potential benefits afforded by this will also be undertaken, including a consideration of potential benefit from a change/reduction/cessation in commercial fishing and the potential for such consequences to be used as mitigation. This requires an objective assessment of the relative merits of a general increase in biodiversity *per se* over an increase in species that naturally and locally colonise local hard substrata (e.g. Linley *et al.,* 2007). However whether such “artificial reefs” increase productivity in the long-term is controversial, and such structures should not automatically be assumed to be beneficial (CEFAS *et al.,* 2004).
		Data on the distribution of EMF sensitive species (particularly elasmobranchs) in and around Atlantic Array will be collated via desk-based studies, site-specific fishery and benthic ecological surveys, and consultation with fishermen and fisheries organisations.

Parameter		Survey/Study Proposed to Assess Impact
	Marine Mammals	Using species-specific audiograms, noise modelling of typical pile-driving operations will be undertaken to determine the radii of zones in which there may be impacts to marine mammals. Data from existing OWF projects will be sourced and used in the EIA. C-PODs, visual boat-based and towed hydrophone surveys will be used to record detection rates of Harbour Porpoises and dolphin species to inform the EIA.
		The difficulty of predicting the nature of secondary impacts makes designing targeted surveys impossible. However, cross-referencing of marine mammals surveys with the marine ecology and fisheries surveys will be made to determine any potential impacts.
		The area will be characterised using from a 12-month monitoring programme, which will establish baseline data on species occurrence, abundance and distribution. The programme will use boat-based sightings surveys, towed hydrophone transects and acoustic data-loggers deployed on seabed moorings (C-PODs). Literature relating to the behavioural responses of marine mammals to offshore wind farms (including findings of previous Round 1 & 2 projects and overseas projects) will be assessed in order to predict potential impacts, based on the EIA baseline.
		Presence of infrastructure: Desktop literature review of observations recorded at other wind farms in UK waters and internationally.
		Changes in fishing activity: During the EIA stage an assessment of commercial fisheries in the area will be undertaken. This will assess the current types and levels of catch and by-catch, as well as intensity of fishing in certain parts of the area.

Parameter		Survey/Study Proposed to Assess Impact
	Ornithology	Summer season boat based bird survey. Thirteen monthly boat based surveys undertaken over 2 years (2009 and 2010) on 22 transects running north-south across the proposed Atlantic Array development area. Transects lines are spaced at 2 km intervals and use three observers, with two observers covering a 180° forward arc, each simultaneously recording a separate 90° arc from mid-ship to bow on each side of the vessel. A third person is present on the observation platform to record the sightings and other parameters. Observations are made along the line transect within a strip width of 300 m with surveyors categorising sightings with bands perpendicular to the ship of 0-50m, 50-100m, 100-200m, 200-300m and 300+m. Flight heights are recorded in three bands: <20m, 20-200m and >200m. The summer boat based surveys have been/will be surveyed over the following months: ▪ Monthly between April and October 2009 (6 surveys) ▪ Monthly between March and September 2010 (7 surveys) Summer aerial survey. Over the survey period 2009-2010 a total of six summer aerial surveys will be undertaken. This will include three surveys undertaken per year in May, June and August. In 2009 these surveys were conducted by WWT on behalf of The Crown Estate using standard aerial survey techniques (observers flying in a light aircraft along transects across the Zone). Due to the discontinuation of this method of survey by WWT the 2010 summer aerial surveys will be undertaken using the high definition (HD) aerial survey technique, involving the use of HD video equipment to record the birds under the aircraft. This is then played back at a slower rate in a laboratory where individual birds are identified and counted. The surveys proposed for 2010 will be conducted over the same transects as in 2009, thus including the entire Bristol Channel Zone. Winter aerial survey. Winter aerial surveys of the site were commissioned by The Crown Estate and covered the period of January to March 2009 and October to March 2009/10. These surveys covered the entire Bristol Channel Zone using the observers in light aircraft method discussed above. For the period of September to December 2010 these surveys will be continued, though as with the summer survey the methodology used at this time will be the HD technique. These surveys will cover the full Bristol Channel Zone as per previous TCE commissioned surveys.

Parameter		Survey/Study Proposed to Assess Impact
		Potential winter boat based survey late 2010. Three surveys are provisionally proposed for October to December 2010 pending review of the 2009/10 winter aerial survey data, which is yet to be received. The necessity for this survey arises out of the poor species discrimination of auks during standard aerial survey. If the 2009/10 winter aerial survey data shows a large number of auks then it is proposed that the boat based survey programme be extended in order to adequately identify actual species present (rather than 'auk sp.', and their numbers in the project area over the second early Winter period (i.e. Oct/Nov/Dec 2010). Nocturnal thermal imaging with image intensifier. After consultation with NE, CCW and JNCC it is proposed that a trial of thermal imaging and image intensifier survey is undertaken in order to characterise the species present and their abundances and behaviour at night. The initial trial is scheduled for May 2010 with a view to undertaking additional surveys in July and September, subject to agreement with NE, CCW JNCC and RSPB that the method is effective. The nocturnal surveys will utilise imaging equipment and will be carried out in a similar manner to that of the diurnal boat based surveys. The nocturnal surveys will follow, wherever possible within the limitations of the imaging technology, the recommendations of Camphuysen *et al* (2004) for a line transect survey with distance sampling and 'snapshot' counts of birds in flight. Carrying out the surveys on a vessel of the same specification (if not the actual vessel) as that used for the diurnal survey programme will mean that many of the recommendations of Camphuysen *et al* (2004) are automatically met.
	Nature Conservation	The proposed benthic and fish ecology characterisation surveys (sections 4.77 and 4.119, respectively), has been designed in order to describe the status and distribution of Annex I habitat. This survey will include the use of non-destructive methods including drop-down video. Data from the geophysical survey of the site, in particular hi-resolution sidescan data, will also be used to describe the distribution of potential Annex I habitats. The presence/absence of Annex II species within the site will be recorded via a combination of desk-based review of existing datasets and data from the on-going monthly boat-based bird surveys (which also record marine mammal sightings). The method of determining the presence/absence of UK BAP habitats and species will be determined via the type of habitat/species in question. A combination of desk-based review and analysis of site-specific survey data will be used.
Human Environment	**Landscape and Seascape**	Desk studies and field surveys

<table>
<tr><th colspan="2">Parameter</th><th>Survey/Study Proposed to Assess Impact</th></tr>
<tr><td rowspan="4"></td><td rowspan="3">Commercial Fisheries</td><td>Comprehensive fisheries assessment from published data (MFA) to determine the extent and nature of fishing activity in the area.
Detailed consultations with fishing industry, fishermen and fishermen’s representatives, fish processors, merchants and fleet owners and the local regulatory bodies (South Wales Sea Fisheries Committee, Devon Sea Fisheries Committee, Cornwall SFC? and the MFA at Milford Haven, Plymouth and Brixham).
Observations and interviews at local ports
Work with Fisheries Liaison Officer</td></tr>
<tr><td>Consultations with fishery interests. Review of sightings and VMS data. Collation of fishing industry’s existing information on seabed obstructions.</td></tr>
<tr><td>‘Rochdale envelope’ approach to assessing likely impacts (Wessex Archaeology 2007).</td></tr>
<tr><td>Shipping and Navigation</td><td>Some displacement impacts on shipping and navigation may include but not be limited to:
Additional voyage distances.
An increase in vessel encounters and the creation of ‘choke points’.
A reduction in the available depth and width of navigable water.
Navigation and collision avoidance impacts may arise from, for example:
Structures hindering the view of navigational features and other vessels.
Interference with electronic navigation and communication equipment.
These issues would be assessed on the basis of a traffic survey, consultations with key stakeholders and if necessary traffic modelling (which may include area traffic assessment and specific traffic assessment). Where modelling is required, information on weather, visibility, tides and bathymetry would be assembled as an input to the model. Future case traffic projections would be based on desk studies and consultation with stakeholders. Published studies into effects on marine radio navigation and communications systems would be consulted (for example the 2004 QinetiQ/MCA report into investigations undertaken at North Hoyle Wind Farm and the 2007 BWEA report into effects on radar at Kentish Flats).</td></tr>
</table>

Parameter		Survey/Study Proposed to Assess Impact
		Some of the main categories of potential hazardous event listed in Appendix G1 of the BERR Methodology are as follows: ▪ Collision between vessels. ▪ Contact with wind farm structures. ▪ Grounding and stranding. ▪ Fire and explosion. ▪ Flooding and sinking. ▪ Inhibited search and rescue operation. ▪ Inhibited pollution clean-up. These issues would be assessed on the basis of a traffic survey, consultations with key stakeholders and if necessary traffic modelling (which may include area traffic assessment and specific traffic assessment). Where modelling is required, information on weather, visibility, tides and bathymetry would be assembled as an input to the model. Future case traffic projections would be based on desk studies and consultation with stakeholders. Information on historic casualty rates would be sought from the Marine Accident Investigation Branch and other organisations holding such data.
	Maritime Archaeology	A desk-based assessment will collate information on known wrecks and recorded losses using the UKHO wreck record, NMR recorded losses and historic and contemporary documentary sources. Side scan sonar and magnetometer data will be subject to archaeological assessment in order to confirm the presence of previously located wreck sites and comment on their character; and to identify, locate and characterise any unrecorded wrecks. The study will consider the importance of each site and the potential level of impact.
	Military Practice Areas	Shipping study to be undertaken to inform the potential need for moving shipping lanes.
	Munitions	Desk based UXO study to be carried out as part of the Environmental Statement.
	Socioeconomics and Tourism	A desk-based study will be carried out to determine the socio-economic background of the region. This will include identification of local port infrastructure and any supporting infrastructure that may be of relevance to the offshore wind farm development.
	Recreation	Study of recreational amenity value of the Atlantic Array site and associated cable route. This will include consideration of disruption and potential alterations to RYA sailing routes. No site specific surveys are anticipated.

Parameter		Survey/Study Proposed to Assess Impact
	Marine aggregates	Coastal processes study to identify sediment mobilisation and deposition rates arising from the construction and operation of the Atlantic Array wind farm.
	Subsea cables and pipelines	Further investigation into the location and operational status of cables and pipelines in the area will be conducted using GIS for the ES. As the exact export cable route is not yet decided there remains the potential for impacts on existing cables/pipelines from this aspect of the project. This will aspect of the project will be included in all GIS investigations outlined above.
	Military and Civil Aviation	Where required, a thorough assessment of aviation and radar issues will be undertaken based on the following methodology: Technical assessment of air navigation and radar systems and their operational requirements; Gathering of operational ATC knowledge (civil and military); Consultation with relevant ANSP; Analysis of radar LOS using specialised software modelling tools; Detailed technical investigation (if required, for example to design specific mitigation solutions); Undertaking an aviation traffic study (if required); Undertaking flight trials (if required, for example to gather specific on-site data to inform mitigation design).
Onshore scoping		
	Landscape	Baseline information on the landscape resource will be gathered through a combination of desk studies, consultation and field surveys. Key documents such as any County or local landscape character assessments will be reviewed as part of the desk study. The geographical extent of potential visibility will be established for the tallest elements of the onshore proposals by production of a Zone of Theoretical Visibility (ZTV) plans. Key viewpoints will be agreed with statutory consultees. Wireline diagrams of the substation and associated infrastructure will be produced to illustrate the location and potential appearance of the proposals from each of the agreed viewpoints. A number will be developed further into photomontages of the onshore elements of the project in agreement with the local authorities.

Parameter		Survey/Study Proposed to Assess Impact
	Terrestrial Ecology and Nature Conservation	A desk study, together with relevant site and species surveys will be carried out to establish the existing ecology and nature conservation interest of the areas covered by the onshore elements of the project. To supplement and update the desk-based study and to obtain detailed information on the habitats present, an extended Phase 1 Habitat survey will be undertaken. This will follow the standard method (JNCC 2003) and will also involve an assessment of potential habitat for protected species. The results of the Phase 1 survey will be used to identify the need for additional detailed species or habitat surveys, which may include surveys for invertebrates, reptiles, badgers, water voles, otters and bats as well as surveys of habitats, including hedgerows. Survey methodologies will take into account the most recent species/habitat specific guidance.
	Historic Environment	The assessment of likely significant effects on heritage resources arising from all elements of the onshore development will consist of: - Desk based assessment to collate and describe the known archaeological and cultural heritage resources. - Walkover field survey from the landfall sites to the substation site to provide information on the archaeological potential of the affected areas. - Site visit or inspection of key resources to assess potential effects on settings and on the wider historic landscape and any associated features. The results of the desk-based assessment and site walkover will be discussed with the archaeological advisor to the local planning authorities and English Heritage (if appropriate) to appraise the quality of available information and determine whether further evaluation in the form of intrusive or non-intrusive archaeological fieldwork is required. Any archaeological fieldwork would be undertaken in accordance with a methodology agreed with the archaeological advisor to the local planning authorities and English Heritage (if appropriate).

Parameter		Survey/Study Proposed to Assess Impact
	Hydrology and Flood Risk	The assessment of likely significant effects on ground conditions would comprise: ▪ Review of the legislative and policy context; ▪ Desktop baseline study to identify ground conditions prevailing across all elements of the project and, in particular, the potential for contaminated land; ▪ Assessment of risk posed by ground and groundwater conditions; ▪ Identification of remedial measures to mitigate any potential effects. For all route options, effects on any sites designated for their geological interest will be considered. The assessment of effects on water resources would include those on the prevailing hydrological, surface water drainage, flooding and water quality environments at the landfall sites, along the cable corridors and at the substation site. This would include: ▪ Baseline data collection. ▪ Site walkover survey would determine the likely requirements for further site investigation. ▪ Identification of potential effects. including flood risk and contaminated water run-off, ▪ Development of a mitigation strategy. ▪ Consideration of flood compensation measures (if required). ▪ Flood Risk Assessment (FRA) for the project, notably the proposed substation(s).
	Soils, Agriculture and Land Use	The work would include a desk study to consider existing information in relation to agricultural land quality and farm holdings. A field survey would be undertaken as a verification of the published information collected, based on reconnaissance survey work, to identify the characteristics of the main soil types along the route and their limitations. The effects on farm holdings would consider information provided by the projects land agents and/or directly from the farmers along the route.
	Traffic and Transport	The work would include a desk study and site visits to review the sensitive parts of the road network. The work will include an abnormal loads study.

Parameter		Survey/Study Proposed to Assess Impact
	Air Quality	The current air quality would be established with specific regard to the findings of the Review and Assessment process of Local Authorities, the results of available local monitoring and data available at the National Air Quality Information Archive. The results of the traffic and transport environmental assessment will be reviewed in the context of these criteria to determine whether an assessment of construction-related vehicle emissions is required. It is envisaged that this will scope out the necessity for quantitative modelling. A risk assessment of dust and emissions during construction would be undertaken, using the London Best Practice Guide (LBPG) on Construction Dust formulated by the Air Pollution Planning and the Local Environment (APPLE) working group.
	Noise and Vibration	The work would include short term baseline noise surveys along the route of the cable corridor and long-term baseline noise surveys in the area of the substation. This will inform a construction noise assessment for the cable burying activity and the sub-station and construction vibration impacts for any specific areas where piling may be required. In addition, the operational effects will be considered for substation site(s).
	Community Effects	Baseline information would be complied based on a desk study, to inform an assessment of effects on recreational resources, tourism and socio-economics will include those arising during the construction and operation of the project, such as effects on employment, effects on recreational and tourism amenities and effects of PRoW. Information regarding existing and proposed PRoW, their purposes and indicative levels of use would initially be collated from existing sources. An initial site visit to establish the nature and use of recreational resources, including PRoW will be undertaken. Targeted user surveys of some PRoW may also to be required.
	Electric and Magnetic Fields	No survey planned.

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1.1

- Conclusions

Appendix II – Best Practice Guidance Documents

i) **Table 2.1: Offshore Best Practice Assessment Methodology Industry Guidance 2009**

Title of Document	Author	Date	Relevant Industry
Generic Guidance			
Best Practice Guidelines for Wind Energy Development http://www.bwea.com/pdf/bpg.pdf	BWEA	1994	Wind
EIA and the Consenting Process			
Offshore Wind Farms: guidance notes for Environmental Impact Assessment in respect of FEPA and CPA requirements. Version 2 http://www.cefas.co.uk/publications/files/wind farm-guidance.pdf	CEFAS	2004	Wind
Guidance notes: offshore wind farm consents process http://www.berr.gov.uk/files/file22990.pdf	Anon	2004	Wind
Environmental Impact Assessment (EIA): Guidance for developers at the European marine energy centre http://www.oreg.ca/docs/emec_EIA_guidelines.pdf	Anon	2005	Wave and Tide
Guidance on consenting arrangements in England and Wales for a pre-commercial demonstration phase for wave and tidal stream energy devices (marine renewables) http://library.coastweb.info/295/1/marine_renewables_consents_process.pdf	Anon	2005	Wave and Tide
Guidance on the Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2000 http://www.berr.gov.uk/files/file21857.pdf	Anon	2000	Wind, Wave and Tide
Consultation			
Best practice guidelines: Consultation for offshore wind energy developments http://www.bwea.com/pdf/bwea-bpg-offshore.pdf	BWEA	2002	Wind
The protocol for public engagement with proposed wind energy developments in Wales http://www.berr.gov.uk/files/file38708.pdf	Centre for Sustainable Energy, BDOR Ltd and Capener, P	2007	Wind
Shipping and Navigation			
MGN 372 (M&F) –	MCA	2008	Wind

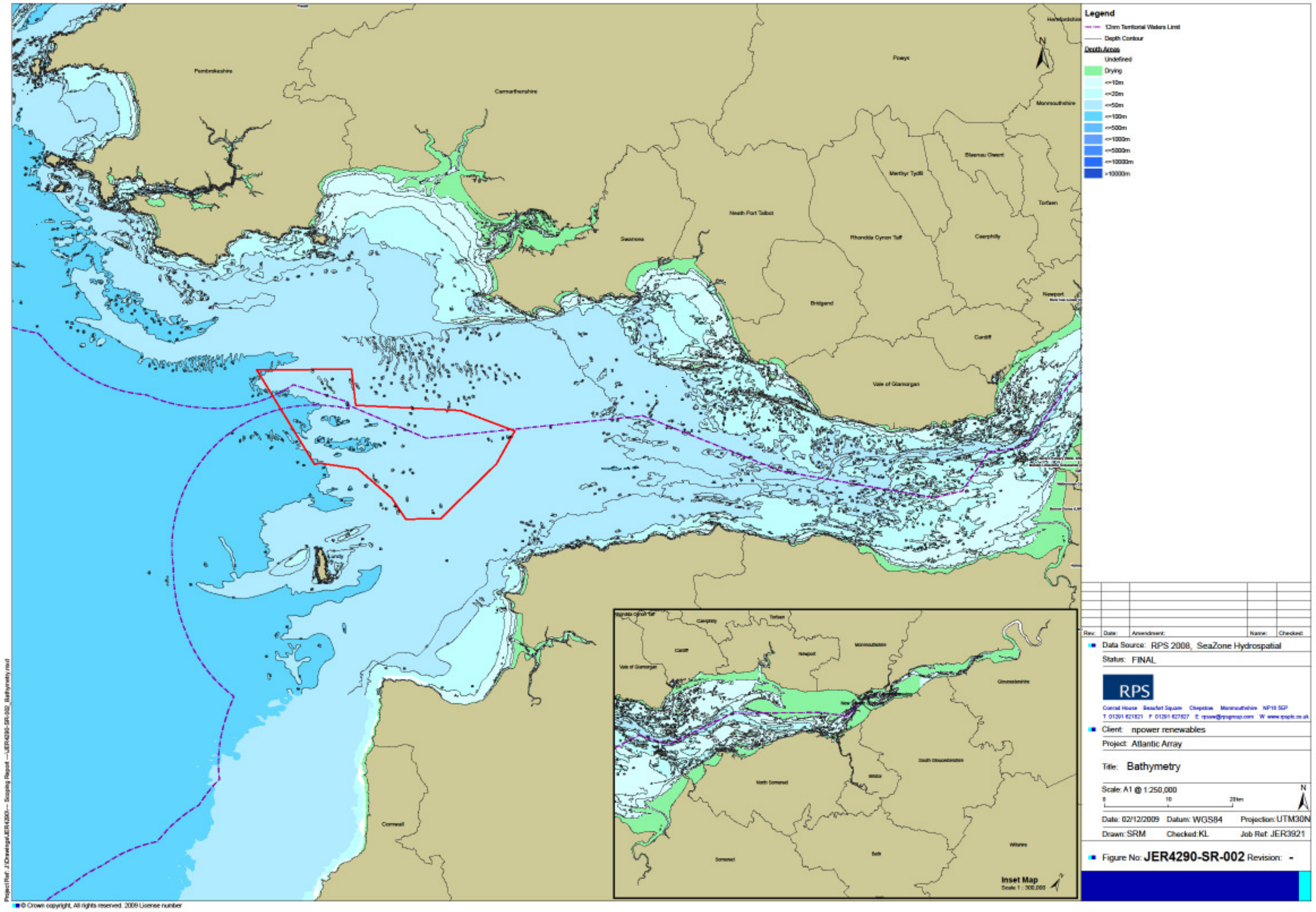
Title of Document	Author	Date	Relevant Industry
Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs http://www.mcga.gov.uk/c4mca/mgn372.pdf			
Trinity House Lighthouse Service Guidance	Trinity House	2005	Wind
Wind Farm Shipping Route Template http://www.mcga.gov.uk/c4mca/windfarm_shipping_template.pdf http://www.mcga.gov.uk/c4mca/windfarm_shipping_template_2_-2.pdf	MCA	2006	Wind
Proposed UK Offshore Renewable Energy Installations (OREI) - Guidance on Navigational Safety Issues http://www.mcga.gov.uk/c4mca/mgn275-2.pdf	Anon	2004	Wind
Guidance on the assessment of the impact of offshore wind farms: methodology for assessing the marine navigational safety risks of offshore wind farms (http://www.berr.gov.uk/files/file22888.pdf)	DTI, MCA and DfT	2005	Wind
IALA recommendation O-117 on the marking of offshore wind farms Edition 2 – **Superseded – See 0-139** http://www.tidelandsignal.com/web/html/IALA-CD.htm	IALA	2004	Wind
IALA recommendation O-131 on the marking of offshore wave and tidal energy devices Edition 1 - **Superseded – See 0-139** http://www.tidelandsignal.com/web/html/IALA-CD.htm	IALA	2005	Wave and Tide
IALA recommendation 0-139 The Marking of Man-Made Offshore Structures http://www.tidelandsignal.com/web/information/IALA/Recommendations/O139%20Marking%20Man-Made%20Offshore%20Structures.zip	IALA	2005	Wave, Wind and Tide
DTI Consultation on Safety Zones http://www.berr.gov.uk/files/file34705.pdf	DTI	2006	Wind
IMO Guidelines for Formal Safety Assessment http://www.imo.org/includes/blastDataOnly.asp/data_id%3D5111/1023-MEPC392.pdf	IMO	2002	
Aviation			
Wind Energy and Aviation Interests – Interim Guidelines http://www.bwea.com/pdf/Wind-Energy-and-aviation-interim-guidelines.pdf	ETSU	2002	Wind
Visual Impact			
Guidance on the Assessment of Effect of Offshore Wind Farms: Seascape and Visual Effect Report	DTI	11/2005	Wind

Title of Document	Author	Date	Relevant Industry
http://www.berr.gov.uk/files/file22852.pdf			
Guide to best practice in seascape assessment http://www.marine.ie/NR/rdonlyres/683C8CD0-3367-4704-8542-D3091607C9C2/0/interreg5_1.pdf	Hill, M, Briggs, J, Minto, P, Bagnall, D, Foley, K and Williams, A	2001	Wind
Visual assessment of wind farms: best practice http://www.snh.org.uk/pdfs/publications/commissioned_reports/f01aa303a.pdf	University of Newcastle	2002	Wind
Guidance on the assessment of the impact of offshore wind farms: seascape and visual impact report http://www.berr.gov.uk/files/file22852.pdf	Anon	2005	Wind, Wave and Tide
Guidelines for Landscape and Visual Effect Assessment	IEMA/Landscape Institute	2002	Wind, Wave, and Tide
Visual Analysis of Wind Farms – Good Practice Guidance http://www.snh.org.uk/pdfs/publications/heritagemanagement/Visual%20Representation%20of%20windfarms%20-%20excerpt.pdf	SNH	2006	Wind
Wind Turbine Development – Landscape Assessment, Evaluation and Guidance	Breckland Council and King's Lynn and West Norfolk Borough Council	2003	Wind
Cumulative Effects of Wind Turbines http://www.berr.gov.uk/files/file17844.pdf	DTSU/DTI	2000	Wind
Greater Wash Round 2 Offshore Wind Farms: Cumulative Effects Scoping Report – Final Draft	Royal Haskoning	2004	Wind
Cumulative Effect of Wind Farms version 2 http://www.snh.org.uk/pdfs/strategy/cumulativeeffectsonwindfarms.pdf	SNH	2005	Wind
Nature Conservation			
Nature conservation guidance on offshore wind farm development	Anon	2005	Wind
Wind farm development and nature conservation: a guidance document for nature conservation organisations and developers when consulting over wind farm proposals in England http://www.bwea.com/pdf/wfd.pdf	English Nature, RSPB, WWF-UK and BWEA	2001	Wind

Title of Document	Author	Date	Relevant Industry
Marine Renewable Energy and the Natural Heritage: An overview and policy statement http://www.snh.org.uk/pdfs/polstat/mrp.pdf	SNH	2004	Wind, Wave and Tide
Ornithology			
COWRIE Bird Survey Guidance. Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K., http://www.jncc.gov.uk/pdf/Camphuysenetal2004_COWRIEmethods.PDF	Camphuysen *et al*	April 2004	Wind
Guidelines for Ecological Impact Assessment in the United Kingdom. http://www.ieem.net/ecia/download.htm	IEEM	2006	Wind
Nature Conservation Agency Guidance on Offshore Wind farm Development	CCW/EN/JNCC	2004	Wind
Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers http://www.offshorewindfarms.co.uk/Assets/CIA%20Report%20Final%20Combined.pdf	COWRIE	2009	Wind
A review of Assessment Methodologies for Offshore Wind farms http://offshorewindfarms.co.uk/Assets/Review_Marine_Surveys_With_Hidef_Annex_2009_09_30_FINAL%20sept%202009.pdf	Maclean, Wright, Showler and Rehfisch	2009	Wind
High Definition Imagery for Surveying Seabirds and Marine Mammals: A Review of Recent Trials and Development Protocols http://offshorewindfarms.co.uk/Assets/COWRIE%20High%20Definition%20Imagery%20Final%20Report20090930.pdf	Thaxter and Burton	2009	Wind
Marine Mammals			
Statutory nature conservation agency protocol for mitigation of wind farm piling noise at sea http://www.jncc.gov.uk/pdf/consultation_epsAnnexA.pdf	Anon	2008	Wind, Wave and Tide
The deliberate disturbance of marine European Protected Species http://www.jncc.gov.uk/page-4227	JNCC	2008	Wind, Wave and Tide
Archaeology			
Guidance for the assessment of cumulative impact on the historic environment from offshore renewable energy http://www.dur.ac.uk/eh.rsa/pdf/COWRIE%20off%20shore%20windfarms.pdf	Oxford Archaeology	2008	Wind, Wave and Tide
Historic Environment Guidance for the Offshore Renewable Energy Sector	Wessex	2007	Wind, Wave and Tide

Title of Document	Author	Date	Relevant Industry
http://www.offshorewindfarms.co.uk/Assets/archaeo_guidance.pdf	Archaeology		
Wind Energy and the Historic Environment http://www.helm.org.uk/upload/pdf/Wind_Energy_%28final%29.pdf	EH		wind
Standard and Guidance for Archaeological Desk based Assessment. http://www.archaeologists.net/modules/icontent/inPages/docs/codes/dba2.pdf	IFA	2001	Wind, Wave and Tide
Health and Safety			
The Health and Safety Risks and Regulatory Strategy Related to Energy Developments http://www.hse.gov.uk/consult/condocs/energyreview/energyreport.pdf	The Health and Safety Executive	2006	Wind, Wave and Tide
Geophysical Survey			
IHO Standards for Hydrographic Surveys http://www.iho.shom.fr/publicat/free/files/S-44_5E.pdf	International Hydrographic Organization	1998	Wind, Wave and Tide
Scroby Sands Offshore Wind Farm –Coastal Processes Monitoring. Contract AE0262	CEFAS	2006	Wind, Wave, Tide
Coastal Process Modelling for Offshore Wind Farm Environmental Impact Assessment: Best Practice Guide http://www.offshorewindfarms.co.uk/Assets/Coastal%20process%20modelling%20best%20practice%20guide%20Final%20report%20sept%2009.pdf	ABPmer/HR Wallingford	2009	Wind
Commercial Fishing			
DEFRA 2004 guidelines	DEFRA	2004	Wind, Wave and Tide

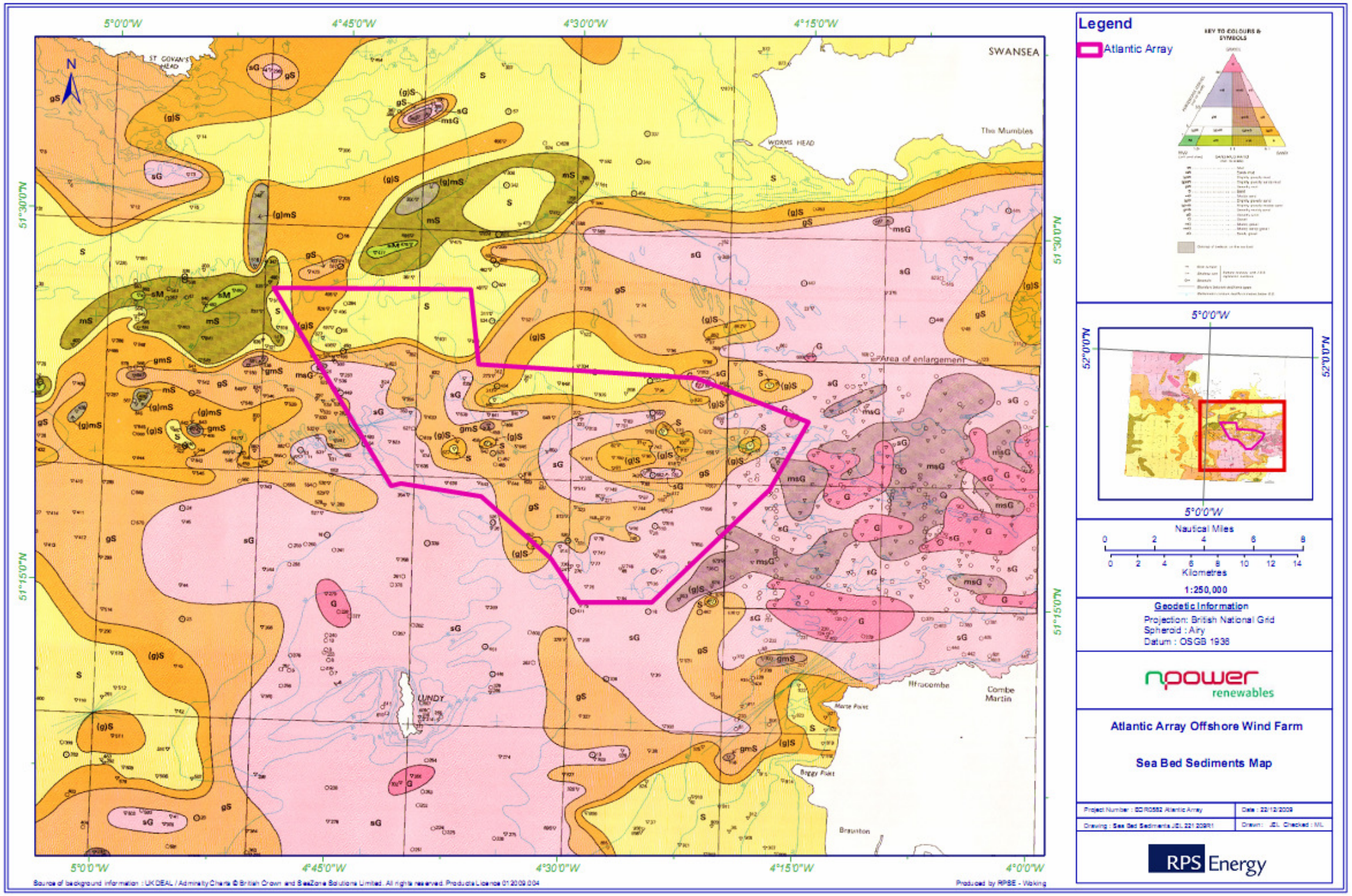
Appendix III – Bathymetry of Atlantic Array



○

ii) **Appendix A: Bathymetry of the Atlantic Array Site**

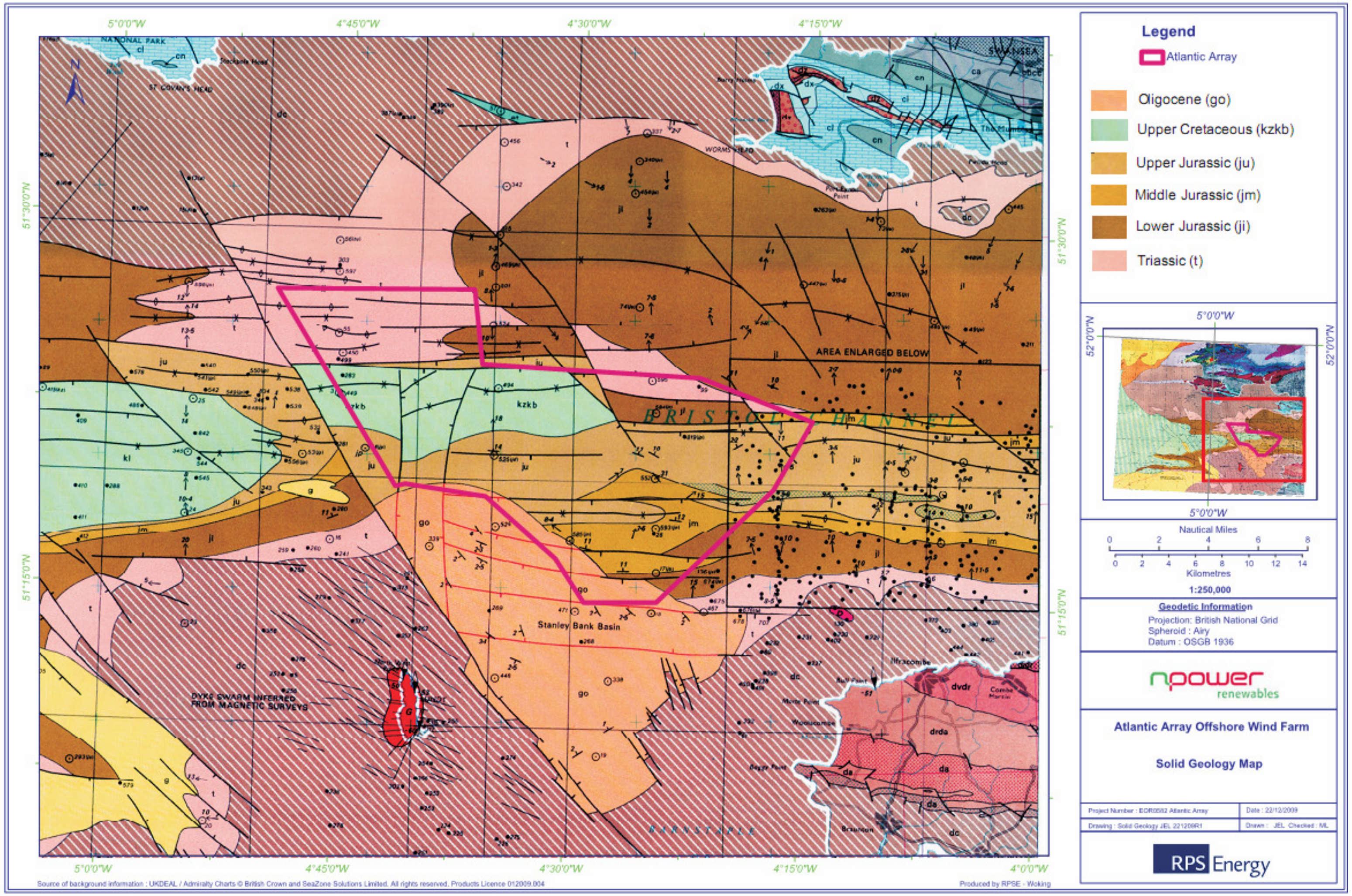
Appendix IV – Seabed Sediments over Atlantic Array



○

iii) **Appendix B: Sea Bed Sediments Geological Map (BGS, 1983b)**

Appendix V – Atlantic Array Solid Geology



iv) **Appendix C: Atlantic Array Solid Geology Map (BGS 1983a).**

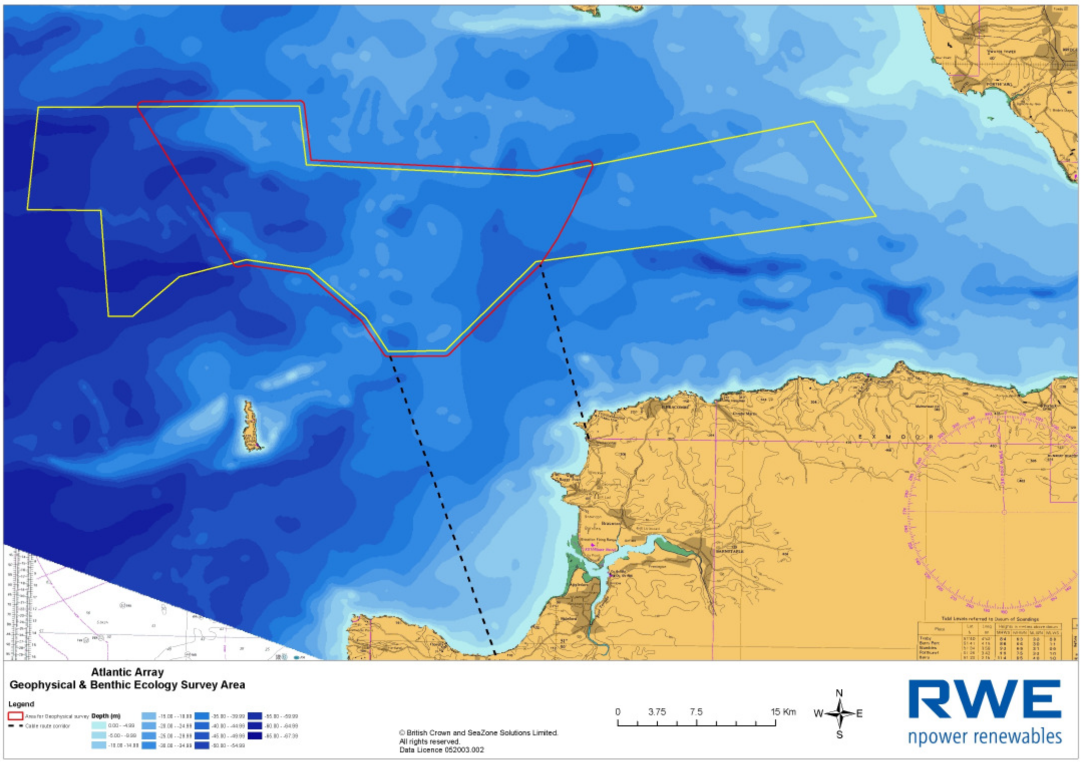
Appendix VI – Detailed Benthic Ecology Survey Specifications

Benthic Survey Approach

1.1 Survey Area

○ The area to be surveyed for the Offshore Wind Farm (known as the project area) represents the potential development area and a 500m 'buffer zone' (to be together known as geophysical survey area). The potential cable landfall has not been determined, so the actual areas to be surveyed between the wind farm and the shore are not currently known. A review of potential cable landfall options is currently being undertaken, and once complete will provide an area to be surveyed at the final stage of the geophysical survey. A desk-top review of the environmental constraints will also be undertaken to ensure these factors are considered in the cable route design.

○



○

v) Figure 1: Map of the Crown Estate Zone 8 boundary and Atlantic Array OWF project area. The area to be covered by the geophysical survey includes a 500m buffer around the potential area for development. The export cable route will fall within the black dotted lines, but potential landfall points, and therefore routes, are yet to be finalised.

○

1.2 Programme

○ The geophysical survey will commence mid- March to mid-April. The project area will be completed before the export cable route is surveyed. The benthic ecology survey will follow the geophysical survey, in late summer/early autumn 2010, allowing enough time for the results of the geophysical survey to feed into the final benthic ecology survey design.

○ A review of the potential cable landfalls is currently underway, and will report in a timely manner to inform the geophysical survey.

○ The results of the geophysical survey will inform the design of the benthic survey, the assessment of the ecology of the area, the coastal processes assessment and the marine archaeological assessment.

1.3 Vessels

○ The geophysical survey will utilise two Bureau Veritas class dedicated geophysical survey vessels, 60-70m in length, and suitable for the Outer Bristol Channel. These vessels will also conduct the majority of the cable route survey, up to the 15m contour. Nearshore work (<15m depth) for the export cable route will be conducted by a dedicated geophysical survey Cheetah catamaran.

1.4 Survey design

○ The geophysical survey has been developed on the basis of NRL's and its contractors' previous experience of geophysical surveys for proposed offshore wind farms. The survey is primarily designed to produce high quality data, whilst complying with the MCA IHO Order I survey requirements.

○ A Multi Beam Echo Sounder (MBES), Side Scan Sonar (SSS), Sub-Bottom Profiler (SBP) and magnetometer will be run on every line. The geophys survey area will cover an area of 540km2. This includes a 500m buffer around the potential development area. The survey will total 5973 line kilometres, inclusive of a 5% infill. A target speed of 4 knots will be aimed for (Kenny *et al,* 2003), depending on weather and sea conditions, to ensure high quality SSS and SBP data.

○ Survey main lines will be orientated east-west with cross lines running north-south. The water depth across the site means full coverage of Multi Beam Echo Sounder (MBES) bathymetry would be achieved using a wide line spacing. However, main lines will be spaced at a maximum of 100m, a distance determined by the requirement to get 200% isonification of Side Scan Sonar suitable for the detection of benthic habitats, such as the Annex I reefs (i.e. *Sabellaria spinulosa*/*S.alveolata*, mussel or cobble reefs). Where the water depth dictates a narrower line spacing to achieve full bathymetric coverage by the MBES this will be followed. Cross lines will be spaced at 2 km intervals, within the requirement for an IHO Order 1 survey.

○ The export cable route survey will employ the same line-spacing criteria as above, though the constraints of water depth on the MBES data collection will be greater. During the cable route survey a client representative will be on board, with the authority to undertake real-time route development. This technical specialist will ensure the route surveyed is optimised for all potential constraints.

1.5 Survey Methodology

○ 1.5.1 Side Scan Sonar (SSS)

○ The geophysical survey has been designed to achieve 200% insonification by SSS, set to maximise the probability of the detection of benthic surface characteristics, including the presence of Annex I biogenic (e.g. *S. spinulosa/S. alveolata* or mussel) or geogenic (cobble) reefs. With a maximum line spacing of 100m, and the SSS range set to 125m, there will be a minimum of a 25% overlap on each survey line, resulting in no loss of coverage at the edges of the swathes, and no 'blind spot' under the tow-fish. The SSS will be located using a USBL system, ensuring a maximum variation from the designed line position of +/- 10m.

○ Both the main offshore vessels and the nearshore vessel will utilise a dual frequency Edgetech 4200FS, set to 100 and 500 kHz, and recording digitally in high definition mode. The 100 kHz sonar is aimed at picking up the limits of gravels, where Annex I reefs may occur. The 500 kHz

sonar will identify potential areas of habitat based on the characteristic of the seabed. The Edgetech 4200FS set to these parameters will record high quality data at the 125m range so required coverage can be achieved within acceptable commercial boundaries, a consideration for a large site such as Atlantic Array.

○ The SSS can only provide information on potential areas of *Sabellaria*, mussel or cobble reefs in order to plan a targeted sampling campaign to confirm the presence or otherwise of different benthic habitats. In particular the contractor has suggested that in practice potential *Sabellaria* reefs are difficult to distinguish from mussel beds. The contractor's geophysicist will take data from the survey to create sidescan sonar mosaics which will be used by the benthic ecologists to help target potential Annex I reefs. Any interpretation of potential Annex I reefs will be confirmed by the benthic sampling campaign comprising targeted drop down underwater photography and grab samples (where applicable; though intrusive sampling will obviously be avoided where potential biogenic or geogenic reef features have been identified).

○ The results of the sidescan sonar survey will be used to provide a picture of the sediment regime within the project area. In addition, the results will be used by the benthic ecologists and marine archaeologists to the provision of baseline information and for undertaking the assessment as part of the Environmental Impact Assessment (EIA). The results of the benthic sampling campaign will then be used to cross check the interpretation of the geophysical survey.

○ 1.5.2 Multi Beam Echo Sounder (MBES)

○ The geophysical survey will achieve full and continuous coverage of multi beam (swathe) bathymetry, with contours shown at 1.0 metre intervals, vertically reduced to LAT, ensuring full coverage to IHO Order 1 standards. The main offshore vessel will utilise a Konsberg-Simrad EM3002D, and the near-shore vessel will utilise a Geoswath Plus. The multi-beam data will be acquired using an industry standard Simrad EM 710, with frequencies between 70 and 100 kHz.

○

○ The MBES will provide detailed bathymetric information on the project area.

○ 1.5.3 Sub-bottom profiling

○ An SBP (boomer) capable of identifying total sediment thickness and basement depths across the survey area as a continuous record along every survey line will be deployed. The main offshore vessel will utilise an EG&G 230 surface tow boomer, with CSP300 bang box will be deployed via a combined power/tow cable up to 30m from the stern of the vessel subject to local conditions such that the wake from the vessel has a minimal effect upon the data. A 20-element hydrophone would also be deployed.

○ The results of the sub-bottom survey will be used to provide a picture of the geology of the project area which will be used both in the project design process and the EIA.

○ 2.0 Marine Ecology Characterisation Survey Specification

○ The following provides details on the intended site-specific benthic and epibenthic ecological characterisation sampling for the proposed Atlantic Array OWF development site, export cable route corridor, within a tidal excursion either side of the site and at a number of potential reference 'blocks' outside the tidal excursion. The following provides details on:

○ • The range of offshore marine ecology characterisation surveys proposed for the project;

○ • The specifications of the proposed marine ecology characterisation surveys;

○ • The programme for the proposed marine ecology characterisation surveys;

○ • The proposed approach to reporting and presenting the findings of these surveys.

○

○ It is proposed that the benthic ecology characterisation survey is undertaken following review and incorporation of the results of the geophysical survey. An indicative survey array has been provided as a basis on which to agree the benthic survey array in principal with the statutory authorities. The final survey design will be refined following review of the geophysical survey and agreed with the statutory authorities prior to commencement.

○

2.1 Benthic Ecology Background Information

○ A number of studies have recently characterised the benthic environment in the vicinity of the proposed Atlantic Array OWF. These include the Environmental Statements (ESs) for various aggregate extraction licences, including Helwick Bank Area 373 (ERM, 2003), Nobel Banks Area 476 (ERM, 2002, ERM, 2009) and Area 486 in the Outer Bristol Channel (EMU, 2007), a PhD on the benthic ecology of Carmarthen Bay (Woolmer, 2003) and the proposed Scarweather Sands OWF ES in Swansea Bay (United Utilities, 2003). A large scale benthic study of the Outer Bristol Channel (Mackie et al., 2006) was also recently conducted by the National Museum of Wales (NMW) and the British Geological Survey (BGS). The area surveyed included the entire proposed development site and therefore the results of the BGS/NMW study are most appropriate as a reference dataset for the Atlantic Array development site (Figure 2).

○ The BGS/NMW survey described the sediment types and mapped the subtidal biotopes occurring in the Outer Bristol Channel. To the north of the development site, the seabed in the Carmarthen Bay area was predominately smooth with fine to medium sand with some small ripples. The biotope SS.SSa.ImuSa.FfabMag dominated, with shallower inshore areas off the Gower Peninsula (Helwick Bank) and the mouth of the River Towy characterised by the less diverse biotopes SS.SSa.IFiSa.NcirBat and SS.SSa.IFiSa.IMoSa. In deeper waters to the west of Carmarthen Bay a biotope complex of SS.Ssa.CmuSa.AalbNuc and SS.Ssa.OSa.OfusAfil was recorded.

○ The area to the south of Carmarthen Bay, covering much of the proposed Atlantic Array project area, was characterised by an extensive (bifurcating high frequency) sand wave field in the south (Nobel Sands) and large sand waves in the east (Helwick Bank). The seabed was generally found to consist of medium sand, with a low to moderate number of benthic species and generally low epifaunal species numbers with SS.SCS.ICS.HeloMsim the predominant biotope recorded. Within this area relatively small isolated areas of the biotope SS.SCS.CCS.MedLumVen associated with the epifaunal biotope SS.Ssa.IfiSa.ScupHyd were also recorded.

○ Much of the rest of the proposed development site is dominated by coarser sediments with high species numbers and moderate to high epifaunal species present. In this area, the benthic

biotope SS.SCS.CCS.MedLumVen, with the epifaunal biotope complex SS.Ssa.IfiSa.ScrupHyd and SS.SBR.PoR.SspiMx dominate. At the eastern edge of the development site and in the south east corner of the BGS/NMW survey area is an area of coarse sand and gravel characterised by a complex of the infaunal biotope SS.Smx.Omx.PoVen and the epifaunal biotopes SS.SBR.PoR.SspiMx and SS.SMx.CMx.FluHyd.

○ This background information provides useful information on which to base the proposed benthic sampling strategy for the development site, cable route and surrounding area, as described below. Geophysical data, to be collected across the development site and export cable route corridor in 2010 will be used to refine the sampling strategy if required.

2.2 Approach to Characterisation Surveys

○ In order to augment the broad scale data collected during the literature review with site-specific information sufficient for the purposes of conducting an EIA, there will be a requirement to undertake specific ecological sampling to characterise the habitats and species occurring in the vicinity of the site.

○ The site is significant in size and therefore, there needs to be a careful balance struck between collecting sufficient samples to characterise seabed conditions and minimising unnecessary sampling in areas of similar habitat. To this end, in designing an appropriate sampling array for the area, our approach will be to utilise geophysical data (swathe bathymetry and side scan sonar) to provide broad scale mapping of the development area and offshore export cable route using field sampling for benthic and epibenthic ecology (and fisheries) to ground truth this dataset.

○ A significant amount of geophysical data has already been collected for the area (Mackie *et al.,* 2006) and it is proposed that further geophysical data will be collected for the Atlantic Array site and export cable route corridor in 2010 (see Section 1.0 above). The sidescan sonar data is being collected in dual frequency (100Hz and 500Hz) in order to detect reef features which are more readily identified at ~500Hz (DEFRA, 2005). Subject to the timely completion of the geophysical survey, a geo-referenced composite/mosaic plot will be provided as an output of the geophysical survey in addition to the interpreted data providing broad ground types and seabed features across the development area. This broad scale mapping will be used to refine the selection of biological sampling locations and also to identify targets for drop down video imagery work in the assessment of potential Annex I features, should this highlight any changes since the BGS/NMW survey in 2005.

○ Following the guidance provided by CEFAS in ‘Guidelines for the conduct of benthic studies at aggregate dredging sites’ (CEFAS, 2002; due to be updated imminently) and that provided on behalf of the Marine Consents and Environment Unit in Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA requirements- Version 2 (CEFAS *et al.,* 2004), the spatial extent of the proposed survey will be designed to cover approximately one tidal excursion either side of the development area and potential reference sites outside the tidal excursion (see Figure 2). This area is to be surveyed in order to characterise the marine ecological resources within areas that could be directly impacted by the development proposals, in areas potentially subjected to secondary impacts, such as may arise from disturbance of seabed sediment released by construction operations and at potential reference sites outside the tidal excursion. Potential effects on ecological resources will need to be assessed as part of the EIA process.

○ The initial design of the sampling array is based on a systematic grid (~4km spacing east-west along the tidal excursion; see Figure 2), whereby benthic sampling stations will be targeted to adequately and appropriately ground truth each of the broad scale ground types identified from the geophysical data. Existing benthic data has previously been used for fine scale biotope mapping across much of the Atlantic Array project area including the Outer Bristol Channel Marine Habitat

Study (Mackie *et al.,* 2006) across the Atlantic Array Offshore Wind Zone, as described above, and ESs for aggregate extraction licences at areas 486, 476 and 373, which all lie to the north of the site (EMU, 2007, ERM, 2002, ERM, 2003, ERM, 2009). Further sampling would be undertaken to 'ground-truth' these existing datasets (sampling at a significant number of the same sample sites used in previous studies, which will provide added value in understanding the natural variability within the site) and infill areas where no recent benthic data has been collected. This will serve to ensure that sufficient samples are taken within each apparent seabed type to characterise the benthic ecological environment. In addition, samples will be taken at distances along the tidal axis, as well as at reference sites outside of the tidal extremities.

○ The potential secondary impact zone, outside the development boundaries, will be delimited on the basis of the hydrodynamic regime in the area. The tidal axis and spring excursion has been defined using Admiralty Chart 1179 Tidal Diamonds A and H, which are in proximity to the development area. These data have been used to define a mean flood direction of 80^{o} with an excursion of approximately 23km and an ebb direction of 260^{o} with an excursion of approximately 12.8km.

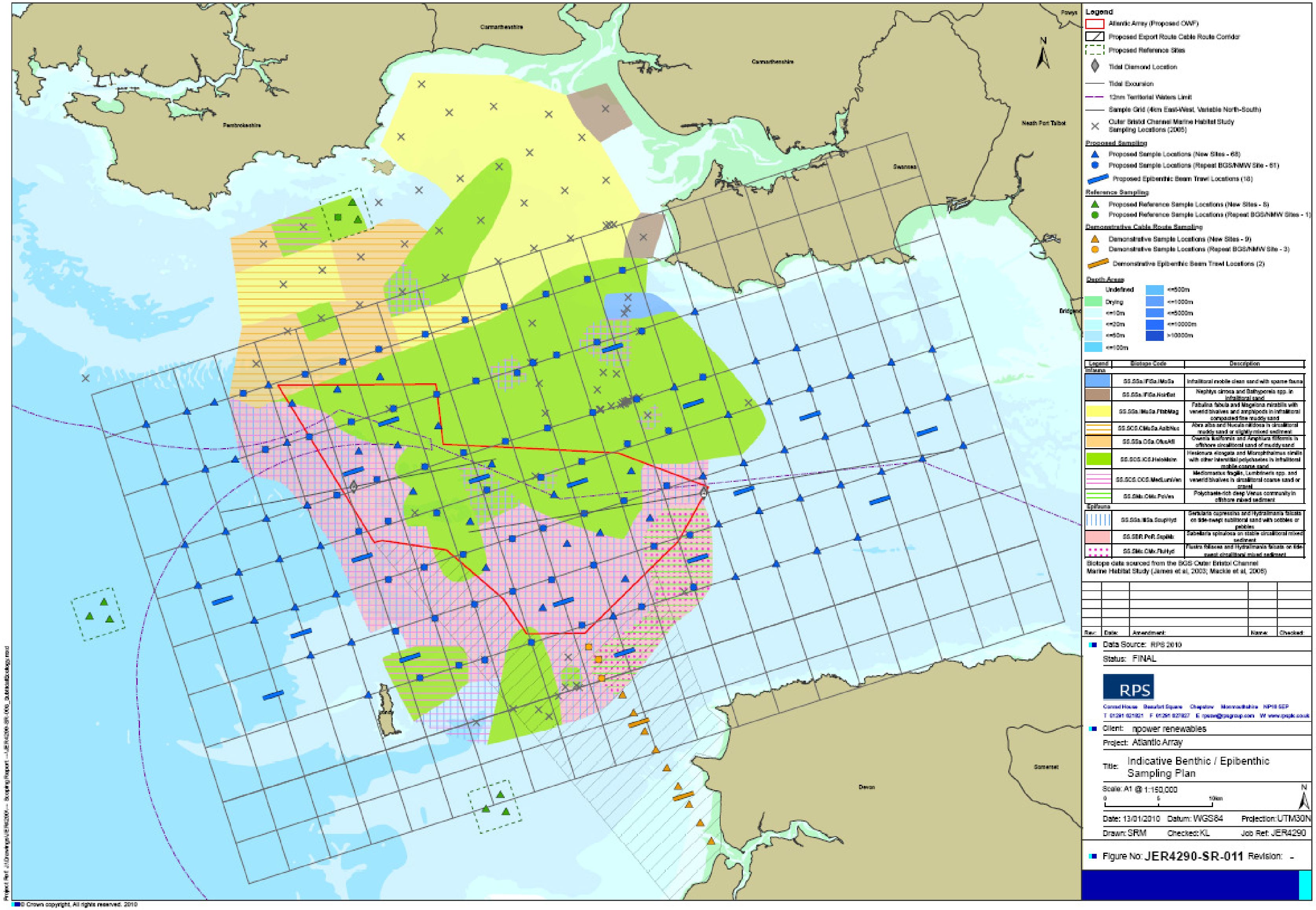


Figure 2: Drawing JER4290-SR-011- Indicative benthic/epibenthic survey plan for Atlantic Array Offshore Wind Farm

○ Figure 2 shows the proposed sampling positions for the benthic survey within the project area and the tidal excursion and at potential reference sites outside the tidal excursion. These have been informed by the sample locations and biotopes identified during the Outer Bristol Channel Marine Habitat Study (see Table 2). As previously discussed, these proposed sample locations will be further refined following the geophysical (bathymetry and sidescan sonar) surveys. Because the export cable route has yet to be finalised, benthic sample locations (2km spacing along a 1km wide corridor) as shown on Drawing JER4290-SR-011 are purely for demonstrative purposes. These will be selected once the cable route has been finalised and sample positions refined following review of the results of the geophysical surveys and discussions with the relevant authorities.

○ Potential reference sites will be established within areas similar in nature to the sites within the main array (based on sediment environment, depth and hydrodynamic conditions – see Figure 2) and are located outside the potential area of effect from any of the works associated with the construction of the wind farm (i.e. beyond the tidal excursion from the site). Reference site samples will provide for subsequent pre and post construction monitoring purposes, allowing comparison of 'natural variation' in the area over time against potential changes arising from the development itself and it is considered important to define these potential reference sites even at this early stage. Where possible, reference sites have been located in areas of previous benthic sampling (i.e. BGS/NMW Outer Bristol Channel survey) but outside areas potentially affected by other activities (e.g. aggregate extraction) so that sites with ecological composition known to be similar to the development site can be selected. Given the various types of development and resource extraction in the Bristol Channel and Severn Estuary, it may not, however, be possible to select sites which are not subject to some potential anthropogenic effects. The Reference block to the southwest of the site, near to the indicative cable route area, may need to be relocated depending on the final cable route selection.

○ Based on experience of other wind farm developments, the extent of the existing (recent) benthic datasets for the area and the size of the proposed Atlantic Array project area, we envisage that approximately 150 benthic sampling sites will provide sufficient sampling to provide an up-to-date characterisation of the area. No replication will be undertaken at this stage as the survey is designed to provide a characterisation of the benthic biological compositions within the area, rather than to establish a 'pre-construction' baseline.

vi) Table 2: Proposed benthic sampling locations for characterisation study of the Atlantic Array OWF development site, tidal excursion, cable route and reference sites. BG-Benthic (Hamon) Grab, DDV-Drop Down Video, ET-Epibenthic Trawl

Number of survey stations	Biotope (Mackie *et al.*, 2006)	Sampling station location/type	Sampling method
18	SS.SCS.ICS.HeloMsim	Within development site	BG & DDV
2	Mosaic of SS.SCS.ICS.HeloMsim, SS.SCS.CCS.MedLumVen and SS.SSa.IfiSa.ScupHyd	Within development site	BG & DDV
1	Mosaic of SS.SMx.OMx.PoVen, SS.SBR.PoR.SspiMx and SS.SMx.CMx.FluHyd	Within development site	BG & DDV
18	Mosaic of SS.SCS.CCS.MedLumVen, SS.SSa.IfiSa.ScupHyd and SS.SBR.PoR.SspiMx	Within development site	BG & DDV
18	SS.SCS.ICS.HeloMsim	Within one tidal excursion	BG & DDV
5	Mosaic of SS.SCS.CMuSa.AalbNuc and SS.SSa.OSa.OfusAfil	Within one tidal excursion	BG & DDV
2	Mosaic of SS.SSa.IMuSa.FfabMag and SS.SCS.CMuSa.AalbNuc	Within one tidal excursion	BG & DDV
1	SS.SSa.IMuSa.FfabMag	Within one tidal excursion	BG & DDV
2	Mosaic of SS.SCS.ICS.HeloMsim, SS.SCS.CCS.MedLumVen and SS.SSa.IfiSa.ScupHyd	Within one tidal excursion	BG & DDV
2	Mosaic of SS.SMx.OMx.PoVen, SS.SBR.PoR.SspiMx and SS.SMx.CMx.FluHyd	Within one tidal excursion	BG & DDV
2	Mosaic of SS.SCS.ICS.HeloMsim and SS.SCS.CCS.MedLumVen	Within one tidal excursion	BG & DDV
13	Mosaic of SS.SCS.CCS.MedLumVen, SS.SSa.IfiSa.ScupHyd and SS.SBR.PoR.SspiMx	Within one tidal excursion	BG & DDV

Number of survey stations	Biotope (Mackie *et al.*, 2006)	Sampling station location/type	Sampling method
45	Unknown	Within one tidal excursion	BG & DDV
3	SS.SCS.ICS.HeloMsim	Reference sites	BG & DDV
6	Unknown	Reference sites	BG & DDV
12	Unconfirmed	Cable route	BG & DDV
2	SS.SCS.ICS.HeloMsim	Within development site	ET
2	Mosaic of SS.SCS.CCS.MedLumVen, SS.SSa.IfiSa.ScupHyd and SS.SBR.PoR.SspiMx	Within development site	ET
1	Mosaic of SS.SCS.ICS.HeloMsim, SS.SCS.CCS.MedLumVen and SS.SSa.IfiSa.ScupHyd	Within development site	ET
1	SS.SCS.ICS.HeloMsim	Within one tidal excursion	ET
1	Mosaic of SS.SCS.ICS.HeloMsim, SS.SCS.CCS.MedLumVen and SS.SSa.IfiSa.ScupHyd	Within one tidal excursion	ET
2	Mosaic of SS.SMx.OMx.PoVen, SS.SBR.PoR.SspiMx and SS.SMx.CMx.FluHyd	Within one tidal excursion	ET
1	Mosaic of SS.SCS.CCS.MedLumVen, SS.SSa.IfiSa.ScupHyd and SS.SBR.PoR.SspiMx	Within one tidal excursion	ET
1	Mosaic of SS.SCS.ICS.HeloMsim and SS.SCS.CCS.MedLumVen	Within one tidal excursion	ET
8	Unknown	Within one tidal excursion	ET
2	Unconfirmed	Cable route	ET

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○ The proposed marine ecology survey will include the following components:

- Benthic Grab Survey
- Drop Down Video Survey (including assessment of Annex I Habitats)
- Epibenthic Beam Trawl Survey

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○ 2.2.1 Benthic Grab Sampling

○ A $0.1m^2$ Hamon grab will be used to sample for benthic biology and characterise the physical nature of the substrate, as this equipment is designed for sampling in mixed coarse deposits such as those occurring in the survey area. Additionally, the Hamon grab has been used for other surveys in this region (ESs for aggregate extraction licences), and the use of consistent sampling equipment will allow direct comparison with these datasets. For the Outer Bristol Channel Marine Habitat Survey, a $0.1m^2$ Van Veen grab was used to ground truth benthic sites – standardisation can be applied using the multivariate package PRIMER to account for different in sample type/size although the important factor here is that the surface area sampled is the same.

○ The Hamon grab has a volume of 12 litres and is fitted with stainless steel jaws, to allow for sediment chemistry sampling. The grab will be operated from a suitable vessel licensed for this type of work. A differential Geographical Positing System (WGS84 chart datum) will be used to ensure the sample locations are accurate. A log of sample positions, time, type, water depth and other field notes will be made for later reference. After collection, the samples will be preserved and analysed in a laboratory for physical and biological properties. Should it be deemed necessary to undertake sampling for sediment chemistry, this will be conducted using a Day or Shipek grab (further details of this sampling method are summarised below). This will be in addition to PSA/infauna sampling using a Hamon grab. The parameters to be measured will include:

- Particle size analysis (PSA) in accordance with BS 1377 (Part 2: 9.2/9.4)
- Benthic infauna analysis, using a National Marine Biological Analytical Quality Control scheme (NMBAQC) participating laboratory
- Benthic infauna biomass determination
- Sediment chemical analysis (to be analysed if deemed necessary through consultation with the statutory authorities)

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○ 2.2.2 Drop Down Video Survey

○ Appropriate approaches to surveying potential *Sabellaria* reefs are briefly discussed in the Nature Conservation Guidance on Offshore Wind farm Development (DEFRA, 2005). These guidance notes recommend that grab samples should be avoided in areas where Annex I habitat features, e.g. biogenic reefs such as *Sabellaria* reef, mussel beds/reef and cobble reefs, are present in order to avoid unnecessary damage to such features. Features identified from the geophysical data that have the potential to be Annex I habitat features e.g. biogenic reefs, will be subject to drop down video (DDV) only (see next paragraph) rather than a combination of benthic biological sampling and DDV. In areas of potential reef habitat (identified from geophysical and previous benthic surveys), limited grab sampling may be undertaken to obtain information on the species assemblages occurring within these habitats.

- The use of the Hamon grab and DDV at each benthic sampling location has been used for recent benthic characterisation studies. This has been widely accepted as best practice approach by the statutory authorities and is particularly suited to wide areas which have potential for biogenic reef habitat or turf/encrusting habitat, where clarification is need to distinguish between areas of reef and non-reef habitat. This is considered to be the case for the southern half of the Atlantic Array project area, which contains *Sabellaria* biotopes. This combined approach, however, may be constrained in the Bristol Channel as drop down video is not always feasible in areas of strong tidal regime and high turbidity (EMU, 2007, Mackie et al., 2006). The ES for the aggregate licence area 486 recommended that drop down video be conducted using a fresh water camera system, which should allow for good quality images of the seabed to be collected. The authors also recommended that the ideal time to collect video footage is during the 1-2 hour window at low or high water during neap tides. Drop down video sampling alone will be used in areas that have the potential to support Annex I habitats during the optimal time window of high/low water during neap tides, to ensure conditions are ideal for ground truthing these sensitive habitats. Drop down video footage will also be collected to augment the data collected using grabs, although, this may be constrained due to high tidal flow and high turbidity.

- Where ‘possible’ reef or reef-type structures are detected then video drops will be extended to validate the percentage coverage (patchiness) of *Sabellaria* or other structures and ground-truth the extent of the habitat. <u>DDV only</u> sampling site will be surveyed at 250m intervals to the east, west, north and south and conducted until such time that confidence in interpreting the underpinning remote sensing data is achieved, that is, until the extent of the reef feature can be defined.

- Annex I habitats

- As stated above, potentially destructive activities (i.e. grab sampling) should be limited in areas of potential Annex I reef (e.g. biogenic and geogenic reefs). However in some instances it may be necessary to undertake limited grab sampling in these areas to fully characterise the biotopes occurring in these areas, particularly if the DDV does not provide a good return for identifying the epibenthic biotope or for confirming absence/presence of reef. In this case the following methodology should be employed.

- In areas identified as potential reef (from previous surveys and/or following review of the geophysical data for the current survey) where benthic grabs are deemed necessary, it is proposed to attempt a single sample following the methodology outlined above (i.e. using a 0.1m2 Hamon grab). If the first attempt is below acceptable volume and contains no evidence of *Sabellaria* reef, another attempt to sample at the site will be made. However, if the first attempt contains evidence of *Sabellaria* reef (regardless of acceptable volume being achieved or not), the site will be abandoned and the sample accepted as a low volume sample in an area of reef. For the purposes of this survey, evidence of *Sabellaria* reef can be defined as the majority of *Sabellaria* tubes within the samples (>50%) measuring more than 2cm. This 2cm measurement has been determined as one of the key criteria for defining a *Sabellaria* reef (reefs should be elevated from the seabed by at least 2cm, see section 2.4).

- In areas not previously defined as potential *Sabellaria* reefs standard grabbing protocol will apply. However, if the first attempt is below acceptable volume and contains evidence of *Sabellaria* reef (as described above), the site will be abandoned and the sample accepted as a low volume sample in an area of reef.

- At all benthic sampling stations, drop down video sampling will be undertaken prior to grab sampling to ensure that the risk of potentially destructive grab sampling being undertaken in sensitive benthic habitats is minimised. Detailed field notes on *Sabellaria*, mussel and cobble aggregations will be made while undertaking drop down video sampling. This will help to inform the Annex I assessment aspect of the monitoring and provide further information on defining the extents/quality of any reef present

○ 2.2.3 Epibenthic Beam Trawl Survey

○ Epibenthic sampling using a standard 2m CEFAS beam trawl fitted with a 5mm cod end will also be undertaken. This methodology is primarily designed to collect information on epibenthic invertebrate species, as well as small demersal and juvenile fish. Trawls can be standardised by length (500m) or duration (10 minutes). Based on previous offshore wind farm surveys, and the size of the Atlantic Array project area, it is suggested that 20 epibenthic trawl samples will be required to sufficiently describe the epibenthic communities across the development area and offshore section of the export cable route. Proposed trawl locations are shown in figure 2 and were selected to provide a representative sample of each of the biotopes previously identified in the survey area and also to characterise areas for which no such historical data exists. As with benthic sampling, trawl sites will be informed by the outputs of the geophysical survey, to reduce the likelihood of damaging any Annex I habitats occurring in the vicinity of the development area.

○ In addition, information collected using the epibenthic beam trawl will be used to augment the epibenthic dataset collected using the drop down video. In addition, local sea fisheries committees with be consulted via the Fisheries Liaison Officer (FLO) to ensure that no fishing gear/grounds are disrupted during this trawl survey.

2.3 Proposed Survey Methodology

○ 2.3.1 Benthic Grab Sampling

○ Benthic infaunal sampling is required to characterise and determine baseline conditions and the sensitivity of benthic species and communities within the area likely to be affected by the proposed wind farm development. Sediment sampling will be undertaken in order to determine the physical nature of the substrate to aid faunal community characterisation and allow assessment of associated seabed disturbance. Samples will also be taken for sediment chemistry if required.

○ <u>Positioning</u>

○ The vessel will be accurately positioned using differential Geographic Positioning System (dGPS) using a Garmin GPS Map 76CS GPS receiver with external marine antenna. Differential corrections will be received from the EGNOS (European Geostationary Navigation Overlay Service) satellite network giving a final positioning accuracy of ± 2m. The proposed trawl locations, admiralty chart background and real time vessel location will be displayed on a helmsman display using a Garmin Mapsource navigation package. Positions will be logged in WGS84 coordinates and imported into GIS.

○ <u>Method</u>

○ The survey has been designed based on guidance provided by 'Procedural Guideline No. 3-9 – Quantitative sampling of sublittoral sediment biotopes and species using remote operated grabs' included in the JNCC Marine Monitoring Handbook March 2001 (Davies et al., 2001). Reference has also been made to Guidelines for the conduct of benthic studies at aggregate extraction sites (CEFAS, 2002).

○ Samples will be collected using a $0.1m^2$ Hamon grab with a stainless steel bucket, which will be operated from a suitable vessel licensed for this type of work. A differential Geographical Positing System (WGS84 chart datum) will be used to ensure the sample locations are accurate. A log of sample positions, time, type, water depth and other field notes will be made for later reference.

○ <u>Timing</u>

○ It is anticipated that the benthic survey (benthic grab, epibenthic trawl and drop down video) will be conducted in late summer/early autumn 2010. This will allow time for the geophysical (swathe bathymetry and sidescan sonar) surveys to be conducted. RPS proposes to undertake the drop down

video and epibenthic beam trawl surveys during the same survey mobilisation to ensure that the datasets are compatible and analysis will include all data from the development site, cable route and surrounding area (i.e. tidal excursion).

- Collection and extraction procedures

- Each Hamon grab sample will be checked for adequacy. Where practicably possible, samples with unsuitable volume (less than 5 litres) of sediment will be discarded and records of the sample sizes made. Further sampling (up to 5 attempts) will be made at each site until a sample of sufficient volume is retrieved. A photograph of each sample will be taken as the samples are retrieved/decanted on deck.

- Any sub-samples, e.g. for organic compound/heavy metal analyses, will be collected directly from the undisturbed grab bucket prior to decanting the sample into a large plastic fish box. These sub-samples will be transferred to suitable containers (to be provided by the laboratory conducting the analysis) and will be kept in a cool storage for transfer to the laboratory.

- Once decanted, a small sub-sample (of approximately 0.5 litres) will be collected from the well-mixed sediments for sediment granulometric analysis. These will be sealed in strong plastic bags with a label both inside and outside of each bag and transferred to a laboratory for analysis.

- The remaining sediment will be washed through a 1mm sieve using a low-pressure deck hose (seawater) and the residue transferred to a pre-labelled bucket with lid and preserved immediately in formalin, to a dilution of approximately 4% w/v. This material will be transferred to a laboratory for faunal analysis.

- Sample analyses

- **Particle size analysis (PSA)**

- Each sediment sample will be processed in the laboratory through sieves over the range 64mm to 63µm (0.063mm) on the Wentworth scale in accordance with (CEFAS, 2002) to determine the particle size composition of the seabed sediments.

- The sediment is washed through a 63µm (0.063mm) sieve and the retained material oven dried at 80ºC before being transferred to the coarsest of a series of stacked sieves. These are placed on an automatic shaker for 15 minutes and the contents of each sieve subsequently weighed. Material washing through the 63µm sieve will be collected in pre-weighed beakers, oven dried at 30ºC and weighed as a separate fraction. This fraction can be analysed by laser sizing should this be required for coastal process studies.

- For each sampling station the results will be expressed as cumulative percentage of each particle size passing through each sieve size. For the purposes of the report and the statistical analysis to be carried out, these percentages are converted to absolute percentage retained on each sieve size.

- **Benthic infauna analysis**

- The preserved sediment material will be processed in the laboratory by carefully washing the samples with a large volume of tap water through a 1mm sieve. Samples will be elutriated with water in order to float off the smaller, lighter components of the fauna. These will be retained on a fine mesh sieve (250µm), transferred to a petri dish and all fauna picked out under a binocular zoom microscope. For samples with large quantities of retained material, (where time constraints make examination of the whole fraction under a microscope unrealistic) material will be placed in griddled, white trays and sorted by eye to remove all remaining fauna. The faunal samples will be preserved in 70% IMS for identification, enumeration and specimen coding following Picton and Howson (1999 CD ROM Version). Colonial organisms e.g. bryozoans, will be recorded as present (P) and for the purposes of abundance counts will be allocated a numerical value of 1.

○ All samples will be subsequently retained in methanol for Quality Assurance Audit purposes if required. 10% of the benthic samples will be subject to internally QA. The laboratory undertaking the analysis is a participant in the National Marine Biological Analytical Quality Control scheme (NMBAQC), and thereby takes part in the UK wide Quality Assurance scheme for this type of analysis.

○ **Biomass determination**

○ Blotted wet weight biomass will be obtained for major faunal groups by weighing after external fluid has been removed on filter paper. Animals will be left on the filter paper until no more distinct wet traces can be seen. Animals with shells are weighed with shells attached. In the case of bivalves, fluid is drained off prior to weighing. Similarly, echinoids are punctured and drained before weighing. Organisms will be weighed to the nearest 0.0001g. This methodology is in accordance with the National Marine Monitoring Programme Green Book (NMMP, 2003).

○ For the purpose of analyses, biomass of benthic communities is expressed as grams (g) of ash-free dry weight (AFDW) per grab sample. This will be estimated by multiplying the blotted wet weight in grams of different taxonomic groups by a conversion factor specific to each group.

○ **Sediment chemistry analysis: Day/Shipek Grab**

○ Sediments for chemical analysis will be sampled using a 0.1m2 Day/Shipek grab. At locations where sediment chemistry sampling is deemed necessary, a Day/Shipek grab sample will be taken in addition to the Hamon grab sample. Prior to deploying the Day/Shipek grab, the grab jaws will be cleaned with Hexane to avoid sample contamination. Once retrieved, a sub sample of this sediment will be collected through the inspection hatch from the undisturbed sediment in the grab, using a stainless steel spoon (also cleaned with hexane). These will then be transferred into appropriate glass containers (laboratory supplied) and labelled with date, time and station number. The sample will then be refrigerated. Once in port the samples will be packed in cool boxes and couriered to the laboratory. A full chain of custody sheet will be filled out. Sediment chemistry analysis will be conducted if deemed necessary through discussions with the statutory authorities and a review of historical source data for the area.

○ 2.3.2 Drop Down Video Survey

○ At each benthic grab sampling site, it is proposed that a drop down video is deployed in conjunction with the grab sampler to augment the benthic sample data. Only the drop down video will be deployed at potential reef targets identified from the geophysical data in order to ground-truth these apparent features using seabed imagery.

○ <u>Method</u>

○ A digital video system will be employed to investigate the nature of the seabed for the purpose of describing extant habitats/biotopes and for direct observation of potential reef features. The system will be capable of acquiring still images to a resolution of 5 megapixels. Seabed images (5 images per station) will be acquired using a weighted fresh water camera system, with a scale object visible. This system is adapted for low visibility conditions to minimise limitations on returned image quality resulting from high-suspended sediment loadings within the water column.

○ Prior to deployment, the video equipment will be tested to ensure it is working correctly and a ‘clapper-board’ used to record survey details including date, time, survey site reference number etc. The video will be started when the camera system is on station and approximately 2m from the seabed. During deployment, the video signal will be monitored on-board the vessel and adjustments made to ensure good quality views of the seabed (by raising/lowering camera frame etc). This real-time monitoring approach also ensures that blurring due to excessive speed over the seabed does not compromise the video imagery captured.

○ Image quality will be checked and the image re-sampled if necessary. The video will be stopped when data of sufficient quality has been obtained. A time related log will be kept, with details of the visibility and notes on the image recorded in a field logbook, together with other information including depth, wind speed, wind direction, cloud cover and sea state. As part of the completion of this log, notes will be made on the exact start/end positions, orientation of vessel/camera, conspicuous species and substratum types, in addition to any other notable features to assist with subsequent analysis of the video data post-surveying. At the end of each day, images will be saved from the camera and burnt onto CD, as well as being saved onto hard drives. The logs and all data will also be saved onto the hard drives and additionally onto disk. All video footage will be converted from DV tapes to DVD.

○ Optimal conditions for using camera equipment are when current speeds are low (<1 knot) and when sea conditions are calm and low winds. Expert boat handling and control of the camera cable will be essential in obtaining good video footage.

○ <u>Timing</u>

○ The drop down video survey will be undertaken at the same time as the benthic grab samples. One of the main limitations on the benthic survey will be the ability to obtain useful images in the strong tidal currents and high turbidity of the Bristol Channel. The timing of benthic surveys will therefore need to be optimised by choosing neap tide periods (when tidal currents are at their weakest) outside the winter storm season and phytoplankton blooms. Indications from the BGS/NMW survey of the Outer Bristol Channel were that the best images were obtained at slack water, particularly around high tide.

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○ 2.3.3 Epibenthic Beam Trawl

○ <u>Method</u>

○ Beam trawl tow distance at each site will depend on the nature of the seabed type, however it is anticipated that tows will be between 200-800m in order to produce a manageable sample size. For the anticipated ground types in the area, each target tow will be of a 10 minute duration assuming a maximum towing speed of approximately 1.5 knots.

○ A log will be maintained of the start heading, trawl speed, trawl direction, tidal state and weather condition. For the start position (when the trawl is on the seabed) the time, latitude, longitude, depth will be recorded. The same will be recorded for the end position (when the trawl is lifted from the seabed).

○ Where practicable, the entire catch will be processed onboard, with all fauna identified to species level, enumerated and weighed. Total fish length for commercial species will also be measured to the centimetre below. Where samples are large, catches will be sorted to identify all target species, with an appropriate sample of these specimens taken to record length distribution and maturity. All other species will be sub-sampled in the same manner. Each trawl sample will be photographed, and a reference sample and/or photograph will be taken of species not readily identified during the survey and sent to a specialist for identification.

○ The MFA/MMO, the local sea fisheries committee (Devon and South Wales SFCs), the Welsh Assembly Government (post 1st April), local and district fishermen's organisations and the NFFO will be informed of the position, date, timing and expected duration of the benthic survey and epifaunal

surveys. Dispensation for the use of under-sized mesh (5mm) on the beam trawl will also be obtained from MFA/MMO prior to commencement of the survey work.

- Timing

- The epibenthic beam trawl survey will be undertaken at the same time as the benthic grab sample and drop down video survey.

2.4 Subtidal Ecology Reporting

- An interpretative technical report (to include the development area, cable route corridor and tidal excursion), which draws upon the results of the physical and biological analyses, will be produced following the completion of the fieldwork. The report will detail fieldwork methodologies and present site records\survey events and laboratory (taxonomy and biomass) procedures.

- For the benthic and epibenthic survey, faunal data will be presented as a spreadsheet showing species presence and abundance expressed as numbers of individuals per sample.

- Macro-invertebrate community structure will be investigated with the use of classification analysis (hierarchical agglomerative clustering). This uses the Bray Curtis similarity coefficient to assess the similarity of sites based on the faunal components. The procedure produces a dendrogram indicating the relationships between sites based on the similarity matrix. The similarity matrix is used to produce a multi-dimensional scaling (MDS) ordination plot. Physical variables can be overlain on the MDS ordination plot allowing some integration between clusters of sites based on fauna similarity and the physical variables, which may be important in determining those clusters. Comparisons to the BGS/NMW previous surveys will be made using multivariate analysis techniques. Full methods for the application of both the hierarchical clustering and the MDS analysis are given in Clarke and Warwick (2001).

- Assessment of the features of each of the clusters of sites produced during the multivariate analyses may be assessed using a variety of community structure measures. As well as assessing the raw species data, a variety of indices may also be calculated, including Margalef's index of Richness, Pielou's Evenness index, the Shannon-Wiener Diversity index and Simpson's index of Dominance. Reference to the calculation of these indices can be found in Clarke and Warwick (2001). Such indices are useful in reducing large faunal datasets to a single figure, which may be used in comparison to other sites in assessing community structure.

- The report will also describe species presence and abundance recorded using the MNCR methodologies, where applicable. Colonial species, recorded within the laboratory, will be given a P (present) value. The report will highlight significant species and habitats within the context of nature conservation. Where appropriate, reference will be made to relevant legislation, natural variability (comparisons to previous surveys) and the known geographical distribution of the feature.

- The video records will be reviewed and analysed using office based facilities and undertaken by experienced marine ecologists. The drop down video footage will be used to assign epibenthic biotopes based on the habitat and species present at each station. Species will be identified using video stills and their abundance or percent coverage quantified using the SACFOR scale. Where possible, this assessment will be conducted on three images per station and one average relative abundance score (on the SACFOR scale) assigned to each station. Epibenthic biotope classification will then be conducted using the JNCC Marine Habitat Classifications for Britain and Ireland 2004 based on those communities present and the particle size analysis (PSA) data collected using the $0.1m^2$ Hamon grab (described above). Multivariate classification analysis (hierarchical agglomerative clustering) will be used to determine which stations were similar to one another in terms of faunal community composition and this analysis will also be used to aid epibenthic biotope classification.

○ Observations will also be made on the substrate type with particular attention paid to the presence of cobbles in stills as this could indicate the presence of an Annex I cobble reef. Video footage will then be analysed to obtain further information on the nature of the substrate (i.e. elevation off the sea floor, abundance of cobbles and boulders on the sea floor) and this information will be compared to PSA (where available) and geophysical data to determine whether or not a potential cobble reef may be present (results from the Mackie *et al*. (2006) geophysical survey did not highlight any potential cobble reefs).

○ The field log will be worked through in combination with recording of habitat features from the video records, specifically Annex I reef features (see scoring system below). Data will be collated initially using Excel spreadsheets, with all site locations recorded. Relevant data will then be transferred to GIS format so that spatial plotting of information can be achieved. Information gathered from the broad scale (swath and sidescan) and fine scale (seabed imagery and/or benthic grab samples) surveys will be interpreted to provide a biotope map for the area and detailed information on the location and extents of *Sabellaria* and any other Annex I habitat features within the development area, cable route corridor and tidal excursion.

○ The scoring system proposed by Gubbay (2007) will be used as a basis for interpreting the 'quality' or 'reefiness' of *Sabellaria* aggregations in the survey area. Recent discussions have suggested that a reef should be elevated above the sea floor by at least 2cm, have an area of at least 25m2 and have a patchiness of no less than 10% (Gubbay, 2007). The parameters summarised in Table 2 will be measured where possible using the broad and fine scale survey data collated during the surveys.

Table 2 Range of figures which could be used as a measure of "reefiness" (Gubbay, 2007)

Measure of 'reefiness'	NOT a REEF	Low	Medium	High
Elevation (average tube height, cm)	<2	2-5	5-10	>10
Area (m^2)	<25	25-10,000	10,000 – 1,000,000	> 1,000,000
Patchiness (% cover)	<10	10-20	20-30	>30

6.1

6.2 A similar scoring system for cobble reefs was proposed by Irving (2009). This scoring system indicates that cobble reefs should be elevated by at least 0.064m, be composed of at least 10% cobbles, cover an areas of at least $25m^2$ and have an associated community of largely epifaunal species. These parameters are summarised in Table 3 and should be used to assess the likelihood of cobble reefs being present. Further information on these parameters and how they should be used in Annex I reef assessments are outlined in the relevant guidance notes.

vii) Table 3: Range of figures which could be used as a measure of "reefiness" for cobble reefs (Irving, 2009)

Measure of 'reefiness'	Not a cobble reef	Low	Medium	High
Composition	<10%	10-40% Matrix supported	40-95%	>95% Clast supported
Elevation	Flat Seabed	<0.064m	0.064m-5m	>5m
Extent	$<25m^2$		$>25m^2$	

Biota	Dominated by infaunal species	>80% of species present composed of epifaunal species

6.3

6.4 Potential *Mytilus* reefs can also be identified from video footage/stills and geophysical data. Based on observations made by Suchanek (1979), *Mytilus* reefs are described in terms of three structural components (as reported in Holt et al.,1998):

- a physical matrix of living and dead shells;
- a bottom layer of accumulated sediments, mussel faeces and pseudofaeces, organic detritus and shell debris.;
- an assemblage of associated flora and fauna.

6.5 As with cobble and *Sabellaria* reefs, for a *Mytilus* bed to be categorised as “reef”, it should also be significantly elevated off the seabed, however there is no clear guidance outlining the degree of elevation required to categorise these features as “reefs”.

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Appendix VII – Designated Sites in the Vicinity of Atlantic Array

Site Name	Designation	Reasons for Designation
Afonydd Cleddau / Cleddau Rivers	SAC (Wales)	Annex I Habitats Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation Active raised bogs Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) Annex II Species Brook lamprey (*Lampetra planeri*)* ○ **River lamprey** (*Lampetra fluviatilis*)* ○ **Bullhead** (*Cottus gobio*)* ○ **Otter** (*Lutra lutra*)* Sea lamprey (Petromyzon marinus)
Carmarthen Bay and Estuaries	SAC (Wales)	Annex I Habitats Sandbanks which are slightly covered by sea water all the time* Estuaries* Mudflats and sandflats not covered by seawater at low tide* Large shallow inlets and bays* *Salicornia* and other annuals colonising mud and sand* Atlantic salt meadows (Glauco-Puccinellietalia maritimae)* Annex II Species Sea lamprey (Petromyzon marinus) River lamprey (Lampetra fluviatilis) Allis shad (Alosa alosa) Twaite shad (Alosa fallax)* Otter (Lutra lutra)
Carmarthen Bay Dunes	SAC (Wales)	Annex I Habitats Embryonic shifting dunes* Shifting dunes along the shoreline with *Ammophila arenaria* (“white dunes”)* Fixed dunes with herbaceous vegetation (“grey dunes”)* Dunes with Salix repens ssp. argentea (Salicion arenariae)* Humid dune slacks* Annex II Species Narrow-mouthed whorl snail *(Vertigo angustior)**

Site Name	Designation	Reasons for Designation
		Petalwort (Petalophyllum ralfsii)* Fen orchid (Liparis loeselii)*
Dunraven Bay	SAC (Wales)	Annex II Species Shore dock (Rumex rupestris)*
Kenfig	SAC (Wales)	Annex I Habitats Atlantic salt meadows (Glauco-Puccinellietalia maritimae) Fixed dunes with herbaceous vegetation (“grey dunes”)* Dunes with Salix repens ssp. argentea (Salicion arenariae)* Humid dune slacks* Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.* Annex II Species Petalwort (Petalophyllum ralfsii)* Fen orchid (Liparis loeselii)*
Limestone Coast of South West Wales	SAC (Wales)	Annex I Habitats Vegetated sea cliffs of the Atlantic and Baltic coasts* Fixed dunes with herbaceous vegetation (“grey dunes”)* European dry heath Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*) Submerged or partially submerged sea caves Caves not open to the public Annex II Species Greater horseshoe bat (Rhinolophus ferrumequinum)* Early gentian (Gentianella anglica)* Petalwort (Petalophyllum ralfsii).
Pembrokeshire Marine	SAC (Wales)	Annex I Habitats Estuaries* Large shallow inlets and bays* Reefs* Sandbanks which are slightly covered by water all of the time Mudflats and sandflats not covered by water all of the time Coastal lagoons Atlantic salt meadows (Glauco-Puccinellietalia maritimae) Submerged or partially submerged sea caves Annex II Species Grey Seal (Halichoerus grypus)* Shore dock (Rumex rupestris)* Sea lamprey (Petromyzon marinus) River lamprey (Lampetra fluviatilis)

Site Name	Designation	Reasons for Designation
		Allis shad (Alosa alosa) Twaite shad (Alosa fallax) Otter (Lutra lutra)
River Usk (included because of migratory fish interests)	SAC (Wales)	Annex I Habtiats Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation* Annex II Species Sea lamprey (Petromyzon marinus)* Brook lamprey (*Lampetra planeri*) River lamprey (Lampetra fluviatilis)* Allis shad (Alosa alosa)* Twaite shad (Alosa fallax)* Atlantic salmon (*Salmo salar*)* Bullhead (*Cottus gobio*)* Otter (Lutra lutra)*
River Wye (included because of migratory fish interests)	SAC (England & Wales)	Annex I Habtiats Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation* Transition mires and quaking bogs Annex II Species White-clawed (or Atlantic stream) crayfish (*Austropotamobius pallipes*) Sea lamprey (Petromyzon marinus)* Brook lamprey (*Lampetra planeri*) River lamprey (Lampetra fluviatilis)* Allis shad (Alosa alosa)* Twaite shad (Alosa fallax)* Atlantic salmon (*Salmo salar*)* Bullhead (*Cottus gobio*)* Otter (Lutra lutra)*
Severn Estuary	cSAC (England & Wales)	Annex I Habitats Estuaries* Mudflats and sandflats not covered by water all of the time* Large shallow inlets and bays* Reefs Sandbanks which are slightly covered by water all of the time Atlantic salt meadows (Glauco-Puccinellietalia maritimae)* Annex II Species Sea lamprey (Petromyzon marinus)*

Site Name	Designation	Reasons for Designation
		River lamprey (Lampetra fluviatilis)* Twaite shad (Alosa fallax)*
Tintagel-Marsland-Clovelly Coast	SAC (England)	Annex I Habitats Vegetated sea cliffs of the Atlantic and Baltic coasts Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles European dry heaths
Braunton Burrows	SAC (England)	Annex I Habitats Mudflats and sandflats not covered by seawater at low tide Shifting dunes along the shoreline with *Ammophila arenaria* (“white dunes”)* Fixed dunes with herbaceous vegetation (“grey dunes”)* Dunes with Salix repens ssp. argentea (Salicion arenariae)* Humid dune slacks* Annex II Species Petalwort (Petalophyllum ralfsii)*
Lundy	SAC (England)	Annex I Habitats Reefs* Sandbanks which are slightly covered by water all of the time Submerged or partially submerged sea caves Annex II Species Grey Seal (Halichoerus grypus)
Carmarthen Bay	SPA (Wales)	Over winter the area regularly supports: Black (common) scoter *(Melanitta nigra)* (Western Siberia/Western & Northern Europe/North-western Africa) 1.0% of the population***
Burry Inlet	SPA (Wales)	Over winter the area regularly supports: 34962 waterfowl (5 year peak mean 30/06/1999) including: Northern pintail *(Anas acuta)* (North-western Europe) 3% of the population** Northern shoveler *(Anas clypeata)* (North-western/Central Europe) 3.6% of the population in GB** Eurasian teal *(Anas crecca)* (North-western Europe) 0.3% of the population in GB** Eurasian wigeon (Anas penelope) (Western Siberia/North-western/North-eastern Europe) 0.6% of the population in GB** Dunlin (*Calidris alpina alpine)* (Northern Siberia/Europe/Western Africa) 1.2% of the population in GB** Red knot (*Calidris canutus)* (North-eastern Canada/Greenland/Iceland/Northwestern Europe) 0.6% of the

Site Name	Designation	Reasons for Designation
		population** Eurasian oystercatcher (*Haematopus ostralegus)* (Europe & Northern/Western Africa) 1.6% of the population** Eurasian curlew (*Numenius arquata)* (Europe - breeding) 1.1% of the population in GB** Grey plover *(Pluvialis squatarola)* (Eastern Atlantic - wintering) 0.8% of the population in GB** Common shelduck *(Tadorna tadorna)* (North-western Europe) 1.3% of the population in GB** Common redshank *(Tringa tetanus)* (Eastern Atlantic - wintering) 0.3% of the population**
Castlemartin Coast	SPA (Wales)	During the breeding season the area regularly supports: Red-billed chough (*Pyrrhocorax pyrrhocorax)* 3.5% of the GB breeding population (Count as at 1998)
Severn Estuary	SPA (England & Wales)	Over winter the area regularly supports: 84317 waterfowl (5 year peak mean 01/04/1998) including: Tundra swan (*Cygnus columbianus bewickii)* (Western Siberia/North-eastern & North-western Europe) 3.9% of the GB population** Gadwall (*Anas strepera)* (North-western Europe) 0.9% of the population** Greater white-fronted goose *(Anser albifrons albifrons)* (North-western Siberia/North-eastern & Northwestern Europe) 0.4% of the population** Dunlin *(Calidris alpina alpine)* (Northern Siberia/Europe/Western Africa) 3.3% of the population** Common shelduck (*Tadorna tadorna)* (North-western Europe) 1.1% of the population** Common redshank (*Tringa tetanus)* (Eastern Atlantic - wintering) 1.3% of the population**
Ramsey and St David's Peninsula Coast	SPA (Wales)	During the breeding season the area regularly supports: Chough *Pyrrhocorax pyrrhocorax*, 11 pairs representing at least 3.2% of the breeding population in Great Britain Over winter the area regularly supports: Chough *Pyrrhocorax pyrrhocorax*, 22 pairs representing at least 3.2% of the wintering population in Great Britain
Skokholm and Skomer	SPA (Wales)	During the breeding season the area regularly supports: Chough *Pyrrhocorax pyrrhocorax*, 4 pairs representing at least 1.2% of the breeding population in Great Britain Short-eared Owl *Asio flammeus*, 6 pairs representing at least 0.6% of the breeding population in Great Britain Storm Petrel *Hydrobates pelagicus*, 3,500 pairs representing at least 4.1% of the breeding population in Great Britain

Site Name	Designation	Reasons for Designation
		Lesser Black-backed Gull *Larus fuscus*, 20,300 pairs representing at least 16.4% of the breeding Western Europe/Mediterranean/Western Africa population Manx Shearwater *Puffinus puffinus*, 150,968 pairs representing at least 56.9% of the breeding population Puffin *Fratercula arctica*, 9,500 pairs representing at least 1.1% of the breeding population
Burry Inlet	Ramsar (Wales)	Species with peak counts in winter: 41655 waterfowl**** Qualifying species/populations: Species with peak counts in spring/autumn: Common redshank (*Tringa totanus tetanus*) 857 individuals, representing an average of 0.7% of the GB population**** Species with peak counts in winter: Northern pintail (*Anas acuta*) (NW Europe) 2687 individuals, representing an average of 4.4% of the population**** Eurasian oystercatcher (*Haematopus ostralegus ostralegus*) (Europe & NW Africa – wintering) 14861 individuals, representing an average of 1.4% of the population**** Red knot (*Calidris canutus islandica*) (W & Southern Africa - wintering) 3618 individuals, representing an average of 1.2% of the GB population**** Species/populations identified subsequent to designation for possible future consideration under criterion 6. Species with peak counts in winter: Northern shoveler (*Anas clypeata*) (NW & C Europe) 467 individuals, representing an average of 1.1% of the population ****
Severn Estuary	Ramsar (England & Wales)	Species with peak counts in winter: 70919 waterfowl (5 year peak mean 1998/99-2002/2003) Qualifying species/populations: Species with peak counts in winter: Tundra swan (*Cygnus columbianus bewickii*) (NW Europe) 229 individuals, representing an average of 2.8% of the GB population**** Greater white-fronted goose (*Anser albifrons albifrons*) (NW Europe) 2076 individuals, representing an average of 35.8% of the GB population*** Common shelduck (*Tadorna tadorna*) (NW Europe) 3223 individuals, representing an average of 1% of the population **** Gadwall (*Anas strepera strepera*) (NW Europe) 241 individuals, representing an average of 1.4% of the GB population**** Dunlin (*Calidris alpina alpine*) (W Siberia/W Europe) 25082 individuals, representing an average of 1.8% of the population****

Site Name	Designation	Reasons for Designation
		Common redshank (*Tringa totanus tetanus*) 2616 individuals, representing an average of 1% of the population**** Species/populations identified subsequent to designation for possible future consideration under criterion 6. Species regularly supported during the breeding season: Lesser black-backed gull (*Larus fuscus graellsii*) (W Europe/Mediterranean/W Africa) 4167 apparently occupied nests, representing an average of 2.8% of the breeding population (Seabird 2000 Census) Species with peak counts in spring/autumn: Ringed plover (*Charadrius hiaticula*) (Europe/Northwest Africa) 740 individuals, representing an average of 1% of the population**** Species with peak counts in winter: Eurasian teal (*Anas crecca*) (NW Europe) 4456 individuals, representing an average of 1.1% of the population**** Northern pintail (*Anas acuta*) (NW Europe) 756 individuals, representing an average of 1.2% of the population****

- * primary reason for site selection (SPA and SAC sites only). Information sources: **www.jncc.gov.uk**, **www.naturalengland.org.uk** and **www.ccw.gov.uk**
- ** 5 year peak mean 1991/92 to 1995/96;
- *** 5 year peak mean 1997/98 to 2001/02;
- **** 5 year peak mean 1998/99 to 2002/03

Appendix VIII – SSSIs in the Vicinity of the Atlantic Array Site

Site Name	CCW/NE	Reason for Designation
Afon Cleddau Dwyreiniol / Eastern Cleddau River	CCw	Nature conservation
Afon Cleddau Gortllewinol / Western Cleddau River	CCW	Nature conservation
Aber Taf / Taf Estuary	CCW	Nature conservation
Afon Tywi	CCW	Nature conservation and geological importance
Angle Peninsula Coast	CCW	Nature conservation and geological importance
Arfordir Marros-Pentywyn / Marros-Pendine Coast	CCW	Nature conservation and geological importance
Arfordir Pen-Bre / Pembrey Coast	CCW	Nature conservation
Arfordir Saundersfoot - Telpyn / Saundersfoot - Telpyn Coast	CCW	Nature conservation and geological importance
Barry Island	CCW	Geological importance
Blackpill, Swansea	CCW	Nature conservation
Bracelet Bay	CCW	Geological importance
Burry Inlet And Loughor Estuary	CCW	Nature conservation
Castlemartin Cliffs And Dunes	CCW	Geological and nature conservation
Caswell Bay	CCW	Geological importance
Crymlyn Burrows	CCW	Geological importance and nature conservation
Cynffig/Kenfig	CCW	Nature conservation
East Aberthaw Coast	CCW	Geological importance and nature conservation
Flat Holm	CCW	Geological importance and nature conservation
Freshwater East Cliffs to Skrinkle Haven	CCW	Geological importance and nature conservation
Gower Coast: Rhossili to Porteynon	CCW	Geological importance and nature conservation
Hayes Point to Bendrick Rock	CCW	Geological importance
Horton, Eastern and Western Slade	CCW	Geological importance and nature conservation
Lydstep Head to Tenby Burrows	CCW	Nature conservation
Merthyr Mawr	CCW	Nature conservation
Minchin Hole	CCW	Geological importance
Monknash Coast	CCW	Geological importance and nature conservation
Oxwich Bay	CCW	Nature conservation

Site Name	CCW/NE	Reason for Designation
Penarth Coast	CCW	Geological importance and nature conservation
Pwll-Du Head and Bishopston Valley	CCW	Nature conservation
River Usk (Lower Usk)/Afon Wysg (Wysg Isaf)	CCW	Nature conservation (included because of migratory fish interests)
River Wye (Lower Wye)/Afon Gwy	CCW/NE	Nature conservation (included because of migratory fish interests)
Severn Estuary	CCW/NE	Geological importance and nature conservation
Southerndown Coast	CCW	Geological importance and nature conservation
St. Margaret's Island	CCW	Nature conservation
Stackpole	CCW	Geological importance and nature conservation
Stackpole Quay - Trewent Point	CCW	Geological importance and nature conservation
Sully Island	CCW	Geological importance and nature conservation
Tenby Cliffs and St. Catherine's Island	CCW	Geological importance and nature conservation
Twyni Chwitffordd, Morfa Landimor A Bae Brychdwn/Whiteford Burrows Etc	CCW	Geological importance and nature conservation
Twyni Lacharn - Pentywyn / Laugharne - Pendine Burrows	CCW	Nature conservation
Waterwynch Bay to Saundersfoot Harbour	CCW	Geological importance and nature conservation
Napps Cave	NE	Geological importance and nature conservation
Morte Point	NE	Nature conservation
Northam Burrows	NE	Nature conservation
Westward Ho! Cliffs	NE	Geological and geomorphological interest
Hele, Samson's and Combe Martin Bays	NE	Geological and geomorphological interest
Hobby to Peppercombe	NE	Geological importance and nature conservation
Mermaid's Pool to Rowden Gut	NE	Geological and geomorphological interest
Braunton Burrows	NE	Geological importance and nature conservation
Marsland to Clovelly Coast	NE	Geological importance and nature conservation.
Taw-Torridge Estuary	NE	Nature conservation.
Saunton to Baggy Point Coast	NE	Geological importance and nature conservation
Barricane Beach	NE	Geological interest
Porlock Ridge & Saltmarsh	NE	Geological importance and nature conservation
West Exmoor Coast & Woods	NE	Geological importance and nature conservation
Lundy	NE	Nature conservation
Steep Holm	NE	Geological importance and nature conservation

Site Name	CCW/NE	Reason for Designation
Blue Anchor to Lilstock Coast	NE	Geological importance
Bridgewater Bay	NE	Nature conservation

Appendix IX – Other Wind Farms within 70 km radius of Atlantic Array (Onshore and Offshore)

Current status of known wind farms within a 70km radius of the outer turbines of the Atlantic Array development.

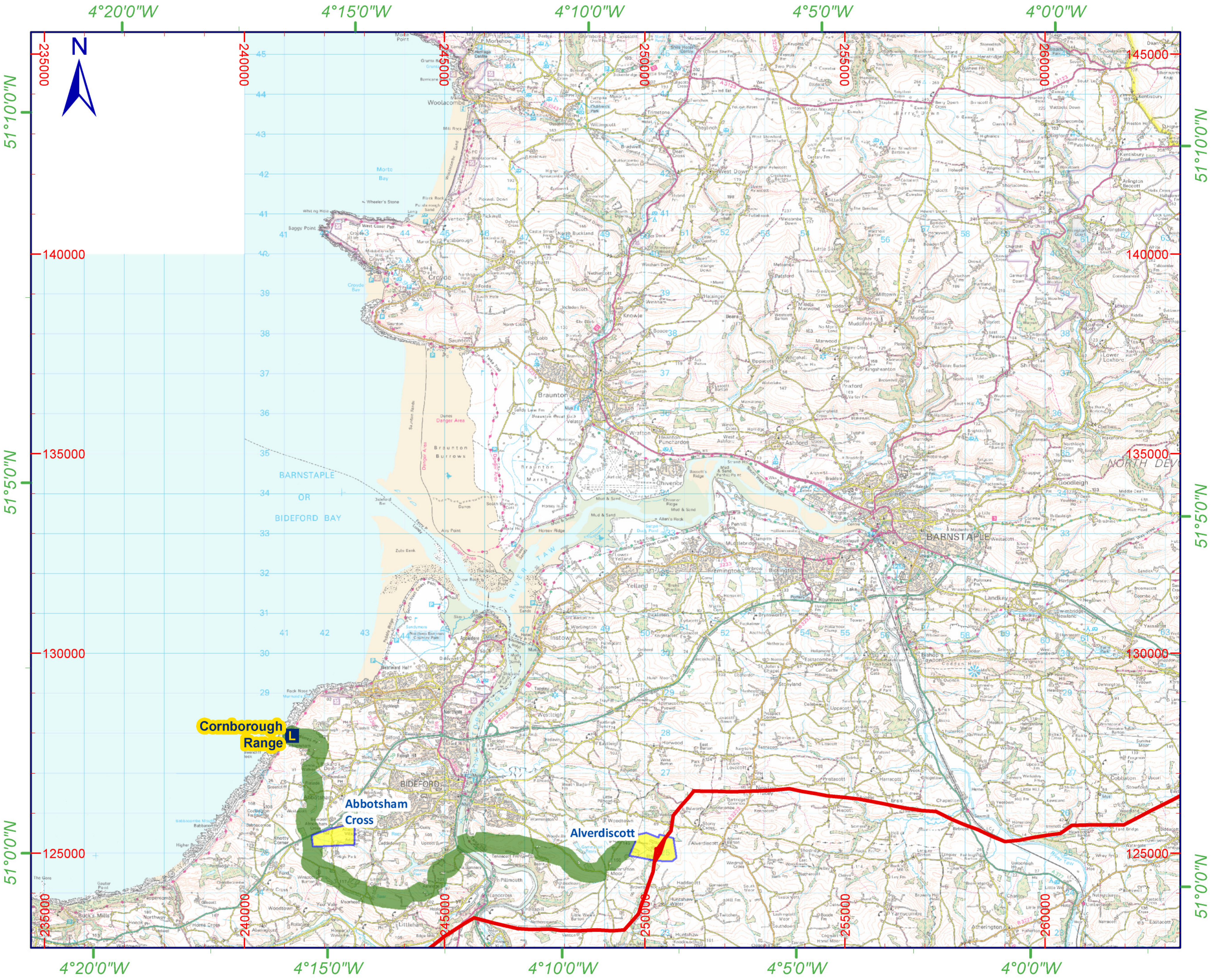
Wind Farm Name	Developer	Status	Distance (metres)
Aberdare Wind Farm	RWE npower	No Application Made	65376
Batsworthy Cross	NPower Renewables	Application Submitted	58517
Bickham Moor	Coronation Power	Application Submitted	61537
Bickham Moor Wind Farm		Application Submitted	61542
Blaen Bowi Wind Farm	Windjen Power Ltd	Operational	62570
Blaen Bowi Wind Farm (Extension)	Windjen Power Ltd / Dulas Ltd	Application Refused	62570
Blaencorrwg Wind Farm	Ecogen Ltd	Application Refused	60448
Blaengwen (Re-Submission)	Force 9	Awaiting Construction	64836
Blaengwen Farm	CATAMOUNT CYMRU CYF (agent ENTEC UK Ltd) Force 9 Energy	Application Refused	64836
Cairn Brae Wind Turbine	M. Chandler	Application Withdrawn	50478
Cilciffeth 'A' Wind Farm	South Wales Power Ltd. / SWALEC / National Windpower Ltd	Application Refused	56893
Cilciffeth 'B' Wind Farm	South Wales Power Ltd. / SWALEC / National Windpower Ltd	Application Refused	56867
Cold Northcott	Westbury Wind farms	Operational	67627
Corston Wind farm	NOVERA/ RES (Renewable Energy Systems)	Application Refused	26884
Crimp Wind Farm	RWE npower	No Application Made	37145
Crimp Wind Farm	Crimp Power Ltd (West Coast Energy)	Awaiting construction	37732

Wind Farm Name	Developer	Status	Distance (metres)
Cross Moor	Devon Light and Power	Application Submitted	55672
Davidstow Wind Farm	RWE npower	Application Withdrawn	69252
Den Brook	Renewable Energy Systems Ltd	Awaiting Construction	64944
Dulais Valley	Acciona Energy UK Ltd	Application Submitted	56798
Dyffryn Brodyn Wind Farm	RES	Operational	51634
Ffoch Nest	Npower renewables	Application Submitted	61448
Fforch	AMEC	Application Refused	58881
Ffynnon Oer Wind Farm	RWE npower	Operational	57258
Forestmoor Wind Project	West Coast Energy	Operational	39740
Fullabrook Down Wind Farm	Devon Wind Power Ltd	Under construction	23157
Galsworthy Wind Park	Ecotricity	Awaiting Construction	38443
Hava Wind Farm	RENEWABLE ENERGY SYSTEMS LTD	No Application Made	44733
High Darracott Reservoir	Mr. and Mrs. P.F. George/ Darracott Moor Wind Farm Ltd	Under Construction	35930
Hirwaun Wind Farm	Pennant Walters Ltd	Application Refused	66040
Hore Down Wind farm	Farm Energy	Application Refused	21628
Jordanston Wind Farm	RWE npower	Application Refused	58535
Lluest Wen Energy Centre	Christopher Rhys Griffiths	Application Refused	49002
Loyton Wind Farm	Mr A Barnes	No Application Made	67617
Maerdy	Camco International	Awaiting Construction	64152
Maesgwyn	Unknown	Unknown	60447

Wind Farm Name	Developer	Status	Distance (metres)
Moel Cynhordy	M & N WIND PROJECTS (NFFO5) LTD	No Application Made	53543
Montagne Jeunesse	Powell Dobson Partnership	Operational	40634
Mynydd Portref	Tegni Cymru Cyf	Application Submitted	61574
Mynydd y Betws	Cambrian Renewable Energy Ltd / Betws Common Holdings Ltd	Awaiting Construction	50208
Mynydd y Gwair Wind Farm	NPower Renewables	Application Submitted	47931
Mynydd Y Gwrhyd Wind farm	Dan McCallun , Awel Aman Tawe	Application Refused	53857
New Werfa Wind Farm	GE Wind	Abandoned	57719
Ogmore & Garw	AMEC	Application Refused	58080
Otterham Down Wind Farm	Otterham Wind Farm Ltd - Powergen Renewables	Application Refused	63929
Otterham Down Wind Farm 2	Windelectric Management Ltd	Application Submitted	63929
Pant Yr Awel	RWE Innogy	No Application Made	60875
Pant-y-wal Wind Farm	Pennant Walters	Application Submitted	61166
Parc Cynog Extension	Nuon	Application Submitted	35369
Parc-Cynog Wind Farm	Micon Wind Turbines (UK) Limited	Operational	35174
Pendine Extension		Application Submitted	33724
Penrhys Wind Farm/Ferndale Power Factory	E-on	Awaiting Construction	66059
Rhoscrowther Wind Cluster	THREE WAY WIND LTD/ TXU Europower Ltd	Application Refused	28589
Scarweather Sands	E.On / Energie 2	Awaiting ConstructionApplication Withdrawn???	32782
Sedborough Farm	Parkham Farms and Power Ltd	Application Withdrawn	32354

Wind Farm Name	Developer	Status	Distance (metres)
Swingdon Farm	SWINGDON WIND POWER LTD	Awaiting Construction	55155
The Old Racecourse	THE OLD RACECOURSE WIND FARM LTD	Application Refused	35599
Three Moors Wind Farm		Application Refused	54640
Timet UK	Timet UK	Application Refused	33879
Ton Marw Farm	Community Power Limited	Application Refused	40648
Trane Renewable Energy Park	Gamesa Energy UK	Application Withdrawn	62750
Trenewydd Wind Farm	RWE npower	Application Refused	56893
Werfa Wind Farm	Amec Wind	Application Refused	57958
Worthy Vale Manor	Worthyvale Manor Partnership	Application Refused	67907
Yelland Wind Farm	West Coast Energy/Yelland Wind Energy Ltd	Application Refused	69229
Llynfi	Gamesa Energy UK	Unknown	56192

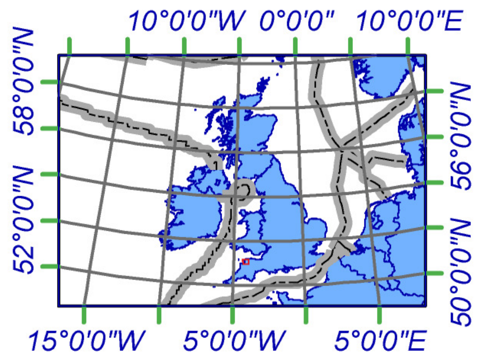
Appendix X – Cornborough onshore route option



Legend

- Landing Option
- Indicative Substation Area (Substation would be up to 10.5ha within area shown)
- Indicative Cable Route (Construction corridor to be up to 57m within area shown)
- National Grid 400kV Line

Project: Atlantic Array
Produced by RPS for
RWE NPower Renewables Ltd
Scoping Report April 2010



Nautical Miles: 0, 0.6, 1.2, 1.8, 2.4

Kilometres: 0, 0.375, 0.75, 1.5, 2.25, 3, 3.75

1:132,591

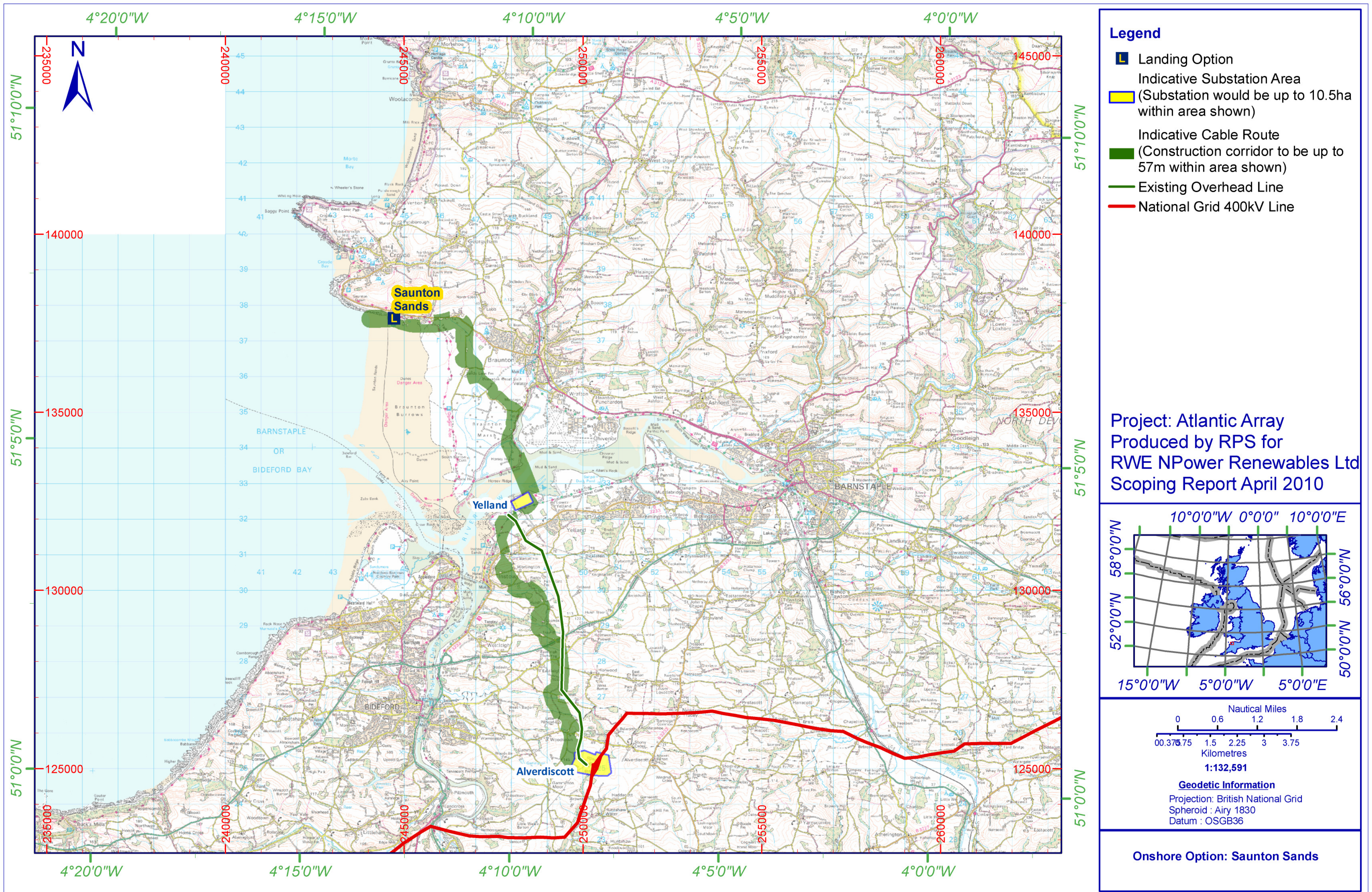
Geodetic Information

Projection: British National Grid
Spheroid : Airy 1830
Datum : OSGB36

Onshore Option: Cornborough Range

Produced by RPSE - Woking

Appendix XI – Saunton Sands onshore route option



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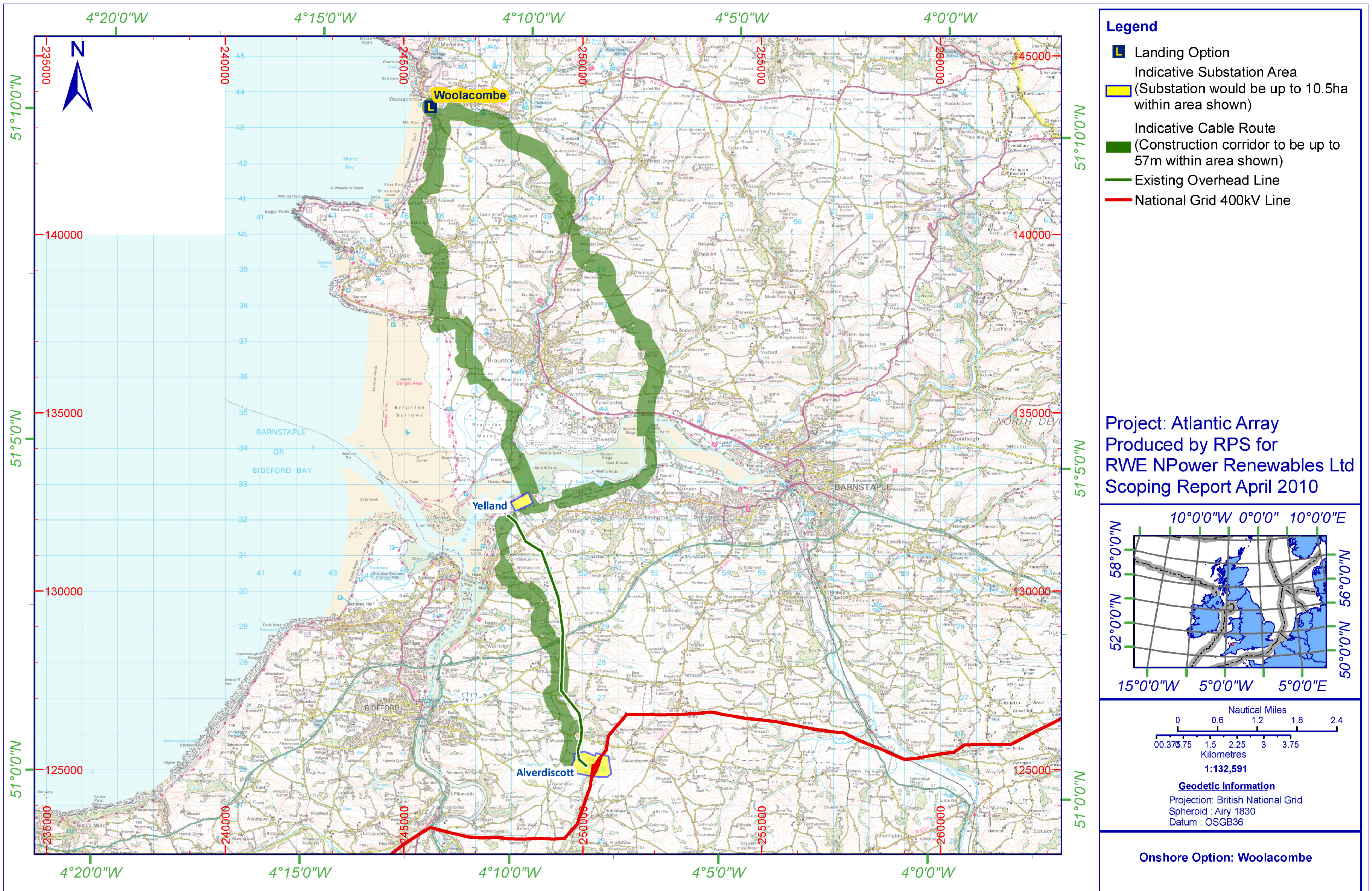
Appendix XII – Woolacombe onshore route option



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