Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Marine Renewable Energy Strategic Framework for Wales

Stage 1 Report FINAL

On behalf of

Welsh Assembly Government

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Summary

S.1 RPS was commissioned by the Welsh Assembly Government (WAG) to undertake work towards the development of a 'Marine Renewable Energy Strategic Framework' for Wales (MRESF). The project forms part of WAGs commitment to strong economic development combined with sustainable growth and prosperity. The work programme is broadly divided into three stages, with the current report describing the outputs from Stage 1. The outputs achieved during Stage 1 can be summarised as follows:

- To describe and, where possible, map in GIS the existing natural and human environmental baseline for Welsh waters (including the wind, wave and tidal resource);
- Determine current understanding of environmental impacts (potential and known);
- Identify development constraints; and
- Identification of the key constraints on development arising from information gaps, with a brief method to address these issues.

S.2 Following discussion and agreement with the Steering Group, Stage 2 is anticipated to take the key constraints forward with the aim of addressing the issues. The final stage, Stage 3, will build on the findings of Stages 1 and 2, aiming towards the development of a strategic approach to the deployment of marine renewable energy technologies in Wales, with the intention of meeting energy targets in a sustainable manner.

S.3 Stage 1 has involved the completion of a desk based literature search, augmented by extensive consultation, to provide a strategic level assessment of the available baseline environmental data for Welsh waters. The topics covered include the following:

- Physical environment;
- Water and sediment quality;
- Visual environment;
- Marine mammals;
- Seabirds, wildfowl and waders;

- Fish ecology;
- Benthic ecology;
- Plankton;
- Designated conservation sites;
- Shipping;
- Tourism and recreation;
- Archaeology;
- Commercial fisheries;
- Military;
- Grid infrastructure;
- Submarine cables and pipelines;
- Renewable energy;
- Marine aggregate extraction;
- Oil and gas;
- Licensed disposal sites; and
- Airspace and radar.

S.4 Stage 1 also involved a review of the potential for CO_2 storage in Welsh waters, based on currently available and importantly, accessible, data.

S.5 The baseline environmental information sourced is summarised in Sections 5.4-5.6, with the data available in GIS format presented in Figures 2-21. The analysis of the extent of existing baseline data enabled an assessment to be made of the key gaps in the knowledge base (Section 6.2), with the following identified (topics highlighted in **bold** are flagged as high priority for wind, wave and/or tidal developments):

- Increased definition of wave and tidal energy resource, particularly in inshore areas;
- Potential limitations in baseline geology regarding rock and gravel areas;
- **Up to date GIS mapping of marine mammal distribution;**

- **Underwater bird behaviour;**
- Baseline mapping of fish ecology;
- Gaps in understanding of the subtidal benthic ecology, particularly in areas within the Severn and around Anglesey and Cardigan Bay;
- Characterisation of benthic species and habitats that occur in areas subject to high tidal flows;
- **Clarity on shipping clearways and potential successors;**
- Mapping of potential wreck sites in apparent 'gap' areas in Cardigan Bay and offshore;
- Availability of consented outfall locations and associated diffusion/dilution requirements; and
- Acquisition of existing data relevant to CO_2 sequestration.

S.6 It should be noted that further data gaps were identified in the baseline, however on-going work is anticipated to at least in part fill the gaps (particularly on landscape/seascape issues) and as such until publication/finalisation of the work, such topics have not been listed here.

S.7 To enable mapping of the potential economic resource for wind, wave and tidal power, a two-staged approach to data collation was followed. Initially, the total wind, wave and tidal energy resource for Welsh waters was mapped, using GIS data sourced from the BERR Renewables Atlas, augmented by additional information held within RPS. The total resource information was subsequently used to enable mapping of the resource requirements of different devices. Device specific information was sourced through the consultation process undertaken for the project, together with the broad literature search, leading to the generation of a list of generic device types (to ensure confidentiality) with a number of associated items of key interest:

- Energy type (i.e. wind, wave or tide);
- Device type (generic description of device type e.g. wind turbine, single point buoy);
- Economic energy requirement;
- Deployment depth; and

- Distance from shore.

S.8 Additional information of interest included potential future expansion of the area of interest (e.g. ability to deploy further offshore as technology develops) together with more general issues such as construction methods and literature on potential/known impacts.

S.9 The outputs comprise a series of figures, generated to visually map the areas of potential resource for each of the device types, where sufficient data was available to do so (Figures 22-30). The figures provide information on areas that may be of interest to various device developers, although it should be noted that these areas are likely to be subject to change over time as devices develop, deployment technology improves and the cost of deployment becomes more attractive. The resource maps do not take into consideration potential constraints, including the availability of a grid connection. It is anticipated that such changes will be built into the MRESF in the future.

S.10 Potential wind resource is available within large areas of Welsh waters, with the primary constraint being water depth. For tidal stream devices, the main areas highlighted are to the north west of Anglesey, off the tip of the Lleyn Peninsula, around west Pembrokeshire and in the inner Bristol Channel/outer Severn Estuary. Potential wave energy resource is very variable between device type, but tends to be concentrated in the outer Bristol Channel and off west Pembrokeshire.

S.11 To enable the current understanding of potential/known environmental impacts (both positive and negative) of marine renewable devices during construction, operation and decommissioning to be identified, the literature search was expanded to an international base. The search was conducted through a combination of input during the consultation process together with a desk-based search. It was notable that literature included both predictions of potential impact together with measured data, with the relative status of devices having a marked effect on the quantity and type of information available. In particular, considerably more literature was available for offshore wind, with the majority of literature for wave and tidal devices being predictive and not measured. A summary of the information sourced is presented in Sections 5.8-5.9.

S.12 The impact assessment literature search addressed the same topics as the baseline review, with the topics sub-divided into groups representing the types of impact that such developments have the potential to lead to. The approach enabled a description of current understanding to be made, while highlighting known work in progress and

projects currently being commissioned. As for the baseline environmental information, the analysis of the information led to a summary of the gaps in current understanding (Section 6.3). Topics highlighted as gaps in knowledge are listed below, with topics highlighted in **bold** flagged as high priority for wind, wave and/or tidal developments:

- **The physical effect of a change in wave or tidal energy;**
- Uncertainty regarding the potential for an effect on vertical mixing, and whether the topic represents an issue;
- How does energy extraction at the surface/mid column affect the seabed;
- Is there a critical amount of energy that can be extracted before a significant effect occurs;
- **Cumulative effects (applicable to all topics);**
- Guidance on the methods for predicting and monitoring physical environment change;
- Potential for sediment to be released during construction/operation/ decommissioning;
- Antifoulants;
- Potential impact on long sea outfalls through mixing and dilution;
- Noise monitoring data;
- **Collision risk for marine mammals, birds and fish;**
- Attraction risk for marine mammals and birds;
- Potential to exclude birds;
- Methods of deterrent for fish;
- Potential damage to fish feeding, spawning and nursery areas;
- Electromagnetic Fields (EMF);
- Standard methods for fish surveys;
- Impact of construction methods other than monopiles on the benthic ecology;
- The effect of wave/tidal energy reduction on the benthic ecology;

- Assessment of the geographic extent of change in wave/tidal energy;
- Impact of increased carbon emissions should vessels be required to re-route;
- Shipping collision risk from fixed structures;
- Shipping collision risk from devices that break free;
- Impact of exclusion zones on tourism and recreation;
- Justification for and tailoring of exclusion zones;
- **Public perception;**
- Potential benefits;
- Understanding of the implications of changes in physical conditions on marine archaeology;
- Potential conflict with existing military use;
- **Potential effect of wave and tidal devices on military interests;**
- Effect on marine aggregate wharves and transit routes; and
- **Potential impact of wave and tidal devices on radar.**

S.13 It should be noted that further data gaps were identified in the understanding of impacts, however on-going work is anticipated to at least in part fill the gaps, and as such until publication/finalisation of the work such topics have not been listed here.

S.14 Potential constraints on the development of marine renewable energy are not restricted to environmental issues. As such, Section 7 of the report considers other types of constraints that can affect development, based on the following headings:

- Practical constraints (e.g. financing, materials, staffing at all levels, grid connection etc);
- Site specific issues (e.g. resource, water depth, geology, weather);
- Support (e.g. financing, research, provision of test sites);
- Legislative considerations (e.g. SEA, sustainability, climate change, consenting, nature conservation legislation);
- Existing use (existing social/economic interests); and

- Data requirements (availability, ownership, financial cost of acquisition, precautionary principle).

S.15 Such constraints were frequently raised during the consultation process as potentially representing either significant benefits to or constraints on development.

S.16 Following completion of the literature review and consultation, an assessment of the potential constraint posed by the presence of each of the receptors identified for Welsh waters was conducted (Section 8). Essentially, the list of topics covered in the baseline literature search was taken forward (which therefore included both natural and human environment) and the GIS data available for each highlighted. An assessment was then made, where feasible, of the degree of constraint that each receptor presents to wind, wave and tidal development in Welsh waters. The assessment of constraint will enable GIS maps to be generated within the areas of potential resource for each device type, highlighting the degree of constraint likely to affect developments. The various degree of constraint highlighted included the following:

- No likely constraint;
- Constraint assessment/study required, but low likelihood of delay;
- Constraint will require assessment and delay likely, but unlikely to stop development;
- Significant issue/constraint – delay and could possibly stop the project; and
- Likely to preclude development.

S.17 Although not presented as a component of Stage 1, constraint maps generated from this approach require careful interpretation, with baseline data gaps highlighted within the report taken into consideration, as essentially there is potential for a data gap to appear as a lack of constraint.

S.18 The final part of Stage 1 was to compile a list of the key data gaps that represent potential constraints on development in Welsh waters, and to provide a brief overview of a method to address the issue. The high priority data gaps identified were taken forward to produce 19 overall amalgamated data gaps, with the titles given listed below:

- Large scale interactions;
- Positive effects;

- Monitoring requirements post consent;
- Understanding of the effect of a change in wave or tidal energy;
- Cumulative effects on the physical environment;
- Antifoulants;
- Distribution of marine mammals;
- Collision risk – marine mammals;
- Measurements of noise during construction and operation of wave and tidal devices;
- Underwater bird behaviour and potential collision risk;
- Collision risk – fish;
- Significance of shipping clearways (or potential successor);
- Collision risk – navigation;
- Public perception;
- Exclusion zones – commercial fishing;
- Sensitivity of different fishing activities to displacement;
- Potential effects of wave and tidal devices on military interests;
- Military interests in Cardigan Bay; and
- The potential effect of wave and tidal devices on radar.

S.19 It is anticipated that Stage 2 of the MRESF project will concentrate on addressing some of the issues identified, with Stage 3 building on the findings of both Stage 1 and 2, culminating in a strategic approach to the deployment of marine renewable energy technologies in Welsh waters, aimed at meeting the energy targets in a sustainable manner.

1 Project Background

1.1 Background

1.1.1 This project is being undertaken in response to an invitation to tender received by RPS from the Welsh Assembly Government (WAG), titled 'Towards a Marine Renewable Energy Strategy for Wales'. The project forms part of the WAG's aim to develop 'the strongest economic development policies to underpin sustainable growth and prosperity in Wales'. Part of this aim is the drive to use an evidence based evaluation of clean energy developments, to achieve the double aim of both an economic drive and the WAG's commitment to sustainable development and internal competitiveness.

1.1.2 Although the project is being undertaken directly for the WAG, the outputs will be reported to a steering group. The purpose of the steering group is to enable input, comment and feedback throughout the project from interested parties, to ensure their expertise and experience is included. In particular, a number of the organisations in the steering group have sponsored or undertaken some of the key work that has preceded the current project. The steering group is comprised of the following:

- WAG;
- Defence Estates – Ministry of Defence;
- Crown Estate;
- Countryside Council for Wales;
- Department for Business Enterprise and Regulatory Reform;
- Marine and Fisheries Agency; and
- Department of Transport.

1.1.3 The objectives of the Steering Group were discussed and agreed at the inaugural meeting for the project, held at Cathays Park on the 3rd August, 2007. These comprised the following:

- To ensure that the first stage of the project is managed to the standards required to meet WAG Project Management criteria;
- To ensure there is a regular flow of information between the WAG and the project team/consultants;

- To oversee the deliverables of the project to ensure that the Project Objectives are met by RPS;
- As a result of the information accruing from the Project, to assess the importance of issues raised concerning the development of marine renewables in Welsh Waters, and their impact on associated WAG, and UK Government current and developing policy;
- To evaluate the Stage 1 Project Closure Report and determine and agree the priorities for the second stage of the contract; and
- To finalise and agree the Plan and Objectives for Stage 2 and Stage 3 of the Project.

1.1.4 The WAG highlights the objectives for Wales' energy supply on its website (www.new.wales.gov.uk) which states the prerequisites for energy supply to be:

- Safe;
- Secure and reliable;
- Affordable and competitive;
- Has minimal effect on the environment;
- Has maximum local inputs and economic development potential; and
- Used efficiently and effectively in all aspects of Welsh life

1.1.5 Further, the WAG has published two consultation reports related to energy in recent years. These comprise the now superceeded consultation document 'Energy Wales: Route map to a clean, low-carbon and more competitive energy future for Wales', published in 2005, and the current 'Renewable Energy Route Map for Wales', published in 2008. Marine renewable developments and carbon capture and storage (CCS) provide an opportunity to help fulfill the WAG's sustainable development duty, while achieving its energy aims.

1.1.6 The project is being undertaken by a team led by RPS with team members including:

- Centre for Law and the Environment, University College London (UCL);
- Econnect Consulting Ltd; and
- Wessex Archaeology.

1.1.7 Together, the team brings extensive experience in marine renewable energy and CCS, complete with a working knowledge of the environmental issues involved, both in the broader picture and more specifically to Wales.

1.1.8 The report is laid out as follows:

Section 1 Project Background

Section 2 Need for Current Project

Section 3 Context

Section 4 Consultation

Section 5 Data Sources

Section 6 Data Gaps

Section 7 Development Constraints

Section 8 Potential Sites for Development

Section 9 Progress to Stage 2 – Focused Data Collection

1.2 Aims and Objectives

1.2.1 The overall aim of the project is to develop a Welsh Marine Renewable Energy Strategic Framework (MRESF). The Framework is aimed at combining renewable energy extraction from the Welsh marine environment (wind, wave and tidal stream) and carbon capture and storage (CCS) with the intention being to minimise impacts on environmental resources and socio-economic activities while maximising the potential for sustainable energy production to be gained from Welsh waters. It should be noted that tidal range technologies, i.e. lagoons and barrages, are outside the remit of the current project and are thus not considered in any of the data collection or assessment work comprising this initiative. The decision to exclude tidal range was made by the WAG in conjunction with the Steering Group in response to the work currently being undertaken at UK level on tidal power in the Severn. At present, work is progressing on a Strategic Environmental Assessment of tidal power in the Severn, and it is anticipated that some cross over between projects will be required during the subsequent stages of the current project. The initial co-operation between the projects has related to data exchange, but there will inevitably need to be review of any framework developed for marine renewables, particularly with regard to spatial areas,

should a tidal range scheme within the Welsh waters of the Severn estuary be progressed. There is thus a clear need for co-operation between the two initiatives as both studies progress and it will therefore be important to establish clear and ongoing communication links between the two project teams.

1.2.2 The MRESF project is divided into three stages, with the current report representing one of the deliverables from Stage 1. The three stages can be summarised as follows:

Stage 1

1.2.3 Stage 1 is essentially focused on the identification of information relevant to the marine renewable energy sector and the identification of data gaps, where these are apparent from this exercise. The deliverables include:

- A list of critical datasets required to build the evidence base;
- A summary of areas within Welsh seas that offer potential for sustainable exploitation for marine renewable energy developments;
- Consultation with key stakeholders, to ensure inclusion of relevant datasets and projects (proposed, on-going and completed);
- The identification of key issues and barriers to such developments;
- Development of a GIS database of spatial datasets, providing the basis upon which areas of potential exploitable resource can be identified, and placed within the necessary context of existing sea area use across all sectors and environmental sensitivities;
- Identification of key gaps in baseline data, and/or understanding of impacts, and interactions of renewable energy projects with the environment, both natural and socio-economic;
- An initial appraisal of area options for development; and
- The production of a prioritised list of research areas and methodologies to address key information gaps, through focused primary data collection in Stage 2, in order to progress development of the strategic framework in Stage 3.

Stage 2

1.2.4 The main purpose of Stage 2 is the collection of information to fill critical data gaps, as identified in Stage 1. This is anticipated to require a combination of primary research (including field survey and data collection) and desk based studies. The detail of Stage 2 will be informed by the deliverables of Stage 1.

Stage 3

1.2.5 The final stage of the project is aimed at developing a Marine Renewable Energy Strategic Framework (MRESF). This will be presented in report format, summarising the knowledge gained during Stage 1 and 2, and using the information to develop scenarios for sustainable renewable energy developments within Welsh waters.

1.3 Terminology and Project Extent

1.3.1 The remit for the project extent is to cover Welsh territorial waters, i.e. from baseline (usually mean high water spring) seawards to the 12nm limit (Figure 1). However, for completeness, some data has been gathered from outside this area. Such information includes partial terrestrial baseline information, primarily where a baseline description of the visual environment is required, together with information on the electricity transmission network in Wales. Although the focus is inevitably on Wales, literature on known and predicted impacts of wind, wave and tidal stream power has been sourced from a wider area, including international projects where relevant. Whilst it is acknowledged that experience and knowledge of impacts gained from plans and projects outside the UK may relate to different physical processes, habitats and species than those found in Welsh waters, such references do add valuable information, in particular for devices where little research has been conducted to date.

1.3.2 The project remit described above makes reference to wind, wave and tidal stream devices, which is an important point. It should be noted that the project specifically excludes tidal range technologies, and hence is not intended to address issues related to barrages or lagoons (see Section 1.2.1).

1.3.3 When discussing renewable devices, the terminology used in the wider literature varies, however for the purposes of the current report the term ‘marine renewable’, whether referring to energy or device, includes wind, wave and tidal stream.

2 Need for current project

2.1.1 The issue of climate change has an increasing profile, with the need for action highlighted in numerous documents, such as 'Climate Change: The UK Programme', published by DETR in 2000. The drive to cut greenhouse gas emissions includes commitments at the national, UK and international scale, for example through the Kyoto protocol. Hand in hand with the commitment for action on climate change is the ongoing need for energy. The UK Government's Energy Bill, which was published in 2008, has as its principal objective the aim of updating the existing legislative framework, to make it more appropriate for the current energy market and need. The Bill includes a chapter on CCS together with a section on renewable energy. A more recent UK Government commitment to renewable energy came via the consultation on the 'UK Renewable Energy Strategy' (http://renewableconsultation.berr.gov.uk/) which is seeking views on how to increase the use of renewable energy across the UK.

2.1.2 Specific to Wales, there are two main documents, the Energy Wales Route Map (published for consultation 2005, now superceded) and the Renewable Energy Route Map for Wales (published for consultation in 2008) which lays out the agenda for energy in Wales. Sustainable development is highlighted in the 2005 document as being central to the WAG's vision for an energy strategy for Wales, to ensure sufficient energy provision whilst maintaining environmental standards and mitigating global warming, with self-sufficiency and a low-carbon economy highlighted in the 2008 report, with an aim of 'maximum social, economic and environmental benefit from reducing climate change'.

2.1.3 The exploitation of renewable energy resources in the UK, including marine-sourced energy, together with exploration of the potential for CCS, will form a critical component in achieving the aims and targets briefly described above. In order to facilitate the truly sustainable realisation of the marine renewable resource in Wales, this study has been initiated to gather relevant information to allow for the strategic planning of development within territorial limits. This Stage 1 work has been targeted at providing a cornerstone in the process for developing the strategic framework. The work represents a contemporary information source and gazetteer of relevant studies as well as providing an auditable assessment of current knowledge and

understanding to inform both subsequent stages in this project and the wider strategic initiatives related to the renewable energy sector.

3 Context

3.1 Introduction

3.1.1 The current project has been preceded by a number of projects and reports that form the starting point from which the strategic framework can be developed. These projects have tended to be undertaken on a broad basis, both for the UK as a whole and for more specific areas including Wales. These initiatives include information on policy, guidance and broad assessments of potential impact. An overview of such projects is given below.

3.2 Energy Policy in UK and Wales

3.2.1 Numerous documents have been published to provide information on and guidance about UK energy policy, with the following being of particular relevance to the current study. The Planning Bill, which includes aspects of relevance to Energy Policy, is discussed under Section 3.3.

The Energy Bill 2007-08

3.2.2 The Energy Bill, which was introduced in the House of Commons in January and finished in March 2008, will implement the legislative aspects of 2007's Energy White Paper. The main areas addressed by the Bill include offshore gas infrastructure, carbon dioxide storage (CCS) the Renewables Obligation, the decommissioning of energy installations and offshore transmission. The principal objective of the Bill, as defined in the accompanying explanatory notes, is '…to make it more appropriate for today's energy market.'

3.2.3 In addition, the department for Business, Enterprise and Regulatory Reform (BERR) state on their website that the Energy Bill will be implemented alongside the Planning and Climate Change Bills, to provide legislation to underpin the long term delivery of both the energy and climate change strategies. As regards CCS and marine renewables, the content of the Bill includes the following:

- Creating a regulatory framework to enable private sector investment in CCS projects;

- Strengthening the Renewables Obligation to drive greater and more rapid deployment of renewables in the UK;
- A strengthening of the statutory decommissioning provisions for offshore renewables and oil and gas installations; and
- Amending powers related to offshore electricity transmission.

3.2.4 The content of the Bill is discussed further in Section 3.3.

Draft Marine Bill

3.2.5 The UK Government published the Marine Bill in March 2007 for consultation, with the draft Marine Bill published on the 3rd April 2008. The document was prepared as part of the UK Government's commitment to introducing a new framework for the seas, aiming to establish a strategic system for marine planning, striking a balance between conservation, energy and resource needs. The content of the draft Bill is discussed further in Section 3.3.

Climate Change Bill

3.2.6 The draft Climate Change Bill was published in March 2007, with the key points (as defined in www.defra.gov.uk/news/latest/2007/climate-0313.htm) as follows:

- A series of clear targets for reducing carbon dioxide emissions;
- A new system of legally binding five year 'carbon budgets';
- A new statutory body, the Committee on Climate Change, to provide independent expert advice and guidance to Government on achieving it's targets and staying within its carbon budgets;
- New powers to enable the Government to more easily implement policies to cut emissions;
- A new system of annual open and transparent reporting to Parliament; and
- A requirement for Government to report at least every five years on current and predicted impacts of climate change, and on its proposals and policy for adapting to climate change.

UK Renewable Energy Strategy

3.2.7 The UK Renewable Energy Strategy was launched as a consultation in June 2008 (http://renewableconsultation.berr.gov.uk/). The associated literature highlights the dual energy policy issues of tackling climate change while ensuring security of supply, with renewable energy highlighted as being a vital part of the overall strategy aimed at meeting the challenge. In essence, a number of additional measures are presented that could be used to help increase the deployment of renewable energy in the UK. The measures highlighted in the summary document are as follows:

- Extending and raising the level of the Renewables Obligation, to encourage up to 30-35% of our electricity to come from renewable sources by 2020;
- Introducing a new financial incentive mechanism, to encourage a very large increase in renewable heat;
- Delivering more effective financial support for small-scale heat and electricity technologies in homes and buildings;
- Helping the planning system to deliver, by agreeing a clear deployment strategy at regional level, similar to the approach established for housing;
- Ensuring appropriate incentives for new electricity grid infrastructure, and removing grid access as a barrier to renewable deployment;
- Exploiting the full potential of energy from waste, by discouraging the landfilling of biomass as far as is practical;
- Requiring all biofuels to meet strict sustainability criteria, to limit adverse impacts on food prices, or other social and environmental concerns;
- Promoting the development of new renewable technologies, through effective support, particularly where the UK has the potential to be a market leader; and
- Maximising the benefits for UK business and jobs, by providing a clear long-term policy framework, working with Regional Development Agencies to tackle key blockages, considering support for specific technologies and addressing skills shortages.

Review of Energy Policy in Wales Part 1: Renewable Energy

3.2.8 The report for consultation was published in 2002, with carbon dioxide emissions and climate change, together with the associated repercussions, being key drivers of the document. The need to reduce emissions was regarded as critical, with increased fuel efficiency and use of low carbon fuel sources seen as the solution, in particular (given the title of the report) renewable energy. To achieve the desired mix of on-shore and offshore wind, biomass, tidal and wave sources of energy, the removal of existing barriers to development was seen as an essential. As part of this, the promotion and development of renewable energy and the setting of targets for renewable energy generation were also highlighted.

Energy Wales: Route Map to a Clean, Low-Carbon and More Competitive Energy Future for Wales (2005)

3.2.9 Although now superceded, the Energy Wales Route Map was aimed at laying a path for sustainable and secure energy supplies for Wales. It highlighted a commitment to both marine renewable developments and CCS, while recognising the input required to achieve these aims. A number of achievements and priority actions were given as part of the route map, including opportunities for marine renewables, cleaner fossil fuel plants and carbon capture. In particular, the document stated the following:

> 'In the medium to long term, we need to facilitate many more clean energy projects, including laying the base for a strong marine renewables sector'.

3.2.10 A number of key tasks are listed, with the following related specifically to marine renewables and carbon capture:

- Engage with stakeholders as appropriate on the construction of wind farms in waters off Wales;
- Examine the potential for marine, wave and tidal technologies in Wales through resource assessment and environmental evaluation;
- Look to increase marine renewable developers interest in establishing business presences in Wales;
- Make appropriate efforts to try to ensure that major demonstration projects are located in Wales by 2010;
- Look to keep open the long-term Severn barrage option; and

- Discuss the potential for CCS.

3.2.11 There is, therefore, a clear commitment to future marine renewable energy developments, together with clean energy technologies such as CCS in Wales. The current project forms part of this drive, being aimed towards setting up a strategic framework within which energy extraction and CCS in Welsh waters can be carried out, in a sustainable fashion.

Renewable Energy Route Map for Wales (2008)

3.2.12 The Renewable Energy Route Map for Wales builds on the 2005 document, aiming to combine a drive towards self-sufficiency in renewable energy with energy efficiency. The programme involves several strands, leading to the production of climate change and energy strategies to assist in meeting the commitment of an annual reduction of 3% in greenhouse gas emissions, from 2011 onwards. Renewable energy sources highlighted in the report include biomass, wave and tidal power, hydro-electricity, waste and both onshore and offshore wind. Together with methods to generate renewable energy, the Route Map also looked at issues such as energy efficiency and micro-generation.

3.2.13 In addition to highlighting methods of generating power, or reducing demand, the consultation document summarises the current consenting process through which developments are required to progress (including the relevant consenting authority for Wales) together with the anticipated changes following the Marine and Planning Bills. A brief summary of the existing electricity grid in Wales is also provided, together with potential topics for research and development.

One Wales: A Progressive Agenda for the Government of Wales

3.2.14 The document was produced in 2007, to provide a four year programme aimed at improving the quality of life in Wales. The document covers issues as diverse as health, the economy, tourism, housing and education, with Section 8 titled ‘A Sustainable Environment’. Climate change is highlighted as being ‘the greatest threat to humanity’, with the programme for addressing the issue including the following points:

- Tackling climate change;
- Supporting rural development;

- Achieving sustainable energy production and consumption; and
- Improving the local environment.

3.2.15 The section also included support for the Energy Route Map and renewable energy in general, including research and development on and off shore.

The Sustainable Development Action Plan

3.2.16 Section 121 of the Government of Wales Act 1998 includes a requirement for the NAW to promote sustainable development. The Sustainable Development Action Plan was produced by the WAG to cover the period from 2004-2007. Of the issues addressed, climate change in particular is highlighted as being the 'greatest international sustainable development challenge'. The Plan set out key actions that were viewed as a route to delivering sustainable development in Wales of direct relevance to the current project, the key actions included the following:

- By 2010 100% of electricity used in all Assembly buildings will be supplied from renewable sources, or good quality embedded generation; and we shall work towards a similar figure for other public sector buildings; and
- By 2006 we will have established pilot projects that explore the potential of using renewable energy solutions in our policies and programmes, aimed at tackling fuel poverty amongst low income vulnerable households, particularly those unable to benefit from traditional improvement solutions.

3.3 Legislation, Planning and Guidance

Legislative Consenting Process

3.3.1 Prior to deployment and construction of a project in UK territorial waters (out to 12nm) and the Renewable Energy Zone (REZ, which extends to 200nm), a number of legislative requirements need to be satisfied. These are summarised below (as of April 2008). However, it should be noted that not all of these will necessarily apply and that local differences may occur as some consents are site dependent.

3.3.2 All developments in Wales require either a lease from the seabed owner (generally the Crown Estate but, in some areas, including the majority of the Severn Estuary, potentially private ownership such as the Swangrove Estate) or site licence (beyond

UK territorial waters in the REZ where the CE does not own the seabed) accompanied by:

- Consent from the Secretary of State for BERR (formerly the Department for Trade and Industry (DTI)), under the Electricity Act 1989, as amended by the Electricity Act, 2004;
- Consent from WAG, under the Food and Environmental Protection Act (FEPA) 1985;
- Consent from Defra under the Coastal Protection Act (CPA) 1949;
- Order from the WAG (in Wales) under the Transport and Works Act (TWA), 1992. This provides an alternative to the Electricity Act (with FEPA, 1985) route for obtaining certain statutory rights necessary for the development of offshore projects, within the territorial waters of England and Wales. A TWA order disapplies the need for consent under CPA and can also disapply section 36 of the EA, displacing the need for consent under these Acts.
- Consent from either the Secretary of State for BERR (via the Electricity Act 1989) or the local authority (under the Town and Country Planning Act 1990) for the onshore works; and
- Completion of an Environmental Impact Assessment through the Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2000.

3.3.3 Potentially including:

- Consent from the Port/Harbour Authority if appropriate;
- Consent from the Environment Agency may be required under the Water Resources Act 1991 (if discharging/draining water or erecting structures, e.g. cabling, in, over or under a water course that is part of a main river);
- Species Disturbance Licence from WAG may be required, if species protected under the Conservation (Natural Habitats &c.) Regulations 1994 (as amended) are present;
- An assent from CCW may be required under the Wildlife and Countryside Act 1981 (including subsequent amendments) if a development is within an SSSI; and

- When a plan or project, either alone or in combination with other plans or projects, is likely to have a significant effect on a European Site (i.e. on internationally important habitats and/or species) and is not directly connected 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 and potentially an Appropriate Assessment, under the Conservation (Natural Habitats, &c.) Regulations 1994.

3.3.4 As regards the legislative process for CCS, the recent Energy Bill considers the issue, with the accompanying explanatory note commenting that:

> 'Permanent storage of carbon dioxide is a novel activity, and existing legislation to control depositions below the surface of the land and seabed is not well suited to licensing the storage of carbon dioxide…the Bill establishes a framework for the licensing of carbon dioxide storage and the enforcement of the licence provisions'.

3.3.5 The framework applies to the offshore area only. Further, in January 2008 the European Commission proposed a regulatory framework, in the form of the European Directive on the Geological Storage of Carbon Dioxide 2008/0014, to enable CCS. The legislative framework in the Energy Bill appears to have been prepared prior to publication of the EC Directive, in part to provide the necessary licensing for a European CCS demonstration project, which is planned to be operational by 2014.

3.3.6 The Marine Bill, published in draft in April 2008, has the potential to affect the application and licensing process for marine renewables, thus changing the licensing process outlined above. The complicated nature of marine licensing, together with the initial aim of the existing legislation (given that it was often written several years prior to the renewables industry growing, and thus not written with the practicalities of the industry in mind), have combined to make a sometimes laborious and complex process. The main purpose of the draft Marine Bill is to provide a framework for sustainable and integrated management of the sea, enabling delivery of better regulation. In particular, the draft Bill states the following:

> 'It will allow us to make better decisions about the activities in our marine area, that will help mitigate climate change – for example the development of renewable energy projects – and the measures

> introduced under the draft Bill will be adaptable, to allow us to manage and use new technologies as they come along'.

3.3.7 The draft Marine Bill also stated the following:

> '…the draft Bill enables ministers to create provisions allowing the Marine Act licence application to be considered through the Electricity Act procedure. The effect is a single process for obtaining consent to build each new renewable energy development'.

3.3.8 There is little mention of CCS in the draft Bill, although potential financial benefits for the industry are highlighted in the appendices of the document.

Planning

3.3.9 In addition to the licensing aspects of the draft Marine Bill discussed above, the document also investigated the issue of planning in the marine environment. The overall aim of the draft Bill as regards planning was given as follows:

> 'To create a strategic planning system that will clarify our marine objectives and priorities for the future, and direct decision-makers and users towards more efficient, sustainable use and protection of our marine resources'.

3.3.10 To this end, the Bill proposed a two staged approach. The first stage involves the joint creation of a Marine Policy Statement (MPS) to be agreed between UK Government departments and the devolved administrations, to lay out the joint visions and objectives. The second stage relates to the creation of a series of marine plans, to provide information on needs and uses in specific areas. The plans will cover human activities and associated infrastructure. Such Plans will not remove the requirement for site specific assessment (i.e. EIA) rather, they will provide 'advice and steer marine users towards a more efficient, sensible use of marine space'.

3.3.11 The UK Government published a White Paper titled 'Planning for a Sustainable Future' in May 2007, followed by the Planning Bill in November 2007. The accompanying explanatory notes summarise the first 8 sections of the Bill as creating 'a new system of development consent for nationally significant infrastructure projects'. Key to the new planning system is the establishment of an Independent Planning Commission (IPC) which will decide on major infrastructure proposals from

April 2009, subject to the Bill securing Royal Assent in summer 2008. The IPC will determine projects that are currently outside the devolution settlement (i.e. consented by the Secretary of State) and thus the new system will cover a range of infrastructure projects, including some energy projects (above threshold criteria) and underground storage of gas. In the marine environment the IPC will be responsible for issuing development consents for large offshore renewable energy projects (>100MW).

3.3.12 As part of the drive towards improved marine planning, a Marine Spatial Planning Pilot was undertaken in the Irish Sea (www.abpmer.net/mspp/). The aim of the Pilot was to obtain a better understanding of the current situation, information on marine planning and to develop a pilot project to test the feasibility and practicality of applying a marine spatial plan. A number of benefits were identified as being associated with a Marine Spatial Plan, in particular for the achievement of sustainable development. Notes of caution were also given, including the absence of key data sets.

3.3.13 The principles of Marine Spatial Planning (MSP) have yet to be applied specifically to Welsh waters (although the Pilot did extend to parts of north Wales), however the current project will provide much useful data which can be used to inform the development of a MSP for Welsh waters, as and when such is developed. There are many synergies between the two initiatives, both seeking to establish a baseline of understanding with respect to spatial uses, requirements and sensitivities in the marine area on a broad scale, encompassing both natural and socio-economic resources. The spatial coverage of information considered in this study will inform the development of a Welsh MSP, at an appropriate scale to allow the development of the regional seas approach, providing for management both within Welsh territorial waters, and across administrative boundaries, where the regional sea approach dictates the appropriate 'management unit'. Although it is currently unclear whether or not MSP will be undertaken at the regional sea scale, in order to provide for management at this scale, it is clear that a Welsh MSP would preferentially integrate with MSPs in adjacent territorial waters.

Guidance

3.3.14 Several documents have been published in the last few years, aimed at providing advice and guidance to regulators and developers as regards marine renewable development in the UK. Due to the more advanced state of the offshore wind industry, a greater proportion of these tend to be directly related to offshore wind.

Whilst these can be used as a starting point for wet renewable developments, an increasing number of documents are aimed specifically at wave and tide. The UK documents identified as part of this study are summarised in Table 3.1 below.

Table 3.1 UK Advice and Guidance Documents for Marine Renewable Developments

Title of Document	Author	Date	Relevant Industry
Generic Guidance			
Best Practice Guidelines for Wind Energy Development	BWEA	1994	Wind
EIA and the Consenting Process			
Guidance notes for Environmental Impact Assessment in respect of FEPA and CPA requirements	CEFAS	2004	Wind
Guidance notes: offshore wind farm consents process	DTI and MCEU	2004	Wind
Guidance on the Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2000	DTI	2000	Wind, Wave and Tide
Environmental Impact Assessment (EIA): Guidance for developers at the European marine energy centre	EMEC	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)	DTI	2005	Wave and Tide
Consultation			
Best practice guidelines: Consultation for offshore wind energy developments	BWEA	2002	Wind
The protocol for public engagement with proposed wind energy developments in Wales	Centre for Sustainable Energy, BDOR Ltd and Capener, P	2007	Wind
Shipping and Navigation			
Assessing the navigational impact of offshore wind farms proposed for UK sites	MCA	2002	Wind
IALA recommendation O-117 on the marking of offshore wind farms Edition 2	IALA	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	DTI, MCA and DfT	2005	Wind
Windfarm Shipping Route Template	MCA	2006	Wind
Proposed UK Offshore Renewable Energy Installations (OREI) - Guidance on Navigational Safety Issues	MCA	2004	Wind, Wave and Tide
IALA recommendation O-131 on the marking of	IALA	2005	Wave and Tide

Title of Document	Author	Date	Relevant Industry
offshore wave and tidal energy devices Edition 1			
Guidance to mariners operating in the vicinity of UK offshore renewable energy installations	MCA	2007	Wind, Wave and Tide
Applications to the Secretary of State for Business, Enterprise and Regulatory Reform for the Establishment of Safety Zones Around Offshore Renewable Energy Installations under the Energy Act 2004	BERR	2007	Wind, Wave and Tide
Aviation			
Wind Energy and Aviation Interests – Interim Guidelines	DTI	2002	Wind
Visual Impact			
Guide to best practice in seascape assessment	Hill, M, Briggs, J, Minto, P, Bagnall, D, Foley, K and Williams, A	2001	Wind
Visual assessment of windfarms: best practice	University of Newcastle	2002	Wind
An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms	Scott, KE, Anderson, C, Dunsford, H, Benson, JF and MacFarlane, R	2005	Wind
Guidance on the Assessment of the Impact of Offshore Wind Farms: seascape and visual impact report	DTI, Countryside Agency, CCW, SNH	2005	Wind
Englands historic seascapes consolidating the national method	Tapper, B and Johns, C	2008	Wind, wave and tide
Nature Conservation			
Windfarm development and nature conservation: a guidance document for nature conservation organisations and developers when consulting over wind farm proposals in England	English Nature, RSPB, WWF-UK and BWEA	2001	Wind
Marine Renewable Energy and the Natural Heritage: An overview and policy statement	SNH	2004	Wind, Wave and Tide
Nature conservation guidance on offshore windfarm development (draft for consultation)	Defra	2005	Wind
The deliberate disturbance of marine European Protected Species: Interim guidance for English and Welsh territorial waters and the UK offshore marine area	JNCC	2007	Wind, Wave and Tide
Archaeology			
Guide to good practice on using the register of landscapes of historic interest in Wales in the planning and development process	CCW, Cadw and WAG	Undated	Wind, Wave and Tide
Guidance for the assessment of cumulative impact on the historic environment from offshore renewable energy	Oxford Archaeology	2007	Wind, Wave and Tide
Historic Environment Guidance for the Offshore Renewable Energy Sector	Wessex Archaeology	2007	Wind, Wave and Tide
Health and Safety			
Health and safety guidelines for wind farm	BWEA	2002	Wind

Title of Document	Author	Date	Relevant Industry
development			
The Health and Safety Risks and Regulatory Strategy Related to Energy Developments	The Health and Safety Executive	2006	Wind, Wave and Tide
Carbon Capture and Storage			
Best Practice for the Storage of CO_2 in Saline Aquifers	Ed A Chadwick, R Arts, C Bernstone, F May, S Thibeau and P Zweigel	No date	CCS

3.4 Climate Change Targets

3.4.1 The UK Government is committed to a number of targets related to the issue of climate change, which stem from European and national articles. The WAG has additional commitments made specifically for Wales, with the Wales Climate Change Strategy setting out how the WAG will deliver its commitments to set targets for reduction in emissions and adaptation to the impact of climate change. Specific targets and commitments made relate to a number of issues connected to climate change, including emissions of carbon dioxide and development of renewable energy. Additional commitments are currently in draft, for example those contained in the draft Climate Change Bill (paragraph 3.2.6) and the UK Renewable Energy Strategy consultation (paragraph 3.2.7). An overview of the targets and commitments made is presented below in Table 3.2.

Table 3.2 Climate Change Targets Applicable to Wales

Commitment	Target	Target Date
Global		
Kyoto	Reduction in greenhouse gas emissions of 12.5% from 1990 levels	2012
European Union		
Reduction in EU energy consumption	20%	2020
Reduction in carbon dioxide emissions	At least 20% from 1990 levels, with a proposal for 30%	2020
EU renewable energy consumption	20%	2020
Biofuel in petrol and diesel	10%	2020
Temperature rise	Limit of 2^oC	unspecified
UK Government		
Climate Change Bill	60% cut in carbon emissions from 1990 levels	2050
Climate change programme	Reduction in greenhouse gas emissions of 20% from 1990 levels	2020

Commitment	Target	Target Date
Renewables Obligation	Increase in electricity generated by renewables by 20%	2020-21
Carbon reduction commitment	Reduction in electricity consumption for organisations with an electricity consumption greater than 6,000MWh per annum	Auction of carbon allowance from 2013
Climate change levy	Cut in annual emissions of 2.5 million tonnes	2010
Welsh Assembly Government		
Annual reduction in greenhouse gas emissions	3%	2011 onwards
Electricity used in Assembly buildings	Supplied from renewable or good quality embedded generation	2010
Renewable energy pilot projects	Establish pilot projects to explore using renewable energy solutions aimed at tackling fuel poverty	2006

3.5 Strategic Environmental Assessment

3.5.1 Strategic Environmental Assessment (SEA) is the process through which the environmental impact of plans and projects can be assessed at a strategic level, i.e. above the level of individual plans or projects. Essentially, it is a broad scale assessment of potential impact from particular types of development in a particular area. It is often undertaken prior to a round of development, to highlight issues that specific projects will need to consider or flag up areas of particular sensitivity. The approach is particularly useful for issues such as cumulative effect and to assist in identifying key data gaps at an early stage. There are five sets of SEA across different sectoral interests that are of current interest to this study, as summarised below.

Oil and Gas

3.5.2 For the purposes of the Oil and Gas Licensing SEA (www.offshore-sea.org.uk) the UK continental shelf was divided into 8 areas, with an SEA to be undertaken on each. Currently, the SEA process has been completed for Areas 1-6, with work ongoing in Areas 7 and 8. Welsh waters are covered by SEA Areas 6 and 8. Although not directly related to renewable energy [*note: see 3.5.5 below*], the documents accompanying each SEA provide a large amount of background and baseline information on each area.

Offshore Wind

3.5.3 Subsequent to the DTI (now BERR) progressing with an SEA for oil and gas, the SEA process for offshore wind commenced in 2002 (www.offshore-sea.org.uk/site/scripts/downloads.php?categoryID=23). The assessment focused on three discrete areas of sea, located in Liverpool Bay, Greater Wash and Thames Estuary. Of these, the Liverpool Bay area falls partially within Welsh waters. Developers of Round 2 offshore wind farms were strongly advised by the DTI (now BERR) to 'take into account the advice given in the SEA Environmental Report, including the possible impact on fishing, navigation and other users of the sea' (www.berr.gov.uk). For the purposes of the current study, the documents provide an overview of the potential impacts and their significance, together with baseline data.

Scottish Renewables SEA

3.5.4 An SEA has subsequently been undertaken in Scottish waters, to assess potential issues for wave and tidal energy development (www.seaenergyscotland.co.uk). The full report was published in March 2007. The main objectives of the project were set out as follows:

- To assess, at a strategic level, the effects on the environment of meeting the Marine Energy Group report target for establishing 1,300 MW of marine renewables capacity around Scotland by 2020;
- Advising and supporting the Scottish Executive in the development and implementation of its marine renewable energy strategy and informing future development of planning guidance for marine energy development;
- To inform the project level decision making process for all stakeholders (to include regulator and developer); and
- To facilitate focused investment into the marine renewable energy sector in Scotland.

Offshore Energy SEA

3.5.5 As a follow up to the Oil and Gas SEAs for Areas 1-7, BERR published a scoping report in December 2007; (www.offshore-sea.org.uk/site/scripts/news_article.php?newsID=32). The report forms part of a process to undertake an integrated Offshore Energy SEA, to enable further rounds of

licensing for oil and gas and leasing for offshore wind. The Offshore Energy SEA will also enable management of Carbon Capture Storage. It is anticipated that it will be linked to a Round 3 for offshore wind licensing, covering areas in English and Welsh waters, and it is understood that the plan already covers wind farms in Scottish waters, beyond territorial seas. For oil and gas, the SEA will extend to include Scotland and Northern Ireland.

3.5.6 The offshore energy SEA effectively encompasses the entirety of the UK, since any exploration/production blocks which are yet to be licensed are re-opened for bids across each of the SEA areas previously completed. As a result, the SEA8 process has provided the opportunity to adopt a regional seas approach, rather than the SEA areas previously used, and this usefully fits with initiatives such as marine spatial planning, in terms of identifying areas of an appropriate scale and function for integrated management.

Severn Estuary SEA

3.5.7 A Strategic Environmental Assessment for tidal range energy in the Severn was publicised for tender in early 2008 and is subsequently underway. The SEA will include the potential for tidal range energy in the Severn, together with the need for an Appropriate Assessment to be undertaken.

3.6 Marine Renewable Energy Studies

3.6.1 In addition to the projects and reports already highlighted a number of research groups have been set up and individual studies undertaken, with specific reference to marine renewable energy. Website details of these, and other similar groups and literature archives, are listed in Table 5.1 in Section 5. These provide significant background information and have been utilised as a basis for data collation in the current project. Key 'umbrella' projects are highlighted below.

BERR Research Advisory Group

3.6.2 The UK Government Renewables Advisory Group on marine renewable energy (RAG) was initiated by the then DTI, now the Department for BERR, to undertake a coordinated approach to addressing the key impact issues raised by Round 2 wind farm proposals. Subsequently, the research areas have been extended to include the

potential impacts of wave and tidal power. Research is conducted under a number of themes, as given below:

- Birds;
- Marine mammals;
- Seascape;
- Fish and benthos;
- Seabed and coastal processes; and
- Navigation.

3.6.3 The most recent RAG research list is included in the bibliography as reference 433.

Countryside Council for Wales and Crown Estate Funded Research

3.6.4 The Countryside Council for Wales (CCW) is statutory advisor to the Welsh Government on 'sustaining natural beauty, wildlife and the opportunity for outdoor enjoyment in Wales and its inshore waters'. In 2004, CCW commissioned the first of 2 studies (the second jointly with the Crown Estate) with the aim of achieving a greater understanding of the characteristics of renewable energy technologies (wind, wave and tide) and in particular in relation to potential impacts on the marine environment. The first, published in 2005 (331), assessed potential impacts on nature conservation and landscape, with the second report published in 2006 (202) being more focused to specifically investigate potential impacts following the extraction of wave and tidal energy.

Collaborative Offshore Windfarm Research into the Environment

3.6.5 COWRIE (Collaborative Offshore Windfarm Research into the Environment) was set up by The Crown Estate in 2001, when the first round of offshore wind farms were announced in the UK. Its remit was to raise awareness and understanding of the environmental impacts of offshore wind developments. The COWRIE Steering Group identified the issues with most significant data gaps and developed projects to help fill those gaps. To date, these have included studies under the following research topics:

- Birds and benthos;
- Electromagnetic fields;

- Marine bird survey methodology;
- Remote techniques; and
- Underwater noise and vibration.

DTI (now BERR) Energy Technology Support Unit and Renewables Advisory Board

3.6.6 The Eneergy Technology Support Unit (ETSU) and now Renewables Advisory Board (RAB) provide a platform and funding for energy research. Topics of particular interest to the current project, with relevant documents available on the publications section of the BERR website (www.berr.gov.uk/publications/index.html) include the following:

- Research on the effect of wind turbines on coastal processes;
- Offshore wind issues such as noise, radar, cumulative effects and general environmental impact issues;
- Fish passage studies for tidal turbines;
- Feasibility and appraisal studies for tidal power;
- Device specific investigations; and
- Economic viability studies.

Electric Power Research Institute

3.6.7 The Electrical Power Research Institute (EPRI) is a non-profit organisation in the US, which conducts research on a number of topics including renewable energy. Several project reports have been sourced, which tend to relate issues such as guidelines on estimating power production from tidal stream devices, feasibility studies of wave and tidal power, environmental and permitting issues and economic assessments.

MINOS

3.6.8 The MINOS project (www.minos-info.org) is a German initiative to investigate whether large scale offshore wind farms in parts of the North and Baltic Seas affect harbour porpoise, common seals and birds. Research is focused on two main topics, as follows:

- Preferential habitats and migratory routes of animals in the Exclusive Economic Zone (EEZ); and
- Sense of hearing in porpoises and seals and their sensitivity to noise.

N-Power Juice Fund

3.6.9 The British Wind Energy Association (BWEA) initiated a project, funded by N-Power Juice, to investigate potential issues that may arise for developers of wave and tidal power technology and to map out a 'path to power'. The project involved considerable consultation with developers and regulators, with the results summarised in four documents under the following themes:

- Legal and regulatory requirements (757);
- Stakeholder views on deployment (308);
- Electricity network access and infrastructure; and
- Summary of the industry potential, hurdles and recommendations for achieving the industry's potential.

3.6.10 The purpose of the reports was to provide a route map for the expansion of wave and tide power schemes in UK waters.

Renewables Atlas

3.6.11 The DTI commissioned a study in 2003 to produce an 'Atlas of Marine and Renewable Energy Resources' (2). An update of tidal energy resources was published in July 2007 (4), with the Atlas itself updated in 2007/08, with project outputs available on the website (www.renewables-atlas.info/). The project was commissioned as part of BERR's SEA process for offshore energy. The purpose of the project was to 'quantify and spatially map the potential wave, tidal and offshore wind resource at a regional scale across the limits of the UK Continental Shelf' (www.berr.gov.uk). A series of maps have been produced, depicting the potential resource, providing an initial overview of areas providing sufficient energy for development, with GIS files available to download.

SuperGen Marine

3.6.12 SuperGen Marine (www.supergen-marine.org.uk) is formed from a consortium of academic partners together with a number of industrial collaborators, to investigate issues connected to wave and tidal devices. Work under Stage 1 has now been completed, with work currently underway through Stage 2. Items of work that have been or are currently being undertaken by SuperGen of particular interest to the current project include the following:

- Economic, environmental and social impacts;
- Methodologies for device evaluation and optimisation;
- Engineering guidance;
- Offshore energy conversion and power conditioning;
- Moorings, foundations and positioning;
- Field validation;
- Combined effects; and
- Arrays, wake and field effects.

3.6.13 A summary report on the research undertaken by SuperGen during stage 1, covering the period from October 2003-September 2007 was published in 2007 (755). Stage 2 funding for a further 4 years progressed from October 2007.

UK Energy Research Centre

3.6.14 The United Kingdom Energy Research Centre (UKERC) is a national initiative in sustainable energy research (www.ukerc.ac.uk). Particular items of interest to the current project include the Research Atlas (including an on-line searchable database of energy related projects, activities and research) and the National Energy Research Network (NERN), the latter being an umbrella network for energy researchers.

United States Department of the Interior Minerals Management Service

3.6.15 The United States (US) Department of the Interior Minerals Management Service (MMS) (www.mms.gov) regulates domestic energy production on the Outer Continental Shelf. Traditionally covering oil and gas, the MMS was recently granted authority by Congress to extend its remit to include wind, wave, ocean current, tidal

and hydrogen generation. In response, the MMS established the Alternative Energy and Alternate Use (AEAU) programme. The AUAE completed its 'Programmatic Environmental Analysis' in 2007 (688), which was aimed at assessing the potential impacts from the development, operation and decommissioning of renewable energy or alternate use on the Outer Continental Shelf, together with the identification of key issues and mitigation measures for site specific reviews.

Welsh Development Agency Study

3.6.16 A further report, undertaken on behalf of the Welsh Development Agency, was published in 2006 (751). The study investigated the current understanding, within Welsh waters, as regards the potential for renewable energy. The information sourced was used to make an assessment of potential development and deployment sites.

Welsh Energy Research Centre

3.6.17 The Welsh Energy Research Centre (www.welshenergy.org) is an independent body, formed by Universities and research groups. The groups work covers a wide variety of energy issues, including marine energy, with current work being undertaken by the Marine Energy Research Group including the following:

- Tidal stream turbine feasibility study;
- Hydro-environmental impact modelling of tidal turbines;
- Modelling of tidal stream turbine wake;
- Surveys and environmental assessments of a potential tidal stream site; and
- Blade design and layout effects n tidal flow and the environment.

3.6.18 The group is anticipated to report during 2008.

Site Specific and Regional Studies

3.6.19 In addition to the more broad scale and in some cases generic studies available regarding potential and known impacts of marine renewables, a number of development projects have undertaken considerable research either as part of the application process or to fulfill the license requirements post consent. Additional relevant experience gained from such projects includes consultation feedback,

meeting notes, mitigation measures applied and monitoring conditions imposed. Such information is valuable to informing the overall process, particularly when understanding delaying factors to a proposal. The information is therefore useful when considering future projects, to minimise the recurrence of such issues or at least to anticipate them in advance.

3.6.20 Beyond the specific studies and general assessments and initiatives described above and earlier in this section, there is a range of information arising from offshore windfarm projects under Round I and II developments, wet renewable proposals and projects in the UK and marine renewable projects overseas which add to the evidence base, primarily from identifying constraints on development and an increased understanding of potential impacts. Although data from these projects are site-specific, the process of assessment, consenting and construction has produced much useful data on the practicalities of delivering projects and the potential impacts arising from the installation of devices and electricity cables, which inform at a strategic level.

3.7 Marine Renewable Developments in Wales

3.7.1 Development of marine renewable technology is progressing, with some projects in the water producing electricity and further demonstration/test sites being developed. Due to the relative stage in development of the various technologies, wind power currently dominates in most areas, with several commercial sites in operation across the UK. However, wave and tidal power technology development is progressing, with commercial, demonstration and prototype sites being developed.

3.7.2 Sites in Welsh waters which are known to have been used for testing, are currently operational, under development, or where an expression of interest in development is known, are summarised in Table 3.3. The location of these sites, where known, is given in Figure 2.

3.7.3 As stated previously, tidal range technologies (i.e. barrage and lagoons) are outside the scope of the current project (see Section 1.2.1).

Table 3.3 Identified Interest in Potential and Actual Marine Renewable Energy Projects in Welsh Waters (as of April 2008)

Site Name	Location	Energy Type	Status
Atlantic Array	Outer Bristol Channel (20km from Welsh and north Devon coasts, 15km from Lundy)	Wind	Initial stages
Gwynt y Môr	13-15km off North Wales	Wind	Consent application submitted December 2005, consultation in progress
Lunar Energy	Ramsey Sound, St. Davids, Pembrokeshire	Tide	Scoping study submitted end October 2007
North Hoyle	7.8km off Prestatyn, North Wales	Wind	Generating since November 2003
Rhyl Flats	8km off Colwyn Bay, North Wales	Wind	Consented. Foundation piling due to start 2008
Rhyl Tidal Impoundment	North Wales	Tide	Initial stages
Scarweather Sands	9.5km off Porthcawl, South Wales	Wind	TWA order in force. FEPA licence under consideration
Severn Barrage	Severn Estuary	Tide	Investigated for several decades, and currently subject to on-going feasibility work and a strategic environmental assessment.
Skerries Tidal Stream Array	Between the Skerries and Camel Head on the Isle of Anglesey	Tide	Scoping Study submitted July 2006
South Stack Tidal Stream Array	2-3km from the west Anglesey Coast	Tide	Scoping Study submitted July 2006
Swan Turbines	River Tawe, Swansea	Tide	Tested scale model of Swan Turbine
Swan Turbines	Milford Haven	Tide	Investigating potential deployment in Milford Haven
Swansea Bay Tidal Impoundment	Swansea Bay	Tide	Early stages of interest – scoping undertaken in 2006
Tidal Hydraulic Generators Ltd	Tidal River Cleddau, possibly between Severn Crossings and/or Ramsey Sound, Pembrokeshire	Tide	Previous trials undertaken, recent linkage with Peter Brotherhood Ltd to install a full scale system (location unknown). Trials in Milford Haven complete
Unknown	Bristol Channel	Tide	Understood that data is being acquired by the Welsh Energy Research Centre for a potential tidal stream turbine site in the Bristol Channel
Wave Dragon pre-commercial demonstrator	1.7km west of St. Ann's Head at Long Point, Pembrokeshire	Wave	EIA submitted April 2007

4 Consultation

4.1.1 Consultation formed a key part of the current study, to highlight work being undertaken, gain access to work not readily available and to identify the issues and concerns that consultees have. The consultation process was also intended to highlight potential interactions between industries, for example requirements to avoid existing structures or to identify suitable port facilities. Beyond this, the engagement of stakeholders and the industry in the process of developing the strategic framework for Wales will foster buy-in to the process, a critical aspect since the strategic framework will be the basis for the system by which maritime sectors and activities will ultimately be governed in Welsh waters. A consultee list was drawn up through discussion with the Steering Group, with additions made based on contacts identified during the literature search, and includes experts and interested parties from the following sectors:

- Developers;
- Academics;
- Research Groups;
- Non-Governmental Organisations (NGO's);
- Unitary Authorities; and
- Government Departments and Agencies.

4.1.2 A full consultee list is given in Appendix A. Of the 105 organisations contacted (including some 132 individuals), some 79 orgainisations replied. Consultation was initiated through telephone calls, followed up by email as required, using pre-prepared proformas to prompt for the type of information sought from each consultee, an example of which is included in Appendix A. Although the questions asked and topics addressed differed between consultee (as would be expected given the varied background and interests of the consultees), the basis for the discussions was common to all. The key points of interest underpinning the consultation are given below.

4.1.3 Examples of questions put to ***regulators*** and ***data providers*** included:

- What are the principal issues of interest and areas of concern?;

- What considerations do you have when commenting on scoping, EIA and AA reports?;
- What level of relevant data and literature (baseline and impact) are you aware of, and is it available?;
- What are the key research priorities from your perspective?; and
- What, from your knowledge/involvement do you see as the key data gaps currently? (baseline and impact).

4.1.4 Examples of questions put to questions for ***developers*** included the following:

- What is the status of the device? – e.g. undertaking flume tests or ready to deploy commercially;
- What are the consenting or development hurdles in your experience? – e.g. perception, lack of data etc;
- What are the specific device requirements for commercial deployment? – e.g. wind/wave/tide energy levels, water depth, substrate etc;
- How would devices be deployed? - e.g. as single or array, position in the water column etc; and
- Have any studies been undertaken and if so, what is the availability of these.

4.1.5 Examples of questions put to ***stakeholders*** (e.g. existing industry, landowners etc) included:

- A request for confirmation of the location and extent of interest;
- What do you see as the potential benefits for stakeholders?;
- Potential infrastructure provision?;
- What potential conflicts or concerns exist (for specific sector)?; and
- What are the potential constraints or exclusions (if any) the stakeholder might look to impose or require on renewable energy developments?

4.1.6 The content of the consultee responses are confidential and hence are not repeated in full within this report. Instead, the feedback has been included in the appropriate

sections of the current report as required. Particular issues raised are, however, summarised below.

Identification of New Baseline Data

4.1.7 A number of consultees identified and in some cases provided baseline data which were new to the project. Such information included academic papers, technical reports and national GIS datasets. Examples include tourism and recreation GIS data from both the Environment Agency and the National Trust, the COWRIE wind farm data website (http://data.offshorewind.co.uk/), literature on EMF, survey data for marine mammals, the Finding Sanctuary Project and the Scottish Sustainable Marine Environment Initiative.

Identification of Additional Literature on Potential Impacts

4.1.8 Relatively few consultees identified new datasets or literature related to known or predicted impacts, with references including academic papers, conference proceedings and computer modelling studies. The majority of these related to physical impacts and in particular to studies that looked to improve the output from wave and tidal devices. Of particular interest to Wales was the Welsh Renewable Research Centre, whose marine energy research topics were provided during the consultation process.

Identification of Marine Renewable Energy Projects

4.1.9 A number of marine renewable energy projects were highlighted during the consultation process, including both UK and international developments at various stages in the consenting process. Specific to the UK, the main sites identified included EMEC in Orkney, the Atlantic Array site in the Bristol Channel, the NaREC test station for wave power in Northumbria, potential deployments of wave or tidal devices off Anglesey, in the Humber and off the east coast of England, the Wavehub project in the Bristol Channel and the Severn barrage.

4.1.10 Outside the UK, particular sites highlighted included the offshore wind farm at Arklow Bank and the MCT site at Strangford Lough in Ireland, the Horns Rev and Nysted sites in Denmark and general interest in offshore wind across North Sea countries. Particular interest in wave and tidal power off Portugal was noted by more than one

consultee, together with increasing interest in marine renewables in general in the US and Canada.

Identification of Projects in Progress

4.1.11 Key projects in progress that were raised during the consultation process include updates to the RYA Recreational Boating Atlas, work to map commercial fisheries in Welsh waters, the extension to the offshore aerial bird surveys (from Round 2 areas to include the majority of Welsh waters), collation of marine mammal data, extensions to HABMAP, ongoing work on LANDMAP, collation of shark sightings in Welsh waters into a GIS database, the potential publication of the AIS shipping database and the proposed and ongoing work programmes for BERR RAG, COWRIE and EMEC.

Provision of Alternative or Additional Contact Details

4.1.12 A particularly useful aspect of the consultation process was the identification of additional consultees. These included individuals within organisations together with organisation or individuals new to the project and enabled the identification of some key datasets, particularly marine mammal information. The process was also useful where individuals named on the original consultee list were no longer the appropriate contact.

Device or Project Specific Data

4.1.13 One of the main purposes behind consulting developers was to gain an improved understanding of device siting requirements. Although the level of detail provided varied between developers, a considerable amount of information was available that has enabled the current understanding of where such devices could be economically deployed to be improved. A number of developers also summarised issues such as the current stage of device/project development.

Key Concerns

4.1.14 Concerns raised by consultees tended to vary depending on the particular interest of each consultee. Developers raised issues such as difficulties in gaining consent, uncertainty in future changes in the consenting process, lack of strategic planning, a perceived lack of resource in regulators (such as experienced staff) leading to delays, concerns about future funding/financial incentives, grid connection problems and the unknown cost or extent of potential monitoring requirements.

4.1.15 The type of concerns raised by regulators reflected the statutory remit of each consultee. Examples included potential for impacts on shipping and radar, the need to meet climate change targets, the need to meet obligations under nature conservation legislation particularly Natura 2000, concerns that undesignated nature conservation is not sufficiently valued and a need to balance the requirements of data acquisition against environmental impact.

4.1.16 The final group of consultees contacted were termed ‘stakeholders’, which essentially included land owners, potential infrastructure providers and representatives from industries with a current interest in Welsh waters. Issues raised included potential economic benefits, primarily for land owners and infrastructure providers, but also potential conflict to arise between marine renewable developments and both existing operations and future developments across a wide range of sectors. The lack of a strategic basis for developments in Welsh waters, and indeed more widely around the UK, was highlighted as a concern by many stakeholders.

5 Data Search

5.1 Data Sources

5.1.1 A comprehensive literature search has been undertaken as part of Stage 1, which has involved several strands aimed at covering all potential data sources, including:

- Desk based research to assemble publicly available information on the baseline environment of Welsh waters;
- Collation of device and development specific information;
- Collation of literature identifying and assessing potential and known environmental impacts from projects in Wales, the UK and overseas;
- An assessment of information on infrastructure provision;
- Assessment of the maritime archaeological interests within Welsh waters;
- The current and future status of the electricity transmission grid within Wales;
- Potential structures offshore that could offer potential for CO_2 sequestration;
- A review of potential legal issues; and
- Consultation with regulators, developers, academics, government agencies/departments, NGOs and recreational groups (as discussed in Section 4).

5.1.2 It should be noted that the literature review for data on potential impacts and the collation of device and development specific information had a broader search area than the baseline environment review, with the latter restricted to Welsh territorial waters. For the broader literature searches, information has been sourced from plans and projects in Wales, the UK and from international studies, for the latter primarily from Europe, America and Canada. While the preference for the current study would be for projects based on the Welsh or UK environment (and hence on environmental processes, human activities, habitats and species likely to be found in Welsh waters), there is considerable value in sourcing studies over a wider area. This is of particular relevance for devices or research topics where little UK work has been completed to date. Although blanket application of the results from a particular device, project or

study to a separate project should always be treated with caution, particularly when data has been gathered in a different country, the international data does provide a useful background against which assessments of potential impact can be made.

5.1.3 To source the information, a number of approaches were used, to ensure a thorough and complete literature search. The main sources of information include the following:

- Broad internet searches;
- Reports associated with developments (e.g. Environmental Impact Assessments (EIA), technical reports, Appropriate Assessments (AA) and monitoring studies);
- Internally (project team) held data, reports and literature;
- Government sponsored research (both Government departments and Government funded bodies in the UK and abroad);
- On-line libraries (e.g. CCW, Natural England);
- Reference lists in appropriate reports;
- Literature reviews undertaken by previous reports;
- Research undertaken by trade associations (such as the BWEA);
- Research undertaken by the landowner (Crown Estate); and
- Research undertaken by academic institutions.

5.1.4 It should be noted that confidentiality issues can create difficulties with obtaining key information, including that from ongoing studies that have been identified which are yet to report, or work for project and device developers which lies outside the public domain and is therefore not available to organisations outside the project. This particularly applies to monitoring studies currently ongoing or proposed, for which the status is either unclear (i.e. whether public domain or confidential) or difficulties in obtaining the data are already apparent. There are also difficulties in obtaining some 'public domain' material, especially EIA documents and associated literature, with commercial confidentiality often cited.

5.1.5 While it is understood that some data may be commercially sensitive, the lack of access to information, particularly monitoring data, may have detrimental

consequences to the progress of the industry as a whole, since essentially these data will not add to the wider knowledge base. Even where data is in the public domain and the holder would be prepared to release it, there are often difficulties in acquiring the information, particularly when it is a few years old or, as found during this study, the project has been consented and the information archived. With specific respect to marine renewables projects, the obligation to provide environmental data will hopefully serve to increase data availability for the sector. Additionally, initiatives such as the COWRIE data management for offshore wind data (http://data.offshorewind.co.uk/catalogue/), the UK Energy Research Council NERN programme (www.ukerc.ac.uk/NERN/NationalEnergyResearchNetwork.aspx), the Marine Data and Information Partnership (www.oceannet.org/mdip) and the Defra Shared Spatial Information Services (www.defra.gov.uk/corporate/gi/spire/index.htm) are particularly welcome as forums for addressing some of these issues.

5.1.6 In addition to the general literature searches, a number of websites were identified that hold relevant, geo-referenced baseline data and/or literature on known and predicted effects of wind, wave or tidal devices. These websites are presented below in Table 5.1.

Table 5.1 Websites holding Relevant Information

Web Address	Organisation	Information Type	Availability
http://www.berr.gov.uk/energy/sources/renewables/policy/offshore/research-advisory/page22590.html	BERR RAG	Research Advisory Group to address key environmental issues of wind, wave and tidal power	On-line – use On-line - use according to relevant terms and conditions
www.bodc.ac.uk	British Oceanographic Data Centre	Holders of publicly accessible biological, chemical, physical and geophysical marine data	On-line - use according to BODC terms and conditions
www.bwea.com	BWEA	Trade and professional organisation, including a number of research projects	On-line - use according to relevant terms and conditions
www.carbontrust.co.uk	The Carbon Trust	Set up by the UK Government as an independent company to work towards a reduction in carbon emissions and a low carbon economy	On-line - use according to relevant terms and conditions
www.ccw.gov.uk/interactive-maps.aspx	Countryside Council for Wales	CCW maps on line, including designated sites	On-line - use according to CCW terms and conditions

Web Address	Organisation	Information Type	Availability
http://www.cefas.co.uk/data/fisheries-information/surveys/irish-sea-and-bristol-channel-survey-(september---october).aspx)	Cefas	Data on plankton, ground fish, fish spawning and fish nursery areas	On-line - use according to Cefas terms and conditions
www.offshorewindfarms.co.uk	COWRIE	Independent company set up to investigate the environmental impacts of offshore wind	On-line - use according to relevant terms and conditions
http://data.offshorewind.co.uk/	COWRIE - Data Management & Stewardship for UK Marine Renewable	On-line library of Round 2 literature and COWRIE research	Dependant on the origin of the report or data
www.dassh.ac.uk	Data Archive for Seabed Species and Habitats	Data archive of digital data sets, together with digital images and video	On-line - use according to DASSH terms and conditions
www.defra.gov.uk/corporate/gi/spire/index.htm	Defra	Spatially mapped data from a number of sources	Only available for Defra, its Agencies and Non-Departmental Public Bodies
www.emec.org.uk	European Marine Energy Centre	Test site for wave and tidal devices	On-line - use according to relevant terms and conditions
www.environmentalexchange.info	Environmental impacts of offshore renewable energy developments for the exchange of information	European wide website aimed at providing a place to log data and research for widespread use	On-line – use according to sites terms and conditions
www.epri.com	Electric Power Research Institute	US non-profit organisation that includes research into wind, wave and tide	On-line - use according to relevant terms and conditions
www.berr-ec.com/CGIBIN/priamlnk.cgi?MP=GINT00&WHAT=Category&SUB=19&CNO=1	BERR Energy Publications (including ETSU)	Various government funded research reports	On-line – use according to appropriate terms and conditions
www.geomatics-group.co.uk	Geomatics, a specialist business unit within the Environmental Agency	Remit includes Light Detection and Ranging (LIDAR), an airborne laser mapping technique which produces accurate elevation data	To order on line
www.habmap.org	Habitat mapping for conservation and management of the Southern Irish Sea	Seabed mapping project covering the southern Irish Sea	Reports and maps available on line. Final report due November 2007
www.hornsrev.dk/Engelsk/default_ie.htm	Horns Reef	Numerous reports related to the offshore wind farm at Horns Reef in Denmark	On-line - use according to relevant terms and conditions

Web Address	Organisation	Information Type	Availability
www.icit.hw.ac.uk/MREDS.htm#workpackage1	Marine Renewable Energy Development in Scotland (MERDS)	Scientific research on wave and tidal power, with particular reference to Scotland	Brief overview of projects available on line
www.jncc.gov.uk/mermaid	MNCR data held by JNCC	Interactive map based information on benthic surveys	On-line - use according to JNCC terms and conditions
www.jncc.gov.uk/page-3663	Seamap	Interactive web based GIS containing seabed and water column data	On-line - use according to JNCC terms and conditions
www.kisca.org.uk	Kingfisher (Cable Awareness) is a department within the Sea Fish Industry Authority	Aimed at improving safety to fishermen and protection of submarine cables	According to Kingfisher terms and conditions
http://landmap.ccw.gov.uk/	CCW	Database containing information related to landscape, including environmental, social and economic	According to *LANDMAP* terms and conditions
www.magic.gov.uk	Partnership of 6 Government organisations	Designated sites, wreck sites, pipelines, bathymetry, bathing waters etc	On-line - use according to Magic terms and conditions
www.marbef.org/data/index.php	Europe wide data website hosted by the Flanders Marine Institute	Marine biodiversity datasets	As per MarBEF terms of use
www.maritimedata.co.uk	Commissioned by BERR	On-line GIS system including data on topics including fishing density, shipping density, port statistics, recreation, routing measures etc	On-line - use according to relevant terms and conditions
www.marlin.ac.uk/	Marine Life Information Network	Contains information on the biodiversity, protection and sensitivity of different species	On-line - use according to MarLIN terms and conditions
www.minos-info.org	MINOS	German project to establish whether large scale wind farms effect harbour porpoise, seals or birds	On-line - use according to relevant terms and conditions
http://www.natwindpower.co.uk/northhoyle/environment.asp	N Power Renewables	Includes reports on monitoring during and post construction	On-line - use according to relevant terms and conditions
http://uk.nystedhavmoellepark.dk/frames.asp	Nysted Offshore wind farm at Nysted	Numerous reports related to the offshore wind farm at Nysted in Denmark	On-line - use according to relevant terms and conditions
www.oceannet.org/mdip/index.html	Marine Data and Information Partnership	Provides access to data management websites and to act as an overview of these	Specific to individual websites

Web Address	Organisation	Information Type	Availability
www.offshoreenergyresearch.ca/Default.aspx?tabid=54	Offshore Energy Environmental Research Association	Canadian non for profit organisation looking ad renewable energy and environmental issues (including the Bay of Fundy SEA)	On-line - use according to relevant terms and conditions
www.pol.ac.uk	The Coastal Observatory	Monitoring data in Liverpool Bay	According to POL terms and conditions
www.primare.org	Peninsula Research Institute for Marine Renewable Energy	Research group linked to Wave Hub	On-line - use according to relevant terms and conditions
www.prism.ie/Project+Summary.htm	Predictive Irish Sea Models	Visual maps of the Irish Sea, including tide, wave, wind, nearshore sediment transport and pollution disturbance	On-line - use according to relevant terms and conditions
www.racerocks.com	Race Rocks tidal power demonstration project	Canadian protected site with an installed tidal turbine	On-line - use according to relevant terms and conditions
www.restats.org.uk	Renewable Energy Statistics Database for the United Kingdom	BERR sponsored website to provide a database containing information on all relevant renewable energy sources in the United Kingdom	On-line - use according to relevant terms and conditions
http://theriteproject.com/	The Roosevelt Island Tidal Energy Project	Information related to the tidal turbines installed at Roosevelt Island, USA	On-line - use according to relevant terms and conditions
www.seaenergyscotland.co.uk	Marine Renewable Strategic Environmental Assessment	SEA and associated technical reports	On-line - use according to relevant terms and conditions
www.searchmesh.net	Mapping European Seabed Habitats (MESH)	Physical data, biological sample data and images of the seabed from over 1000 studies	On-line - use according to MESH terms and conditions
www.seageneration.co.uk	Tidal energy converter to be installed in Strangford Lough	Confidential EIA and associated technical reports	Confidential
www.supergen-marine.org.uk	SuperGen Marine	Academic research ‘umbrella’ organisation looking at wave and tidal power	On-line - use according to relevant terms and conditions
www.ukcip.org.uk	The UK Climate Impact Programme	Includes research that investigates both potential change and how different features may react to that change	On-line – according to UKCIP terms and conditions
www.ukdeal.co.uk	UK Offshore Oil and Gas Information	Digital data on the UK offshore oil and gas industry	On-line - use according to UK Deal terms and conditions

Web Address	Organisation	Information Type	Availability
www.ukerc.ac.uk	UK Energy Research Council	Database of energy information	On-line
www.ukho.gov.uk	The UK Hydrographic Office	Digital Admiralty Charts	To purchase
http://www.mms.gov/	US Department of the Interior Minerals Management Service (MMS)	US government sponsored research including impact assessments of wind, wave and tide	On-line - use according to relevant terms and conditions
www.wavedragon.co.uk	Wave Dragon	Proposed wave power development off Pembrokeshire	On-line - use according to relevant terms and conditions
www.wavehub.co.uk	Wave Hub	Planned test site for wave devices	On-line - use according to relevant terms and conditions

5.1.7 The literature search has enabled the construction of a comprehensive spreadsheet of literature and data, and is currently made available to the project team and steering group on a web based data portal. The information covers all available literature identified during this study describing the baseline for Welsh waters, including environmental, social and existing infrastructure, together with information related to potential environmental impacts known or predicted to result from marine renewable developments. Where documents have been sourced (or not currently held) this is highlighted. A full bibliography of references is presented in Appendix B, with each reference within the bibliography individually numbered.

5.1.8 In addition to the listing of reports and documents, a GIS database has been set up to store digital, geo-referenced information. These data are accompanied by the appropriate metadata (i.e. information about the data) using the structure described in the UK Gemini metadata elements. Gemini defines the elements (or fields) to be completed to describe the data. The Gemini elements are listed below, with those that are mandatory highlighted in bold.

- **Title;**
- Alternative title;
- **Dataset language;**
- **Abstract;**
- **Topic category;**
- Subject;

- **Date;**
- **Dataset reference date;**
- Originator;
- Lineage;
- **West bounding co-ordinate;**
- **East bounding co-ordinate;**
- **North bounding co-ordinate;**
- **South bounding co-ordinate;**
- **Extent;**
- Vertical extent information;
- **Spatial reference system;**
- Spatial resolution;
- Spatial representation type;
- Presentation type;
- **Data format;**
- Supply media;
- **Distributor;**
- **Frequency of update;**
- Access constraint;
- Use constraints;
- Additional information source;
- Online resource;
- Browse graphic;
- **Date of update of metadata;**
- Metadata standard name; and

- Metadata standard version.

5.1.9 It should be noted that much of the data held in the GIS database have been acquired from external sources, with the metadata attached not necessarily in the Gemini format. In such cases, the information required to complete the mandatory elements has been sourced where feasible. The GIS data are currently made available to the project team and steering group within the web-based data portal created for the project.

5.2 Desk Based Review of Baseline Data

5.2.1 The first step in identifying baseline data for Welsh waters was to determine the topics under which data would be searched for and logged. The topic categories employed in this study, under the broad headings of 'Natural Environment' and 'Human Activities', are as follows:

Natural Environment

- Physical environment (to include ocean currents and fronts, tidal flow, hydrography, seabed sheer stress, temperature, salinity, bathymetry, seabed sediments, energy resource);
- Water and sediment quality;
- Visual environment;
- Marine mammals;
- Seabirds, wildfowl and waders;
- Fish ecology;
- Benthic ecology;
- Plankton; and
- Designated Conservation sites.

Human activities

- Shipping;
- Tourism and recreation;
- Archaeology;

- Commercial fisheries;
- Military;
- Grid infrastructure;
- Submarine cables and pipelines;
- Renewable energy;
- Marine aggregate extraction;
- Oil and gas;
- Licensed disposal sites; and
- Airspace and radar.

5.2.2 In order that the baseline data could be appropriately managed, where applicable the information was further sub-divided into spatial units to allow focus on specific areas as follows:

- National (i.e. Wales) and/or broad scale;
- North Wales;
- Anglesey;
- Cardigan Bay;
- Pembrokeshire; and
- South Wales.

5.2.3 These areas do not represent management or legislative regions, rather an opportunity to highlight data availability on a regional basis as well as that from a more broad scale, national perspective. The regional areas identified are depicted in Figure 1.

5.2.4 In addition to these, a review of existing information on subsea geological strata which offer potential for the sequestration of CO_2 within Welsh waters was completed. This aspect of the work was undertaken with a focus on identifying potential sites within Welsh waters (i.e. within 12nm from baseline), however the scope of this work was broadened during the study to allow an appreciation of potential areas in proximity to Welsh waters.

5.2.5 The type and extent of data sourced under each of these categories are described in the following sections, with information on regional importance given where possible.

5.3 Broadscale and Generic Reviews

5.3.1 A number of recent projects have been undertaken wholly or partially in Welsh waters that review or provide summary information of the existing marine environment. These are briefly summarised below.

Irish Sea Pilot

5.3.2 The Irish Sea Pilot project was initiated in 2002, to test the potential use of an ecosystem approach to managing the marine environment at a regional scale. The project included data mapping, with information providing an overview of the environment for north and west areas of Wales. The resulting data includes mapping of marine landscapes on a broad scale, including coastal, seabed and water column features (307, 407, 408, 415, and 704).

Offshore Wind SEA

5.3.3 A SEA was conducted as part of the Round 2 offshore wind farm process, which included waters in north Wales. The documents contain broad scale baseline environmental data for the region, including both natural and human environment (123).

Oil and Gas SEA

5.3.4 A sequence of sectoral SEAs that will cover UK waters when complete. The studies were initiated to 'assess the implications of further licensing of the UK Continental Shelf (UKCS) for oil and gas exploration and production'. Each SEA is accompanied by a series of technical reports that provide broad scale information on the existing environment within each sector. Welsh waters are covered by SEA Area 6, which includes north and west Wales; and Area 8, which encompasses the Bristol Channel. SEA 6 is complete, with technical reports for SEA 8 becoming available as they are completed. Reports sourced included select reports for Area 6 (256, 294, 321, 337, 340, 390, 391, 414, 417, 467, 546, 602, 607, 722 and 730), Areas 6, 7 and 8 (85, 86, 319, 418 and 419) and Area 8 (60, 105, 152, 182, 183, 203, 257, 434, 449, 540, 541, 603, 608, 662, 681, 682, 705 and 706).

Marine Spatial Planning Pilot (MSPP)

5.3.5 The MSPP was commissioned in 2004 to research options for developing, implementing and managing marine spatial planning in coastal and offshore waters, with the project completed in early 2006 (471). The region selected for the pilot study was the Irish Sea and hence included the north Wales coastal area. The associated literature includes detailed information on the baseline environment, capturing both natural resources and socio-economic activities.

Quality Status Report of the Marine and Coastal Areas of the Irish Sea and Bristol Channel

5.3.6 The report was initiated as part of a programme for a quality assessment of the OSPAR Convention maritime area 'north east Atlantic'. It includes descriptions of the natural and human environment, together with an assessment of issues of importance (233). The main aim of the study was to identify certain chemical, biological and physical features of the coastal environment and the impacts that man's activities have had and are having upon them. The report identified and prioritised the impacts arising from human activities based on geographic scale and the 'seriousness' of effect from a scientific perspective. Issues of high importance in the area included fishing, endocrine disruption, Tri-butyl Tin (TBT), and coastal development.

Charting Progress : an Integrated Assessment of the State of UK Seas

5.3.7 In the UK Governments first Marine Stewardship Report 'Safeguarding our Seas' a commitment was made to produce an integrated assessment of UK waters, to help assess if the vision is being achieved. Charting Progress was jointly prepared by Defra, the Scottish Executive, the WAG and the devolved administration in Northern Ireland to illustrate the extent to which UK continental seas meet the vision. The key messages from the reports were given as follows:

- UK seas are productive, supporting a wide range of fish, mammals, seabirds and other marine life;
- The open seas are generally not affected by pollution and levels of monitored contaminants have decreased significantly;
- The main contamination problems identified are in part due to the legacy of the past and are generally observed at higher levels in industrialised estuaries or areas local to the activity;

- Human activity has already resulted in adverse changes to marine life and continues to do so, for example, continued widespread commercial fishing practices threaten many fish stocks by over-exploitation and damage sea floor areas; and
- Evidence exists that the marine ecosystem is being altered by climate change, for example sea temperatures are rising and the distribution of plankton species is changing. These effects are not yet well understood.

5.4 Natural Environment

Physical Environment

5.4.1 The literature search to collate information on the physical environment followed two main aims. The first was to collect information on the baseline environment and the second to assess the potential wind, wave and tidal resource in Welsh waters. Information on the baseline environment sourced and held is summarised in Table 5.2 below.

Table 5.2 Physical Environment – Data Sourced

Data	Data Format	Data Extent	Description
Tidal flow	GIS files	Welsh waters	Sourced from the BERR Renewables Atlas
Tidal height	Data files	Discrete points in Welsh waters	Mean data from individual tide gauges
Tidal power	GIS files	Welsh waters	Sourced from the BERR Renewables Atlas
General physical conditions	Visual maps (www.prism.ie/Project+Summary.htm)	Irish Sea	Visual maps for descriptions only
Coastal information	LiDAR data	National	Provides elevation data of the coast, available to order
Oceanography and hydrography	Pdf report	Oil and Gas SEA Areas 6 and 8	Descriptions of the hydrography and oceanography, which include Welsh waters
Water temperature	Data files (to purchase) and pdf report	Discrete points to broad scale summaries within Welsh waters	ICES data, SAHFOS ferry data and Cefas descriptions
Bathymetry	GIS data files	Welsh waters to high water	Gridded and contour bathymetric data, including 1m and 5m contour lines (sourced from Seazone and required contours derived from that data)

Data	Data Format	Data Extent	Description
Seabed sediment	GIS data files and pdf reports	Welsh waters including subtidal and intertidal	Intertidal mapping of sediments (CCW and CALM, as GIS files), Seazone subtidal data (BGS, as GIS files), seabed landscape data (JNCC, as GIS files), descriptions of the geology undertaken for Oil and Gas SEA 6 (pdf files), Oil and Gas SEA 8 (pdf file)and marine aggregate literature for the Bristol Channel (including MADP, pdf file)

5.4.2 Where data are available as GIS files, these are depicted in Figures 3, 3i and 3ii.

5.4.3 A number of studies have been sourced that assess the energy resource for wind, wave and tide (e.g. 2, 4, 114, 118, 120, 122, 138, 139, 140, 185, 310, 323, 359, 448, 707, 714, and 751). The location, scale and detail available varies between projects, with some presenting broad scale information at the UK level and others related to discrete areas, not necessarily within Welsh waters. The nature of the literature means that for the majority of these studies, the base data is not available, with the information restricted to descriptions (particularly site specific information and conference proceedings). The notable exception to this is the BERR Renewables Atlas (2), which includes GIS data files of wave, tide and wind resource for UK waters. The original Atlas, published in 2004, has been updated with outputs available on the project website (www.renewables-atlas.info/). The GIS data for tidal stream resource has also been augmented by outputs from an RPS model for the Welsh coastline (135m grid cell), providing additional definition of tidal energy resource within areas covered by the Renewables Atlas model and also capturing areas excluded in the Atlas work due to the larger cell size of the model employed (1.5km grid cell), for example within the channel between St David's Head and Ramsey Island.

5.4.4 In addition to studies that have assessed the available resource, a limited number of authors have undertaken studies which compliment the resource literature. Such projects include those highlighted below:

- Methods for analysing ocean waves (e.g. 84);
- The effect of climate change on marine energy resources (e.g. 323);
- Variability in resource and implications for commercial exploitation (e.g. 137, 159); and
- The use of different modelling techniques to determine resource (e.g. 84, 650).

5.4.5 It is understood that the Welsh Energy Research Centre is currently undertaking work related to tidal stream energy that includes bathymetric and hydrodynamic data collection in the Bristol Channel. Cefas currently host some information on the Defra strategic wave monitoring network for England and Wales on their website (www.cefas.co.uk/data/wavenet.aspx) which, when complete, will provide a single source of real time wave data from wave buoys located in areas at risk from flooding. It is also understood that the South West Regional Development Agency (SWRDA) is currently funding a project separate from work associated specifically with the Wave Hub looking at providing information on wave climate for commercial developments. The SWRDA work is focused in waters off Cornwall and it is unclear if it will include data of interest to Welsh waters. Additional work is currently being undertaken by the British Geological Survey, UK Hydrographic Office and SeaZone Solutions Ltd to create a GIS based map of seabed character and bedforms.

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Water and Sediment Quality

5.4.6 Water quality sampling tends to be undertaken as a monitoring tool to test for compliance against specific articles of legislation, with public domain data held primarily by the Environment Agency. Private companies that abstract or discharge to the marine environment are also likely to hold data; however such information is generally confidential and has not been sought during the project. Specific monitoring undertaken, together with the type of data sourced, is summarised in Table 5.3.

Table 5.3 Water Quality Monitoring Data

Purpose for Sampling	Type of parameters assessed	Extent of data available	Extent of GIS data held
Bathing Waters	Primarily for bacteria and viruses, but includes additional parameters including visual, sampled at regular intervals during the bathing season (15 May to 30 September)	Discrete sample points around the Welsh coast, together with the associated results and measure of compliance for 1988 - 2007 (Fail/Guideline/ Imperative/Not Sampled)	EC and non EC Bathing Water locations
Shellfish Waters	Heavy metals, organohalogens, colour, dissolved oxygen, faecal coliforms, hydrocarbons, pH, salinity, suspended solids and temperature	Routine monitoring within shellfish waters, together with the associated results and measure of compliance	The location of designated shellfish waters
Integrated Pollution Prevention and Control	Dependant on specific emission (includes emissions to air, land and water)	Point locations covered by regulations	-
Riverine quality	Regular monitoring of the biology, chemistry, nutrients and aesthetic quality of numerous rivers	Available on request	-
ICES data	Data held by ICES, including alkalinity, ammonium, chlorophyll a, nitrate, oxygen, pH, silicate, total nitrogen, total phosphorus	Point locations	Welsh waters

5.4.7 In addition to monitoring data, there are a number of articles of legislation which have resulted in geographic zoning of coastal waters, including both discrete areas and broad scale zones. Such zoning has been undertaken for various reasons, for example to highlight an area considered to be particularly susceptible to nutrients or as a management tool on a regional or national level. The location and extent of such areas provides useful information on the issues that may arise for developers, with the

zoning areas related to water quality identified in Welsh waters listed below (Figure 4):

- Shellfish waters (Figure 4);
- Shellfish beds (extent not held);
- Pollution control zone (Figure 4);
- Source protection zones (Figure 4);
- Urban Waste Water Treatment Directive Sensitive Areas (Figure 4); and
- Water Framework Directive water bodies (with a broader remit than purely water quality) (extent not held).

5.4.8 In addition to specific datasets that describe water quality in Welsh waters, a number of reports have been sourced that provide a background description of the existing environment. These include literature within the Oil and Gas SEA areas 6 and 8 (182, 391, 705) and the Defra report on the quality status of the Irish Sea and Bristol Channel (233).

5.4.9 Limited information on sediment quality was sourced during the project. Data tends to be restricted to specific sites, for example routine monitoring of licensed disposal sites or collected as baseline data for an application. Such information can be found in documents such as site specific EIAs (e.g. 23, 42, 692, and 693); although an overview of sediment contamination is given in the SEA reports for the region (182, 391, and 705). The site characterisation work conducted on European Marine Sites in the south west of England covered the Severn Estuary and summarised sediment quality data for the site (www.mba.ac.uk/nmbl/publications/charpub/occasionalpub13.htm).

5.4.10 It is understood that the Welsh Energy Research Centre is currently undertaking work related to tidal stream energy that includes data collection in the Bristol Channel and an assessment of potential impacts on the ecology, including an assessment of general water quality characteristics.

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Visual and Landscape

5.4.11 CCW has devised a national system for Wales to enable the existing landscape to be taken into account during the decision making process, called LANDMAP (167). The system has separated the landscape into 5 main aspects, as summarised below:

- Geological landscape;
- Landscape habitats;
- Visual and sensory aspects;
- Historic landscape; and
- Cultural landscape.

5.4.12 LANDMAP is available as a GIS dataset and provides the most complete terrestrial dataset for landscape in Wales. However, some gaps are apparent, with not all areas covered for each aspect. Figures 5-5iv highlights the data that were available and downloaded as of 28/08/08. It is understood that LANDMAP is anticipated to be complete by the end of Spring 2009, with the final outputs to be included in the subsequent stages of the MRESF project.

5.4.13 As regards the marine visual environment, or seascape, less baseline information currently exists, although CCW have developed, and are nearing final reporting of, a comprehensive seascape assessment for Wales. It is anticipated that the outputs of

this work will be available in the Autumn of 2008 and will substantially increase the information base, both in terms of spatial extent and an informed, robust seascape character valuation. Once the CCW information is made available, it will be integrated into the current work, most usefully in terms of the GIS developed to inform and develop the strategic framework, though it's inclusion within this Stage 1 report is obviously not possible to achieve at the current time.

5.4.14 The CCW assessment work aside, the main source of information currently comes from seascape assessments carried out for specific offshore windfarms, which for Welsh waters include north Wales, Pembrokeshire and Swansea Bay. Of these, the technical study undertaken for Gwynt y Môr (north Wales) is currently held (277), together with the EIA documents for North Hoyle (692), Wave Dragon (542), Rhyl Flats (753) and Scarweather Sands (693). In addition to visual impact studies, the ASIDOHL process is used to assess the significance of the impacts of a development on historic landscapes (e.g. the Gwynt y Môr Cultural Heritage Technical Report, 436), with such documents providing additional information on exiting landscapes. Issues connected to historic parks and gardens are dealt with by Cadw (www.cadw.wales.gov.uk).

5.4.15 It is understood that the BERR RAG currently has a project scope in development to undertake a seascape baseline study for England (although the project specification is yet to be finalised). As with the CCW work noted above, once the seascape information becomes available, it will be incorporated into the subsequent stages of the current project.

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Marine Mammals

5.4.16 Marine mammals include cetaceans and seals, with the latter being restricted to grey seals in Welsh waters. The data sourced to describe the baseline situation for marine mammals in Welsh waters includes a combination of GIS data files and text reports, ranging from small and localised studies to broad scale reviews. The data available are reviewed for individual species below, together with a summary of the more generic marine mammal data sourced.

Grey Seals (Halichoerus grypus)

5.4.17 Grey seals are monitored on shore regularly to provide a census of breeding populations and haul out sites around the Welsh coastline, with reports issued regionally (638, 644, 727, 728, 729, 762, 763, and 806). In particular, a series of reports is available for Skomer (127 and 764-781). In addition, the Wales BAP Atlas, published in 2002 (466) presents a summary of known pupping and haul out sites, with GIS files on such sites sourced from CALM (Figure 6ii). The main areas noted for grey seals around Wales include north Wales and Anglesey, around the Llyn Peninsula, southern Cardigan Bay and Pembrokeshire.

5.4.18 As regards offshore data, a study was conducted by the SMRU as part of Oil and Gas SEA 6 (318), which involved tagging 19 grey seals and tracking their movements by satellite. The area covered by the study extended from Pembrokeshire north into the Irish Sea, including the north Wales coast. The data includes modelling of 'at sea usage' and hence provides an indication of areas subject to relatively high usage. Those in Welsh waters included areas along the north coast, west and south west from the Lleyn Peninsula, areas of Cardigan Bay and offshore from Pembrokeshire. Visual observations of grey seals were also noted during the marine mammal boat surveys undertaken at the Gwynt y Môr site in north Wales.

Harbour Porpoise (Phocoena phocoena)

5.4.19 The harbour porpoise is the smallest cetacean occurring in British waters, with a wide and mainly coastal distribution. Overall distribution data for Welsh waters was examined in 2002 as part of a national study looking to identify potential sites to be designated for harbour porpoise (288), however several projects have taken place since then (e.g. 227, 286, 383, 429, 537, 538, 539, 661, 634, 683, 713, 787, 804, 806) and the report could now be considered to be out of date.

5.4.20 In south and south west Wales, a number of studies have been conducted including the deployment of PODs, with the most recent effort being undertaken as part of the Gower Marine Mammals Project (713) and subsequently the Scarweather Sands offshore wind farm project (537, 538). Documents include descriptions of distribution (based on a combination of shore based sightings, boat surveys and POD data) together with information on foraging in high energy areas. Harbour porpoise have also been studied over several years off the north coast of Anglesey, with an assessment of distribution and abundance made based on boat surveys (383, 429). Both projects are understood to be on-going. Cetacean surveys were also undertaken off north Wales as part of the Gwynt y Môr project from December 2003-March 2005, involving boat survey and POD deployment (196). Harbour porpoise were the only species recorded.

5.4.21 GIS data for harbour porpoise distribution have been sourced from the JNCC Cetaceans Atlas (Figure 6i). As would be expected, the data depicts a general broad scale distribution in coastal waters, with high occurrence evident around Pembrokeshire.

Bottlenose Dolphin (Tursiops truncatus)

5.4.22 The bottlenose dolphin is known to occur throughout most of Welsh coastal waters; however it is particularly prevalent in west Wales, with Cardigan Bay being one of only two places in the UK to hold a semi-resident population, the other being the Moray Firth in Scotland. The available literature on bottlenose dolphins in Welsh waters is a reflection of this population, with specific reports primarily restricted to west Wales, and Cardigan Bay in particular (25, 76, 77, 160, 161, 290, 533, 534, 535, 536, and 683). However, a recent report published in 2008 (758) summarises sightings information of bottlenose dolphins off North Wales. Reports specific for Cardigan Bay include general descriptions of the distribution of the species, reports on the findings of boat surveys, a photo-identification catalogue (160), prey species and habitat sampling trials (290) and studies investigating bottlenose dolphin and boat traffic (533, 534, 535, 536).

5.4.23 GIS data for bottlenose dolphin have been sourced from the JNCC cetaceans' atlas (584 and Figure 6). Sightings are generally restricted to the southern and northern parts of Cardigan Bay, between the Llyn Peninsula and Anglesey and off north Wales.

Short-beaked Common Dolphin (Delphinus delphis)

5.4.24 The short-beaked common dolphin is also considered to occur throughout most of Welsh coastal waters, in general tending to occur slightly further offshore than the bottlenose dolphin or harbour porpoise, and in particular (from sightings information) off Pembrokeshire. Two reports have been published that describe it's presence in Pembrokeshire waters (263, 264).

5.4.25 GIS data for the short-beaked common dolphin have been sourced from the JNCC Cetaceans Atlas (584 and Figure 6). Inshore data are concentrated around Pembrokeshire.

General Data

5.4.26 A number of reports are available that consider cetacean distribution more generally. These include the following:

- Mapping of known distribution of Biodiversity Action Plan (BAP) species, including small cetaceans and grey seals (466);
- Interactive map of Cardigan Bay, highlighting hotspot areas for marine mammals (161);
- An Atlas of Cetacean Distribution across UK waters (584);
- Reports on marine mammal and turtle strandings in Welsh waters (525);
- Baseline reviews carried out for Oil and Gas SEA Areas 6, 7 and 8 (318, 319, 419, 662);
- Baseline data collected for offshore wind farms in north Wales and Swansea Bay (23, 693, 537, 538);
- Status review of UK cetaceans (289);
- Boat based survey around the Welsh coast and south west England (227);
- Sightings data collected from ferry routes (663);
- Overview of cetacean sightings data in Liverpool Bay and northern Irish Sea (286, 286); and
- Cetacean surveys at Bardsey Island (716, 782, 783, 784, 785, and 786).

5.4.27 The JNCC Cetaceans Atlas data (584) includes information on all cetaceans sighted in Welsh waters (including those described above). Species include harbour porpoise, dolphins, odontocetes and mysticetes. The data indicates key areas particularly around Pembrokeshire but also southern Cardigan Bay, Llyn Peninsula, and Anglesey.

5.4.28 In addition to data on marine mammal distribution, a recent study by Subacoustic (492) provides a summary of current understanding of marine mammal audiograms. For work in progress, it is understood that CCW are currently collating marine mammal data for Welsh waters.

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Seabirds, Wildfowl and Waders

5.4.29 Numbers of wildfowl and waders have been monitored for several years by the Wetland Bird Survey or WeBS (e.g. 796). The intertidal and coastal zone is divided into sections, with counts of birds made within individual sections. The data are particularly valuable to highlight which species are present, where and at what time of year. Such information is available to purchase. In addition to WeBS data, the Oil and Gas SEA 6, 7 and 8 included a review of overwintering swans and geese (86), a review of inshore seabird species (85) and a review of offshore seabirds (418). A separate report is available specifically for SEA 8 (203).

5.4.30 A number of reports have been published by CCW that provide baseline bird data for specific areas of Wales. Within the Severn Estuary, these include an unpublished report prepared for CCW in 2005 (794) that mapped the locations of non-breeding birds on the Welsh side of the estuary, with a further report for CCW presenting baseline bird monitoring data for the Severn (795). In Cardigan Bay, reporting includes data on wintering birds (797). For Carmarthen Bay, non-species specific monitoring of bird distribution and behaviour data is available (798), with data on seabird distribution available for Skomer and Skokholm Islands (799).

5.4.31 The common scoter (*Melanitta nigra*) is a seaduck that occurs in coastal waters during the breeding season. It has been subject to a number of recent surveys to determine its distribution and population in Welsh waters, and the UK more widely,

including links to its prey distribution and other environmental parameters (218, 388). GIS data files for the common scoter have been sourced. In Wales, key sites for the common scoter are Carmarthen Bay, north Cardigan Bay and the north Wales coast (Figure 7).

5.4.32 The JNCC seaduck survey programme has run annually since the winter of 2000/01 (231). The programme mainly uses aerial surveys and is aimed at collecting current, detailed data on the numbers and distribution of wintering seaduck, divers and grebes. The surveys that covered sites in Welsh waters were conducted in 2000/01 and 2001/02, including an area to the north of Cardigan Bay (although no GIS data are held).

5.4.33 Seabird colonies and nest sites are monitored around the Welsh coast, with GIS data files held that summarise the total number of bird pairs at each site (Figure 7). Additional data sourced includes JNCC Seabird 2000 data, which includes the third complete census of the entire breeding seabird population of Britain and Ireland (459). Digital GIS data from Seabird 2000 held includes the location of breeding fulmar, puffin, gulls, terns, black guillemots, manx shearwater, storm and leaches petrel (Figure 7).

5.4.34 The British Trust for Ornithology (BTO) has organised national winter surveys of gull roosts each decade since 1953, with the most recent covering the period 2003/04-2005/06. The surveys aim to assess changes in the populations and to give numbers of species overwintering in the UK. The latest report was published in 2007 (800). An additional BTO survey of interest was the 1997-98 Non-Estuarine Waterfowl Survey (NEWS) (801), which was designed to survey non-estuarine species, notably ringed plover, sanderling, purple sandpiper and turnstone. Although generally included in the WeBS Core Counts data, only a small proportion of the total population of these species is recorded on an annual basis. It is understood that the survey was repeated in the winter of 2006/07.

5.4.35 Offshore, data on seabird distribution comes from a variety of sources, which include the following:

- GIS mapping of the vulnerability of seabirds at sea to oil spill;
- Reviews prepared for Oil and Gas SEA areas 6, 7 and 8 (no GIS data held) (includes offshore and inshore species) (85, 86, 203, 418);

- Monitoring studies undertaken for Natura 2000 sites (no GIS data held) (82);
- Baseline studies for offshore wind farms on the north Wales coast (no GIS data held) (283, 711);
- Work on GPS tracking of Manx shearwater on Skomer is underway at present, which is recording how the species utilise the Irish Sea at different times (no GIS data held);
- Aerial seabird surveys, mainly in Round 2 windfarm sites (no GIS data held) (including north Wales) (255, 566, 567, 568, 617); and
- Current aerial bird surveys throughout Welsh waters (excluding an area at the south west tip of Cardigan Bay and along the north Wales coast) (568, 617).

5.4.36 It should be noted that offshore data on seabird distribution is, as with marine mammal distribution, heavily reliant on survey coverage. A lack of records for a particular area does not automatically equate to the absence of a given species, but may reflect a lack of observation/survey. There has been a recent UK wide study to highlight gaps in bird survey coverage (545), which looked at data coverage by area, month, season and data age, together with an assessment of under recording of certain species. The current round of aerial bird surveys, which were initiated as part of the research undertaken for Round 2 and subsequently continued through the offshore energy SEA process, should ensure data coverage is available throughout most Welsh waters (433). The location of survey areas in Welsh waters are depicted in Figure 7. It is understood that an analysis of the data collected in the same areas for Round 2 and the data collected for the offshore energy SEA will be made to determine any requirement for an additional year's survey.

5.4.37 In addition to baseline data on bird species distribution in Welsh waters, there is a current BERR Rag proposal to assess bird flight patterns by radar, including looking at migration volume and the spatial distribution and altitude of birds (573). A number of other studies have investigated methods of seabird data collection, for example using hi definition video (445) and other remote sensing techniques. Such information is particularly important if methods of data collection can or will be standardised between sites (157). COWRIE has recently announced a number of research projects, including a project to quantify the relative use of coastal waters by breeding terns. It is understood that a report on using radio-telemetry to define protected areas for seabirds is pending publication.

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Fish Ecology

5.4.38 The data sourced on fish ecology primarily relates to reports and papers, rather than mappable (digital) datasets, although some hard copy data has been digitised for the current project. The exception to this is fish species that are included in the Welsh BAP Atlas, for which it is understood that GIS data are available, although not

sourced for the current project (466). For fish, this is restricted to the basking shark (*Cetorhinus maximus*), common skate (*Dipturus batis*), the spiny seahorse (*Hippocampus guttulatus*), the long snouted seahorse (*Hippocampus guttulatus*) and the angler fish (*Lophius piscatorius*). However, in addition to these species, the BAP Atlas has recorded catch per unit effort data for cod (*Gadus morhua*), sole (*Solea solea*) and whiting (*Merlangius merlangus*).

5.4.39 A key source of information for broad scale fish species distribution are the fisheries sensitivity maps, which were produced by Cefas in 1998 (214). Additional information for some species is provided on the Cefas website (http://www.cefas.co.uk/data/fisheries-information.aspx). Figures 8 and 8i present data from the 1998 report which included maps of the following:

- Individual species spawning areas (herring off south Pembrokeshire, cod off north Wales, whiting off north Wales and in Cardigan Bay, plaice off north Wales, south Pembrokeshire and in Cardigan Bay, lemon sole in the western Irish Sea and off south Wales, sole off north Wales and north and south Pembrokeshire, sprat throughout Welsh waters); and
- Individual species nursery areas (herring off north east Wales, whiting off north and south Wales, plaice and sole throughout Welsh coastal waters, lemon sole off south Wales);

5.4.40 Regular September groundfish surveys have been undertaken in the Irish Sea and Bristol Channel since 1979 (initially by MAFF, subsequently Cefas), employing a standard 4m beam trawl since 1988, with further approach-standardisation (using a consistent survey grid) established from 1993. Equivalent spring surveys were also conducted between 1993 and 1998. GIS data from 1987 to 2003 are reported on the Cefas website (http://www.cefas.co.uk/data/fisheries-information/surveys/irish-sea-and-bristol-channel-survey-(september---october).aspx) and although it is not possible to directly download these data, this information has been requested from Cefas to inform the project. In addition, through the Fisheries Science Partnership (FSP) a series of groundfish surveys commenced in the Irish Sea in 2004, using trawlers to gather data on the distribution of cod, haddock and whiting (www.cefas.co.uk/data/fisheries-science-partnership-(fsp)/reports.aspx) (63, 64, 205, 206, 207, 208, 401).

5.4.41 Additional information on nursery areas is available for bass (58), which in Welsh waters include Milford Haven and the rivers Taf, Twyi, Gwendraeth, Dyfi, Mawddach, Dwyryd, Glaslyn, Conwy and the Dee.

5.4.42 A project to provide data on the movements, distribution and population dynamics of basking sharks in European waters began in 2001, run by Cefas and the MBA (www.cefas.co.uk/projects/basking-shark-population.aspx). The basking shark population assessment reported in 2005 (625), from which it is apparent that basking sharks are found in Welsh waters, although it is difficult from the data presented to identify areas of particular importance. The Marine Conservation Society published a report in 2007 (634) that presented data from megafaunal surveys in the Outer Bristol Channel, however the report included only limited parts of Welsh waters in its assessment of spring/summer basking shark surface water hotspots, with Welsh hotspots identified being restricted to parts of Pembrokeshire. During the consultation process undertaken for the current project, it was confirmed that there is currently a project commissioned by CCW to compile a GIS dataset of shark sightings, within Welsh waters, which would represent a more complete dataset than those currently available.

5.4.43 A number of studies have reviewed fish ecology in the Severn Estuary, the Bristol Channel and south west UK in general (20, 61, 547). In addition, fisheries monitoring surveys have been undertaken at the Scarweather offshore windfarm site in 2005-2006, however the reports have not been sourced as they have since been archived (670, 671, 672). For north Wales, a number of reviews of fish and fishing were conducted during the applications for Round 2 offshore wind farms (135, 411, 412), which contain a certain amount of background information, albeit primarily based on commercial fisheries data.

5.4.44 The presence of migratory fish in Welsh waters can be determined by reports published by Cefas on salmon stocks in England and Wales, with some 31 rivers in Wales included in the list of main salmon rivers (184). A CCW report from 2003 (326) provides information on shad and lamprey, finding that current knowledge of the marine stages in the life cycle of the fish is poor.

5.4.45 For broad scale reviews of fish ecology, it is understood that a monitoring programme of marine and estuarine fish has been undertaken (papers covering the 1990's), with documents held in the CCW library (548, 549, 550, 551). Work ongoing for the Oil

and Gas SEA process in Welsh waters does not appear to include fish ecology documents, concentrating instead on commercial fisheries data. In addition, it is understood that there is a current BERR RAG project to look at seabed communities in areas with strong tidal streams (433).

5.4.46 In addition to data on fish ecology, a recent study by Subacoustic provides a summary of current understanding of fish audiograms (492).

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Plankton

5.4.47 Literature sourced on plankton is fairly limited, and relates to broad scale overviews. The information is contained in reports prepared for the Oil and Gas SEA process areas 6 (390) and 8 (257, 608), but also in Cefas reports on spring plankton surveys of the Irish Sea (142, 143). The latter covers the period from 2000-2003. Data from the 1995 Irish Sea survey of plankton (eggs and larvae) are available to view on the Cefas website at www.cefas.co.uk/data/isea---interactive-spatial-explorer-and-administrator.aspx.

5.4.48 The Sir Alistair Hardy Foundation for Ocean Science (SAHFOS) runs the continuous plankton recorder programme, and has been collecting data on plankton since 1931. The programme utilises vessels of opportunity to collect data on plankton and temperature, with datasets available to purchase.

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Benthic Ecology

5.4.49 Data on benthic ecology has been sourced primarily from four main routes. These include site specific surveys (e.g. baseline survey data for a proposed project), national monitoring programmes (e.g. the CCW intertidal surveys), protected habitats and species data (e.g. the Wales BAP Atlas, SAC mapping etc) and large scale predictive mapping exercises (such as HabMap). It should be noted that other benthic ecology data sources do exist, both subtidally and intertidally (e.g. see Marine Recorder, www.jncc.gov.uk/page-1599), however for the purposes of the current project a more focused review was conducted. Particular emphasis was placed on studies that are strategic in scale or provide a collated view of a large number of datasets, e.g. the Oil and Gas SEA documents. The literature and data sourced have been summarised in Table 5.4. Where data are available in GIS format, these are noted and presented in Figure 9.

5.4.50 Relevant work currently in progress includes a BERR RAG project to look at seabed communities in areas with strong tidal streams (433), ongoing work on HABMAP and a COWRIE project to provide data standards guidance for marine benthic data.

Table 5.4 Summary of Benthic Ecological Data Sources

Data Source	Data Description	Data Availability
National and Broadscale Reviews		
SAC citations	Mapped distribution of habitats and species within the designation boundary	GIS data files
Wales BAP Atlas	Description and point location of BAP species in Welsh coastal waters	Pdf file only (466)
CCW Surveys	Biotope mapping of intertidal habitats and species	GIS data files
www.searchmesh.net/	Interactive web based GIS system containing benthic habitat data (EUNIS), covering most of Welsh waters.	To be viewed only – data owners specified
www.habmap.org	Habitat maps and some seabed sediment data of the southern Irish Sea, using predictive modelling. Project recently extended to cover all Welsh waters	GIS data files
CCW Science Report 539	Macrofaunal survey of Welsh sandbanks	CCW library (221)
Oil and Gas SEA Area 6	Summary of benthic information for offshore Oil and Gas SEA Area 6	Project report held (730)
Oil and Gas SEA Area 8	Summary of benthic information for offshore Oil and Gas SEA Area 8	Project report held (541, 706)
NNC report for MNCR coastal sectors 10 and 11 1991)	Review of knowledge of the benthos of Cardigan Bay, North Wales, Liverpool Bay and the Solway	Document not held (no location available)
NNC report for	Review of knowledge of the benthos of the western	Document not held (no

Data Source	Data Description	Data Availability
MNCR coastal sectors 8 and 9 (1991)	Channel and the Bristol Channel	location available)
CALM	Location and extent of specific intertidal habitats in Welsh waters	GIS data files
North Wales		
Aggregate sites	Benthic surveys and monitoring data	Not held (confidential and/or requires consent from data owner)
North Hoyle Offshore Wind Farm	Baseline monitoring report, including some information on the benthic survey conducted	Project report held (23)
Gwynt y Môr Offshore Wind Farm	Baseline marine ecology report, detailing the benthic data collected at the site	Project report held with some GIS data (196)
Rees, 2004	Subtidal sediment biotopes in Red Wharf and Conwy Bay	Project report held (583)
Anglesey		
SensMap Atlas (CCW library)	Sensitivity and mapping of inshore marine biotopes of Gwynedd	Document not held (379) (CCW library)
CCW library	Menai Strait tidally exposed seabed and shores	Document not held (26) (CCW library)
SensMap Atlas (CCW library)	Sensitivity and mapping of inshore marine biotopes of Ynys Mon (Anglesey)	Document not held (381) (CCW library)
Cardigan Bay		
SensMap Atlas (CCW library)	Sensitivity and mapping of inshore marine biotopes of Ceredigion	Document not held (378) (CCW library)
Pembrokeshire		
Various	Benthic monitoring data for Milford Haven	Data available in excel format
Various	Benthic monitoring at Skomer	Not held (CCW library)
Various	Reports related to the Sea Empress oil spill	Some held (e.g. 468)
CCW library	Study of the seabed and shore of Milford Haven and Daugleddau Estuary	Document not held (27) (CCW library)
CCW library	Study of the seabed and shore of West Pembrokeshire	Document not held (31) (CCW library)
SensMap Atlas (CCW library)	Sensitivity and mapping of inshore marine biotopes at Pembrokeshire	Document not held (380) (CCW library)
South Wales		
Aggregate sites	Benthic surveys and monitoring data	Not held (confidential and/or requires consent from data owner)
Natural England	Biotope mapping of intertidal habitats and species within the Severn Estuary	Not held (requested during project but not received)
Mettam, C, Conneely, ME, White, SJ	Benthic macrofauna and sediments in the Severn Estuary	Not held (paper available to purchase)

Data Source	Data Description	Data Availability
Warwick, RM and Davies, JR	The distribution of sublittoral macrofauna communities in the Bristol Channel in relation to the substrate	Not held (paper available to purchase)
Scarweather Sands Offshore Windfarm	Benthic sampling within Swansea Bay	Not held (confidential and/or requires consent from data owner)
ALSF project 'Outer Bristol Channel Marine Habitat Study'	Benthic and geophysical survey carried out in the Bristol Channel	Project report held (366, 420)
Woolmer, 2003	Benthic biotope maps of Carmarthen Bay	Project report held (736)
Warwick et al, 2001	Benthic ecology survey results of part of the Severn Estuary (between Flatholm Island and King Road)	Project report held (712)

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Designated Sites

5.4.51 Sites are designated under a range of legislation and for a variety of reasons, with the degree of protection afforded each site varying from non-statutory to international. Sites in Welsh waters are summarised in Table 5.5 and depicted in Figure 10.

Table 5.5 Designated Sites – Data Sources

Type of Site	Purpose of Designation	GIS Data held?
No statutory Protection		
Bird Reserves	Sites owned and managed by the RSPB	Yes
Heritage Coast	Undeveloped coasts for informal recreation (no specific statutory legislation)	Yes
Historic Landscapes	Best examples of different historic landscapes in Wales (no specific statutory legislation)	Yes
Marine Environmental High Risk Areas (MEHRA)	Sea areas with high environmental sensitivity that are at risk from shipping (contained in Marine Guidance Notes, which set out advice, guidance and recommendations on best practice to mariners)	Yes
Regionally Important Geological Site	Important sites for mineralogy as registered with local Planning Authorities (no specific statutory legislation)	No (requires contact with individual authorities)
World Heritage Site	Aim to protect the values of cultural or natural sites, which could deteriorate or disappear (no statutory control but serves to highlight the international importance of the site)	Yes
Special Landscape Area	Landscapes of County Importance (no specific statutory legislation)	Yes
Local Designation		
Local Nature Reserve (LNR)	Set up by Local Authorities to include features of special interest locally (National Parts and Countryside Act 1949)	Yes
National Designation		
Country Park	Initially set up by the Countryside Commission in the 1970s (Countryside Act 1968)	Yes
Area of Outstanding Natural Beauty (AONB)	Landscapes designated for character and natural beauty (National Parts and Countryside Act 1949 and Countryside and Rights of Way Act 2000)	Yes
Marine Nature Reserves (MNR)	Single MNR in Wales on the Pembrokeshire coast. Set up through bylaws, aimed at protecting habitats, species and features along the coast and subtidally (Wildlife & Countryside Act 1981).	Yes
National Nature Reserves (NNR)	Designated for wildlife habitats and sites, and may include geological features (National Parts and Countryside Act 1949)	Yes
National Park	Site protected for landscape, including coastal zones (NPACA, 1949)	Yes
Protected Wreck Sites	Information on these sites is available from Cadw	Yes
Scheduled Ancient Monument	Monuments whose preservation is given priority over other land uses (Ancient Monuments and Archaeological Areas Act)	Yes
Site of Special Scientific Interest (SSSI)	Sites notified for wildlife, geological or landform features considered to be of special importance (Wildlife and Countryside Act 1981 (as amended))	Yes
International Designation		
Offshore Habitats	Potential sites for designation under Natura 2000 (SPA/SAC)	No (not available at

Type of Site	Purpose of Designation	GIS Data held?
Directive		time of request)
Ramsar Sites	Internationally important sites for birds and wetlands (Ramsar Convention 1971)	Yes
Special Area of Conservation (SAC)	Sites designated for habitats and species of European importance (Conservation (Natural Habitats, &c.) Regulations 1994)	Yes
Special Protection Area (SPA)	Sites designated for their international importance for birds (EC Birds Directive on the conservation of wild birds (79/409/EEC))	Yes
Water Framework Directive	Requires all inland and coastal waters to reach good status by 2015 (EU Water Framework Directive)	No (not deemed necessary)

5.4.52 For the majority of the sites listed in Table 5.4 citation information is available from the statutory authority (for Wales, generally CCW), to provide a summary of why the site has been designated, highlighting features of particular interest and importance.

5.4.53 In addition to information related to specific designated sites and their geographic location, a number of other sources of information were located. These included broad scale conservation reviews (conducted during Oil and Gas SEA 6 (467), SEA 8 (152) and the Irish Sea Pilot (407, 408, and 415)) and information on the application of the Offshore Marine Conservation Regulations (primarily related to how boundaries will be defined) (371, 443, and 599).

5.4.54 Sites designated under the Offshore Habitats Regulations will lie beyond the 12nm limit and as such will be outside the current study area. However, for completeness, current progress in the identification of offshore sites was highlighted during the consultation process. Areas in English waters with the potential to be located near Welsh waters are understood to include potential reef features offshore from Anglesey and also within the central area of St Georges Channel. It is understood that an area of potential reef identified offshore from Cardigan Bay is no longer under consideration for designation. Further, it is understood that there is a small possibility of a site being established within 12nm to the north of Wales for harbour porpoise; however this is in the very early stages of data consideration. As part of a UK wide search to investigate potential seaward extensions of SPAs, there is potential interest along the north Wales coast and in the outer Severn/Bristol Channel area, the latter for manx shearwater. In English waters, it is understood that the seaward extensions to SACs that are being considered closest to Welsh waters are found at Lizard Point, Cape Bank and Outer Morecambe Bay.

5.4.55 Further documents are available that specifically address Natura 2000 sites, i.e. SAC and SPAs (and include Ramsar citations). These include documents such as Management Plans (144, 739), Action Plans (740) and Regulation 33 reports (168, 169, 170, 171, 172, 271, 272), which are produced as part of the Natura 2000 requirements. These documents provide more detailed information on specific areas, including information on the known distribution and condition of features, activities that may affect the features and plans to improve the condition of the features.

5.4.56 Other documents of interest are those prepared by English Nature (now Natural England) to define 'Marine Natural Areas'. No reference to such areas in Welsh waters was found, however areas have been identified in the Irish Sea (375), the South West Peninsula (376) and the Western Approaches (377), all of which can provide some information on features of interest in Welsh waters.

5.4.57 It is understood that CCW are looking at defining a process to identify 'Highly Protected Marine Reserves' in Welsh waters, although designated areas are yet to be formally identified. Such information may include baseline environmental information on very sensitive marine areas.

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5.5 Human Activities

Shipping

5.5.1 Shipping is a wide spread commercial activity in Welsh waters, with activity in coastal areas concentrated around port and harbours and movements offshore, broadly defined by shipping routes between Welsh ports and harbours, and the origin or destination of the vessel. In order to describe the baseline conditions, a number of factors were looked at, as follows:

- Shipping routes;
- Shipping density;
- Location of ports and harbours (including associated zoning such as pilot boarding places); and
- Clearways (although the term is understood to be no longer in use, no replacement is yet available).

5.5.2 Military activities, including military shipping, are addressed separately within this section.

5.5.3 The majority of the data sourced are in GIS format, providing information on the geographic location of existing port and harbours, together with data depicting shipping routes, highlighted as shipping density. These are depicted in Figure 11. From the data it is apparent that shipping mainly occurs around south Wales, Pembrokeshire, north Wales and to the west of Anglesey. It should be noted that during consultation it was commented that to accurately assess potential impact on navigation issues, knowledge of both existing shipping lanes, together with how they change with time is required, whether those changes were a result of issues such as future port changes, changes in trade or due to natural changes in channel topography. Such information, however, is very difficult to determine.

5.5.4 Designated clearways refer to a previously proposed establishment of a network of routes to provide for the safety of shipping in UK waters. Such areas were intended

to coincide with main shipping routes, and were initially used as a presumption against offshore oil and gas licensing within these areas. Their use was also discussed during the development of the Round 2 offshore windfarm SEA, in addition to being raised in discussion at individual Round 2 project level. Though broad in extent, the concept of clearways provides useful information on areas important for navigation, and where hazards to navigation would need to be considered in detail by an applicant. From comments made during the consultation process, it appears that the term clearway may be falling out of favour, although no replacement is as yet apparent.

5.5.5 The consultation process highlighted a MCA/DfT project that is currently investigating the release of the AIS database between government departments. It is understood that the database represents the most detailed dataset of shipping routes and port usage. Discussions related to how to release the data are currently underway. Through consultation it is apparent that release of the database is not intended to necessarily identify areas within which solely shipping use would be permitted, but to ensure the most detailed possible data on shipping activity is available to inform and underpin assessments made. In addition, it is understood that an on-going BERR RAG project to maintain a marine navigation database of the three strategic areas is to be extended to cover the remaining UK waters (433).

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Tourism and Recreation

5.5.6 Tourism and recreation are widely held as being of commercial importance to Wales, with the coastline and coastal waters representing key resource areas. Data defining existing use of the coastal environment were sought during the project, with a number of key studies identified. These include written descriptions of the existing situation, together with GIS datasets which describe current activity in Welsh waters (Figures 12 and 12i). Table 5.6 presents a summary of the information sourced.

Table 5.6 Summary of Tourism and Recreation Data

Information Source	Data Format	Data Extent
National and Broad Scale Information		
RYA UK Atlas of Recreational Boating	GIS files	Includes mapping information across Wales on the location and extent of marinas and slipways, RYA clubs, RYA training centres, recreational sailing routes, recreational sailing and racing areas and power boat racing zones (understood to be scheduled for update during 2008)
Environment Agency Recreation Review	GIS files	Mapping information giving the location of coastal recreation in Welsh waters. Includes scuba diving areas, EC bathing beaches, surfing areas and recreational fishing
SEA 6 and 8 (414, 419, 602, 603	Pdf files	Relevant information contained in reports on 'Other Users' and specific reports on recreational sailing
A Draft Strategic Plan for Water Related Recreation (WRR) in Wales (684, 685)	Pdf files held	Including an overview of existing demand and activity across Wales
Recreational fishing (21, 521)	Pdf files	A number of broad reports covering recreational fishing were sourced, including a report at the European level and a strategy for recreational fishing in Wales
Coastal cycle routes	GIS files	The location of coastal cycle routes in Wales were obtained from Sustrans
Attractions	GIS files	The location of tourist attractions in Wales were obtained from Visit Britain
National Trust Property and Land	GIS files	The National Trust are in the process of conducting a coastal audit and kindly provided the project with copies of GIS files for Wales, including the location and extent of Trust assets
Welsh Coastal Tourism Strategy – SEA (720)	Limited files held in pdf format	Summarises existing coastal tourism in Wales
North Wales		
Recreational fishing (411)	Pdf file	Recreational and commercial fishing in Liverpool Bay were assessed as part of the Gwynt y Môr offshore wind farm project, including an overview of the activity.
Anglesey		
None identified	-	-
Cardigan Bay		
None identified	-	-
Pembrokeshire		
South West Wales Recreation Audit (126)	Pdf file held (it is understood a GIS database is being established)	Covers the coastlines of Pembrokeshire, Carmarthenshire, Swansea and Neath Port Talbot, providing information on recreational activity, recreational hotspots and trends in demand for activity
South Wales		
Recreational fishing	Available to purchase	Recreational fishing in the Severn Estuary

5.5.7 A number of recent studies have been conducted, with a general aim of understanding which activities take place and where. Most of these studies extended across Wales, although the Pembrokeshire work is restricted to south west Wales. Most recently, a draft strategic plan for water related recreation has been published for Wales, which includes coastal activities (684).

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Archaeology

5.5.8 Data pertaining to existing wrecks were sourced from SeaZone Solutions Ltd. In addition, the RCAHMW and the four Welsh archaeological trusts were consulted regarding additional data relevant to this project and additional data supplied from these sources has been incorporated. Data regarding known archaeological sites was collated and mapped onto a GIS, along with data regarding navigational hazards

sourced from Admiralty Charts. The occurrence and density of wrecking events were analysed with reference to the data for navigational hazards, mercantile activity and conflict and warfare in an effort to suggest areas of high archaeological potential.

5.5.9 Due to the nature of historical record keeping in regard to maritime losses, the current data on which assessments of maritime archaeology is based have a bias towards vessels lost in the last 250 years. In addition to this it should be noted that though records of losses from the 18th century onwards are relatively extensive, they will only reflect a proportion of the wrecks lost in recent centuries. While the baseline data may account for archaeological sites that are already known, the potential for the existence of previously unknown archaeological remains limits the reliability of current data sources as a guide to archaeological potential.

5.5.10 Further limitations of the current data sources can be highlighted by the research conducted by private individuals. At least 459 wrecks are thought to have been lost on the Sarn Badrig reef (219), including the Diamond; a site designated under the Protection of Wrecks Act. This constitutes a considerable difference from the eight wrecks recorded in that area in the UKHO data.

5.5.11 The majority of the available data for wreck sites for known wrecks around the coast of Wales comes from Naval Hydrographic survey records. The full list of sources is as follows:

- The United Kingdom Hydrographic Office (UKHO);
- The maritime section of the National Monuments Record of Wales (NMRW) and the databases maintained by the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW);
- The Historic Environment Records (HERs) maintained by the four Welsh archaeological trusts; and
- Research conducted by private individuals.

5.5.12 The UKHO holds data for 1370 wrecks and obstructions within the Study Area. The distribution of these wrecks is illustrated in Figure 13. Four areas with a higher density of known wrecks and obstructions can be identified from the distribution map. Higher densities of wreck occur around Anglesey, off St. David's Head, off Milford Haven and in the approaches to the Severn Estuary. A more detailed description of

the baseline of these areas is provided in the archaeological technical report, provided as a component of the current study (Wessex Archaeology, 2008).

5.5.13 As with the recorded wrecks associated with natural hazards, the incidence of reporting wrecks will have a similar coastal and inshore bias. Thus the analysis of shipping routes could provide some degree of guidance for the potential for the presence of wrecks within offshore areas, as well as in areas around ports and harbours, since areas of higher density shipping may have a disproportionately higher incidence of wrecks due to the inherent hazards related to multiple vessels operating in proximity to each other.

5.5.14 In addition to wreck sites, archaeological remains within the study area are also likely to be related to the effects of the three major glaciations, and the subsequent rises and falls in sea-level on the Welsh landscape. These events provide the potential for the existence of previously inhabited landscapes to exist that may now lay submerged off the coast (e.g. 8, 9, 10, 97, 474, and 733). Throughout the Palaeolithic and Mesolithic periods human populations were hunter-gatherers, whose activity patterns were focused around areas of rich food resources. These would have included the coastline, and water courses. Elsewhere in the UK deposits associated with submerged landscapes have tended to survive, in association with palaeovalleys and other topographic lows. Around Wales these features are likely to provide the best, but not only opportunity to identify submerged terrestrial sites.

5.5.15 The potential for the presence of submerged prehistoric sites, finds and other data may be summarised as follows:

- Lower, Middle and Early Upper Palaeolithic sites that are more likely to survive as derived artefacts present within seabed deposits;
- Late Upper Palaeolithic and Mesolithic sites which may survive either as derived artefacts or in situ sites; and
- Areas of surviving terrestrial soils that have the potential to contain palaeo-environmental evidence for the nature and development of past landscapes and their inundation.

5.5.16 Areas of importance are presented as figures in the accompanying technical report.

5.5.17 The Research Framework for the Archaeology of Wales is run by the archaeological community in Wales, with the aim of evaluating the achievements already made, together with identifying some key questions still to be answered in understanding the archaeology of Wales. The resulting research framework includes one for Maritime and Coastal Wales (808).

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Commercial Fisheries

5.5.18 The most complete commercial fisheries dataset currently available for Welsh waters is contained within surveillance and fish landings data, which provide an overview of commercial fishing based on ICES squares. Such information can be used to highlight areas known to be used for specific types of fishing, together with the value of fish landed. Figure 14 provides a summary of this data. The location and extent of shellfish waters and bivalve harvesting classification zones are available as GIS files (Figure 14).

5.5.19 The Oil and Gas SEA process includes assessments of commercial fisheries, with the reviews for Oil and Gas SEA 6 (414, 456) and 8 (60, 449) held. Additional broad scale information on commercial fisheries includes Cefas reports on the coastal fisheries of England and Wales (312, 520), the most recent of which covers the period from 1999-2001. Two further broad scale projects related to commercial fisheries in Welsh waters were identified during the course of the project, including the Wales fisheries strategy study, for which a consultation document was published in late 2007 (http://new.wales.gov.uk/consultations/closed/envandcouncloscons/1878951/?lang=en) and a strategic action plan for fisheries and aquaculture (721). The 2007 consultation document provides useful overviews of fishing activity (aquaculture, commercial and recreational) across Wales and sets the principles underpinning the sustainable management and development of fisheries in Wales.

5.5.20 A number of recent offshore wind farm applications have been made in Welsh waters, which have each undertaken studies to determine existing commercial fishing activity in their vicinity. Such information is therefore restricted to north Wales and Liverpool Bay (primarily Gwynt y Môr but to a lesser extent the earlier Rhyl Flats and North Hoyle), for which the regional fisheries study has been sourced (411) and Swansea Bay (Scarweather Sands, which was not available following project archiving). In addition to the studies undertaken for planned wind farms in Welsh waters, a further commercial fisheries study was undertaken for the Eastern Irish Sea area (412), which included information for north Wales. A review of commercial fisheries was also undertaken as a component of the Wave Dragon EIA in Pembrokeshire (542).

5.5.21 During the consultation process, a project to enable commercial fishing activities in Welsh waters to be mapped in GIS was highlighted. It is understood that the project is being undertaken through two routes, the first being a collation of verbal information and observations within a GIS database. It is understood that data for 2005 is currently being reported, with practicalities such as format and title to be determined. Data for 2007 is currently being collated. The second aspect of the work involves the use of data logging equipment on vessels, which is understood to be currently in use on a limited number of vessels, with the intention of widening the use of this equipment in the near future. The data will provide a database of existing fishing activity, with the intention of enabling regular updates to demonstrate seasonal and annual variability.

5.5.22 A further commercial fisheries project in progress has been commissioned by COWRIE, and involves the development of spatial information layers for commercial fishing and shellfishing to help inform the strategic siting of offshore windfarms.

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Military

5.5.23 The presence of military activity or interest in an area can represent a significant constraint against development, with such activities being of significant national importance. The main types of military interest site within Welsh waters including those identified by the Seazone datasets include the following:

- Exercise areas and firing ranges;
- Military radar;
- Firing danger areas;
- PTA manoeuvring;
- MoD establishments;
- Ordnance demolition;
- Underwater explosion trials;
- Location of munitions sea dump sites; and
- Military aero traffic.

5.5.24 GIS data files for the majority of these constraints have been sourced (Figure 15). The majority of the GIS data has been sourced from Seazone data, with information on the actual locations of munitions disposal sites available from the MoD website (www.mod.uk/NR/rdonlyres/7A6C0C8F-C581-40F3-A77E-9C804503604D/0/bi_exp_dump_sites.doc). Summary information on Military interests is available in the relevant Oil and Gas SEA documents for SEA 6 (414). Investigations into the availability of GIS data files for military radar and airspace data are currently ongoing.

5.5.25 Military interests do overlap to an extent with civilian interests, with those considered under shipping (Figure 11) and aviation radar (Figure 16). However, it should be noted that military shipping and aviation interests will vary when compared to civilian, for example submarine use of areas.

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Grid infrastructure

5.5.26 The ability to transport electricity generated at sea to the point of use is essential, and to do so requires a link to the National Grid of sufficient capacity. The existing

National Grid layout is depicted in Figure 17. A detailed assessment of the existing grid in Wales is presented in an accompanying technical report (Econnect, 2008) in which an overview of the Welsh electrical infrastructure, both transmission and distribution, is provided. A summary is presented below. Data have been sourced from information held within Econnect with reference to the most recent National Grid and distribution network operator's statements.

5.5.27 The transmission system in Wales is owned and operated by National Grid Electricity Transmission plc (NGET). The present National Grid system in Wales consists of four dual 400kV transmission lines, two of which travel through the north of Wales out to the Nuclear Power station at Wylfa on Anglesey, and the hydro electric power stations at Dinorwig and Ffestiniog (Trawsfynydd) and two parallel to the south Wales coastline out to the site of the former power station at Pembroke. A dual 275kV transmission circuit also runs along the coastline of south Wales, connecting the demand centres of Newport, Cardiff and Swansea. The transmission network infrastructure is divided between the far north and far south of the country. This is primarily because of the northern sources of generation and densely populated load centres along the southern coast. The rugged terrain in the centre of Wales (e.g. the Brecon Beacons) also makes it difficult, and hence more expensive, to construct a transmission system in this area.

5.5.28 The majority of generation in Wales is connected directly at transmission level, with a total of 17% of generation in Wales connected as embedded generation at distribution level, i.e. at less than 275kV. The predominant contribution of generation connected to the National Grid transmission system in Wales comes from large coal fired power plants or gas fired power plants. Nuclear generation also currently contributes to nearly a third of the Welsh generation resource, however, it is planned to decommission the existing Wylfa Nuclear Magnox station, which has a transmission entry capacity (TEC) of 980 MW in 2010.

5.5.29 Table 5.7 provides an insight into the specific generation sites connected or due to connect to the transmission system in Wales where the network licensee is NGET. The table presents the power station name, its capacity, when the station was commissioned, the substation (Node) at which the site is connected and the SYS Zone in which the substation falls, with Chart 1 on the following pages showing the breakdown of the generation connected or due to connect in Wales, within the next seven years, with over a fifth of the generation capacity connected at transmission

level being provided from renewable sources. Note that the Open Cycle Gas Turbines (OCGT) at Aberthaw are normally only used as a standby or for emergency situations.

Table 5.7 Breakdown of present generation connected to NGET in Wales

Station Name	Set No	Plant Type	Unit Effective Capacity (MW)	Commissioning Year	Node	SYS Study Zone
Aberthaw B	7	Large Coal	547	1976	ABTH20	Z13
	8		547	1971		
	9		547	1979		
		Open Cycle Gas Turbine (OCGT)	17	1967	ABTH20	
			17			
			17			
Baglan Bay		Combined Cycle Gas Turbine (CCGT)	520	2002	BAGB20	
			32.3			
Barry	1	CCGT	245	1998	AESB11	
	2		75			
	4	Dual Fuel	527	1975		
			25	1970		
			230			
			290			
Uskmouth	1	Small Unit	121	2000	USKM10	
	2		121			
	3		121			
Connahs Quay		CCGT	345	1996	DEES41	Z9
			345			
			345			
			345			
Deeside		CCGT	89.5	1994	DEES42	
			163			
			148			
Dinorwig	1	Pumped Storage	274	1984	DINO40	Z9 cont.
	2		274			
	3		274	1983		
	4		274	1984		
	5		274			
	6		274			

Station Name	Set No	Plant Type	Unit Effective Capacity (MW)	Commissioning Year	Node	SYS Study Zone
Ffestiniog	1	Pumped Storage	90	1961	FFES21	
	2		90			
	3		90	1963	FFES22	
	4		90			
Shotton		CCGT	70	2001	SHOT10	
			70		SHOT10	
			70		SHOT10	
Wylfa	1	Nuclear Magnox	245	1971	WYLF40	
	2		245		WYLF40	
	3		245		WYLF40	
	4		245		WYLF40	

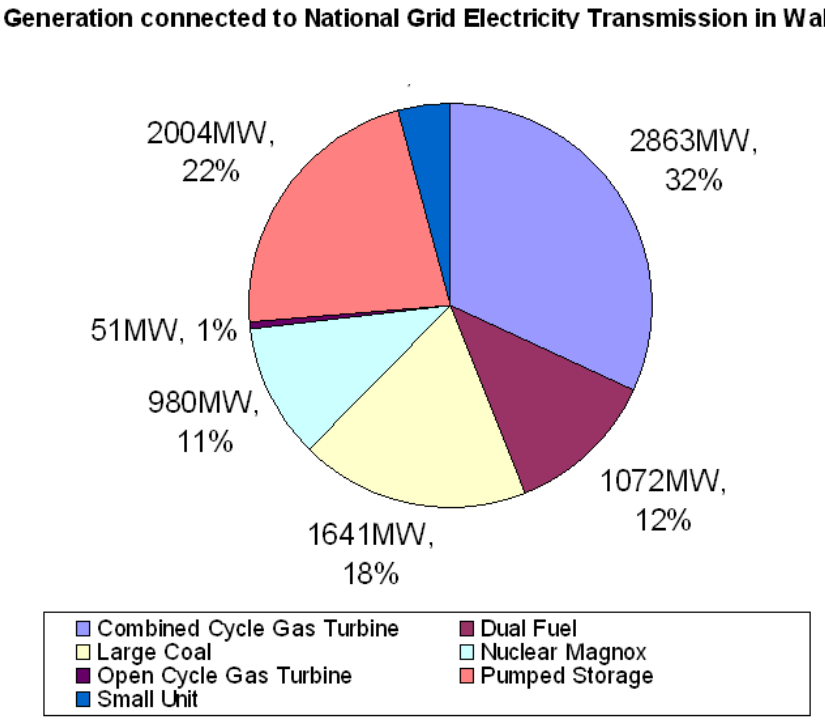

Chart 1: Generation connected or due to connect to NGET in Wales

Planned Changes to the Welsh Grid

5.5.30 Table 5.8 below lists all the currently planned generation to be connected at transmission level in Wales for the next seven years, based on the most recent National Grid 7 year statement (May 2007).

Table 5.8 Planned NGET generation from 2007 to 2012

Station Name	Plant Type	2007	2008	2009	2010	2011	2012	2013
Pembroke 1 Stage 1	CCGT	800						
Pembroke 1 Stage 2	CCGT		1200					
Severn Power Stage 1	CCGT			425				
Rhigos	Onshore wind			299				
Severn Power Stage 2	CCGT				425			
Pembroke 2 Stage 1	CCGT				400			
Pembroke 2 Stage 2	CCGT					1600		
Amlwch	CCGT						270	
Prenergy Woodchip Power Station, Port Talbot	Biomass							295

Other planned developments

5.5.31 Table 5.9 below details all the planned transmission network developments for the next seven years in Wales. The list demonstrates that there is a large amount of work planned relating to infrastructure reinforcement, upgrading and connection of additional generation. Items of particular interest are a) the commissioning of Pembroke Stages 1 and 2, contributing a total of 4GW of new generation and b) the decommissioning of the 980MW magnox nuclear power station at Wylfa. In addition the proposed interconnector between Wales and Ireland will also represent a substantial development in the grid infrastructure. As these interconnectors will be bi-directional they could potentially introduce power flows between Ireland and Wales, potentially reducing the available transmission access capacity in Wales.

Table 5.9 Planned developments in Wales for the next seven years

Location/Item of work	Year	Details
Pembroke	2007	Connect 800MW of new CCGT capacity (Pembroke 1 stage 1) at Pembroke 400kV substation for RWE Npower plc.
	2008	Connect a further 1200MW of new CCGT capacity (Pembroke 1 stage 2) at Pembroke 400kV substation for RWE Npower plc.
	2010	Connect 400MW of new CCGT capacity (Pembroke 2 stage 1) at Pembroke 400kV substation for Milford Power Ltd.

Location/Item of work	Year	Details
	2011	At Pembroke 400kV substation double up the three bus section and two bus coupler circuit breaker bays. Extend the 400kV busbars to accommodate five new generator bays. Replace all 400kV feeder circuit breakers and line protections.
	2011	Connect a further 1600MW of new CCGT capacity (Pembroke 2 stage 2) at Pembroke 400kV substation for Milford Power Ltd.
Uskmouth	2008	Construct a new 9-bay double-busbar 275kV substation including a bus coupler circuit breaker. Connect the Uskmouth-Whitson 275kV 1 & 2 circuits into the new substation. Connect Uskmouth SGT1 and SGT2A/2B supergrid transformers into the new substation. Install a new 132kV series reactor at Uskmouth 132kV substation. Install a new 132kV dual busbar section connection arrangement for SGT4. Connect the Cardiff East-Uskmouth-Whitson 275kV circuit into the new Uskmouth 275kV substation. Connect the Uskmouth SGT4A/4B supergrid transformer into the new Uskmouth 275kV substation.
	2009	Connect the 425MW Uskmouth 2 Stage 1 CCGT at Uskmouth 275kV by 31/10/09.
	2009	Connect 425MW of new CCGT generation (Severn Power Stage 1) at Uskmouth 275kV by 31/10/09.
	2010	Connect 425MW of new CCGT generation (Severn Power Stage 2) at Uskmouth 275kV by 31/08/10.
Wylfa	2010	Planned closure of Wylfa Nuclear Magnox station (TEC = 980MW).
Swansea North	2011	Construct a new 400kV substation at Swansea North. Turn the Pembroke-Cilfynydd and Pembroke-Rhigos 1 & 2 400kV circuits into the new substation. This forms Pembroke-Swansea North 1 2 3 & 4 Swansea North-Cilfynydd 1 & 2 and Swansea North-Rhigos 1 & 2 400kV circuits.
Amlwch	2012	Connect 270MW of CCGT generation (Amlwch) at Amlwch 400kV.
	2012	Construct a new 4-bay indoor double-busbar GIS 400kV substation at Amlwch.
Transmission Works	2009	Install a second cable per phase on the Ross-on-Wye cable sections of the Rhigos-Walham and Rassau-Walham 400kV double circuit. Construct a new 400kV Severn Crossing to increase the capacity of the Cilfynydd-Whitson-Seabank and Imperial Park-Melksham 400kV circuits. Divert the existing 275kV Severn crossing circuit through the vacated 400kV cable tunnel to increase the capacity of the Whitson-Iron Acton 275kV double circuit.
	2013	Refurbish sections of the VE route on the Margam-Pyle and Baglan Bay-Swansea North 275kV circuits including cable sections on each circuit at Baglan Bay and Pyle. Hotwire the following circuits: Pyle-Cowbridge 1 & 2 275kV Iron Acton-Whitson 1 & 2 275kV Swansea North-Cilfynydd 1 & 3 400kV Swansea North-Rhigos 1 & 2 400kV Rhigos-Cilfynydd and Rhigos-Walham 400kV.
Overhead Line Works	2011	Carry out thermal upratings on the Pembroke-Swansea North 400kV 1 2, 3 & 4 circuits Swansea North-Cilfynydd 400kV 1 2 and 3 circuits and Baglan Bay-Margam 275kV circuit.
	2012	Up-rate the 275kV circuits between Kirkby and Penwortham to 400kV operation. Replace the two 275/132kV 180MVA SGTs at Washway Farm with 400/132kV 240MVA units. Replace other 275kV substation assets at Washway Farm with 400kV equipment. Remove the 400/275kV transformers at Penwortham and rationalise the remaining 275kV assets. Construct a new 400/275kV banking compound at Kirkby. Install 4 x 1000MVA 400/275kV transformers of which one will be an existing Penwortham unit. Install a quadrature booster at Lister Drive 275kV substation to be connected in series with the Birkenhead-Lister Drive 275kV circuit.

Location/Item of work	Year	Details
	2012	Construct a new 400kV double-circuit overhead line of length approximately 7.5km from the existing Pentir-Wylfa 400kV double-circuit overhead line to a point near Amlwch using L2 towers and 2 x 700mm^2 conductors. Connect the new line to the existing Pentir-Wylfa 400kV double-circuit overhead line using a double-tee arrangement including a 300m section of underground cable. Connect the new line to the new Amlwch 400kV substation by constructing a new 400kV double-circuit underground cable of length approximately 1km.

Distribution Network Operators

5.5.32 The Distribution Network Operators (DNO's) in Wales consist of WPD and SP Manweb. WPD operate throughout the Southern region of Wales and SP Manweb operates the distribution network in the mid and North Wales regions.

5.5.33 DNOs are not involved directly in either the buying or selling of electricity to end use customers, which is the responsibility of electricity supply companies. The DNO solely provides the electrical network to distribute electricity from the transmission network to these end customers.

5.5.34 The main responsibilities of the DNO are in:

- Maintaining the distribution electricity network on a daily basis;
- Repairing the distribution electricity network when faults occur;
- Reinforcing the distribution electricity network to cope with changes in the pattern of demand; and
- Extending the distribution network to connect new customers.

5.5.35 Chart 2 below shows that there is approximately 1.3GW of embedded generation capacity in Wales, connected at distribution level. This generation capacity is in the form of CHP (Combined Heat & Power), Hydro, Coal, Gas and wind.

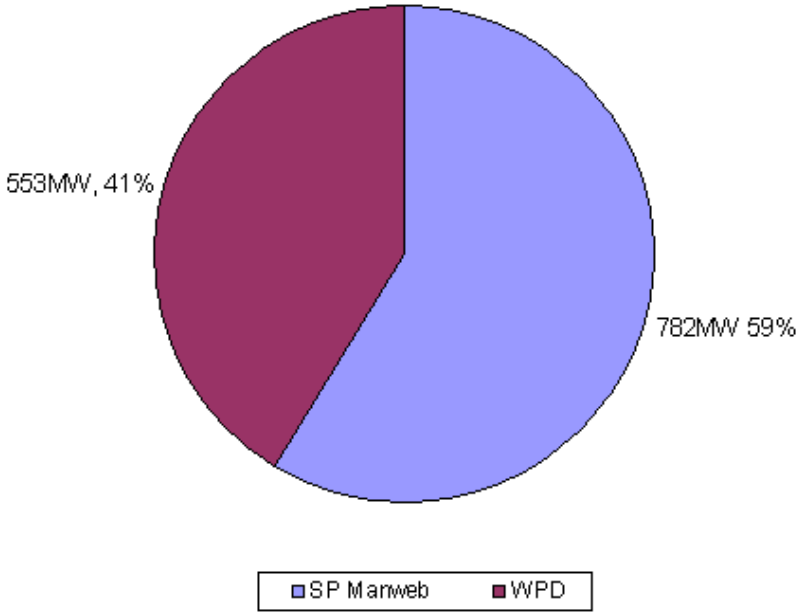

Chart 2: Total DNO contribution of embedded generation in Wales

5.5.36 There are many factors which affect the connection of generation. Connection at distribution voltages may require significant system modifications arising from thermal, voltage or fault level issues. Some renewable technologies may naturally cluster in a particular geographic area due to the nature of the energy resource, as such; this may necessitate significant distribution infrastructure works in such an area.

5.5.37 The Distribution Network Operator covering the southern Welsh region is Western Power Distribution. Chart 3 below shows a breakdown of the contribution from generation connected to the WPD system in south Wales.

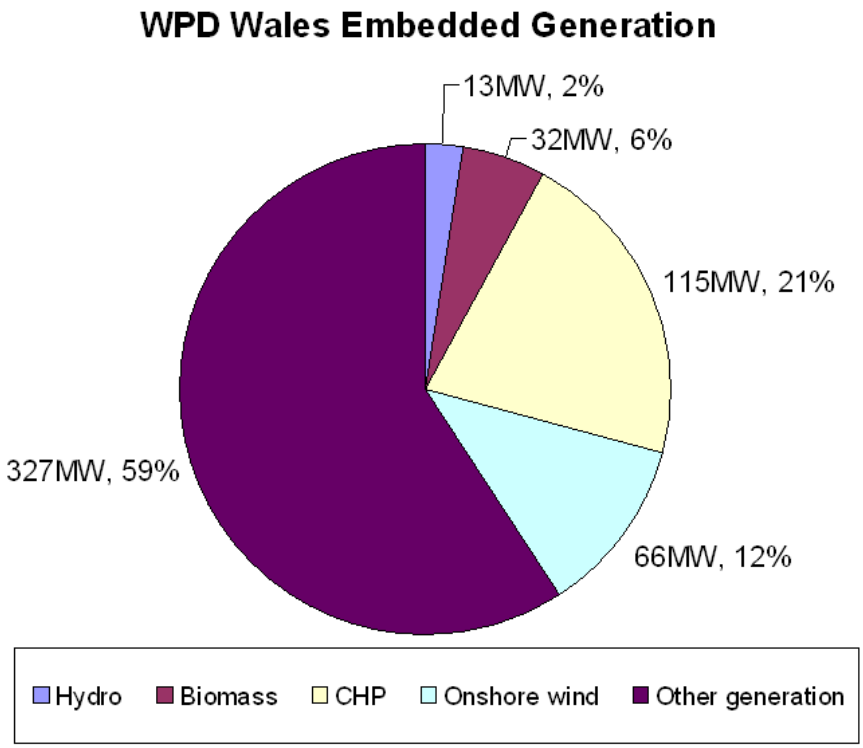

Chart 3: Embedded Generation within the WPD South Wales Region by Fuel Source

5.5.38 According to WPD's long-term development strategy (LTDS) statement, there are a range of developments scheduled in order to counteract the limitations imposed by network assets forecast to reach their capabilities in the next five years. These are listed in the relevant section of the accompanying technical report.

5.5.39 The second Distribution Network Operator covering the mid and north Wales region is Scottish Power (SP) Manweb. Chart 4 below shows a breakdown of the contribution from generation connected to the SP Manweb system in north Wales.

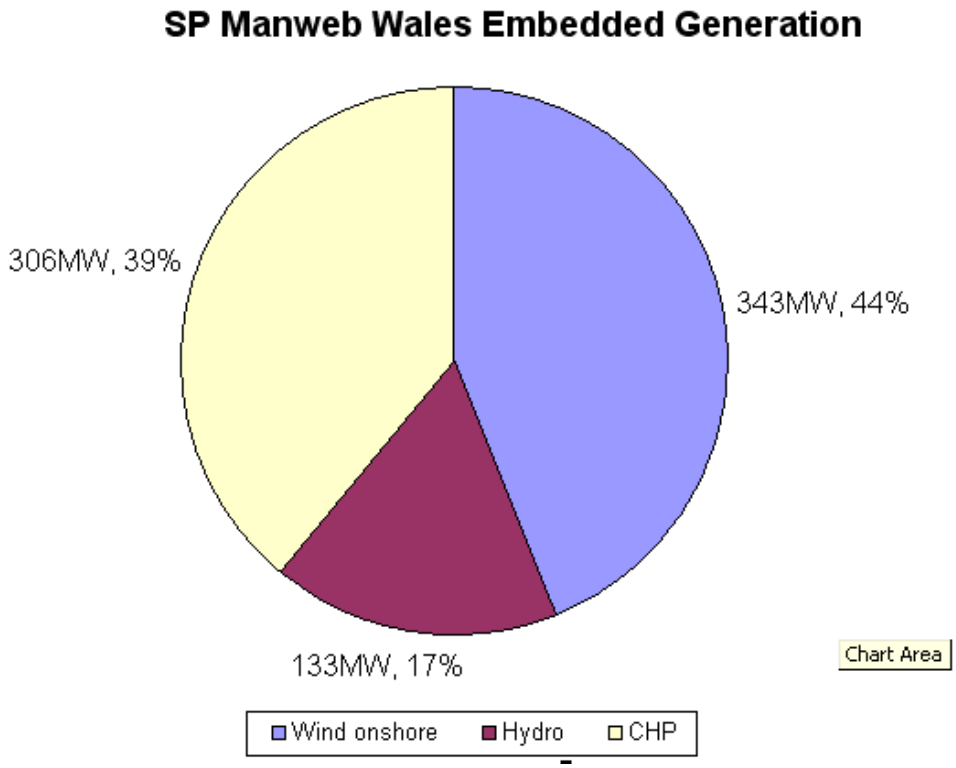

Chart 4: Embedded Generation Contribution from SP Manweb within the Mid to North Wales Region

5.5.40 Again, according to the LTDS statement, SP Manweb is scheduling a range of developments in order to counteract the limitations imposed by network assets forecast to reach their capabilities in the next five years. These are listed in the relevant section of the accompanying technical report.

References

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Submarine Cables and Pipelines

5.5.41 Cables and pipelines are laid on or under the seabed for a number of reasons, including oil, gas, telecommunications and to facilitate consented discharge (e.g. sewage). Data collated and held for this project includes information on cables and pipelines that are both currently active and those which are historic and no longer in

use, predominantly from the SeaZone map data. The known location of cables and pipelines in Welsh waters, including those related to the water industry, are depicted in Figure 18. Some additional information is available in the appropriate documents for Oil and Gas SEA 6 (414) and 8 (449).

5.5.42 It should be noted that as cables and pipelines are installed on the seabed, often remotely, positioning information is not always fully accurate, particularly for those laid prior to the widespread use of DGPS, and some caution may be required.

References

414, Luddington, L and Moore, JJ, 2005, SEA 6 Area Other Users

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Renewable Energy

5.5.43 During the course of the project, a number of sites in Welsh waters that have been or are currently of interest to the renewables industry have been identified. Some of these relate to brief references of early testing of devices, through formal applications to fully developed and operational sites. Figure 2 shows the location of each site, with a summary provided in Table 3.3 in Section 3.7. The amount of information on the geographic location of each site varies, and where the area is approximate it is indicated as such. Some additional information is available in the appropriate documents for Oil and Gas SEA 6 (414) and 8 (449).

References

414, Luddington, L and Moore, JJ, 2005, SEA 6 Area Other Users

449, Metoc, Undated, SEA 8 Area Other Users

Marine Aggregate Extraction

5.5.44 Marine aggregate extraction is a licensed activity and occurs in a number of locations in Welsh waters. Such activities are defined under the following terms:

- **Production licence areas**, from which material is actively dredged. These comprise an exclusive licence from the land owner (generally Crown Estate), coupled with a Government View or Dredging Permission (essentially the environmental consent);

- **Application areas**, which represent areas for which a Dredging Permission is actively being sought by the developer. For these areas, The Crown Estate will have confirmed that they are minded to issue a production licence, pending the award of Permission. The consent process itself can take anything between 5-10 years to complete;
- **Prospecting areas** are awarded by The Crown Estate under a commercial tendering process. They provide developers with the exclusive right to prospect for marine mineral resources, the discovery of which will normally lead to application area status; and
- **Non-exclusive prospecting** can be undertaken by developers in advance of a Tender for a prospecting area, to inform their selection of site. Depending upon the timing of the Tender process, individual operators may have several areas of interest highlighted for further investigation.

5.5.45 The location of these areas is shown in Figure 19, being primarily located in the Severn Estuary and Bristol Channel, with one site off north Wales. Some additional information is available in the appropriate documents for Oil and Gas SEA 6 (414) and 8 (449). Reviews of marine aggregate dredging across a number of licence areas have been undertaken, are currently in progress or are anticipated to occur across a number of areas in the UK, with such areas currently restricted to English waters in the eastern English Channel, Thames Estuary, Isle of Wight region and the east coast.

References

414, Luddington, L and Moore, JJ, 2005, SEA 6 Area Other Users

449, Metoc, Undated, SEA 8 Area Other Users

Oil and Gas

5.5.46 Oil and gas interest is well documented, with the location of infrastructure and licences readily available in GIS format. The location and extent of these are depicted in Figure 20, clearly indicating that the main area of current interest to the oil and gas industry in Welsh waters is to the north and east, within Liverpool Bay. It should be noted that there is currently an application for oil and gas exploration within 3 blocks in southern Cardigan Bay (100). Some additional information is available in the appropriate documents for Oil and Gas SEA 6 (414) and 8 (449).

References

100, BERR, 2007, Appropriate Assessment with regard to 24th Oil and Gas Licensing Round, Blocks 106/30, 107/21 and 107/22 (Cardigan Bay).

414, Luddington, L and Moore, JJ, 2005, SEA 6 Area Other Users

449, Metoc, Undated, SEA 8 Area Other Users

Licensed Disposal Sites

5.5.47 In the UK, there are a number of sites in coastal waters licensed for marine disposal, with approximately 100 licensed in England and Wales at any one time. Use of such sites is tightly controlled, with consent only granted if no safe and practicable alternative to marine disposal can be found on land and, in the case of marine dredgings, only if the material cannot be used beneficially. Disposed material is primarily capital and maintenance dredgings from ports and harbours, with few other types of waste considered. The location of such sites in Welsh waters is given in Figure 21, including small groups of sites off north Wales, Pembrokeshire, Swansea Bay and the Severn Estuary. Some additional information is available in the appropriate documents for Oil and Gas SEA 6 (414) and 8 (449) and from the Marine and Fisheries Agency website (www.mceu.gov.uk/MCEU_LOCAL/mceu1-test-E.htm).

References

414, Luddington, L and Moore, JJ, 2005, SEA 6 Area Other Users

449, Metoc, Undated, SEA 8 Area Other Users

Airspace and Radar

5.5.48 This section refers to civilian aviation only, with military issues addressed separately. The principal issues of interest regarding aviation for offshore renewables relates to radar and the location of aerodromes. To date, this has been of relevance to offshore wind only. The National Air Traffic Service (NATS) has, through NATS En Route Plc (NERL), undertaken a review of the infrastructure and aids that could be affected by a wind farm, including mapping of potentially affected areas. GIS data files have been sourced that depict the following:

- Location of aerodromes;
- Aerodrome traffic zones;
- Topographic air charts; and

- NERL radar data.

5.5.49 These are shown on Figure 16, with areas of particular concern for radar to NATS NERL being areas of north Wales and parts of Pembrokeshire. It should be noted that the location and extent of military aviation interest is depicted on Figure 15.

CO_2 Sequestration

5.5.50 Underground storage of carbon dioxide (CO_2) is a strategy/process which can be utilised to reduce the amount of greenhouse gases in the atmosphere. The potential for the sequestration of CO_2 in Welsh waters is poorly understood, with some work carried out by academia, hydrocarbon exploration companies, and the coal and coal bed methane industries in Welsh waters which provides an insight into potential areas for further study (e.g. 188, 393). Onshore geological mapping, and seismic and borehole data will also be relevant to the investigation of potential sites and geological intervals suitable for sequestration.

5.5.51 Much of the geology in Welsh waters has been resolved by data gained from hydrocarbon exploration. Seismic survey data has assisted the understanding of the structural geology. Wells provide physical rock samples and information on the composition and age of sediments, whilst wireline logging of the borehole provides data on rock properties. This is especially important in Welsh waters as the rocks are not widely seen on land. Much of the information gained through hydrocarbon exploration could be used to identify potential targets for CO_2 sequestration.

5.5.52 The research undertaken for this study has identified some of the prerequisites for acceptable sequestration as proposed for this relatively new process, and evaluated some of the current research programmes. This information has subsequently been summarised in terms of the general geology of Welsh Waters from publications (e.g. 130, 134, 145, 502, 528, and 630) and discusses, broadly, potential horizons for sequestration. It is notable that no specific near-shore sites are identified at this preliminary research stage.

5.5.53 Data is available from a number of sources. These include published papers in academic journals and private company archives. The DEAL website (www.ukdeal.co.uk) is a good source of information relating to exploration and production of hydrocarbons in the UK. The site is supported by Oil and Gas UK,

BERR and is managed by the BGS and aims to be a single point source for these data in the UK (Figure 20).

5.5.54 The following types of data are available, for purchase, via UK Deal:

- Well header records;
- Well data catalogues;
- Seismic survey header records;
- Seismic data catalogues;
- Pipeline alignments;
- Platform locations;
- Licence and block geometry;
- Regional report catalogues;
- Field outlines;
- Strategic environmental assessments;
- Coastlines; and
- International boundaries.

5.5.55 Successful sequestration of CO_2 depends on a number of factors which need to be identified, modelled and tested. Such requirements include a permeable, saline aquifer which is constrained in its extent and geometry, and well understood in terms of its lithological properties and how fluids can flow within it and between the various units. Also required is an unfaulted, impermeable cap rock and a suitable, closed physical structure. This is imperative to ensure that gas does not escape to pollute fresh water aquifers or escape to the surface. All of these factures need to be modelled and later monitored.

5.5.56 The review of available information has found that although there are no specific near shore sites known at present, attempts to identify such sites from previous work, may, given the acquisition of new data, prove useful in identifying targets close to the study area which may be able to be utilised. However, many may be impractical to take forward at the current time because of the costs associated with the research effort required to ensure effective and safe CO_2 sequestration. It is also important to

appreciate that these methods are relatively novel and are being rapidly developed; some of the ideas discounted currently may become possible in the future.

5.5.57 The most suitable in terms of the quantity of data available for further study are: the Cenozoic Sandstones of the St Georges Channel, the area of 'Dragon' discovery in Cardigan Bay and the East Irish Sea Basin, which are areas proven to have hydrocarbons and have been studied and developed by commercial operators. All these areas lie outside of the 12nm limit of the Welsh Coastline.

5.5.58 St Georges Channel was evaluated in a DTI (now BERR) investigation into possible CO_2 storage sites close to a proposed power plant in the South Wales Valleys (188). A number of targets were highlighted as potential sites for CO_2 sequestration, with the Cenozoic sandstones being the most favoured. Cenozoic Sandstones consist of 63m gross sand interval in the 163m thick succession, and these sands are well sealed by the overlying Cenozoic mudstones. A structure with a three-way dip closure has also been identified in the area with closure against the St Georges Fault being possibly sealed by salt emplacement. This structure has been extensively modelled in this report, based on available seismic and well data. They do however recommend further computer modelling and injection testing for this target, as a next step to research this prospect.

5.5.59 The Dragon Gas Discovery and could represent potential CO_2 storage potential, following its development and subsequent depletion. The discovery proves that gas can be trapped in this structure. Data on this field is proprietary so discussion with the current operators, Marathon Oil Ltd, would be necessary.

5.5.60 The East Irish Sea Basin (EISB) area offshore from North Wales is the most successful region for oil and gas production in Welsh waters. Consequently, it is relatively well understood in terms of the properties of the rocks and the structures. It is notable that transportation issues related to CO_2 captured for subsequent injection/storage may be of significance since the locations for storage are relatively distant from major (industrial) sources of CO_2 emissions. Location of potential storage sites is also a potential issue from the perspective of Welsh governance as any depleted reservoirs lie outside the 12nm limit of the current study, however notwithstanding such limitations, it is suggested that dialogue with the operator of the (Liverpool Bay) reservoirs may be useful in terms of taking any potential reservoir

sites forward, identifying dual benefit delivered through CO_2 sequestration and enhanced oil/gas recovery.

Areas considered in Welsh Waters

5.5.61 Areas within the 12nm limit included in the study are considered to be less useful for a variety of reasons, including the potential size of reservoir or the lack of good data. There are three however that are worth summarising here as their areas of interest lie with the study area and may yield potential in the future. For each of these, data is proprietary and discussion with the operating companies would be necessary to gain access to this information.

5.5.62 In South East Wales, Sonorex Oil holds licences which include the Eastern Seven Estuary. They have been acquiring seismic data and making geophysical studies to assess potential for oil and gas. Evaluation of their data may show suitable structural traps.

5.5.63 Further West, Eden Energy is planning to investigate Devonian Sandstones for their hydrocarbon potential, although the precise location is not known. Any data acquired by that company to help them to evaluate this area would help to identify suitable rock and structures for CO_2 sequestration.

5.5.64 In the Southern part of the East Irish Sea Basin, a number of potential targets have been identified for sequestration in saline aquifers. This work (393) has identified one structure which is in part within the study area. Further research is required to understand the rock properties, structure and especially the integrity of any seal that may be there.

5.5.65 Use of the south Wales coalfields, which offers the potential to utilise CO_2 to enhance methane production, has been considered following on from Eden Energy's project to produce methane from Coal Measures near Margham. Although the Coal Measures offer apparent potential for CO_2 sequestration initiatives, further, extensive study of this option is critical to ensure that CO_2 would not escape to the surface. The coals in South Wales are geologically complex and highly faulted so ensuring sufficient seal is imperative and is likely, ultimately, to be inadequate in this area. An example of a project like this can be found in the Kaniów demonstration site in Poland. The coals are of the same age as South Wales, although of a different grade and depth, but perhaps the most significant difference is that the Polish site has a cap rock of

Triassic clays, which is absent in South Wales. However, the potential is clear; at Kaniów, they found that 91% of the injected CO_2 was absorbed by the coal, with the methane produced containing some 40-60% CO_2.

5.5.66 Eden Energy in partnership with Coastal Oil and Gas Ltd are currently drilling three core holes to assess the potential to produce Coal Bed Methane in PEDL100, 148 and 149, an area covering some 20% of the South Wales Coalfield. These studies are of interest for two main reasons: firstly, the utilisation of the damaging green-house gas methane as a power source in the area, and secondly, the potential to use CO_2 to enhance this methane recovery, should advances be made in this field in the future that would ensure that there would be no CO_2 leakage, under the conditions found in South Wales.

5.5.67 Given the current, i.e. early stage of development of identifying potential sites for CO_2 storage sites within Welsh waters, it is difficult to follow through to assessing potential impacts and impact data gaps sections in this report in the same way as other topics have been considered. This arises since although generically there will be potential impacts to consider, for example risks associated with leakage of CO_2 from subsurface structures, the potential for this to occur would necessarily be dealt with at the licensing stage. Hence no section on impacts (or indeed impacts data gaps) is presented in sections 5.8 or 6.3 of this document.

References

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630, Smith, NJP, 1987, The Deep Geology of Central England: the prospectivity of the Palaeozoic Rocks

5.6 Summary of Baseline Data

5.6.1 The baseline data collected, together with its broad geographic extent (where applicable), is summarised in Table 5.10.

Table 5.10 Summary of Baseline Data

Issue	Specific Issue	Data Extent	Geographic Extent of Data					Work in Progress
			North Wales	Anglesey	Cardigan Bay	Pembrokeshire	South Wales	
Physical environment	Ocean currents	N/A	SEA 6 and 8					None identified
	Ocean fronts	N/A	SEA 6 and 8					None identified
	Tidal flow	National	Main digital data is from the BERR Renewables Atlas only (versions 1 and 2). Sufficient for broad scale studies, with some issues inshore. Also, the relevant reports from SEA 6 and 8					Work in the Bristol Channel on tidal stream energy
	Tidal height	National	Tide gauge data from point locations					On-going data collection
	Seabed sheer stress	N/A	No data held					None identified
	Water temperature	National	Primarily broad scale descriptions contained in published reports (generally Cefas), with limited point data (e.g. ICES data)					Routine water quality monitoring by Environment Agency Work by PML on sea surface temperatures for SEA 8
	Bathymetry	National	Gridded and contour bathymetric data, including1m and 5m contour lines for Welsh waters up to mean high water					Work in the Bristol Channel
	Seabed sediment	National	Intertidal mapping of sediments (CCW), with broad scale subtidal data from Seazone (BGS) and the JNCC seabed landscape data, descriptions of the geology for Oil and Gas SEAs 6 and 8					Current work by BGS, UK Hydrographic Office and SeaZone Solutions Ltd
		Regional	-	-	-	-	MADP and ALSF mapping	None identified
	Wind resource	National	Main digital data is from the BERR Renewables Atlas (versions 1 and 2). Sufficient for broad scale studies					None identified

Issue	Specific Issue	Data Extent	Geographic Extent of Data					Work in Progress
			North Wales	Anglesey	Cardigan Bay	Pembrokeshire	South Wales	
	Wave and tide resource	National	Main digital data is primarily from the BERR Renewables Atlas (versions 1 and 2) and (for tidal energy) the Stage 2 report. Sufficient for broad scale studies, with some issues inshore.					Cefas Wavenet data SWRDA work off north Cornwall
Water and sediment quality	Sediment quality data	N/A	Quality Status Report for the Irish Sea and Bristol Channel, SEAs 6 and 8					None identified
	Routine monitoring points	National	Welsh waters (e.g. bathing and shellfish waters)					Routine water quality monitoring by Environment Agency
	Discharge data	National	Welsh waters (e.g. IPPC)					None identified
Visual (seascape and landscape)	Baseline – land	National	Data from LANDMAP for Welsh coastal areas where available					On-going work to complete LANDMAP by Spring 2009
	Baseline – seascape	N/A	No data held					BERR RAG project scope in development (probably just England) with CCW project soon to report
			Work undertaken for Gwynt y Môr, Rhyl Flats and North Hoyle	-	-	Work undertaken for Wave Dragon	Some information from Scarweather	
Marine mammals	Harbour porpoise	National	Broad scale information for Wales (e.g. BAP Atlas, UK Atlas of Cetacean Distribution, marine mammal strandings, SEA 6, 7 and 8, Status review of UK cetaceans, boat survey of Wales and SW England, ferry sightings data, Liverpool Bay and Eastern Irish Sea sightings)					CCW work to collate marine mammal data
		Regional	Monitoring and survey data	Monitoring and survey data	Survey data	Survey data	Monitoring and survey data	None identified
	Bottlenose dolphin	National	Broad scale information for Wales (e.g. BAP Atlas, UK Atlas of Cetacean Distribution, marine mammal strandings, SEA 6, 7 and 8, Status review of UK cetaceans, boat survey of Wales and SW England, ferry sightings data, Liverpool Bay and Eastern Irish Sea sightings)					CCW work to collate marine mammal data
		Regional	Summary of sightings data	-	Monitoring and survey data	-	-	None identified
	Short-beaked common dolphin	National	Broad scale information for Wales (e.g. BAP Atlas, UK Atlas of Cetacean Distribution, marine mammal strandings, SEA 6, 7 and 8, Status review of UK cetaceans, boat survey of Wales and SW England, ferry sightings data, Liverpool Bay and Eastern Irish Sea sightings)					CCW work to collate marine mammal data

Issue	Specific Issue	Data Extent	Geographic Extent of Data					Work in Progress
			North Wales	Anglesey	Cardigan Bay	Pembrokeshire	South Wales	
		Regional	-	-	-	Survey data	-	None identified
	Baleen whales	N/A	Broad scale information for Wales (e.g. BAP Atlas, UK Atlas of Cetacean Distribution, marine mammal strandings, SEA 6, 7 and 8, Status review of UK cetaceans, boat survey of Wales and SW England, ferry sightings data, Liverpool Bay and Eastern Irish Sea sightings)					CCW work to collate marine mammal data
	Grey seal	National	Broad scale information on pupping and haul out sites for Wales, SEA 6 and some recent satellite tracking offshore for the Irish Sea and Liverpool Bay					CCW work to collate marine mammal data
		Regional	Data on distribution and abundance (including pups)	Data on distribution and abundance (including pups)	Survey data for Ceredigion	Grey seal monitoring data (particularly Skomer)	-	None identified
Birds	Wetland, wildfowl and waders	National	Some summary data held for Welsh coastal areas, SEAs 6, 7 and 8, more detailed data available to purchase from WeBS, non-estuarine waterfowl survey data from BTO, digital summary sourced from CALM					None identified
		Regional	-	-	-	-	Survey data for Carmarthen Bay	None identified
	Black Scoter	Regional	-	-	-	-	Survey data for Carmarthen Bay	Possible inshore SPA
	Seaduck, diver and grebe surveys	Regional	-	-	Survey data for northern area	-	-	None identified
	Common Scoter	National	Welsh distribution data					None identified
	Non-breeding	National	Overwintering data for gulls					None identified
		Regional					Survey data for the Severn	None identified
	Seabird nesting sites	National	Location of coastal sites across Wales including numbers of breeding pairs (e.g. JNCC Seabird 2000)					None identified

Issue	Specific Issue	Data Extent	Geographic Extent of Data					Work in Progress
			North Wales	Anglesey	Cardigan Bay	Pembrokeshire	South Wales	
	Seabirds at sea	National	Broadscale data from the seabirds vulnerable to oil spill dataset and Oil and Gas SEAs 6, 7 and 8					BERR RAG radar studies of bird migrations. BERR RAG aerial bird surveys throughout Welsh waters, COWRIE work on breeding terns at sea Work to define protected areas at sea pending publication
		Regional	North Hoyle, Gwynt y Môr, aerial surveys in Round 2 areas	-	Wintering bird data	Data at Skomer and Skokholm	-	None identified
Fish ecology	Fish ecology	National	Broad scale mapping of spawning and nursery areas in UK waters (Cefas), known distribution of BAP species in Welsh waters, published information on bass, some data on basking shark (Cefas/MBA), Oil and Gas SEA 6, CCW monitoring of marine and estuarine fish, EA data on use of rivers by migratory fish, groundfish surveys undertaken by Cefas					GIS mapping project for sharks in Welsh waters in progress, BERR RAG project looking at seabed communities in strong tidal streams
		Regional	Recent review of fish and fisheries	-	-	-	General literature for the Severn and Bristol Channel, recent surveys in Swansea Bay	None identified
Plankton	Plankton	National	Broad scale reviews of species distribution and seasonal changes, including SEA 6 and 8, Cefas surveys and SAHFOS data					None identified
Benthic ecology	Intertidal biotopes	National	Data from CCW coastal surveys, CALM, Welsh BAP Atlas and SAC citations					None identified

Issue	Specific Issue	Data Extent	Geographic Extent of Data					Work in Progress
			North Wales	Anglesey	Cardigan Bay	Pembrokeshire	South Wales	
	Subtidal biotopes	National	Broad scale projects include MESH, HabMap, MNCR Reviews, Welsh BAP Atlas, SensMap Atlas, Oil and Gas SEA 6 and 8, survey of Welsh sandbanks					BERR RAG project looking at seabed communities in strong tidal streams Ongoing work on HABMAP COWRIE work to provide data standards guidance for marine benthic data.
		Regional	Baseline information for North Hoyle and Gwent y Môr, with a survey in Conwy Bay	Study in the Menai Straits, SensMap data for Gwynedd and Anglesey	SensMap data for Ceredigion	Benthic surveys in Milford Haven, Daugleddau Estuary, Pembrokeshire, Sea Empress data, SensMap data for Pembrokeshire	Biotope map of Carmarthen Bay and the outer Bristol Channel, baseline data for Scarweather, academic literature	None identified
Designated sites	Designated sites	National	Maps of the location and extent of designated sites					Potential extensions to coastal sites and establishment of offshore sites
Shipping	Shipping	National	Shipping routes, clearways and shipping density maps, location of ports and harbours (Anatec and SeaZone) SEA 6 and 8					MCA/DfT project to release AIS database in preparation, ongoing BERR RAG work to maintain navigation data for 3 strategic regions and expansion to include all UK waters

Issue	Specific Issue	Data Extent	Geographic Extent of Data					Work in Progress
			North Wales	Anglesey	Cardigan Bay	Pembrokeshire	South Wales	
		Regional	Traffic survey for Gwynt y Môr	RYA data currently being updated	-	-	-	None identified
Tourism and Recreation	Tourism and recreation	National	Location of RYA clubs and training centres, recreational sailing routes and racing areas, powerboat racing zones, scuba diving areas, EC bathing beaches, surfing areas, recreational fishing, coastal cycle routes, coastal attractions, National Trust sites, SEA 6 and 8					RYA data currently being updated
		Regional	Recreation fishing in Liverpool Bay	-	-	GIS database of recreation	Recreation fishing in the Severn Estuary (not held)	None identified
Archaeology	Distribution of archaeological resources	National	Distribution of wrecks and known submerged landscapes, SEA 6 and 8					None identified
Commercial Fisheries	Shellfish beds and waters	National	Location of shellfish beds and waters in Welsh coastal areas					None identified
	Commercial fishing	National	Surveillance and landings data, reviews carried out for Oil and Gas SEA 6 and 8, coastal fisheries reviews by Cefas					Fisheries Strategy Study (?), Welsh fisheries data collation programme, COWRIE GIS mapping of fishing and shellfisheries
		Regional	Studies undertaken for Liverpool Bay, North Hoyle, Gwynt y Môr, Walney and West of Duddon and Eastern Irish Sea	-	-	Wave Dragon EA review	Work completed for Scarweather Sands especially during the Inquiry (not held)	None identified
Military Use	General Military interest	National	SEA 6					None identified

Issue	Specific Issue	Data Extent	Geographic Extent of Data					Work in Progress
			North Wales	Anglesey	Cardigan Bay	Pembrokeshire	South Wales	
	Firing danger areas	National	-	Areas to the west of Angelsey	Substantial areas of Cardigan Bay	To the north and south of Pembrokeshire	Carmarthen Bay	None identified
	PTA manoeuvring	National	-	Area to the south west of Anglesey	Patchy areas across Cardigan Bay	-	-	None identified
	Military Radar*							
	MoD establishments	National	Various sites	Various sites	Various sites	Various sites	Various sites	None identified
	Ordnance demolition	National	-	-	-	-	Inshore site within Carmarthen Bay	None identified
	Underwater explosion trials	National	-	-	-	-	Area within Severn Estuary	None identified
	Location of explosive disposal sites identified in MOD document	National	-	-	-	Milford Haven	-	None identified
	Military aerodrome traffic	National	None identified					None identified
Grid Infrastructure	Existing grid including capacity	National	Existing grid, capacity and distribution network and sites of electricity generation					Planned changes to existing grid up to 2013
Cables and pipelines	Cables and pipelines	National	Existing and historic cables and pipelines in Welsh waters (SeaZone) with overview information in SEA 6 and 8					None identified
Renewable	Renewable	National	SEA 6 and 8					None identified

Issue	Specific Issue	Data Extent	Geographic Extent of Data					Work in Progress
			North Wales	Anglesey	Cardigan Bay	Pembrokeshire	South Wales	
Energy	Energy	Regional	Gwynt y Môr, North Hoyle, Rhyl Flats, Rhyl Tidal Impoundment,	Skerries and South Stack Tidal Stream Arrays	-	Tidal Hydraulic Generator testing, Wave Dragon	Scarweather Sands, Swansea Tidal Lagoon, Severn Barrage, Tidal Hydraulic Generator testing, the Atlantic Array	Potential issues with the Severn Estuary
Aggregate Extraction	Aggregate Extraction	National	SEA 6 and 8					None identified
		Regional	Single licensed area	-	-	-	Several application and licensed areas	None identified
Oil and Gas	Oil and gas	National	SEA 6 and 8					Ongoing work on SEA 8
		Regional	Extensive interest outside Welsh waters, with some interest within Welsh waters		Current application for exploration license			Current application for exploration licence
Licensed disposal site	Licensed disposal site	National	Map of site locations from SeaZone, general information in SEA 6 and 8					None identified
Airspace and Radar	Airspace	National	Location of existing aerodromes, aerodrome traffic zones, topographic air charts and NERL radar data					None identified
CO_2 Sequestration	Potential sites	National	Potential for East Irish Sea Basin discussed	Purchase of data required to enable an assessment of Caernarfon Bay	Highlighted St Georges Channel and potential areas of interest in Cardigan Bay	Highlighted the south Celtic Sea, but more research required. Also St Georges Channel	Highlighted due to data availability. Not known suitable geology present	None identified

* *Data not obtained at time of writing*

5.7 Device and Development Specific Information

5.7.1 During the course of the literature review, a number of marine renewable energy devices and developments were identified. These include wind, wave and tidal power projects at various stages, ranging from initial plans through to consented and operational commercial projects. The type and quantity of information available for each device or development is a function of the relevant status of the industry, with wind energy being relatively well established (hence having numerous commercial sites) and wave and tidal devices primarily in a research and development phase, although clearly some are at a more advanced stage than others, with demonstrator or 'pre-commercial' devices deployed. Commercial sensitivity is a key factor in the availability of information, with considerably more data available for some devices than others. As new information becomes available during the later stages of the MRESF project, these will be incorporated as applicable.

5.7.2 A particular issue is understanding the current and future device requirements – i.e. if/how siting requirements such as depth, available energy and distance from shore will change as devices develop. These issues are particularly difficult to address, for a number of reasons which include confidentiality, uncertainty of device requirements as models are scaled up to commercial size and the ability of some devices to be tailored to a variety of conditions. In many cases, it is unclear whether such information is available (but deemed confidential) or still in the planning and development stages. However, for long term planning and the future applicability of the MRESF, an understanding of such issues, as far as possible, is required, combined with a flexible approach that will enable changes to be made as more details on device requirements become available. In doing so, it is important to keep a balance between aspirations (i.e. what can be delivered) in the short to medium term and what can be delivered post 2020. The Strategic Framework will plan to be revised at intervals to enable changes to be incorporated.

5.7.3 The information presented here is an amalgamation of currently known information - i.e. it includes data on device requirements as they exist at present, supplemented, where available, with data on likely future requirements. Of particular note here are the changing requirements of offshore wind, through Rounds 1, 2 and 3.

5.7.4 The type of information sourced includes the following (with references identified listed below):

- Computer modelling to test device feasibility (wave and tide);
- Tank testing of scale models (wave and tide);
- Performance feedback on demonstrator devices deployed at sea, in estuaries or rivers (wave and tide);
- Environmental Impact Assessments and associated reports for commercial scale deployment (primarily wind but also wave and tide);
- Monitoring of the construction and operation of developments (wind); and
- Consultee feedback (primarily wind).

5.7.5 Such reports contain information of relevance to the project, potentially including issues such as:

- Commercial siting constraints – e.g. energy requirements, distance offshore etc;
- Device scale, visibility, deployment position (seabed, mid column, surface, shoreline) and array density/structure;
- For proposals in Welsh waters, baseline data within a discrete area;
- Predicted/measured impacts – scale, extent, significance and duration; and
- Views of consultees regarding issues of concern, consenting restrictions and limitations of current data.

5.7.6 The offshore wind farm industry is characterised by strong similarity in the technology used. The turbines deployed offshore typically follow the same type, with differences generally restricted to issues such as turbine size and the method used to fix the turbines to the seabed (primarily monopile but can be gravity base or multipile). It was commented during the consultation process that technology used to fix wind turbines is evolving, in particular related to concrete and piling technologies, with the latter for example expected to reduce requirements for materials and hence become cheaper financially.

5.7.7 In sharp contrast, the wave and tidal industry includes numerous devices types, with marked differences in size, deployment strategy and operational characteristics. Such

differences can be found between devices but also for the same device where site specifics can require structural differences.

5.7.8 In order to understand where such devices could be located and the potential environmental impacts that may result, it is necessary to appreciate these differences and the siting constraints that are associated with them. The process also enabled the identification of data gaps undertaken in later sections of the current report to be further refined, focusing on data gaps in areas of potential interest to marine renewable developers.

5.7.9 For wind, the process of identifying device deployment requirements is relatively straight forward. However, for wave and tide the complexity of device types and the limited data availability due to commercial sensitivity required a review of wave and tidal devices, with a full list of the devices identified given Appendix C. For simplicity and to ensure confidentiality, the wave and tidal devices identified were subsequently grouped, based on the criteria summarised in Table 5.11. These are broadly based on groupings made in previous studies, being updated for the current situation. It should be noted that the increasing number of groups compared to earlier studies is a reflection of the increase in available information and the differences between devices, with strong differences in siting requirement between device types necessitating the inclusion of a wide number of groups. It is anticipated that these groupings may similarly require revisions during the subsequent stages of the project, as devices are developed.

Table 5.11 Categories and Criteria used for Device-Type Groupings (Wave and Tide)

Energy Type	Device Type Group	Device Type	Device Description
Wave	Installed on the shore or on harbour walls or other man made structure, with a general requirement for hard substrate	Oscillating water column	Wave energy causes water levels to rise and fall in a cylindrical shaft, powering an air-driven turbine.
		Hydraulic pressure	Uses shore fixed 'paddles' to absorb vertical wave motion and convert it to hydraulic pressure
		Overtopping	Incoming waves run up a slope, flowing back down into reservoirs. The water then powers a turbine.
	Nearshore, typically tens to few hundreds of metres from shore in water generally 15-40m but potentially up to 100m deep	Oscillating water column	Wave energy causes water levels to rise and fall in a cylindrical shaft, powering an air-driven turbine.
		Collector	Gathers wave energy over a given area, focusing the energy down to a central point

Energy Type	Device Type Group	Device Type	Device Description
		Individual point/buoy	Individual point/buoy acting as a point absorber of wave motion.
		Orbital wave velocity	Rotor driven by circulating water resulting from surface waves within the water column
		Multiple buoy	Series of buoys linked together, operating on same principle as individual buoys
		Oscillating wave surge converter	Seabed mounted with oscillating arm to extract wave energy movement, primarily sub surface
	Offshore, typically in the range of kilometres, in water depths generally around 50m, with a broad range between 30-100m	Oscillating water column	Wave energy causes water levels to rise and fall in a cylindrical shaft, powering an air-driven turbine.
		Collector	Gathers wave energy over a given area, focusing the energy down to a central point
		Individual point/buoy	Individual point/buoy acting as a point absorber of wave motion.
		Attenuator	Generally float on or at the surface, using the movement induced by the waves to generate power
Tide	Individual device(s) situated within the tidal stream (i.e. tidal stream)	Rotating turbine	Device rotating horizontally or vertically in the tidal flow
		Hydroplanes, hydrofoils and sails	Use of hydroplanes, hydrofoils or sails moving in the vertical in response to tidal flow
		Single blade	Single blade aligned to the flow
		Venturi effect	The Venturi effect is used to accelerate water through the device, creating a pressure drop to drive a turbine
	Barrier across the tidal flow, using either tidal stream or tidal range	Lagoon	Enclosed impoundment, separate from land, using turbines to generate power from the difference in water level (head) on either side of the lagoon
		Pontoon	Vertical axis turbine within a fixed structure
		Barrage	Impoundment 'wall', typically across an estuary

5.7.10 It should be noted that tidal range developments (including barrages and lagoons) have been specifically excluded from this project (see Section 1.2.1).

5.7.11 The data sourced for particular device types were combined with data acquired during the consultation process to enable potential sites for economic development to be mapped. This is discussed further in Section 8.

5.7.12 The final type of device specific literature sourced relates to the deployment of devices at sea, or in some instances in rivers or estuaries. For wind in the UK, this primarily

relates to Round 1 and 2 development sites and for wave and tide to scale models, demonstrator and pre-commercial sites, particularly for single devices. Studies were also sought from international projects. Early studies for commercial deployment of wave and tide arrays (i.e. multiples of devices) are starting to become available. Depending on the country the reports are sourced from, the scale and status of the proposal, the number and detail of documents available (in English) will vary. However, reports sourced have included the following:

- Scoping Reports;
- Environmental Impact Assessments (or national equivalent);
- Summary of EIA findings;
- Non-technical summaries;
- Appropriate Assessments;
- Supporting Technical Annexes;
- Monitoring of construction and/or operation; and
- Consultation responses.

5.7.13 The literature therefore provides considerable information on predicted and potential impacts associated with marine renewable devices. The increasing amount of monitoring data available (primarily wind) is providing important information that will enable the accuracy of predicted impacts to be assessed. This will enable greater certainty to be attached to future assessments of potential impact.

5.7.14 A summary of the projects identified that are going through the consenting process or already hold consent is provided in Appendix D, including a note on whether any associated documentation were sourced.

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5.8 Potential Impacts

5.8.1 The literature search has revealed a number of reports that provide information on the potential impacts associated with marine renewable developments. The availability of information on the potential impacts arising from devices, both in terms of construction and operational phase effects is largely dictated by the current status of the technology and industry, with significantly more information on offshore wind projects than for wave or tide. The status of the industry means that no monitoring data on decommissioning has been sourced, although the impacts likely to be associated are generally assumed to be similar to those during construction. It is also apparent that the majority of the literature relates to *predicted* rather than *measured* impacts, whether that is included in an EIA and its associated technical reports or held within a research report or paper. Such predictions may be based on expert judgment, computer modelling or by inference from experience gained in other offshore industries. A relatively small number of reports provide information measured directly from deployed devices. A greater quantity of information is available for offshore wind than for wave or tide, with some of the offshore wind research directly applicable to wave and tide, for example the effect of cable route installation on intertidal and subtidal habitats.

5.8.2 The literature review for data on potential impacts had a broader search area than the baseline environment review. Literature has been sourced from plans and projects in Wales, the UK and from international studies, for the latter primarily from Europe, America and Canada. While the preference for the current study would be for projects based on the Welsh or UK environment (and hence on environmental processes, human activities, habitats and species likely to be found in Welsh waters), there is considerable value in sourcing studies over a wider area. This is of particular significance for devices or research topics where little UK work has been completed to date. Although blanket application of the results from a particular project or study to a separate project should always be treated with caution, particularly when data has been gathered in a different country, the international data does provide a useful background against which assessments of potential impact can be made.

5.8.3 To aid the literature search, an initial review of predicted and/or known impacts associated with marine renewable developments and devices was made. The review enabled a more focused literature search, while ensuring that each issue or potential issue was addressed (where literature is available). As such, it should be noted that the literature search included issues that do not, or are unlikely to, result in an impact as well as those that have the potential to lead to significant effects (both positive and negative). The potential impacts identified are given in Table 5.12.

Table 5.12 Summary Categories of Potential Impacts

Issue	Potential Impact
Physical environment	Change in sediment deposition
	Change in wave energy
	Change in tidal energy
	Change in vertical mixing/stratification
	Change in direction/reflection of energy
	Scour
	Change in tidal range (limited to specific device types)
	Change in sediment transport
	Change in coastal processes
	Cumulative effects
Water and sediment quality	Mobilisation of fine sediment
	Mobilisation of contaminated sediment
	Accidental spillage/leakage e.g. fuel oil, hydraulic fluids, drilling muds/cuttings
	Use of antifoulants
	Cumulative effects
Visual and Landscape (seascape/landscape	Visual disturbance from additional traffic (road)
	Visual disturbance from increased shipping
	Visual disturbance from temporary construction/decommissioning related structures

Issue	Potential Impact
character, visual amenity)	Visual disturbance from construction/operation/decommissioning of onshore components
	Visual disturbance from construction/operation/decommissioning of above sea-level structures (including lights/paint)
	Visual disturbance of cable landfall point
	Visual disturbance of navigational aids (particularly flashing lights)
	Impacts on Landscapes of Historic Interest
	Physical changes to the landscape (e.g. affecting its character, quality and use)
	Cumulative effects
Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)
	Disruption of migratory routes and habitat exclusion or avoidance
	Use as haul out
	Potential collision risk
	Cumulative effects
Seabirds, wildfowl and waders	Disturbance of seabirds from roosting, breeding or feeding due to noise
	Physical presence of new structures affecting use of area (e.g. displacement, changes to migratory routes, exclusion)
	New roosting site
	Potential collision risk
	Aggregations due to lighting
	Cumulative effects
Fish Ecology	Disturbance/displacement/avoidance of/by fish due to noise (incl migratory routes)
	Direct habitat loss within device footprint
	Change in sediment deposition
	Water quality
	Artificial reef effect
	Potential collision risk
	Potential effects of EMF
	Cumulative effects
Plankton	Vertical mixing
	Cumulative effects
Benthic ecology	Artificial reef effect
	Direct habitat loss within device footprint
	Change in physical conditions
	Impact of construction/decommissioning equipment, anchors and moorings
	Effect of cable route
	Cumulative effects
Designated sites	Potential for adverse effect to site integrity
	Impact on protected habitats
	Impact on protected species
	Impacted on protected geological feature
	Cumulative effects
Shipping	Potential collision risk from fixed structures
	Potential collision risk should devices become loose
	Increased collision risk due to increased shipping
	Search and rescue
	Increased/displacement of shipping density
	Potential for sediment accretion to affect dredging programmes
	Radio navigation and Radar

Issue	Potential Impact
	Cumulative effects
Tourism and recreation	Visual impacts
	Increase in site related vessel/vehicle traffic
	Disturbance to recreational activities
	Collision risk for recreational vessels
	Noise
	Provision of tourist attraction
	Impact of exclusion zones
	Cumulative effects
Archaeology	Disturbance/damage to archaeology
	Cumulative effects
Commercial fisheries	Direct disturbance of fishing grounds
	Displacement from fishing grounds
	Impact of exclusion zones
	Power cables and fishing activity
	Cumulative effects
Military Use	Use of danger areas
	Use of military exercise areas
	Munitions
	Disruption of sonar and radar
	Cumulative effects
Grid Infrastructure	Existing location and capacity
Cables and pipelines	Direct damage caused by physical interaction by anchors, device foundations or device installation
	Reduced access to existing infrastructure for maintenance
	Cumulative effects
Renewable Energy	Cumulative effects
Marine Aggregate Extraction	Sterilisation of potential resource
	Conflict with existing vessel movements
	Cumulative effects
Oil and gas	Sterilisation of potential resource
	Cumulative effects
Licensed disposal sites	Disruption of vessel access to disposal areas
	Direct disturbance to disposal areas
	Cumulative effects
Airspace and Radar	Potential interference with radar

5.8.4 It should be noted that not all of these potential issues will have literature or references that are applicable and it is these gaps, together with topics where insufficient or poor quality information and/or understanding is apparent, that will be addressed in subsequent sections of this report and, if considered to be a significant gap, potentially in subsequent stages of this project.

Physical Environment

5.8.5 The main sources of information on potential or known impacts on the physical environment come from site-specific studies (EIA, AA and monitoring reports),

government sponsored research, academic consortia and conference proceedings. The literature is varied in content and detail, with the information sourced summarised below (in no order of priority).

Change in Sediment Deposition

5.8.6 No literature was identified that specifically investigated potential for a change in existing sediment deposition, although the issue is generally considered within site specific EIAs. Such assessments draw on modelling outputs and existing knowledge of the impact of sediment deposition, gained from other marine industries. In general and largely related to wind turbine installations, limited potential for sediment disturbance is predicted and hence limited potential for significant changes in sediment deposition, although site specifics always require consideration. It is possible that there may be more significant issues for wave and tidal technologies in affecting sedimentation rates within an area given that the devices extract energy from the system, and thus could reduce tidal current speeds, for example (see also 'Change in Tidal Energy' below). Any reduction in flow rate would have the effect of increasing the depositional characteristics of an area. However, the level of energy reduction at a site at which economic deployment of additional devices is precluded may occur before any critical threshold is reached, which could alter the depositional characteristics of an area.

Change in Wave Energy

5.8.7 A number of studies have investigated the potential for a change in wave energy associated with marine renewable developments, primarily for wave energy devices, and to a lesser extent for offshore wind farms. For wave device studies, topics tend to include issues such as modelling of the existing wave climate (e.g. 628), interactions between waves and floating devices (190, 226) and assessments of the impact ranging from the overall physical resource (628) to the effect on the inshore wave climate (629). A single study by Cefas was sourced that considered the potential effect of an offshore wind turbine array, deployed by monopiles, on the inshore wave regime (180). Few authors have investigated links between the physical and biological environment in detail, although some preliminary work has been conducted (e.g. 202) with initial discussions held at workshops (e.g. 442).

5.8.8 Essentially, the work undertaken on offshore wind farms found that predicted changes in the inshore wave climate were in line with predictions made within site-specific assessments (around 2%), with factors such as diffraction, bathymetry and topography

being important considerations. Such changes are smaller than current monitoring methods can detect. For wave devices, the majority of the work available is from Wave Hub and from academic papers. For work undertaken for Wave Hub, research has found that changes in wave height in the lee of devices, i.e. the 'shadow', reaches it's minimum at a distance that was mainly related to the size of the wave device. It was noted that considerable further work is needed to improve modelling of the effect of wave devices (629).

Change in Tidal Energy

5.8.9 Studies that have specifically investigated a change in tidal energy all relate to tidal power devices and the work available tends to be found in academic papers and conference proceedings, with the notable exception of confidential monitoring information undertaken on a tidal turbine, which includes ADCP data investigating the change in tidal energy (596). Projects sourced include both modelling studies and predictions of the effect of energy extraction on tidal flow in general (e.g. 209, 210, 211), but also more specifically for example within estuaries or at specific sites such as Portland Bill (121). The main drive of such projects to date has been related to device and array optimisation, with caution attached pending the availability of public domain monitoring data, which could be used to validate the modelled results.

5.8.10 From conference proceedings it is understood that additional projects have considered issues connected to the resulting 'wake' in the lee of tidal turbines, how far that extends and the reduction in energy that would be expected within the wake, together with modelling simulation of tidal device farms, however the project outputs were not available (73, 90). In a similar manner to research on wave energy reduction, few authors have investigated links between the physical and biological environment in detail, with work restricted to the same projects as for wave energy (e.g. 202), with initial discussions at workshops (e.g. 50). It is understood that the Welsh Energy Research Centre is currently undertaking work related to tidal stream energy that includes modelling of wake effects.

Change in Vertical Mixing and/or Stratification

5.8.11 No literature was identified that specifically investigated potential for changes in existing vertical mixing processes or stratification, with the issue highlighted as a knowledge gap in the recent Scottish SEA (292). However, it should be noted that the lack of information may be a reflection of the low significance attached to the issue.

Change in Direction/Reflection of Energy

5.8.12 The potential for devices to lead to diffraction or reflection of tidal flow has been considered by very few authors, with the information primarily related to sea trials and computer models of OWC wave devices (132, 133, and 437). Such devices are installed either on/in natural hard rock substrate or on man-made structures such as harbour breakwaters. For such devices, the issue is relevant both for internal energy generation but also for broader physical processes interaction, with investigations primarily aimed at device efficiency.

Scour

5.8.13 In terms of renewable energy developments, the issue of scour around a structure has to date in general been restricted to offshore wind farms. However, it is likely that some wave and tidal devices will have similar issues, with some of the wind farm research applicable to some devices, particularly those that use monopiles. The topic has been considered primarily in connection with specific developments through computer modelling studies (e.g. 36, 37), although broader studies have included work assessing the effect of scour on the design of turbines (690), a conference in Denmark that focused on scour (44), and a current BERR RAG project which is understood to be looking at the dynamics of scour pits and scour protection (355). It is understood that scour has been a particular issue for a Round 1 offshore wind farm on the east coast of England, although no data on this particular site has been identified.

5.8.14 Scour can be an important issue for projects and as such it tends to be studied in detail by developers to ensure stability of devices.

Change in Tidal Range

5.8.15 The potential for a change in tidal range is generally considered to be restricted to tidal technologies that generate power from tidal range, i.e. barrages and tidal lagoons. As such the issue is outside the scope of the current report since tidal range is unlikely to be affected by the installation of wave, tidal stream or wind devices.

Change in Sediment Transport

5.8.16 Just two reports that specifically investigated potential for a change in sediment transport were identified. These were an ABPmer report that looked at the potential for Round 2 offshore wind farms to affect sediment transport (3, not sourced, uncertain if

public domain) and a BERR RAG project that is yet to report, which is reviewing Round 1 sediment process monitoring data (357). Information for wave and tidal devices is restricted to site specific EIAs and their associated technical reports, with similar information in wind farm EIAs. Predicted effects tend to be small and localised, although site specifics always require consideration.

Change in Coastal Processes

5.8.17 In addition to EIA documents for wind, wave and tidal power devices, specific assessments sourced included two separate studies on the potential for offshore wind farms to affect coastal processes (1, 587), together with some site specific monitoring of an offshore wind farm post construction (181). The issue was also considered during the Wave Hub application in north Cornwall (317, 454). A Foresight report from 2005 looked at the potential for wave, tide and wind devices to aid coastal defence, based on Bridgwater Bay (296, available to purchase). It is understood that the potential for wave devices to provide coastal defence is a research topic at the University of Edinburgh. In addition, it is understood that a BERR RAG project is active that is investigating models to predict effects on seabed and coastal processes (561) together with a COWRIE project to provide best a practice guide to coastal process impact assessments.

5.8.18 Assessments of potential change in coastal processes are conducted as standard for all proposed marine renewable developments, with a requirement for monitoring attached to some consents, to ensure that significant effects do not occur.

Cumulative Effects

5.8.19 An issue that is often difficult to assess but is required during the EIA process is the assessment of cumulative or in-combination effects. Assessments of cumulative effect are therefore generally included within site specific wave, wind and tide EIAs; however such assessments tend not to be conducted when the potential impact from individual devices is negligible. Specific literature sourced is mainly academic research or conference proceedings, including modelling of an array of wave power devices (95, 96, and 701) and a single study on the flow effects of a tidal turbine array (479). Methods to assess interactions between wave and tidal devices appear to be at an early stage of development (e.g. 190).

On-going Work

5.8.20 The Welsh Energy Research Centre is currently undertaking work related to tidal stream energy that includes modelling to predict potential impacts on hydrodynamics, sediment transport, wake effects and morphology. The Centre is also studying issues connected to power offtake, the level of impact and an assessment of the footprint of a tidal stream array. It is understood that the potential for wave devices to act as coastal defence is a research topic at the University of Edinburgh. The PRIMaRE project is undertaking research on the impacts of Wave Hub on the shoreline and seabed processes, together with a study looking at the dynamic response to energy extraction and mixing (www.primare.org), with MREDS is looking at issues such as coastal physical processes, hydrodynamics and water column processes (www.mreds.co.uk/wp4.htm). BERR studies pending include the review of Round 1 sediment process monitoring data (357), although this is cited as completed in the RAG environmental research portfolio status report (433), a project looking at the dynamics of scour pits and scour protection (355) and a project to investigate models to predict effects on seabed and coastal processes (561). COWRIE have recently announced a research project to provide a best practice guide for offshore wind farm coastal process modelling

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Water and Sediment Quality

5.8.21 The potential for impact on water and sediment quality is routinely assessed during the EIA process, particularly related to issues such as suspended sediment, spillages of

fuel oil, leakage of hydraulic fluids and increasingly the use of antifoulants (the latter primarily related to wave and tide). The majority of the issues are addressed through adherence to best practice and construction/decommissioning environmental management plans etc developed for the specific project, often stipulated as conditions from the consents process. However, very little work has been sourced that specifically monitors the effect of wind, wave or tidal devices on water and sediment quality, with literature sourced limited to a single FEPA monitoring report for a wind farm off north Wales (32).

5.8.22 The main sources of information available therefore relate to desk-based predictions of the effect on water or sediment quality (primarily in EIA documents), with the assessment of potential significance drawing on the experience from other offshore industries.

Mobilisation of Fine Sediments

5.8.23 The potential for construction, operation and decommissioning of marine renewable devices to mobilise fine sediment material such as silt is assessed in EIA documents, with the majority finding minimal potential for significant effect. This is largely based on the selection of appropriate construction/decommissioning methodologies for a particular project, based on ground conditions and environmental sensitivities in the area. The combination of low predicted effect, together with the application of appropriate safeguards such as best practice, is likely to be the main reason for a lack of specific studies.

Mobilisation of Contaminated Sediment

5.8.24 The potential for a mobilisation of contaminated sediment is subject to similar issues to the mobilisation of fine sediment (as discussed above). However, it is anticipated that should a proposal be made in an area where contaminated sediments are known or found to be present, it is likely that there will be a requirement for more detailed studies prior to development to provide greater certainty of potential impact. Clearly if the development would serve to raise significant amounts of seabed material, and thus introduce similarly significant quantities of contaminants into the water column, it is likely that the project would face greater challenges when seeking consent.

Accidental Spillage or Leakage

5.8.25 The potential for accidental spillage or leakage during construction, operation and decommissioning is similarly considered in site specific EIA documents, with much covered by best practice guidelines and in some cases the consenting process. The mitigation offered by the approach means that the majority of studies conclude that the issue represents minimal potential for significant effect. The combination of low predicted effect, together with the application of appropriate safeguards, is likely to be the main reason for a lack of specific studies.

Use of Antifoulants

5.8.26 Biofouling and the need for antifoulants is not generally an issue for offshore wind developments as the portion of the turbine structure within the water column is static, but it is an issue that is considered to be relevant to many wave and tidal devices due to the presence, indeed requirement, of moving parts subsurface. Set against a background of considerable research into the efficiency and environmental impact of antifoul methods used on leisure and commercial vessels (e.g. the Green Blue project, www.thegreenblue.org.uk), the issue is likely to need addressing. The significance of fouling may have site-specific considerations; evidence from the Race Rocks deployment of a tidal device has shown biofouling to be a significant issue for the project. However, it is understood that the case has not been so for the prototype current turbine deployed off Lynmouth in the Bristol Channel. This latter device has apparently not been subject to fouling of the moving rotor even though no antifoulant treatment has been applied to the structure.

5.8.27 Although current research is limited, it is understood that both biofouling and methods of antifoul are a research topic at Glasgow and Newcastle Universities, with a conference proceeding on the effect of biofouling on the efficiency of tidal stream turbines published by Swansea University (509). The Swansea University study found that biofouling is likely to inhibit movement in a specific tidal stream technology.

Cumulative Effects

5.8.28 An issue that is often difficult to assess but is required during the EIA process is the assessment of cumulative or in-combination effects. Assessments of cumulative effect are therefore generally included within site specific wave, wind and tide EIAs. Such assessments tend not to be conducted when the potential impact from individual

devices is very small or negligible and as such do not generally consider water quality issues in detail.

Ongoing Work

5.8.29 The Welsh Energy Research Centre is currently undertaking work related to tidal stream energy that includes modelling to predict potential impacts on water quality, and issues connected to biofouling. Biofouling and methods of antifoul are understood to be research topics at Glasgow and Newcastle Universities.

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Visual and Landscape

5.8.30 Table 5.12 identifies a number of potential sources of visual and landscape impacts; however, the literature identified does not tend to fall within such specific categories, tending to relate instead to visual impact issues more generally. As such the information has not been divided into separate categories for this particular issue.

5.8.31 The potential visual impact of offshore wind farms became a key issue during several Round 1 and Round 2 applications (as well as for onshore wind turbines), with numerous studies investigating the topic. Guidance on the assessment of the impact of offshore wind farms on seascape and visual issues is provided in a report published by DTI (now BERR), the Countryside Agency, the CCW and Scottish Natural Heritage (261). In addition, a recent report to English Heritage (809) provides a method for applying the principles of Historic Landscape Characterisation to England's coastal and

marine zones. A further report of relevance is available for Scottish waters (810), which was commissioned to assess, at a strategic level, where the impacts of offshore wind energy development on the Scottish seascape were likely to be of least significance.

5.8.32 The significance of the potential for visual impact during Round 1 for offshore wind led in part, to the implementation of a blanket exclusion zone around the coast for Round 2 sites, extending in general 8km from the shore but up to 12km in areas of particular environmental, landscape and/or seascape sensitivity. Although there is currently a scope in development to assess the success of the exclusion zone (616), anecdotal evidence suggests that such a blanket restriction reduced the capacity for flexibility in siting for some proposals, potentially reducing the ability of developers to relocate away from areas of particular interest to other users of the sea. It was commented during the consultation process that there was a preference for siting developments 20km from land, at least partially in response to visual impact issues. For the current project, it was requested by the Steering Group that such a blanket exclusion zone be excluded from any constraint mapping at this point in the project.

5.8.33 Visual impact studies for offshore wind sourced for the current project include site specific visual impact assessments as part of applications for consent, which for Welsh waters included the technical report for Gwynt y Môr (277), together with EIA assessments for North Hoyle (23, 32, 692), Rhyl Flats (753) and Scarweather Sands (693). In addition to visual impact studies, the ASIDOHL process is used to assess the significance of the impacts of a development on historic landscapes (e.g. the Gwynt y Môr Cultural Heritage Technical Report, 436), with such documents providing information on existing impacts on the landscapes and the potential changes that a proposal will lead to. Potential impacts on historic parks and gardens are dealt with by Cadw (www.cadw.wales.gov.uk). It is understood that some authors have investigated methods of reducing the visual impact of offshore wind farms (e.g. 299), although the study sourced was purely related to terrestrial turbines. Public perception of visual impact can also by very variable, with some proposals eliciting a very favourable public response and others significant opposition (as evidenced by certain projects in Welsh waters).

5.8.34 For wave and tidal devices, very little assessment of visual impact was sourced, being primarily restricted to assessments contained within EIA documents (e.g. Wave Dragon (542), the SeaGen project in Strangford Lough (591) and Wave Hub (316)). The lack

of specific studies is probably a reflection of two factors, the first being that relatively few devices have been deployed at sea and therefore visual impact has been difficult to assess outside of the EIA process. This issue is compounded by the limited understanding for many devices of issues such as numbers of device per deployment, array density and layout. The second is that not all wave and tidal devices will be visible once deployed. Some wave and tidal devices are fully submerged, and for those that have surface piercing aspects, the height of the device above the waterline is generally much less than for a wind turbine. Hence it is generally assumed that the visual impact of wave and tidal devices is likely to be less (although this assumption does not always take into consideration requirements for marking, lighting and onshore structures). The distance from shore will also have considerable influence on the visual impact. It should also be noted that even for devices that are fully submerged, temporary visual impact is likely to occur during construction and decommissioning, with onshore components present and likely to be visible for the lifetime of the device.

5.8.35 As regards undertaking a visual impact study, it is understood that a report was prepared for CCW that undertook a 'geographical analysis of the intervisibility of the coastal areas of Wales' (455). However, the report was not located during the current project. Additional literature on visual assessments of marine renewables has been published by CCW, including a report that compared visual perception with photo-montage (29).

5.8.36 Issues connected to the potential for cumulative effects tend to be addressed in EIA and SEA documents and hence to date are primarily restricted to wind.

Ongoing Work

5.8.37 Current BERR RAG project in scope to assess the success of the Round 2 exclusion zone (616).

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Marine Mammals

5.8.38 The main sources of information on potential or known impacts on marine mammals come from site specific studies (EIA, AA and monitoring reports), from government sponsored research, from academic consortia and conference proceedings. The literature is varied in content and detail, with the information sourced summarised below. A general overview of the impacts of offshore wind farms on marine mammals,

together with methodologies for assessing such impacts, was published subsequent to the ECS/ASCOBANS, ACCOBAMS workshop in 2007 (803).

Disturbance/Damage from Noise and Vibration

5.8.39 Probably the main issue covered in the literature to date regarding offshore wind and marine mammals has related to the potential impact from noise during the construction, operation and decommissioning, although it should be noted that these studies relate primarily to cetaceans and do not always include seals. The issue of noise is also raised in connection to wave and tidal devices, although as limited monitoring data is available it is difficult to assess the potential significance for the operational stage of such devices. The potential impact from wave and tidal device construction and decommissioning methods, where known, are likely to have strong similarities to existing construction/decommissioning methodologies, particular where techniques such as piling are deployed.

5.8.40 Sources of noise associated with marine renewable developments can include seismic survey, construction/decommissioning activities (especially piling) and noise and vibration during operation. A number of studies are available that investigate various aspects of the issue. These include several reviews of baseline noise, both natural and noise from anthropogenic sources (e.g. 409, 419), together with an increasing number of studies reporting on measurements of noise taken during construction and operation of offshore windfarms (both above and below water) (103, 395, 405, 441, 488, 518). In general, the most significant source of noise arises during the construction process (particularly for methods such as piling), with physical and behavioural effects on some species having been observed. Some of these wind farm studies will be applicable to wave and tidal devices.

5.8.41 A study for a Round 2 wind farm in the Thames Estuary (624) made an assessment of the effect of noise, extending beyond the reactions of individuals and taking a more population level approach. It also reviewed the success of noise reduction measures used, including discouragement methods (e.g. acoustic deterrents), operational methods (e.g. timing) and at source methods (e.g. bubble nets), including some real time monitoring of the reaction of individuals. Additional work has been undertaken on wind farms in Denmark (103) and through the MINOS project in Germany (www.minos-info.org).

5.8.42 In order to assess the impact of noise on marine mammals, it is necessary to understand the noise levels (both frequency and volume) that different species can hear. In response to this requirement, there has been a recent study which reviewed the method used to predict the impact of noise on specific species (493), with the report finding that a distinction should be drawn between actual loudness of a given noise and how that noise is perceived by the animal.

5.8.43 Further relevant research has been undertaken by the MINOS project, which was set up to investigate whether large scale offshore wind farms in the North and Baltic Seas would endanger harbour porpoise, common seal or sea birds. A major part of the study has involved investigations into the sense of hearing and sensitivity to noise in harbour porpoise and common seals, resulting in complete audiograms of both species (from captive individuals). The study found that seals are in general more sensitive at lower frequencies than porpoises, with the latter being more sensitive in the middle and high frequency range (40, 389).

5.8.44 For tidal power, the only study sourced that relates to noise and its potential impact is a confidential report published as part of the EIA for the MCT SeaGen project in Strangford Lough (519). The report included measurements of noise taken from a device *in-situ*, together with an assessment of potential impact from the turbine now consented to be deployed in Strangford Lough. It is understood that noise monitoring of the tidal turbines deployed in New York by Verdant Power is ongoing (www.theriteproject.com). No studies were identified that specifically assessed noise associated with wave power devices, although it is understood that some confidential work has been undertaken on Pelamis.

5.8.45 The concerns around noise and marine mammals have lead, in several cases, to mitigation and monitoring requirements being included in the consent. Mitigation measures used have included techniques such as a soft start to piling (i.e. a slow build up in the rate at which piles are driven), methods to detect the presence of marine mammals prior to the commencement of piling and the use of acoustic deterrents during construction. The JNCC report on the deliberate disturbance of European marine protected species (759) includes reference to the standard FEPA licence conditions for offshore windfarm piling operations, which comprise a combination of soft start, marine mammal observers and passive acoustic monitoring. However, the report does note that additional measures may be required in particularly sensitive areas.

5.8.46 Several studies were sourced that review the use of such mitigation measures for offshore wind (373, 517, 606) together with an assessment and cost of potential engineering solutions for noise mitigation (302). Favoured methods of mitigation, both as regards methods that mitigate impacts and are cost effective, include the soft start approach and the use of acoustic deterrent devices.

Disruption of Migratory Routes and Habitat Exclusion or Avoidance

5.8.47 The potential for the presence of devices to cause marine mammals to be excluded from or to avoid an area has been considered in most EIA and SEA documents, with some monitoring undertaken at offshore wind farms during construction and operation. Of particular note are the studies taken at Nysted in Denmark, which monitored seals and harbour porpoises (265, 652, 653, 675). Similar studies were undertaken at Horns Reef in Denmark on harbour porpoise (335, 654, 674, 676, and 677). The projects included extensive monitoring surveys of seal populations (including video and aerial surveys) and harbour porpoises. The surveys were conducted over several years and included construction and operation periods, providing the most complete information to date for a specific site as regards potential change in behaviour, population and distribution of marine mammals. The reports found that the main effect on both harbour porpoises and seals occurred during the piling stage. An additional recent study provides methods for assessing the effect of construction, operation and decommissioning of offshore wind farms on marine mammals (110).

5.8.48 One of the key areas of research undertaken as part of the MINOS project in Germany included looking at preferential habitats and migratory routes of marine mammals, to increase understanding of why animals use certain areas and the routes taken to move between areas (40, 389), although the majority of the data are only available in German. It is understood that some projects are currently planned or underway that address aspects of this concern in the UK, including a baseline survey of wildlife presence and behaviour at the EMEC site in Orkney (558) and a BERR RAG project involving seal tagging, during and post construction of an offshore wind farm (563).

Use as a Haul Out

5.8.49 The potential for seals to use devices, primarily certain wave and tidal devices, as a haul out site has been raised by some authors (e.g. 331). However, to date no reference has been identified which recorded whether this has actually happened or what the effect might be, whether to the seal or the device.

Potential Collision Risk

5.8.50 An issue that tends to be raised primarily in relation to tidal devices, and to a lesser extent to wave devices, is potential collision risk – i.e. the potential for marine mammals to collide with an underwater structure, particularly when part of the device is moving. The potential for entrainment in some wave devices should be included in this issue. Some desk based work has been undertaken; primarily work for the Scottish SEA (732) but also an MSc project at SAMS (165). Such assessments tend to draw on current understanding of marine mammal behaviour underwater and their ability to detect objects. Specific modelling undertaken for the Scottish SEA (292) determined that for a particular population group of harbour porpoise over a period of a year, there would be 'encounters' with a device for 3.6% of the population. The potential outcome of such an encounter, however, is currently uncertain.

5.8.51 Monitoring data to assess actual collision risk of devices in the water are very limited and no published information has been identified, although tidal stream devices in the water in Canada at Race Rocks (www.racerocks.com) and Roosevelt Island in New York (www.theriteproject.com) are anticipated to provide initial information on potential collision risk for marine mammals and fish respectively once the data are reported.

Cumulative Issues

5.8.52 Where issues connected to the potential for cumulative effects are addressed, it tends to be in EIA and SEA documents and hence to date are primarily restricted to wind.

On-going work

5.8.53 It is understood that two separate projects are in progress in the UK that are looking at developing hardware and software to enable underwater monitoring of marine mammal interaction with submerged devices (559, 576), together with a proposal to monitor seal interactions with a tidal stream turbine (565). Baseline studies are underway at EMEC against which change will be measured (558), with a BERR RAG project involving seal tagging during and post construction of an offshore windfarm (563). Monitoring at Race Rocks in Canada is anticipated to provide data on potential marine mammal collision risk with a tidal turbine (www.racerocks.com). The Welsh Energy Research Centre is also currently undertaking work related to tidal stream energy that includes data collection in the Bristol Channel and an assessment of potential impacts on the

ecology, including marine mammals. Underwater noise monitoring is understood to be ongoing at the Verdant Power site in New York (www.theriteproject.com).

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Seabirds, Wildfowl and Waders

5.8.54 The main sources of information on potential or known impacts on birds come from site specific studies (EIA, AA and monitoring reports), from government sponsored research, research conducted by COWRIE, from academic consortia and conference proceedings. The literature is varied in content and detail, with the information sourced summarised below.

5.8.55 In addition to literature addressing specific interactions between birds and marine renewable devices, there are a number of reports that investigate interactions more broadly. These include an assessment of methods for determining the impact at a population level (422), several broad scale reviews of the effects of offshore wind farms on birds (30, 228, 251, 526), summaries of monitoring data from construction and operation of wind farms (385, 386, 527, 609) and a workshop on cumulative effects (499). General literature that discusses potential impact on birds from wave and tidal devices is very limited, with the issue raised as part of broad scale workshop discussions (50, 442) or as part of literature reviews (331, 453, 619).

Disturbance of Seabirds from Roosting, Breeding or Feeding Due to Noise

5.8.56 The potential for noise to disturb birds is widely acknowledged in the general literature, for example some of the studies on noise disturbance from seismic surveys (679). However, of the studies conducted on potential impacts from noise associated with marine renewables (mainly wind farm studies); birds are generally not specifically considered, with documents tending to concentrate on marine mammals and fish. This is probably a reflection of the location of such developments (offshore and away from areas hosting large bird congregations such as intertidal mudflats), with much of the noise of concern being generated underwater. Birds spend considerably less time underwater than fish and marine mammals and it is likely that the concentration of literature on these latter groups of species and not birds is a reflection of the degree of exposure anticipated to be experienced by birds to underwater noise generated by wind farm construction, operation and decommissioning.

Physical Presence of New Structures Affecting Use of an Area

5.8.57 An additional issue of concern relates to the potential for birds to be disturbed, particularly during the construction/decommissioning process and as a result of access to site for routine maintenance. Such issues are normally addressed in EIA documents and associated technical reports; however some specific studies have been carried out. Projects specifically related to wave and tidal devices are currently restricted to the baseline studies at the EMEC site, against which change following development can be assessed (558).

5.8.58 For offshore wind, two studies have provided descriptions of methods for undertaking aerial bird surveys to determine displacement (423, 424), with a further study to predict the displacement of common scoter (*Melanitta nigra*) from benthic feeding areas (387). The latter study stated that birds that forage on sessile benthic organisms are most likely to be displaced by offshore wind farms, with the potential for impact in the Liverpool Bay area coming from in-combination effects as more developments become operational. A number of reports are available from the Horns Reef wind farm, including one that compared baseline data to data from the year of construction (192). The report found no significant avoidance of the area by birds during construction.

5.8.59 Work undertaken during and post construction of offshore wind farms in the UK (e.g. 788, 789, 790, and 791) includes information of disturbance or avoidance compared to baseline conditions. Analysis of the Lynn and Inner Dowsing survey (788), which was

conducted during the period of foundation construction, revealed no significant or discernible effect on the area by the various species monitored. The continued presence of red-throated diver was observed, with the comment that it would be interesting to determine if disturbance would have an affect at later stages of construction, given the sensitivity of the species noted at some Danish sites. Construction period monitoring conducted at Burbo Bank (791) confirmed the continued presence of low numbers of birds and species. The cormorant showed an increase post construction due to the use of turbines as roosts, with common scoter and red throated diver showing some bias towards control sites; although the low bird numbers meant that the distribution could not be related to construction.

5.8.60 Monitoring of little tern at Scroby Sands post construction (789) was affected by unrelated impacts on the breeding colony, although from the data gathered the birds did not appear to be displaced by the construction activity, with the formation of a sand bar associated with construction actually appearing to offer new foraging opportunities. The work undertaken at Barrow (790) was also post construction, with the results indicating that the wind farm had not lead to significant changes in the occurrence and distribution of common scoter, divers or other wildfowl.

New Roosting Site

5.8.61 The potential for structures at sea to provide roosting sites for birds is evidenced by existing use of such structures. The potential for marine renewable devices to provide a roosting site has therefore been raised by some authors (e.g. 331). Such roosting could have positive effects, such as a safe resting place away from land, or potential negative effects, should it bring a risk of collision with moving parts either in flight or should the bird dive. No literature has been identified that specifically addresses the issue, although reference was made in monitoring of the Burbo Bank wind farm that cormorant numbers increased post construction due to the use of turbines as roosts (791).

Potential Collision Risk

5.8.62 A key concern as regards birds and wind farms, both onshore and offshore, relates to the potential for collision with the blades. A similar concern exists for wave and tidal devices, where there is potential for birds to collide with or become entangled in moving parts on or below the water surface. The majority of collision studies to date have been undertaken for wind farms, with a summary of the literature sourced provided below.

5.8.63 The general literature contains several papers related to the potential risk for birds to collide with offshore wind farms, including studies on bird migration (344) and reviews of remote methods for counting and estimating collisions between birds and offshore wind farms (240). Assessments of potential collision risk between birds and turbines are carried out for all offshore wind farms in the UK to accompany the EIA as part of the application for consent, with a number of such documents sourced (38, 81, 283, 352, and 595). Examples of species which have lead to concern in the UK to date include red-throated diver, lesser black backed gulls, terns, geese (including the pink-footed goose), ringed plover, avocet and common scoter (www.rspb.org.uk).

5.8.64 For some operational wind farms, survey data is available. For example at Nysted in Denmark, two studies are available that present the data collected using a thermal animal detection system, which uses a heat activated infrared video camera to record bird flight (236, 237). During the monitoring periods, although no collisions were recorded, it was felt that more monitoring devices would be required to more accurately determine the overall risk of collision. At Horns Reef in Denmark, a similar study was undertaken using visual and radar observations (193). The report found that birds adjusted their flight path to avoid wind turbines, with such adjustments being more precise during daylight hours. A further study on bird migration across an offshore wind farm was undertaken at Kalmar Sound in Sweden for the period 1999-2003, using a combination of field observations and radar (529). The Swedish study found that eider migration paths did not change significantly post wind farm construction, with birds avoiding the turbines on the small scale. Work undertaken at Barrow post construction (790) stated that no bird collisions were observed during the monitoring surveys conducted.

5.8.65 Studies that assess the potential for collision between diving birds and wave or tidal devices are highly limited, with the only study sourced conducted as part of the Scottish SEA (732). The report acknowledged the current lack of empirical knowledge on the issue, noting differences in potential risk between wave and tidal devices and between devices and mooring arrays. The ability of a bird to detect the devices was considered important in the ability to avoid collision. Further, it is understood that initial studies are being discussed at the University of Aberdeen as regards diving birds and wave and tidal devices, for example looking at how deep birds dive and the area of the water column they use, although we are not aware of any definite projects and as yet nothing has been published. There is some information in the wider literature related to

behaviour of specific birds underwater, including some in-situ monitoring. Examples include research on northern gannets and the work by Wanless *et al* (793).

Aggregations Due to Lighting

5.8.66 It is broadly noted that artificial lighting can attract birds, for example Wiese *et al* (792) studied the issue in connection with offshore oil platforms in the north west Atlantic. The study found the main impacts to be associated with impact on the structure, oiling and incineration by the flare. Issues associated with any such attraction as applicable to marine renewables are likely to be similar to the issues listed under the use of devices as a roosting site.

Cumulative Effects

5.8.67 Where issues connected to the potential for cumulative effects are addressed, it tends to be in EIA and SEA documents and hence to date are primarily restricted to wind. In addition, a workshop was held in 2007 by COWRIE (499) to discuss the cumulative impacts of offshore wind farms on birds.

Ongoing Work

5.8.68 It is understood that a BERR RAG project is underway to assess the energetic costs of barrier effects on birds (569), although it is unclear which technologies the document will refer to, with an additional BERR RAG project to look at the behavioural response of red-throated diver and common scoter to wind farm construction and operation currently being under discussion (574). Monitoring at EMEC is anticipated to provide a baseline against which change can be measured (558). Additional research is currently being undertaken by MREDS (www.mreds.co.uk/wp5.htm) to look at diving birds, with discussions at the University of Aberdeen regarding similar research proposals. COWRIE has recently announced a research project to develop guidance on cumulative impact assessments of birds for offshore wind farm.

5.8.69 Additionally, it is understood that the Welsh Energy Research Centre is currently undertaking work related to tidal stream energy that includes data collection in the Bristol Channel and an assessment of potential impacts on the ecology, including sea birds.

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Fish Ecology

5.8.70 The main sources of information on potential or known impacts on fish ecology come from site specific studies (EIA, AA and monitoring reports), from government sponsored research, from academic consortia and conference proceedings. The literature is varied in content and detail, with the information sourced summarised below.

Disturbance, Displacement or Avoidance due to Noise

5.8.71 Of the research available that considered fish ecology and marine renewables, a significant number relates to the potential impact of noise, particularly during construction/decommissioning but also during the operation of wind farms. The references sourced address issues such as baseline levels of noise (409), monitoring noise data from wind farm sites (103, 441, 624) or predictions of potential impacts based on known fish hearing and response to noise (269, 485, 664, 700, 709).

5.8.72 In addition to the majority of monitoring reports, which essentially record noise levels during construction and operation, a more detailed report is available for a Round 2 wind farm in the Thames Estuary (624). The document made a detailed assessment of the effect of noise, extending beyond the reactions of individuals and taking a more population level approach. It also reviewed the success of noise reduction measures used, including discouragement methods (e.g. acoustic deterrents), operational methods (e.g. timing) and at source methods (e.g. bubble nets). Real time monitoring of the reaction of individuals was restricted to marine mammals, with the difficulties in determining causal changes in fish population and distribution discussed. Studies that monitor the effects of noise directly on fish are restricted to some caged fish studies undertaken during port and harbour piling operations, e.g. in San Francisco Bay (153) and Southampton Water (489). The San Francisco Study observed considerable mortality, finding that bubble net curtains reduced but did not eliminate fish mortality. However, in the Southampton Water study, video monitoring of caged trout revealed no reaction to vibro piling even at distances of just 50m. For impact piling in the Southampton Water study, there was no evidence that the trout reacted at the monitoring range of 400m.

5.8.73 Literature investigating noise emitted from wave and tidal devices is highly limited, with the only report sourced being a confidential study undertaken as part of the MCT SeaGen project in Strangford Lough (519). The report included measurements of noise taken at an operational, commercial scale turbine, together with an assessment of potential impact from the then proposed turbine for Strangford Lough. It is understood that a project to monitor noise from the tidal turbines deployed by Verdant Power in New York is currently underway (www.theriteproject.com). No studies were sourced that specifically assessed noise associated with wave power devices, although it is understood that some confidential work has been undertaken on Pelamis.

Direct Habitat Loss within Device Footprint

5.8.74 The significance of a direct habitat loss within the device footprint is assessed on a site by site basis and as such is included within individual site specific EIAs.

Change in Sediment Deposition

5.8.75 The potential for marine renewable devices to lead to a change in sediment deposition is discussed above (5.8.6). Specific to the potential for such a change to impact on fish, a report has been sourced from work undertaken at the Nysted wind farm in

Denmark, which addressed the potential effect of sediment released during construction on fish (270). The study was undertaken as part of the EIA process and as such does not include monitoring data. Predicted effects during construction were temporary, small and localised and unlikely to be lethal to juvenile and adult fish.

Water Quality

5.8.76 Potential impacts on water quality are discussed above (5.8.21). Specific effects of a potential change in water quality on fish are addressed, where appropriate, in site specific EIAs.

Artificial Reef Effect

5.8.77 Potential issues related to the formation of artificial reefs are investigated in several reports published on the Nysted and Horns Reef wind farms in Denmark (108, 111, 112, 404, and 641). The documents range from predictions of change to monitoring data collected over several years. It is understood that a BERR RAG project is currently underway that is reviewing the reef effects of offshore wind farms (572), together with the potential for enhancement and mitigation. Data sourced for wave and tidal devices were restricted to a conference paper that looked at wave devices (400) and to reviews (e.g. 331), although it is understood that work is ongoing at the tidal turbine deployed at Race Rocks in Canada (www.racerocks.com). There is considerable research available in the wider literature related to artificial reefs, including long term monitoring sites (e.g. Poole Bay) and the European Artificial Reef Research Network (EARRN). When considering the potential for artificial reef, issues connected to biofouling and use of antifoulants should be taken into consideration (as discussed under water and sediment quality).

5.8.78 The Nysted surveys highlighted the speed with which species started to become established on the new substrate, with mussels, barnacles, algae and associated mobile species arriving in the first season (112). Biomass increased in the second year, primarily due to mussel growth, with issues such as water depth and location (i.e. on the shaft or on the scour protection) affecting the community structure (111). Monitoring at the Horns Reef site found similarities in species composition, also noting the influence of depth on the species recorded (404).

5.8.79 Where studies have looked at potential artificial reef issues for wave and tidal devices, the potential to impact on device performance is generally balanced against the

potential benefit to the ecology. Of note is the concrete foundations used to anchor the wave buoys in a Swedish study (400), which demonstrated a succession in colonisation over time.

Potential Collision Risk

5.8.80 The potential for collision with submerged wave and tidal devices, as discussed for marine mammals in 5.8.50, is similarly raised for fish. Fish passage through turbines has been studied at a number of coastal power station intakes over the years, including methods and devices to reduce fish entrainment and mortality, with studies also completed on fish passage through various turbines (e.g. 325, 361, 494, 635, and 680). Such studies may have some applicability for tidal stream technologies. It is understood that research into non-physical fish deterrents has been conducted at Herriot-Watt University.

5.8.81 Studies specifically related to renewable energy devices tend to be restricted to desk based reviews and predictions of effect, for example the Scottish SEA (732), however there are two projects that have monitored the potential for fish to collide with tidal turbines. These include a study published in Dutch and as such not available (341) and an ongoing project by Verdant Power in New York (www.theriteproject.com) that has yet to report. The review undertaken for the Scottish SEA found that although collision risks are not well understood in general, the issue is best understood for fish. A further project of potential interest, despite it being purely freshwater in nature, is the Archimedes screw deployed on the River Dart, which was found to be 'fish safe' (811, 812).

Potential Effects of EMF

5.8.82 The requirement to use cabling to transport power generated at sea to shore is common to all marine renewable technologies, with the exception of onshore wave energy devices. Specific concerns were raised during the early stages of Round 1 offshore wind regarding the potential for such cables to generate an electromagnetic frequency (EMF). Some marine species (particularly elasmobranch fish) are electrically and/or magnetically sensitive and there has been a series of studies investigating the potential impact of cables on these species, initially as a CCW project (305) but subsequently several projects have been undertaken through COWRIE (195, 217, 303, 306). The final report from the current COWRIE project has yet to be published, however from the interim reports it is understood to include *in-situ* studies with fish

tagging. It is understood that there is currently a project planned by the US Minerals Management Service titled 'Effects of EMF From Transmission Lines on Elasmobranchs and Other Marine Species'.

Cumulative Effects

5.8.83 Where issues connected to the potential for cumulative effects are addressed, it tends to be in EIA and SEA documents and hence to date are primarily restricted to wind.

Ongoing Work

5.8.84 A BERR RAG project is currently in progress that is reviewing the reef effects of offshore wind farms (572), with the Race Rocks tidal energy project in Canada including monitoring of artificial reef associated effects. It is understood that the Welsh Energy Research Centre is currently undertaking work related to tidal stream energy that includes data collection in the Bristol Channel and an assessment of potential impacts on the ecology, including migratory fish. Further work is understood to be in progress at PRIMaRE (www.primare.org), which will involve monitoring at the Wave Hub site to measure fish movements and distribution, population structure and genetic variability of commercially important species with the aim of detecting any changes as a result of the Wave Hub project. MREDS (www.mreds.co.uk/wp5.htm) are undertaking research on fish, particularly through PhD projects, with non-physical fish-deterrents research being conducted at Heriot-Watt University. A further COWRIE report on EMF is anticipated, with a new EMF project at proposal stage in the US. Finally, underwater noise monitoring and research on the potential for fish strikes is ongoing at the Verdant Power site in New York (www.theriteproject.com).

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Plankton

5.8.85 No specific research has been sourced that addresses the potential impact of marine renewable energy on plankton. The issue is, however, addressed briefly in some of the

broad scale reviews (311, 453, and 619) and through discussions that have been published in recent years (e.g. 50).

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Benthic Ecology

5.8.86 The majority of the literature that assesses the potential for impact on benthic ecology from marine renewable energy developments is connected to specific developments, including both predictions of impact contained within EIA documents and associated technical reports (wind, wave and tide), together with a more limited number of reports presenting results of monitoring of change during and post development (currently wind only). Information in the broader literature tends to be more generic, based on literature reviews or broad scale discussions.

Artificial Reef Effect

5.8.87 The potential for new structures in the marine environment to form artificial reefs is discussed above (5.8.77) on fish ecology.

Direct Habitat Loss within Device Footprint

5.8.88 Placing a new structure onto the seabed invariably leads to the loss of the previous habitat that existed within the structure footprint, with the footprint including the actual device (together with any associated foundation/anchor structure) together with potential loss along the cable route corridor, subtidally and intertidally, depending on the method of cable laying deployed. The requirement for additional material such as scour protection can increase the initial footprint, and thus the level of impact associated with habitat loss. In general, assessments of the potential impact from such habitat loss are addressed within site specific EIA documents, with significance based on a consideration of the area affected relative to that existing in the vicinity which would remain unaffected, together with the sensitivity of the surrounding habitat and

associated species. The area of effect for an offshore windfarm can be relatively minor, for example, at Gwynt y Môr the EIA (601) determined the area of overall habitat loss from both turbine and scour protection as being some 0.4% of the project area. This minimal area is predicated on the device foundation strategy, and the use of monopiles in the majority of wind turbine installations equates to a small area of direct effect (notwithstanding any requirement for scour protection and so on). However the case may not always be so for wave and tidal stream devices, where relatively large area gravity foundations may be employed. In addition, consideration should be given to potential habitat loss intertidally, depending on the cable route deployment method chosen. The significance of habitat loss effects will, therefore, be determined by the actual footprint of a specific device and the sensitivity of the habitat to be impacted.

Change in Physical Conditions

5.8.89 The potential for the deployment of a marine renewable device to alter physical conditions at a specific site, with subsequent implications for the existing subtidal benthic ecology, is often a key concern for wave and tidal power devices, with the issue perhaps raised less in connection with wind turbines. This arises since the submerged parts of wind turbines are static structures and thus have much in common with other structures installed within coastal waters (piers, oil and gas rigs etc). Potential for changes to the intertidal ecology are generally addressed through coastal impact studies (see 5.8.17), whereby essentially a lack of significant effect on coastal processes is interpreted to mean a lack of significant effect on intertidal habitats. Assessments of such effects therefore benefit from many years of assessment on potential scour, tidal and suspended sediment flow interruption for example, which provide the evidence base for predicting likely effect. However, with respect to wave and tidal technologies, the complexities of device interaction with the physical environment are less well studied, with the nature of the devices meaning that any effect will be less well understood and may be more significant, either solely as a result of the devices moving within the water column, or from the consequent effects of energy (tidal flows or wave power) extracted from the system. The available literature which investigates the potential for such devices to alter the existing conditions is discussed above (5.8.5; Physical Environment), however it is notable that these studies rarely use these data to focus on subsequent effects on habitats and species, a necessary step in increasing understanding of the potential implications for ecology (intertidal or subtidal), with such efforts primarily delivered through development-specific EIAs.

5.8.90 EIAs related to offshore wind farm projects generally consider the potential for a change in physical conditions to affect intertidal and subtidal benthic ecology (e.g. 601, 268) with minimal (localised) impacts usually cited, but other technology types are increasingly subject to study as the wave and tidal sector develops. For example the MCT Strangford Lough proposals discuss the potential for effects, not just resulting from the physical placement of a structure in the water, but from the perspective of energy extraction effects on the benthic ecology. This study broadly concluded that any such changes would be negligible, primarily due to the small extent and magnitude of the predicted effect together with the natural variability of the habitat. More information on the collective effect of a device array within a specific area is needed to provide an understanding of the potential effects at a habitat or species level.

5.8.91 A recent report for CCW and the Crown Estate (202) investigated current understanding of the potential for energy extraction associated with wave and tidal devices to affect intertidal and subtidal ecology, with the report finding that 'some receptors are likely to be more vulnerable to changes resulting from marine renewable devices than others, with the effect appearing to be highly habitat specific'. This links with a need for increasing understanding of the dependency of certain habitats and/or species to high energy environments, and indeed what the thresholds of effect might be.

Impact of Construction/Decommissioning Equipment, Anchors and Mooring

5.8.92 The use of anchors and mooring devices to secure structures and vessels to the seabed is widely applied in the marine environment. It is also anticipated that use of anchors and moorings will be made by certain wave and tidal devices (e.g. 322, 370). Input from the Steering Group has indicated that scour, for example caused by slack mooring chains, can be a concern, particularly over sensitive habitats such as reefs. To date, the literature that is available on potential or actual impacts of anchors and moorings is limited to references for commercial or recreational shipping and sailing (e.g. references to work on the River Medina referenced under the 'Green Blue' initiative, www.thegreenblue.org.uk). However, the mechanisms by which impacts may occur are well understood, comprising disturbance or damage to seabed fauna and flora either temporarily by increasing seabed sediment disturbance (and thus suspended sediment levels), through scouring by chains particularly at slack water or through direct contact with anchoring devices (particularly if anchors are dragged). The

significance of effects is related to the frequency and magnitude of the disturbance, together with nature of the seabed within a specific area, both physical and ecological. Impacts are minimal in areas of soft sediment where the ecological community is characterised by disturbance-tolerant species, but is likely to be more severe in areas of stable seabed colonised by sensitive, sessile or slow-growing species. Effects will be particularly significant in important spawning or nursery areas, areas of seagrass, maerl, rocky or biogenic reefs and shellfish beds.

5.8.93 Construction and decommissioning equipment with the potential to affect the benthos will include anchors and moorings (as discussed above) together with equipment such as jack ups and drilling equipment. The effect of such devices would be temporary and likely to be limited in scale to a relatively discrete area in and around the device footprint. In a similar manner to the potential impacts described for anchors and moorings above, the significance will greatly depend on the type of species present, with the more long-lived and sessile species potentially being at greater risk.

Effect of Cable Route

5.8.94 Ecological impacts arising from cable laying are dealt with within project EIAs since the level of impact is dictated by the nature of the seabed and associated habitats and species (both intertidally and subtidally) and the technique to be employed. The process of laying export and inter-device array cables generally involves ploughing or water jetting techniques where the seabed is suitable for cable burial. However, should cable need to be laid over rock (as may be required for some wave and tidal devices), different techniques such as blasting/armour protection may be required. Impacts from techniques currently used (i.e. ploughing and water jetting) are related to sediment disturbance, smothering and abrasion, temporary direct loss of habitat and direct disturbance/damage effects. Impacts likely to arise from cable laying over rock will therefore differ but could potentially include noise and the introduction of rocky material. The impact of noise is dealt with under marine mammals and fish, with the introduction of rocky material under artificial reefs in the fish ecology section.

5.8.95 Ploughing strategies mitigate potential smothering effects on benthic fauna, flora and habitats by avoiding sidecasting of trench material, with rapid replacement of seabed material over the cable in a dynamic process as the cable length is installed (e.g. 268). However, water jetting requires subsequent infill with suitable material over the cable in the excavated trench, with mobilised material from the seabed significantly elevating

suspended sediment levels in the vicinity of the works. Assessments of impact to benthic fauna usually draw upon impact and recovery studies undertaken for other industries on the subtidal (e.g. 742, 743), with recovery expected to be rapid providing reinstatement of habitat is achieved. No specific references were sourced that considered the issue for the intertidal, with the issue generally addressed at EIA level based on an assumed short lived impact affecting a discrete area. Such intertidal sections are generally sited to avoid sensitive habitats and species, thus mitigating the impact.

5.8.96 In terms of renewable-specific projects, survey information is available from the Nysted wind farm site (243), with ongoing work at the Race Rocks tidal turbine in Canada (available literature on the latter is currently minimal, www.racerocks.com). The results are likely to be applicable to cable routes constructed for wave and tidal devices since the export cables are common in nature across the technology types.

5.8.97 The work at Nysted was particularly focused on the potential effect of disturbed sediment on eel grass (*Zostera marina*), various algal species and benthic community (particularly *Macoma* and *Hydrobia*). It is understood from the literature available on the Nysted site that the extent of visible change at the cable route corridor was up to 10m wide, with sediment disturbance understood to have reduced eel grass growth in the vicinity of the cable route, while the effect on macro algae was unclear. *Hydrobia* numbers declined in the trench, with a subsequent slow recovery. Such data are useful, serving to add to existing knowledge of impact and recovery of benthic habitats and species; however actual gaps in understanding are more evident for specific habitat or community types which are as yet subject to limited study, particularly in terms of recovery periods.

Cumulative Effects

5.8.98 Where issues connected to the potential for cumulative effects are addressed, it tends to be within EIA and SEA documents and hence to date are primarily restricted to wind projects.

On-going Work

5.8.99 For wave and tidal power, it is understood that funding is in place for an ROV survey at EMEC to provide a baseline against which change can be measured (560) together with a current proposal to look at seabed communities in strong tidal streams (575).

There are BERR RAG projects in progress to provide a statistical basis for seabed monitoring as part of the management of offshore wind farms (686), to review reef effects of offshore windfarm structures and the potential for enhancement and mitigation (572) and to investigate cable techniques and effects related to offshore wind farms (571).

5.8.100 It is understood that the Welsh Energy Research Centre is currently undertaking work related to tidal stream energy that includes data collection in the Bristol Channel and an assessment of potential impacts on ecology, including a specific species of polychaete worm (presumably *Sabellaria spp.*). In addition, it is understood that PRIMaRE (www.primare.org) will be monitoring the benthic environment at the Wave Hub site with the dual purpose of detecting change as a result of the project but also to assess potential benefits from the exclusion zone. Research topics at MREDS (www.mreds.co.uk/wp5.htm) include benthic and pelagic dynamics and device mooring requirements and methods.

5.8.101 Although not directly related to marine renewables, it is understood that CCW are currently looking at the sensitivity of benthic habitats to fishing in Welsh waters. The outputs from the work may be useful in understanding potential impacts from marine renewables, particularly those that affect the seabed e.g. anchors and moorings.

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Designated Sites

5.8.102 Few reports are aimed specifically at addressing nature conservation issues associated with marine renewable energy, with recent reports including those produced by ABPmer for CCW and the Crown Estate (202, 331), together with early examples from the NCC (460, 461). The issue is, however, addressed at least indirectly in a number of more general reports where habitats and species of conservation importance are looked at. These include those undertaken on specific species (e.g. marine mammals and birds) or habitats (e.g. indirectly through coastal process studies), with these topics discussed under the relevant headings throughout the preceding section.

5.8.103 Various initiatives have been established that specifically consider nature conservation issues related to marine renewable energy. Such initiatives provide a framework in which issues can be raised and discussed, with the potential to establish solutions or at least a potential route to a solution to specific problems. These include the Offshore Renewables Energy Environmental Forum (OREEF), which was established by DTI (now BERR) with the following aim:

> ‘to provide a forum for government, industry and NGOs to discuss environmental issues relevant to the UK’s offshore renewables energy sector. Through this it informs policy-making and contributes to sustainable development’’

5.8.104 Where issues connected to the potential for cumulative effects are addressed, it tends to be in EIA and SEA documents and hence to date are primarily restricted to wind.

References

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Shipping

5.8.105 A number of projects are available in relation to shipping, which tend to focus on issues such as safe navigation or interference with shipping lanes and radar. The issue is also considered in site specific navigation risk assessments, undertaken on a project basis. There are a number of areas that are of potential interest, which can be summarised as follows:

- Potential collision risk from fixed structures;
- Potential collision risk should devices become loose;
- Increased collision risk due to increased shipping;
- Search and rescue;
- Increase in or displacement of shipping density;
- Potential for sediment accretion to affect maintenance dredging programmes;
- Radio navigation and Radar; and
- Cumulative effects.

5.8.106 Much of the literature relates to safety aspects such as provision of adequate markings and lights (349, 350), guidance on determining navigational risk (28, 260, and 564) and guidance to mariners operating in the vicinity of marine renewable energy devices (439). Such guidance is applied to site specific assessments of navigational risk, with documents sourced for Morecambe Bay (15), Wave Hub (19) and Gwynt y Môr (643). Briefer assessments of risk are available within project specific EIAs.

5.8.107 Particular issues that were raised during the consultation process undertaken for the current project centered on the potential collision risk for shipping, with adequate consultation required early on to enable an informed site selection. The requirement to ensure appropriate aids to navigation are in place then follow, for which Trinity House commented that these should be provided and maintained by the developer/operator. It was also commented that an appreciation of how mariners react to certain conditions at sea would be required. The final issue raised during the consultation process stated that although the incidence of ship to ship and/or ship to device encounters may be relatively low, the effect of such incidents is high in potential loss of life, environmental consequences and the effects of subsequent remedial action (wreck removal).

5.8.108 The use of exclusion zones can be contentious, whether it relates to areas set aside for safe navigation or areas where the right to navigation has been extinguished. In recognition of this, a consultation on safety zones was conducted by BERR in 2006/07 (99, 101), although the regulations are yet to be published.

5.8.109 The Nautical and Offshore Renewables Energy Liaison (NOREL) Group was established by the DTI (now BERR) with the following aim:

> ‘To ensure that the commercial and recreational shipping and ports industries can successfully co-exist with the offshore renewable energy industries and that the needs of the former are taken into account in Government policy on offshore renewable energy. The meetings will do so by providing a forum for Government, developers and stakeholders to discuss and take forward a range of wind farm and other renewable energy related issues’.

Cumulative Issues

5.8.110 Issues connected to the potential for cumulative effects tend to be addressed in EIA and SEA documents and hence to date are primarily restricted to wind.

Ongoing Work

5.8.111 It is understood that a project is currently underway through BERR RAG that is looking at the potential for navigation channel migration due to changes in sediment processes resulting from the construction of offshore wind farms (356).

References

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Tourism and Recreation

5.8.112 A number of projects are available in relation to potential impacts of marine renewable devices on tourism and recreation, which tend to be fairly broad in nature, and not conducive to splitting into sub-categories. For example, a number of studies have looked at the broad effects on the tourist industry (e.g. 149, 497). As such, the issue is discussed below in a more general sense, broadly following the literature review topics which can be summarised as follows:

- Visual and landscape impacts;
- Increase in site related vessel/vehicle traffic;
- Disturbance to recreational activities;
- Collision risk for recreational vessels;
- Noise;
- Provision of tourist attraction;
- Impact of exclusion zones; and
- Cumulative effects.

5.8.113 Perhaps the main issue in connection to tourism and recreation is the potential visual impact. The issue is particularly raised in connection to wind farms. The issue is considered in more detail under ‘Visual and Landscape’.

5.8.114 A particular issue that has been raised as a concern in connection to two proposals in the UK is the potential impact on surfing. It is understood that concerns were raised during the Scarweather Public Inquiry regarding potential impacts on surfing, although no documents have been sourced, with the topic having been subject to several

investigations for the Wave Hub project in north Cornwall (e.g. 117). The most recent report for Wave Hub (117) concluded that '…the impacts of the facility are expected to be low (less than 5% wave height absorption at the shoreline)'.

5.8.115 The final issue that is raised most commonly is the potential impact on recreational vessels and recreational fishing, both in terms of the effect of exclusion zones and the potential navigation hazard posed by increased vessel traffic and the addition of new structures in the marine environment. The issue was highlighted in 'Sharing the Wind' (604), published in connection to the Round 2 strategic areas. The document highlighted the main concerns as follows:

- Navigational safety (including collision risk, risk management and emergency response, marking and lighting, effect on small craft navigational and communication equipment and weather);
- Location (including loss of cruising routes, squeeze into commercial routes, effect on sailing and racing areas, cumulative effects and visual intrusion and noise);
- End of life (including dereliction and decommissioning); and
- Consultation.

5.8.116 During the consultation process, specific concerns were raised regarding safety zones and exclusion zones for recreational activities. It was commented that for offshore wind, such zones have the potential to force recreational activities into alternative areas, potentially areas with greater hazards such as shipping lanes. This concern reflects the issues raised in the above reference (604). The issue was highlighted as being of particular concern off north Wales, where such an effect was considered to be a factor. It was also commented that the need for such zones to apply to recreational activities will depend on site specifics such as device spacing and as such a 'blanket' exclusion distance was not supported. As regards wave and tidal devices, concerns were expressed over the large exclusion zones requested, with the safety basis for these questioned. It was commented that for fully submerged wave and tidal devices, a clearance of 3.5m below mean high water springs would be required.

5.8.117 Potential impacts on tourism and recreation, including cumulative issues, are also considered within site specific EIA documents and SEAs. Cumulative issues are also addressed to a degree in reports that assess the affect of renewable energy (to date

terrestrial wind farms only) on tourism in a broad area (149, 497). The literature tends to show a strong support for renewable energy in general, with negative effects seen as negligible by many, particularly if locations are chosen with care.

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Archaeology

5.8.118 It should be noted that a guidance document on the survey, appraisal and monitoring of the historic environment during the development of marine renewable projects is available (725).

Disturbance/damage to archaeology

5.8.119 Archaeological remains may be damaged or destroyed during the construction/decommissioning of renewable energy installations by; the installation/removal of foundations; pre-construction seabed dredging; ploughing, jetting and cutting involved with the laying/removal of submarine cables; and impacts from the mooring systems of the various vessels which will need to operate in the area during the construction/decommissioning phase.

5.8.120 The impacts upon archaeological remains following the construction phase are primarily related to the potential for seabed scouring. Changing the topography of the seafloor may affect sediment transportation dynamics and/or currents, and could therefore have a secondary impact on maritime archaeological remains. By changing these dynamics, the rate of scouring around a wreck may be increased allowing the wreck to become more exposed and in danger of decay.

5.8.121 Typically the major areas of impact are connected with the construction phase of an offshore renewable development. The direct damage to sites from foundations and cable laying has been the focus of most mitigation measures for renewable schemes around the UK. Most measures have focused upon the identification of wrecks and their subsequent avoidance and for mitigation through compensatory works designed to offset damage to submerged terrestrial archaeology.

5.8.122 Damage to sites from changes to sedimentation regimes has to date been more difficult to assess, however current and future studies may increase the need to consider this type of impact in the future.

Impacts on Landscapes of Historic Interest

5.8.123 The main operational phase impact upon archaeology from the development of offshore renewables, particularly offshore wind farms, relates to the visual impact upon areas of historic designation. Cadw, the Countryside Council for Wales (CCW) and the International Council on Monuments and Sites (ICOMOS UK) have produced a Register of Landscapes of Historic Interest in Wales as a means of identifying the most important historic landscapes in Wales. There are currently 58 areas designated in this way, with an even scatter of such sites around the coast of Wales.

5.8.124 The Guide to Good Practice on using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process produced by Cadw (752) sets out the process whereby the significance of effects from direct physical impacts and indirect visual impacts are to be assessed. It notes that this assessment will be required at the EIA stage in the development process, and that power generation, storage and distribution projects are among those where assessment is likely to be required.

5.8.125 The key impact upon Landscapes of Historic Interest from the development of offshore renewables will be in the effect upon ‘views from’ the landscape, particularly arising from the development of offshore wind farms, as discussed in the section on Visual and Landscape (above).

Cumulative Effects

5.8.126 Cumulative impacts relate to two primary aspects; the potential for renewable projects to collectively alter physical process characteristics within an area, thus affecting archaeological material currently preserved within bed sediments; and the impacts of

land or sea-scape character for areas of historic interest. In terms of strategic planning of projects, the need for consideration of these aspects will be important, but certainly for visual issues, such assessment will relate in the main to offshore wind developments.

References

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Commercial Fisheries

5.8.127 Commercial fisheries issues are addressed within SEA and site specific EIA documents, including wind, wave and tide. Project specific documents sourced that address the issue in or near Welsh waters include the commercial fisheries studies for Wave Hub (284) and Liverpool Bay (411). More general literature on the potential impact of offshore wind farms on commercial fishing include a report on a consultation exercise (313) and a report on the perceived socio-economic impact of offshore wind (421). Potential loss of access to traditional fishing grounds was widely seen as the main concern, together with continued profitability of fishing in general. Potential benefits were limited to opportunities for recreational sea angling, potting and conservation benefits from what would essentially be 'no-take' zones.

5.8.128 The Fisheries Liaison with Offshore Wind and Wet Renewables Group (FLOWW) was established by the DTI (now BERR) with the following aim:

> 'To ensure that the commercial fishing and fisheries industries can successfully co-exist with the offshore renewable energy industries and that the needs of the former are taken into account in Government policy on offshore renewable energy. The meetings will do so by providing a forum for Government, developers and stakeholders to discuss and to take forward a range of wind farm and other renewable energy related issues'.

5.8.129 During the consultation process concerns were expressed that significant problems remain between offshore wind and commercial fishing. In particular, it was felt that project specific consultation is often inadequate and started too late in the process. It

was acknowledged, however, that there are often difficulties on both sides when instigating dialogue between developers and fishing interests.

Direct disturbance of fishing grounds

5.8.130 Direct disturbance of fishing grounds has the potential to impact on the fishing industry if the commercial available fish stocks are affected. The issue is therefore ecological and is addressed in the sections on Benthic Ecology and Fish Ecology above.

Displacement from fishing grounds and the Impact of exclusion zones

5.8.131 The main concern among fishermen tends to be the potential for exclusion from traditional fishing grounds or increased difficulties in accessing such areas, e.g. increased travelling time to site (421). The actual impact is difficult to determine, often compounded by limited data on actual fishing activities and difficulties with project specific consultation. A number of projects are or have been investigating the effect of no-take zones, not necessarily wind farm related, with those identified highlighted below:

- UK Marine Protected Areas (www.ukmpas.org) includes a reference list of literature related to no-take zones and similar areas;
- Marine Protected Areas as a tool for Ecosystem Conservation and Fisheries Management (PROTECT) (http://ec.europa.eu/research/fp6/ssp/protect_en.htm);
- The Lundy No-Take Zone (http://lundynotakezone.org);
- Marine Protected Areas as tools for fisheries management and conservation (EMPAFISH) (http://www.um.es/empafish/); and
- Finding Sanctuary (www.finding-sanctuary.org).

Power cables and fishing activity

5.8.132 Power cables are potential issues for commercial fishing for two main reasons. Depending on the fishing method deployed, they can represent a hazard, e.g. if nets become trapped, together with the more ecological issue of EMF. The latter is discussed in more detail under Fish Ecology earlier in this section. It is the potential hazard posed by cables that may lead to the requirement for an exclusion zone, although it should be noted that not all sites exclude fishing.

5.8.133 A more detailed review of potential effects from a developed wind farm is available for the Vindeby site in Demark, which considered the effects of EMF and noise on commercial fishing (107). The study was undertaken in response to concerns raised by a local fisherman that although fish numbers had increased in the area, flat fish (particularly turbot) did not appear to migrate through the turbines when it was windy. The concern was that the combination of EMF and windy conditions was affecting the fish and therefore his catch. Unfortunately, due to adverse weather conditions, the study was unable to determine whether any such effect was occurring. Subsequent to the fisherman retiring, the project appears to have ceased.

Cumulative effects

5.8.134 Issues connected to the potential for cumulative effects tend to be addressed in EIA and SEA documents and hence to date are primarily restricted to wind.

Ongoing Work

5.8.135 It is understood that there is currently a BERR RAG project in progress that is looking at fishing in and around wind farm sites.

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Military

5.8.136 The potential for impact on military interests is a key issue when considering siting of a proposed marine renewable development and hence military interests are considered

in all EIA and SEA documents, where such interests occur. However, anecdotal information suggests that the potential degree of constraint offered by MoD interests may be so significant that proposals are altered prior to the consent application starting, effectively removing the issue and hence resulting in limited relevant literature. Indeed, during the consultation undertaken it was commented that problems had been encountered with identifying potential development sites in Welsh waters due to the degree of constraint posed by military interests and nature conservation.

5.8.137 The recent Memorandum of Understanding reached between the Department for Business, Enterprise and Regulatory Reform, the Ministry of Defence, the Department for Transport, the Civil Aviation Authority, NATS and the British Wind Energy Association is aimed in part at addressing some of these concerns. In particular, the MoU includes the following agreements:

- Explore innovative technological solutions to Air Defence and Air Traffic radar, as well as radar absorbent wind turbine technology;
- Shorten pre-planning times, by introducing a web-based screening tool for the early stage of planning;
- Establish a new Aviation Management Board which reports directly to Ministers; and
- Work with industry to establish financial and staffing resources dedicated to finding solutions.

5.8.138 There is some information available on the potential effects of marine renewable devices on military interests within existing EIA and SEA documents for sites within a reasonable distance of military interests. Hence, most of the information available is for offshore wind. Further, it is understood that MoD interest in wave and tidal devices is likely to be more site and device specific, and as such it is likely that the potential significance of MoD interests as a constraint may differ between wave and tidal developments.

Use of Danger Areas

5.8.139 The potential constraint imposed by danger areas is likely to be device and site specific, related to issues such as the type of military activities undertaken and the exact location of offshore devices. It is understood from feedback with the Steering Group that there has been an instance that involved a proposal to deploy a wave/tidal

device within a MoD Danger Area in Welsh waters. It is understood that the proposal was considered to compromise MoD range safety, resulting in the proposal being relocated elsewhere.

Use of Military Exercise Areas

5.8.140 In a similar fashion to danger areas discussed above, the issue is likely to be device and site specific. No reference to a conflict between these interests has been sourced.

Munitions

5.8.141 The presence of live munitions in an area would represent a potential hazard to construction, operation and decommissioning of a marine renewable device. No reference to a proposed marine renewable development within such an area has been sourced.

Disruption of Sonar and Radar

5.8.142 The potential for marine renewable devices, to date primarily wind, to disrupt radar has been subject to considerable discussion. The issue is also relevant to civil aviation and as such is discussed further in this section under Aviation and Radar.

5.8.143 A report prepared for COWRIE considered Round 2 sites in the Greater Wash and the potential for unacceptable interference of offshore wind farms with primary air surveillance radars (83). The study examined the potential to deploy new radar to fill in the coverage anticipated to be lost following construction of the offshore wind farms. Although reporting was limited by commercial confidentiality and non-disclosure agreements (with these documents therefore not available), it is understood that a number of potential solutions were identified. There are also some public domain MoD research reports available that consider the effects of onshore wind turbines on a specific radar centre (462, 463, and 464).

5.8.144 The Wind Energy, Defence and Civil Aviation Interests Working Group was set up in 2001 by the DTI (now BERR) to determine the potential impact from wind turbines on aviation, particularly radar and low flying aircraft. Representatives from the MoD were included in the group. Project outputs have included guidelines on the siting of wind farms (365) and it is understood that the group is currently discussing topics including potential impact of wind farms on radar and potential mitigation methods, although no further details were available at the time of writing.

Cumulative Effects

5.8.145 Issues connected to the potential for cumulative effects tend to be addressed in EIA and SEA documents and hence to date are primarily restricted to wind. More wide ranging reports, specifically the Wash radar in-fill study (83), are also applicable here.

References

11, Alenia Marconi Systems Ltd, 2003, Feasibility of wind turbine radar filters

68, Auld, A, 2006, Options for mitigating the impact of wind turbines on NERLs primary radar infrastructure

83, Bannister, DJ, 2007, Radar In-fill for the Greater Wash Area Feasibility Study

365, Jago, P and Taylor, N, 2002, Wind turbines and aviation interests - European experience and practice

462, MoD, Undated, Further Evidence of the Effect of Wind Turbine Farms on Air Defence Radar, RAF Air Warfare Centre, August 2005

463, MoD, Undated, The Effects of Wind Turbine Farms on Air Defence Radar, RAF Air Warfare Centre, January 2005

464, MoD, Undated, The Effects of Wind Turbine Farms on Air Traffic Control Radar, RAF Air Warfare Centre - May 2005.

552, Poupart, GJ, 2003, Wind farms impact on radar aviation interests - final report

581, Raytheon Canada Ltd, 2006, On advanced mitigating techniques to remove the effects of wind turbines and wind farms on the Raytheon ASR-10/23SS radars

Grid Infrastructure

5.8.146 The assessment of potential 'impacts' arising from grid infrastructure development given in the following section relate primarily to the potential challenges of connection rather than impacts *per se*, since these would largely be related to the terrestrial environment (over and above the subsea cable effects which are discussed separately below). However, it is considered appropriate to note within this section the nature of the grid system in extant within Wales to inform development constraints, i.e. 'impacts' on development and on existing grid infrastructure from connecting new renewable projects, rather than strictly environmental effects.

5.8.147 Due to the structure of the transmission system in Wales, it would be easier to incorporate the connection of any new generation of any substantial size within areas with an existing good supply, i.e. north or south Wales. The limited capacity in mid

Wales is likely to result in connections requiring long cabling to route power back to transmission network significantly increasing costs.

5.8.148 There are many factors which affect the connection of generation. Connection at distribution voltages may require significant system modifications arising from thermal, voltage or fault level issues. Some renewable technologies may naturally cluster in a particular geographic area due to the nature of the energy source. This may necessitate significant infrastructure works in such an area.

5.8.149 As stated in the Distribution Long Term Development Statement for SP Manweb PLC in many locations, 'the onshore wind resource is in areas where the distribution system at 132kV and 33kV is very limited, or where existing renewable generation has fully utilised distribution circuits. In these areas, significant transmission and distribution infrastructure is required to connect further generation'. This statement clearly states that the majority of the SP Distribution system is currently highly loaded in terms of thermal capacity and areas of spare capacity on the SP Manweb distribution network are hard to find.

Submarine Cables and Pipelines

5.8.150 A number of issues were identified at the start of the current project as regards potential impacts on or conflict with the cable and pipeline industry. These can be summarised as follows:

- Direct damage caused by physical interaction by anchors, device foundations or device installation;
- Reduced access to existing infrastructure for maintenance; and
- Cumulative effects.

5.8.151 No studies were identified that specifically addressed issues connected to cables and pipelines. EIA and SEA documents consider the issue as standard and, where cables and pipelines are present; tend to apply an exclusion zone of 500m around existing cables and pipelines with the intention of removing the potential for impact on the physical structure. There is potential for tidal devices to affect the mixing and dilution properties of the water column in the vicinity of a long sea outfall, however no such studies have been identified, although it is understood that the issue has been raised in respect of a tidal power proposal in south Wales.

5.8.152 Concerns were raised during consultation regarding licences being granted for offshore wind in an area with existing cables or pipelines (an example was cited in the Irish Sea), with concerns regarding security and maintenance of such cables and pipelines. Additional comments were made regarding potential requirement for crossings with export cables. As regards potential larger scale developments, concerns were also raised that such developments may limit future routing and landings of cables and pipelines.

Renewable Energy

5.8.153 Potential for an interaction to occur between different marine renewable devices or developments would be assessed through a cumulative impact assessment. Such assessments are included within EIA documents where applicable, and to date primarily relate to wind. It is anticipated that similar work may be required at wave and tidal demonstration sites as more devices look to be deployed. Some specific cumulative assessments have been undertaken in the offshore wind Round 2 strategic areas, although these tend to relate to potential impacts on other industries or issues and not to renewable developments, e.g. visual impact (399) or broadscale interactions (590). Where literature is available on device and array interactions, literature sourced relates to modelling of hypothetical wave or tidal arrays (95, 96, 479, 701), undertaken as part of studies to optimise device efficiency.

5.8.154 Cumulative impact issues were also highlighted in the recent Sustainable Development Commission reports on the Severn Barrage, where the potential for various types of tidal power in the Severn was considered (116, 276, and 448). The reports noted in particular that comparisons between single tidal range devices (i.e. barrages and lagoons) to single tidal stream devices would not include cumulative effect resulting from the deployment of multiple tidal stream devices, with such cumulative effects considered to be largely unknown.

References

95, Beels, C, Project in progress, A farm of interacting wave power devices

96, Beels, C, Troch, P, De Backer, G, De Rouck, J, Moan, T and Falcão, A, 2006, A model to investigate interacting wave power devices

116, Black and Veatch, 2007, Research Report 3 - Severn Barrage Proposals

276, Entec, 2007, Research Report 2 - Tidal Technologies Overview

399, Landscape Design Associates, 2000, A Guide to Assessing the Cumulative Effects of Wind Energy Development

448, Metoc, 2007, Research Report 1 - UK Tidal Resource

479, Myers, LE and Bahaj, AS, 2006, Flow effects in marine current turbine arrays

590, Royal Haskoning, 2004, Greater Wash Round 2 Offshore Wind Farms: Cumulative Effects Scoping Report

701, Venugopal, V. and Smith, G.H, 2007, Wave climate investigation for an array of wave power devices

Marine Aggregate Extraction

5.8.155 The potential for conflict between marine renewable developments and aggregate extraction is addressed in SEAs and site specific EIAs. Two main potential areas of conflict were highlighted during the literature search, with a third added during the consultation round. Information available for each of these points is discussed below.

Sterilisation of Potential Resource

5.8.156 It is understood that the issue of marine aggregate extraction was raised during the Scarweather offshore wind farm public inquiry, specifically in relation to the potential for cumulative impact with the Nash Bank licence and potential sterilisation of any potential aggregate resource on Scarweather Bank. However, none of the associated literature was available as a result of project archiving following completion of the Public Inquiry. Concerns regarding sterilisation relate to the placing of both devices and the associated cables, which would essentially preclude extraction, with the issue raised during consultation.

Conflict with Existing Vessel Movements

5.8.157 Additional concerns were raised during consultation as regards the potential for indirect conflict from shipping and vessel movements. Specific concerns raised related to the requirement for safe navigation between wharf and dredging site together with the requirement for flexibility to enable safe navigation while dredging. Potential conflict noted can relate to interference with current navigation routes, i.e. between dredging area and wharf, or should existing shipping routes be diverted, potentially increasing the navigation risk and financial cost.

Cumulative Effects

5.8.158 Issues connected to the potential for cumulative effects tend to be addressed in EIA and SEA documents and hence to date are primarily restricted to wind.

Oil and Gas

5.8.159 The potential for conflict between marine renewable developments and the oil and gas industry is addressed in SEAs and site specific EIAs. Two main areas of potential conflict were highlighted as search topics during the literature search, namely potential sterilisation of potential resource and cumulative effects, however no studies were identified that specifically addressed issues connected to oil and gas. During the consultation process, the only interest noted was the potential for conflicts with logistics, which is best addressed on a site by site basis.

5.8.160 Issues connected to the potential for cumulative effects tend to be addressed in EIA and SEA documents and hence to date are primarily restricted to wind.

Licensed Disposal Sites

5.8.161 The potential for conflict between marine renewable developments and licensed disposal sites is addressed in SEAs and site specific EIAs. Three main areas of potential conflict were highlighted as search topics during the literature search, namely potential disruption of vessel access, direct disturbance to disposal sites and cumulative effects, however no studies were identified that specifically addressed issues connected to licensed disposal sites.

5.8.162 Issues connected to the potential for cumulative effects tend to be addressed in EIA and SEA documents and hence to date are primarily restricted to wind.

Airspace and Radar

5.8.163 The main issue to date for civil aviation as regards marine renewable energy relates to the potential for offshore wind turbines to interfere with radar. It is understood that low flight issues tend to be restricted to military interests, although helicopter routes, e.g. between shore and oil and gas installations, may also be an issue. The issue is considered where appropriate within SEA and site specific EIA documents. In addition, a number of projects have investigated the interaction between wind farms and radar, with the literature including assessments of impact (365, 552), guidelines on how to

address the issue (259) and methods of minimising or mitigating the effect (11, 68, 581). However, it is understood from comments received during the project that such mitigation measures are not universally accepted.

5.8.164 The Wind Energy, Defence and Civil Aviation Interests Working Group was set up in 2001 by the DTI (now BERR) to determine the potential impact from wind turbines on aviation, particularly radar and low flying. Project outputs have included guidelines on the siting of wind farms and interim guidelines on wind farms and aviation interests (365, 552).

5.8.165 The recent Memorandum of Understanding reached between the Department for Business, Enterprise and Regulatory Reform, the Ministry of Defence, the Department for Transport, the Civil Aviation Authority, NATS and the British Wind Energy Association is aimed in part at addressing some of these concerns. In particular, the MoU includes the following agreements:

- Explore innovative technological solutions to Air Defence and Air Traffic radar, as well as radar absorbent wind turbine technology;
- Shorten pre-planning times, by introducing a web-based screening tool for the early stage of planning;
- Establish a new Aviation Management Board which reports directly to Ministers; and
- Work with industry to establish financial and staffing resources dedicated to finding solutions.

5.8.166 Issues connected to the potential for cumulative effects tend to be addressed in EIA and SEA documents and hence to date are primarily restricted to wind.

References

11, Alenia Marconi Systems Ltd, 2003, Feasibility of wind turbine radar filters

68, Auld, A, 2006, Options for mitigating the impact of wind turbines on NERLs primary radar infrastructure

80, Banister, DJ, 2007, Radar in-fill for greater Wash Area

259, DTI, CAA and MoD, 2002, Wind energy and aviation interests - interim guidelines

365, Jago, P and Taylor, N, 2002, Wind turbines and aviation interests - European experience and practice

552, Poupart, GJ, 2003, Wind farms impact on radar aviation interests - final report

581, Raytheon Canada Ltd, 2006, On advanced mitigating techniques to remove the effects of wind turbines and wind farms on the Raytheon ASR-10/23SS radars

5.9 Summary of Literature Sourced Related to Potential Impact

5.9.1 Literature sourced that provides information on predicted or known impacts tended to fall into a few defined categories, which include the following:

- Site specific EIA or AA or within broader scale SEA;
- Site specific technical report;
- Monitoring data;
- Technical research report;
- Academic literature;
- Research group;
- Conference proceedings; and
- Workshop or consultation.

5.9.2 The information sourced is summarised in Appendix E, which highlights where data are available for a specific issue together with the type of data that is available. The intention is to indicate which topics are addressed more widely together with those that have been addressed in specific documents only. It also makes reference to any work in progress. Such an approach makes data gaps very clear, as although the issue may be relevant there will be no 'tick' in the box for issues where no relevant literature has been identified.

5.9.3 The identification of potential impacts that may be associated with marine renewables has highlighted issues that have either been subject to research, to help identify the potential significance of the issue, or present cause for concern, the latter primarily due to uncertainty as a result of the status of wave and tidal technologies and the limited research and in-situ monitoring. When considering the degree of constraint that such impacts may impose on a development (construction, operation and decommissioning), it is important to have a measure of understanding of the relative significance or importance of the potential impacts, both positive and negative. To fully understand the significance that a particular issue may have, site and project specific information would

be required, which is not feasible for a broadscale study such as the MRESF. As such, the term 'importance' is being used, to enable the issues to be ranked, following the terms high (1), medium (2) and low (3). When a measure of importance is assigned, the judgement takes into consideration factors such as the following:

- The potential magnitude of change – for example, is it likely to be within natural variation or does it have the potential to exceed statutory limits;
- The potential extent of change – for example, is the change likely to affect the immediate environment, such as a few 100m, or does it have the potential to cause change over a regional area;
- Sensitivity and/or importance of the receptor – the issue relates to factors such as how marked would the impact be on a receptor (e.g. cause death versus temporary disruption) together with issues such as the degree of legislative protection afforded the receptor or how crucial a particular area/activity is; and
- Mitigation measures routinely applied e.g. exclusion zones.

5.9.4 The assessment of 'importance' is being undertaken at a strategic level and it should be noted that site and project variations will need to be taken into consideration. The information is presented as a guide only.

5.9.5 The degree of confidence is also important – for some issues, the topic is well studied and understood and hence a good degree of confidence can be applied to the assessment of importance. However, for others considerably less is known and for these, the assessment of importance is likely to be more subjective and hence be associated with a lesser degree of confidence. As such, an additional measure of confidence in the assessment is added, following the values attributed to importance i.e. high (1), medium (2) and low (3).

Table 5.13 Relative Importance of Potential Impacts Identified

Issue	Potential Impact	Importance			Confidence		
		Wind	Wave	Tide	Wind	Wave	Tide
Physical Environment	Change in sediment deposition	3	2	2	1	3	3
	Change in wave energy	3	1	3	1	1	2
	Change in tidal energy	3	3	1	1	3	1
	Change in vertical mixing/stratification	3	2-3	2-3	1	2-3	2-3

Issue	Potential Impact	Importance			Confidence		
		Wind	Wave	Tide	Wind	Wave	Tide
	Change in direction/reflection of energy	3	2	3	1	3	3
	Scour	1-2	2-3	1-2	1	3	3
	Change in tidal range	NA (restricted to tidal range technologies)					
	Change in sediment transport	3	2-3	2-3	1-2	2-3	2-3
	Change in coastal processes	1-2	1-2	1-2	1	2-3	2-3
	Cumulative effects	2	2	2	2	3	3
Water and sediment quality	Mobilisation of fine sediment	3	3	3	1	2	2
	Mobilisation of contaminated sediment	2-3	2-3	2-3	1	2	2
	Accidental spillage/leakage e.g. fuel oil, hydraulic fluids, drilling muds/cuttings	3	3	3	1	2-3	2-3
	Use of antifoulants	3	1-2	1-2	1	2-3	2-3
	Cumulative effects	3	3	3	1	1-2	1-2
Visual and Landscape (seascape/landscape character, visual amenity)	Visual disturbance from additional traffic (road)	3	3	3	1	2	2
	Visual disturbance from increased shipping	3	3	3	1	2	2
	Visual disturbance from temporary construction/decommissioning related structures	3	3	3	1	2	2
	Visual disturbance from construction/operation/decommissioning of onshore components	2	2-3	2-3	1	2-3	2-3
	Visual disturbance from construction/operation/decommissioning of above sea-level structures	1	2-3	2-3	1	2-3	2-3
	Visual disturbance of cable landfall point	3	3	3	1	1	1
	Visual disturbance of navigational aids	2-3	2-3	2-3	1-2	1-2	1-2
	Impacts on Landscapes of Historic Interest	1	2	2	1	2	2
	Physical changes to the landscape	1	2	2	1	2	2
	Cumulative effects	1-2	2-3	2-3	1	2-3	2-3
Marine mammals	Disturbance/damage from noise and vibration	1	2	1-2	1	2-3	2-3
	Disruption of migratory routes and habitat exclusion or avoidance	1	1-2	1-2	1	2-3	2-3
	Use as haul out	3	3	3	1	2	2
	Potential collision risk	3	1	1	1	2-3	2-3
	Cumulative effects	1-2	1-2	1-2	1	2-3	2-3
Seabirds, wildfowl and waders	Disturbance of seabirds from roosting, breeding or feeding due to noise	2-3	3	3	1	2-3	2-3
	Physical presence of new structures affecting use of area	1-2	2	2	1	2-3	2-3
	New roosting site	3	2-3	2-3	1	2-3	2-3
	Potential collision risk	1	1-2	1-2	1	2-3	2-3

Issue	Potential Impact	Importance			Confidence		
		Wind	Wave	Tide	Wind	Wave	Tide
	Aggregations due to lighting	3	2-3	2-3	1	2-3	2-3
	Cumulative effects	1-2	2	2	1	2-3	2-3
Fish Ecology	Disturbance/displacement/avoidance of/by fish due to noise	1-2	2	1-2	1	3	2-3
	Direct habitat loss within device footprint	3	3	3	1	3	3
	Change in sediment deposition	3	2	2	1	3	3
	Water quality	3	2	2	1	2-3	2-3
	Artificial reef effect	2-3	2	2	1-2	3	3
	Potential collision risk	3	1-2	1-2	1	3	3
	Potential effects of EMF	2-3	2-3	2-3	2	2	2
	Cumulative effects	2	2	2	2	3	3
Plankton	Vertical mixing	3	2-3	2-3	1	3	3
	Cumulative effects	3	2-3	2-3	1	3	3
Benthic ecology	Artificial reef effect	2-3	2	2	1-2	3	3
	Direct habitat loss within device footprint	2-3	2-3	2-3	1	3	3
	Change in physical conditions	2-3	1-2	1-2	1	3	3
	Impact of construction/decommissioning equipment, anchors and moorings	2-3	2-3	2-3	1	2-3	2-3
	Effect of cable route	2-3	2-3	2-3	1	1-2	1-2
	Cumulative effects	2	2	2	2	2	2
Designated sites	Potential for adverse effect to site integrity	1-2	1-2	1-2	1	3	3
	Impact on protected habitats	Discussed under the appropriate individual sections					
	Impact on protected species						
	Impacted on protected geological feature						
	Cumulative effects	2	3	3	2	3	3
Shipping	Potential collision risk from fixed structures	2-3	2-3	2-3	1	2-3	2-3
	Potential collision risk should devices become loose	3	2-3	2-3	1	2-3	2-3
	Increased collision risk due to increased shipping	3	3	3	1	2-3	2-3
	Search and rescue	2-3	2-3	2-3	1	2-3	2-3
	Increased/displacement of shipping density	3	3	3	1	2-3	2-3
	Potential for sediment accretion to affect dredging programmes	3	2	2	1	3	3
	Radio navigation and Radar	2	2-3	2-3	1	3	3
	Cumulative effects	2	2	2	1	3	3
Tourism and recreation	Visual impacts	See relevant information under visual and landscape					
	Increase in site related vessel/vehicle traffic	3	3	3	1	2	2

Issue	Potential Impact	Importance			Confidence		
		Wind	Wave	Tide	Wind	Wave	Tide
	Disturbance to recreational activities	2	2	2	1	3	3
	Collision risk for recreational vessels	3	2	2	1	3	3
	Noise	2-3	3	3	1	3	3
	Provision of tourist attraction	2	2	2	1	3	3
	Impact of exclusion zones	2	2	2	1	3	3
	Cumulative effects	1-2	1-2	1-2	1	3	3
Archaeology	Disturbance/damage to archaeology	2-3	2-3	2-3	1	3	3
	Cumulative effects	2	2	2	1	3	3
Commercial fisheries	Direct disturbance of fishing grounds	Addressed through the benthic and fish ecology sections					
	Displacement from fishing grounds	1-2	1-2	1-2	2	2	2
	Impact of exclusion zones	1-2	1-2	1-2	2	2	2
	Power cables and fishing activity	2	2	2	2	2	2
	Cumulative effects	2	2	2	2	3	3
Military Use	Use of danger areas	1-3	1-3	1-3	1-3	1-3	1-3
	Use of military exercise areas	1-3	1-3	1-3	1-3	1-3	1-3
	Munitions	1-3	1-3	1-3	1-3	1-3	1-3
	Disruption of sonar and radar	1-2	2	2	1-2	3	3
	Cumulative effects	1-2	2	2	1-2	3	3
Grid Infrastructure	Existing location and capacity	1-2	1-2	1-2	1-2	1-2	1-2
Cables and pipelines	Direct damage caused by physical interaction by anchors, device foundations or device installation	3	3	3	1-2	1-2	1-2
	Reduced access to existing infrastructure for maintenance	3	3	3	2	2	2
	Cumulative effects	2	2	2	2	2	2
Renewable Energy	Cumulative effects	2-3	2-3	2-3	1-2	3	3
Marine Aggregate Extraction	Sterilisation of potential resource	2	2	2	2	2	2
	Conflict with existing vessel movements	3	3	3	2	2	2
	Cumulative effects	2-3	2-3	2-3	2-3	2-3	2-3
Oil and gas	Sterilisation of potential resource	3	3	3	2	2	2
	Cumulative effects	3	3	3	2	2	2
Licensed disposal sites	Disruption of vessel access to disposal areas	3	3	3	2	2	2
	Direct disturbance to disposal areas	3	3	3	2	2	2
	Cumulative effects	3	3	3	2	2	2
Airspace and Radar	Potential interference with radar	1-2	2	2	1-2	3	3

6 Data Gaps

6.1 Data Gaps

6.1.1 The literature review and consultation have revealed a wealth of baseline information related to the Welsh marine environment and the potential effects of marine renewable energy. However, it is clear that despite the quantity of data available, the information is patchy, both geographically and technically, and that significant gaps exist. In many cases, although broadscale data are available, the information is not considered sufficient to be used on a site specific basis. In some cases, the lack of data has the potential to cause delays and potentially lead to an increased financial burden for developers. Such uncertainty was cited during the consultation process as being a significant concern for some, both in relation to difficulties in gaining initial financial backing but also being a consideration when undertaking site selection.

6.1.2 Although there will always be a requirement for site specific data and assessment, there is also a need for broad scale studies, both to enable individual developments to be placed in context and to enable impacts to be better predicted and understood. It would be very difficult to ensure sufficient site specific data are available for all potential development sites in Welsh waters, being perhaps more appropriate to ensure that the broadscale is understood as a starting point before increasing knowledge on the smaller scale.

6.1.3 Although the purpose of the project is to identify data gaps at the broadscale, it should be noted that the emphasis is placed on identifying gaps that may have the potential to present a constraint on marine renewable development. As such, there is a degree of subjectivity involved. For example, when considering potential broadscale data gaps in the baseline information, the types of impact and their significance have been a consideration when determining whether sufficient data exists – i.e. for environmental aspect types where limited impact is anticipated or impacts are well understood from other industries (e.g. water quality), a lower level of baseline broad scale data is considered acceptable than for an environmental aspect where either significant impacts are anticipated or impacts are largely unknown (e.g. wave and tidal device effects on marine mammals and birds). For the impact data gaps, a similar approach was taken in that for issues where the effect is either anticipated to be significant or where significant uncertainty exists (e.g. the effect of energy extraction on the benthos);

a greater amount of understanding would be required than for issues of less significance.

6.1.4 As a result of the approach taken to determining where data gaps exist, no summary has been provided of topics where sufficient baseline data is deemed to be available at the broadscale, as this may be considered misleading particularly for other industries interested in broadscale environmental data. Instead, the summary information has concentrated on highlighting identified data gaps, as taken forward in Section 9.

6.1.5 Once the data gaps have been identified at a broad level, as presented in Sections 6.2 and 6.3, these will be taken forward in Section 9 to 'rank' the data gaps according to the priority for identified areas of potential commercial viability within Welsh waters. Priority in this context refers to the main aim of the overall project, which is to provide a framework for marine renewable development in Wales. To do so, the main hurdles and barriers to development (including data gaps) need to be identified and, where feasible, addressed. Those with a high priority will be address in more detail in Section 9.

6.2 Data Gaps in Understanding of the Baseline Environment

Physical Environment

6.2.1 A reasonable amount of data exists to provide broad scale information on much of the physical environment. Such information includes seabed sediments, bathymetry, tidal flow, tidal height, wave energy and wind energy. Particular problems with the data tend to occur in near shore and estuarine areas. It is noted that much of this information can be sourced from the BERR Renewables Atlas, which has recently been updated, however there are still limitations in the dataset, notably for waves inshore.

6.2.2 Specific broad scale information that is lacking relates to issues such as water column mixing and ocean fronts. Although concerns have been raised regarding the potential for some devices to affect vertical mixing processes, the potential for such changes to occur is currently unclear and as such it is not considered necessary at present to acquire broad scale information on these issues.

Summary of data held:	Broad scale information for most parameters
Summary of work in progress:	Work being undertaken by the Welsh Energy Research Centre.

	Defra/Cefas strategic wave monitoring network. Potential work at Wave Hub may include some Welsh waters information. Research in progress at MREDS looking to improve current wave/tide monitoring methods to increase applicability on the broadscale. Current project by BGS, UK Hydrographic Office and SeaZone to produce GIS maps of the seabed Work in the Bristol Channel on tidal stream energy and bathymetry
Significant broad scale data gaps at present:	Increased definition of wave and tidal energy resource using smaller mesh grid to provide information for inshore areas and constrained coastal areas. Potential limitations in the BGS dataset relate to under representation of rocky areas and potential limitations in the broad 'gravel' classification for ecological purposes.

Water and Sediment Quality

6.2.3 Water quality data sourced are primarily coastal, with limited information beyond the immediate coastal zone. No sediment quality data have been sourced outside of site specific EIAs. Most water and sediment quality issues for proposed developments are addressed by compliance with the appropriate best practice methods and as such are unlikely to cause significant problems for developments. The main exceptions to this are likely to be related to the release/disturbance of sediment (and any associated contaminants), consents to discharge and antifoulant paints. To enable the impact of these to be assessed, an understanding of the baseline environment will be required. Such information is generally required on a site specific basis and it is not considered that additional broad scale data would be beneficial.

Summary of data held:	Coastal water quality data. No sediment quality.
Summary of work in progress:	Routine monitoring by the Environment Agency
Significant broad scale data gaps at present:	None identified

Visual and Landscape

6.2.4 There are a number of sources of information to describe the existing landscape of Welsh coastal areas, including a number of site specific assessments of offshore wind farms, with the main source being LANDMAP. LANDMAP is currently in its final phases and is expected to be completed by the end of spring 2009. LANDMAP data files used in the current project were complete as of 28/08/08, with the dataset to be updated with the final versions during Stage 2 of the project. Limited information is available for seascape issues, being restricted to individual site specific projects. There is an important CCW seascape assessment report due in autumn 2008 which is anticipated to significantly uplift the level of understanding and evidence base for Wales and there is currently also a BERR RAG project in scope, although this is currently proposed to extend to England only.

Summary of data held:	Broad scale information for terrestrial landscapes, limited information on seascapes
Summary of work in progress:	Seascape project scope in development for England. CCW seascape project due to report On-going work to complete LANDMAP by Spring 2009
Significant broad scale data gaps at present:	The CCW Seascape assessment (once published) is likely to address current data gaps, and adjacent (England) areas will also be covered by the BERR seascape project.

Marine Mammals

6.2.5 To enable an assessment of impact on marine mammals, it is necessary to have information on the species present, their sensitivities and ideally their distribution and behaviour. Several reports present broad scale data on cetacean distribution, with a number of ongoing projects specific to discrete areas of Welsh waters, in some cases providing more detailed information on seasonal use of areas. Grey seals are monitored at pupping and haul out sites, with some recent satellite tracking offshore in the Irish Sea and Liverpool Bay.

Summary of data held:	A number of disparate studies, with limited information on overall distribution or use of an area
Summary of work in progress:	On-going monitoring at discrete points. Collation and mapping work in progress

	by CCW.
	Work being undertaken by the Welsh Energy Research Centre in the Bristol Channel
Significant broad scale data gaps at present:	Up to date GIS mapping to collate all existing data, replacing older datasets (primarily hard copy) that lack more recent information.
	Analysis of survey/sightings density would be beneficial in placing distribution information into context (including hotspots).
	Use of high current areas by marine mammals.
	Ideally, available data would include up to date information on distribution and abundance, behaviour, migration routes etc including spatial and temporal variations.

Seabirds, Wildfowl and Waders

6.2.6 A number of sources of information exist regarding coastal bird distribution and numbers on a broad scale, including WeBS data and seabird nesting sites information. Information on seabirds at sea is currently available for specific species (e.g. common scoter) and more widely, from a series of projects including oil spill vulnerability data and Seabirds 2000. The recent aerial surveys for the Round 2 SEA regions have increased data coverage for north Wales, with the current BERR RAG surveys anticipated to provide aerial bird data throughout the majority of Welsh waters, with the exception of an area at the south west tip of Cardigan Bay and along the north Wales coast. Discussions during the consultation process identified work in an early stage that is investigating behaviour of diving birds underwater.

Summary of data held:	Reasonable broad scale coverage for intertidal and nesting sites. Recent aerial surveys in north Wales. Patchy and very broad scale information for the majority of Welsh waters
Summary of work in progress:	Ongoing BERR RAG work throughout Welsh waters on aerial surveys.
	Work to investigate behaviour of birds underwater at MREDS.
	Work being undertaken by the Welsh Energy Research Centre.
	BERR RAG study of bird migration

	COWRIE work on the use of coastal waters by breeding terns
	The identification of new designated sites for birds offshore
	CCW work tracking Manx shearwater at Skomer.
	Work using radio-telemetry to define protected areas for seabirds at sea is currently pending.
Significant broad scale data gaps at present:	Ideally, available data would include up to date information on distribution and abundance, behaviour, migration routes etc including spatial and temporal variations.
	Underwater bird behaviour including use of the water column, seasonal variations, dive depth and dive profile.

Fish Ecology

6.2.7 Information on fish ecology is patchy. The most recent reviews include work undertaken for Oil and Gas SEA 6, a review completed for offshore wind farms off north Wales and Liverpool Bay and several surveys in Swansea Bay for Scarweather Sands. Data becoming available on the Cefas website should improve the availability of fish ecology data. Basking shark distribution in the UK has been the subject of recent study, with a project currently in progress to map sightings in Welsh waters.

Summary of data held:	Broad scale information for some species together with patchy information in general literature. Site specific studies for wind farm sites
Summary of work in progress:	GIS mapping of basking sharks in Welsh waters.
	Work being undertaken by the Welsh Energy Research Centre
	Data becoming available on the Cefas website.
	BERR RAG project to look at seabed communities in strong tidal streams.
Significant broad scale data gaps at present:	Publicly available data is in general limited, particularly regarding migratory species and elasmobranchs
	Definition of important areas for wider range of species (not solely commercial stocks)
	Ideally, available data would include up to

	date information on distribution and abundance, behaviour, migration routes etc including spatial and temporal variations.

Benthic Ecology

6.2.8 Welsh intertidal habitats have been subject to recent survey by CCW which, combined with SAC biotope maps, provides good coverage. Subtidal data are available from various broad scale projects, each tending to cover slightly different areas, together with more localised data for north Wales, Pembrokeshire and south Wales. Little recent data were sourced for Cardigan Bay, the Severn Estuary and around Anglesey.

Summary of data held:	A large amount of information is available at different scales, but the information is not complete for the subtidal. Intertidal coverage is assumed to be complete following the CCW surveys.
Summary of work in progress:	Extension of HabMap work to include subtidal areas in the Dee and Severn Estuary. Work being undertaken by the Welsh Energy Research Centre. BERR RAG project to look at seabed communities in strong tidal streams. COWRIE project to provide data standards guidance for marine benthic data.
Significant broad scale data gaps at present:	Limited information for Cardigan Bay, around Anglesey and in the Severn Estuary Limited sampling data to inform and characterise benthic habitats offshore in deeper water areas where potential projects may be sited. Lack of broadscale biotope information in Severn Estuary

Plankton

6.2.9 The requirement for information on plankton was raised during consultation, with concerns regarding issues around vertical mixing within the water column and shading by devices. The significance of such issues is uncertain and as such, the requirement for detailed plankton information is yet to be determined. Information that has been sourced on plankton distribution is currently limited to broad scale information and literature reviews.

Summary of data held:	Broad scale reviews
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Dependant on an improved understanding of potential impact

Designated Sites

6.2.10 The location of inshore and coastal designated sites is well mapped, with the location of features relatively well known for Natura 2000 sites.

Summary of data held:	GIS data files of the extent of designated sites.
Summary of work in progress:	Work to identify offshore sites and seaward extensions to coastal sites
Significant broad scale data gaps at present:	Dependant on future offshore sites

Shipping

6.2.11 Shipping routes are monitored by radar, with information on routes, vessel type and number held as GIS files, together with port and harbour extents.

Summary of data held:	Shipping routes, location of ports and harbours and shipping clearways (the latter term understood to be no longer in use)
Summary of work in progress:	MCA/DfT report in preparation. BERR RAG project to extend existing maintained database on 3 strategic areas to UK waters
Significant broad scale data gaps at present:	Clarity on shipping clearways (or subsequent successors), their location and implications for development

Licensed Disposal Sites

6.2.12 The extent of licensed disposal sites has been sourced in GIS files.

Summary of data held:	Extent of licensed disposal sites
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	None identified

Tourism and Recreation

6.2.13 A number of sources of information have been sourced that map recreational activities along the coast and within Welsh waters. These provide broad scale information together with more detailed data for Pembrokeshire and north Wales.

Summary of data held:	GIS mapping of recreational activities throughout Welsh waters
Summary of work in progress:	Ongoing work in a GIS database of recreational activities in Pembrokeshire. It is understood that the RYA Atlas is scheduled to be updated in the second half of 2008
Significant broad scale data gaps at present:	None identified

Archaeology

Summary of data held:	Broadscale data on the distribution of wreck sites and information on shipping routes and seabed features which can inform prediction of areas likely to be important for which no data exists. Geological data for some areas to inform submerged landscapes, though incomplete
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Marked gap in the data within the Cardigan Bay area, which includes a known natural hazard in the form of St Patrick's Causeway Lack of data for areas offshore. More comprehensive information on recorded losses (and their significance). Marine geophysical data to attempt to identify currently unknown wrecks. Geophysical data to resolve potential submerged landscape features and/or deposits.

Commercial Fisheries

Summary of data held:	Primarily surveillance data but also broadscale reviews and site specific studies
Summary of work in progress:	Collation of Welsh fisheries data currently in progress COWRIE project to develop spatial

	information layers for commercial fishing and shellfishing to help inform the strategic siting of offshore windfarms
Significant broad scale data gaps at present:	Dependant on outputs of the current work and timescales of its publication, but likely to include the need for robust information on fished areas, over appropriate spatial and temporal scales. Definition of areas relied upon by smaller inshore vessels

Military Use

6.2.14 The location of MoD interest and military activity areas is available as GIS data files, with information on munitions within the MoD archives.

Summary of data held:	Geographic extent of MoD interest and military activity areas
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	None identified

Grid Infrastructure

Summary of data held:	Existing grid and planned/proposed additions over next few years
Summary of work in progress:	Transmission Access Review and associated work
Significant broad scale data gaps at present:	The gap does not relate to data but rather to capacity in required locations

Cables and Pipelines

Summary of data held:	Geographic location of cables and pipelines
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Certainty in baseline data, particularly accuracy of the location of redundant cables and pipelines.

Renewable Energy

Summary of data held:	Known locations of operational, consented and proposed sites together with test sites
Summary of work in progress:	A number of sites are currently going through the application process and deployment locations may change
Broad scale data gaps at present:	None identified

Aggregate Dredging

Summary of data held:	Location of application and licensed areas
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Lack of information on aggregate wharves and routes travelled between wharf and dredging site

Oil and Gas

Summary of data held:	Location of oil and gas interests in Welsh waters
Summary of work in progress:	Current licensing rounds may lead to changes, including the current application in southern Cardigan Bay. Ongoing work on SEA 8
Significant broad scale data gaps at present:	None identified

Airspace and Radar

Summary of data held:	Location of existing facilities and potentially affected areas
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Dependant on potential for impact from wave and tidal devices

CO_2 Sequestration

6.2.15 The major constraints at this stage are the time available and the data quality required. The majority of data are typically old or only available at high costs, with the basis of the work primarily gleaned from academic papers or from work published by BGS. Use of information from such disparate sources has problems with correlation. It is considered, however, that attention be drawn to evaluating the potential of St George's Channel, the area of the 'Dragon' discovery at Cardigan Bay and the existing production areas in the East Irish Sea basin.

Summary of data held:	Review of studies in public domain, more data available to purchase
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Further work to identify potential targets for further evaluation will necessitate the acquisition of existing seismic and well data and geophysical work done to date Only when an area of possible sequestration has been identified would it be recommended to acquire new data, if

	needed, because of the high cost of data acquisition.
	The source of the volumes of CO_2 identified for sequestration (as this will potentially have implications for the location of sequestration sites).

6.3 Data Gaps in Understanding of Potential Impacts

Physical Environment

6.3.1 Overall it was apparent that although physical impacts are increasingly well understood for offshore wind farms, with current projects expected to increase that knowledge, information for wave and tidal devices is, in general, limited. It is considered premature to determine key data gaps for offshore wind prior to the publication of some of this work, particularly the review of Round 1 monitoring data. However, key data gaps for wave and tidal device have been identified below, some of which are anticipated to still apply to offshore wind farms (particularly issues around cumulative effects).

Summary of data held:	Primarily EIA and SEA data, with select topics addressed in technical reports. Increasing number of grey literature, particularly workshops and conference proceedings
Summary of work in progress:	BERR Rag research including Round 1 monitoring, wind farm related scour, review of models to predict effects on sediments and coastal process
	Work being undertaken by the Welsh Energy Research Centre.
	Work on coastal physical processes and water column processes being undertaken at MREDS.
	Work at PRIMaRE on seabed and shoreline processes and the dynamic response to energy extraction and mixing.
	Research at University of Edinburgh on wave devices as coastal defence.
	COWRIE project to provide a best practice guide to coastal process impact assessments
Significant broad scale data gaps at present:	What will be the change in wave or tidal energy, the extent and magnitude of any wake effects and potential for subsequent change in sedimentary and coastal processes

	Guidance on how and what to monitor to improve modelling prediction capabilities.
	Potential implications for vertical mixing (unclear if this represents an actual cause for concern)
	If or how energy extraction at the surface or mid column will affect the seabed
	Whether there is a critical amount of energy that can be extracted prior to significant change occurring
	Cumulative effects
	Guidance on the methods available for predicting and monitoring such change is lacking, including the suitability of the different techniques, together with what actually needs to be measured.

Water and Sediment Quality

6.3.2 The majority of potential water and sediment quality impacts are addressed through adherence to best practice and the relevant guidelines and hence are generally best addressed through site specific studies. However, a number of key areas have been identified where additional work would be beneficial to understanding predicted or actual impacts, as well as enabling effective mitigation to be applied. These are highlighted below.

Summary of data held:	Primarily EIA and SEA data, with very limited information from elsewhere (primarily site specific sediment disturbance information)
Summary of work in progress:	Work being undertaken by the Welsh Energy Research Centre.
	Work on water column processes being undertaken at MREDS.
	Research on biofouling and antifoul at Glasgow and Newcastle Universities.
Significant broad scale data gaps at present:	Information on the likely need for antifoulants by wave and tidal devices.
	Reference to vertical mixing in physical processes section.
	Advice on which antifoulants would best suit the requirements of the industry, together with advice and guidelines on best practice in application and removal
	Potential for energy extraction to affect mixing and dilution near outfalls

	Potential for release of sediment during construction, operation and decommissioning

Visual and Landscape

6.3.3 Visual impact has been demonstrated to be a key issue for several offshore wind farm sites in the UK, something reflected in the available literature. Currently perceived to be of less concern in general for wave and tidal devices, however the issue should not be overlooked as it can be a particularly important, especially during consultation. Key data gaps identified are summarised below.

Summary of data held:	Primarily EIA and SEA data, with additional work for wind including potential impacts on visual aspects, methods of minimising or mitigating impact.
Summary of work in progress:	Wind energy research looking at the effectiveness of visual limits used in Round 2. CCW seascape assessment work, completion anticipated Autumn 2008.
Significant broad scale data gaps at present:	Site specific work Cumulative effects will become increasingly important as developments increase in size and number.

Marine Mammals

6.3.4 The key issues to date regarding marine mammals and marine renewables have been related to noise and exclusion of animals from a given area. More general issues relate to secondary impacts such as water quality, prey availability etc. Issues that typically cause concern for wave and tidal devices include risk of collision and noise. Although a relatively large body of work exists to enable assessments of impact to be made for offshore wind, there remain a number of key data gaps, particularly for wave and tidal devices. These are summarised below.

Summary of data held:	Various issues broadly covered in EIA and SEA documents sourced, including noise, exclusion from key areas and water quality. Specific literature is primarily related to noise, particularly construction and operation of wind farms, with monitoring data of exclusion. Some baseline studies looking at the risk of collision and confidential information on noise for tidal devices.

Summary of work in progress:	Current research looking at methods to monitor potential collision risk. A proposal to monitor seal interactions with a tidal stream turbine. Work at EMEC against which change can be monitored. BERR RAG project on seals during and post wind farm construction. Monitoring at Race Rocks tidal turbine. Work being undertaken by the Welsh Energy Research Centre. Underwater noise monitoring at the RITE tidal turbines.
Significant broad scale data gaps at present:	Lack of public domain noise monitoring data from wave devices and little from tidal devices. Need to understand the risk of collision between marine mammals and underwater devices, including the ability to detect them, the physiological effects of avoidance for an individual, the result of a collision and the effects at a population level. Potential for devices to attract mammals and methods of deterrent. It is possible that a number of current projects will be confidential and/or difficult to acquire and as such may not add to the general knowledge base. Cumulative effects will become increasingly important as developments increase in size and number

Seabirds, Wildfowl and Waders

6.3.5 The impact of offshore wind farms with birds is increasingly well studied, however little work has been undertaken to date on wave and tidal devices. Although monitoring data is required, there are desk based studies that would increase understanding and assist in assessing potential impact. The status of current research is summarised below.

Summary of data held:	Primarily related to the effect of wind farms, particularly noise, disturbance, collision risk, cumulative issues and monitoring, information on wave and tidal devices primarily restricted to EIA and SEA
Summary of work in progress:	BERR RAG study looking at the energetic

	cost of barrier effects, with discussions on a further project to look at behavioural response of some species to wind farm construction and operation. Monitoring at EMEC to provide a baseline against which to measure change. Research on diving birds being undertaken by MREDS and University of Aberdeen. COWRIE research to provide guidance on undertaking cumulative impact assessments on birds for offshore wind farms
Significant broad scale data gaps at present:	The potential for birds to be attracted to devices by lights or for roosting. Lights can also lead to confusion, collision and exhaustion as birds circle lights. Potential entanglement or collision risk and the resulting effect to the bird at a population level. Ecological impact of exclusion from an area. Very little information on wave and tidal devices for the majority of issues including information on noise, physical presence and potential collision risk. Cumulative effects will become increasingly important as developments increase in size and number

Fish Ecology

6.3.6 The literature sourced is primarily related to offshore wind farms, with information in particular on the effects of noise, artificial reef related issues and EMF. It was unclear, however, if wind farm areas provided a benefit to fish ecology through the reef effect and restrictions on commercial fishing. For tidal devices, limited (confidential) information is available for noise, with a project to determine actual collision risk underway in New York. The majority of other issues (including all those addressed for wave devices) are addressed in EIAs and SEAs only.

Summary of data held:	In addition to information presented in EIA and SEA documents, several studies assess the impact of noise, artificial reefs and EMF from wind farms, with some information on noise from a tidal turbine.
Summary of work in progress:	Baseline noise study at EMEC against which impact can be assessed

	BERR RAG project to review the reef effects of wind farms.
	Work at Race Rocks tidal turbine on artificial reef effects.
	RITE tidal turbine project in New York to determine in-situ risk of fish strike and noise monitoring.
	COWRIE research project on EMF.
	Work being undertaken by the Welsh Energy Research Centre.
	Research proposal for the US MMS on EMF and elasmobranchs.
	Research at MREDS on mooring requirements and general fish research.
	Work at PRIMaRE on potential Wave Hub impacts and exclusion zone benefits plus general changes in fish ecology.
	Work at Heriot-Watt University on non-physical fish deterrents.
Significant broad scale data gaps at present:	Lack of public domain noise monitoring data from wave devices and little from tidal devices.
	How do site conditions effect noise generation (e.g. piling) and transmission.
	Potential artificial reef effect of wave and tidal devices.
	Potential collision or entrainment risk in wave and tidal devices (depending on device type) – e.g. is this affected by turbine speed or schooling behaviour, can fish detect and avoid underwater devices, what is the physical effect of collision on an individual and what do devices mean at a population level.
	What deterrent methods for wave and tidal devices are available, their effectiveness and impacts.
	Potential damage to feeding, spawning and nursery areas (particularly from cable routes, anchoring and mooring).
	A conclusion of ongoing EMF work – is this sufficient for wind and is it directly applicable to wave and tide.
	No standard method for determining baseline, monitoring change or determining the effectiveness of mitigation (if possible to define).

	Cumulative effects will become increasingly important as developments increase in size and number

Plankton

6.3.7 The potential for impact on plankton has to date been considered briefly in some SEA and EIA documents. In general, it is not considered to be a significant issue for offshore wind. However, the issue has been raised during the consultation process with regard to wave and tidal devices, particularly with respect to potential issues connected to vertical mixing within the water column and shading by devices. The potential significance of any such effect is not clear and it is difficult to conclude that wave or tidal devices would represent a serious risk to plankton. However, the current uncertainty coupled with consultee concerns may present unnecessary problems for developers.

Summary of data held:	Limited to some assessments based on expert judgment
Summary of work in progress:	Work on water column processes and pelagic dynamics being undertaken at MREDS
Significant broad scale data gaps at present:	Unclear as to the requirement for additional work – more information on the actual change in physical conditions associated with wave and tidal devices is required, particularly on vertical mixing

Benthic Ecology

6.3.8 Impacts on benthic ecology from marine renewable developments are often thought to be localised, small and site specific, with the majority of literature therefore being site specific, with marine renewable assessments of impact frequently drawing on the experiences of other offshore industries (which is primarily subtidal). Where specific research is available, the majority of reports are associated with offshore wind farm EIAs and address topics such as the artificial reef effect and the impact of the cable route. Wave and tidal devices bring additional issues, notably the potential effect of a reduction in energy, which has been subject to a desk based study. The main data gaps are summarised below.

Summary of data held:	Many issues affecting benthic ecology are best addressed through site specific assessments, with sufficient knowledge in other industries to enable this for several but not all of the issues. Research specific to marine renewables in general

	tends to relate to issues such as artificial reefs and the cable route, with a number of papers and reports that consider potential biological impacts in general. Intertidal issues are considered under coastal processes and through methods such as mitigation. Potential for intertidal impacts is generally informed by coastal impact studies together with careful siting of the onshore cable route corridor and a site specific assessment of the route chosen.
Summary of work in progress:	Funding at EMEC for an ROV survey to provide a baseline against which to measure change. BERR RAG project reviewing the reef effects of wind farms, a proposal to look at seabed communities in strong tidal streams, project on statistical basis for seabed monitoring of offshore wind farms, methods to investigate cable techniques and effects. Work being undertaken by CCW to look at the effect of fishing on Welsh benthic environments. Work being undertaken by the Welsh Energy Research Centre. Work on pelagic and benthic dynamics being undertaken by MREDS. Work at Race Rocks on the cable route corridor impacts Work on device mooring requirements at MREDS Planned monitoring of benthos at the Wave Hub site by PRIMaRE.
Significant broad scale data gaps at present:	The effect of a reduction in energy, what degree of change is significant and how capable/reliable are the methods available for predicting such change and its significance. The effect of methods of installation other than monopiles, such as gravity base, anchors and moorings. What is the geographic extent of change? How do devices that extract energy at the surface or mid depth affect the seabed? (stability, depositional characteristics etc) Cumulative effects will become increasingly important as developments

	increase in size and number

Designated Sites

6.3.9 The issues related to designated sites are addressed in sections which cover the habitats and species for which sites are designated. As such, no specific information has been identified here.

Shipping

6.3.10 Potential conflicts with shipping were raised during the consultation process and the issue can present a significant constraint to development. An additional concern related to the potential for an increase in carbon emissions should vessels need to divert to avoid installations. Much of the approach to date relates both to the avoidance of areas that may pose a constraint and a practical response to radar issues. The need to understand future changes in shipping patterns was raised, however as such changes may result from unpredictable influences (e.g. shifts in trading patterns) it may be difficult to include these changes beyond a certain point (e.g. knowledge of port developments or capital dredging programmes). The current state of knowledge is summarised below.

Summary of data held:	Guidelines on markings and lightings, site specific risk assessments, potential definitions of safety zones, issues connected to the potential for interference with radar
Summary of work in progress:	BERR RAG project looking at the potential effect on shipping channels A baseline study of shipping at EMEC MREDS project looking at surface collision risk between wave and tidal devices and vessels
Significant broad scale data gaps at present:	Potential collision risk with devices that are on the surface or subsurface. Potential collision risk with devices that break free. Potential increase in carbon emissions due to vessel diversions Cumulative effects will become increasingly important as developments increase in size and number

Tourism and Recreation

6.3.11 Marine renewables have been viewed as potential benefits to marine recreation, although the potential for impact both positive and negative does vary between device and recreational activity. Tourism and recreational issues are strongly linked to visual effects, which are covered separately within this section.

Summary of data held:	Literature available includes EIA and SEA data, research assessing the potential effect of offshore wave devices on surfing (which was also considered during the Scarweather offshore wind farm Public Inquiry), recreation boating and general reviews of the effect on tourism (primarily for onshore wind farms).
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Understanding of exclusion areas that may be required around wave and tidal devices. Understanding of the justification for exclusion zones proposed together with how these could be tailored for different recreational activities. Public perception, particularly regarding visual impacts. Noise during construction, operation and decommissioning. Assessment of benefits from different devices and for different activities. Cumulative effects will become increasingly important as developments increase in size and number

Archaeology

Summary of data held:	Existing EIA data from marine renewable and other developments on potential impacts from construction/ decommissioning methods and predicted implications for physical process alteration
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Understanding of the implications on physical process alteration arising from wave and tidal devices

Commercial Fisheries

6.3.12 The potential for impact on commercial fisheries generally involves an understanding of the potential loss of an area, for some or all commercial fishing activities, as a result of a development (temporarily or permanently) together with the potential for new activity once in operation (e.g. potting), dependant on exclusion zones. Issues such as the effect of a proposal on fish ecology are assessed separately within this section.

Summary of data held:	Commercial fishing is addressed on a site specific basis within each EIA and SEA document. Additional literature is available on the perceptions of the fishing industry as regards socioeconomic effect of offshore wind farms.
Summary of work in progress:	BERR RAG project investigating fishing in and around offshore wind farms
Significant broad scale data gaps at present:	The need for exclusion zones around wave and tidal devices and what it may entail. Potential benefits to fish stocks from fishery exclusion zones (drawing on work undertaken for UK MPAs). Sensitivity of different fishing activities to displacement (including transit routes and fishing grounds). Potential cumulative effects from exclusion zones (positive and negative) Cumulative effects in general will become increasingly important as developments increase in size and number

Military Use

6.3.13 Military presence and or activity within an area can represent a significant constraint on development, particularly as information regarding activities and potential impacts on such activities may be confidential. The presence or absence of a military interest in an area is therefore important to determine, with potential for impact often being very site specific. In practice, some sites have been redesigned at an early stage to exclude areas of potential conflict with military interests. Literature held is summarised below.

Summary of data held:	Coverage in EIA and SEA documents, a study in the Greater Wash area to investigate the potential to infill for radar coverage that would be lost by offshore wind farm developments, onshore assessments of the effect of wind turbines on specific radar centres.

Summary of work in progress:	It is understood that there are currently a number of ongoing research programmes to evaluate radar infill, radar processing software and stealth turbine technologies by BERR, MoD and privately funded initiatives
Significant broad scale data gaps at present:	Extent of MoD interests in Cardigan Bay Potential effects of wave and tidal devices on sonar and radar – is there a potential effect and if so what aspect of devices or sites may cause it and how can it be mitigated. Cumulative effects will become increasingly important as developments increase in size and number

Grid Infrastructure

6.3.14 The transmission system in Wales reflects the main points of power use and generation and hence is primarily located along the north and the south coasts of Wales, with very little infrastructure covering the central areas of Wales. Further increases in generation capacity would place a lot of pressure on the existing infrastructure, especially on those network assets at the transfer boundaries between England and Wales. The issue is especially pertinent for marine renewables, when areas of potential power are not necessarily located in areas associated with either power generation or near sites of heavy use, e.g. cities.

6.3.15 As regards the distribution system in Wales, both the regional sectors have assets due for replacement over the next five years, in order to accommodate load growth and embedded generation. Based upon the information available it is likely that the distribution infrastructure would need to be reinforced, for projects in excess of 30MW, due to a limited thermal and voltage capability especially in the regions of Strategic interest highlighted in TAN8.

Summary of data held:	Data and understanding of the transmission capabilities of existing grid and the effects of increased capacity needs.
Summary of work in progress:	Work being undertaken by MREDS
Significant broad scale data gaps at present:	None identified – will be driven by the connection strategies and locations for new power schemes

Cables and Pipelines

6.3.16 Conflict with cables and pipelines are generally avoided by the use of exclusion zones. However, recent work has highlighted potential for interaction between wave and tidal devices and long sea outfalls.

Summary of data held:	EIA and SEA based literature for offshore wind farms
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Potential for energy extraction to affect mixing and dilution in the vicinity of long sea outfalls Cumulative effects will become increasingly important as developments increase in size and number

Renewable Energy

Summary of data held:	Current known locations of proposed, planned or generating sites
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Cumulative effects will become increasingly important as developments increase in size and number

Marine Aggregate Extraction

Summary of data held:	EIA and SEA based literature for offshore wind farms
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Potential for cumulative effects on transit routes and aggregate grounds (concerns primarily relate to navigation issues but also to resource sterilisation)

Oil and Gas

Summary of data held:	EIA and SEA based literature for offshore wind farms
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Cumulative effects will become increasingly important as developments increase in size and number

Licensed Disposal Site

Summary of data held:	EIA and SEA based literature for offshore wind farms
Summary of work in progress:	None identified

Significant broad scale data gaps at present:	Cumulative effects will become increasingly important as developments increase in size and number

Airspace and Radar

Summary of data held:	EIA and SEA based literature for offshore wind farms, together with some studies related to the effect of wind turbines on radar
Summary of work in progress:	None identified
Significant broad scale data gaps at present:	Clarification that wave and tidal devices are unlikely to present an issue for radar
	Cumulative effects will become increasingly important as developments increase in size and number

7 Development Constraints

7.1.1 The route from the initial inception of a project through to commercial reality can be lengthy and convoluted, with a number of constraints that may present limitations on the proposed project. Although the type of constraints encountered will differ between both technology type and site, there are a number of similarities reported, both in the general literature and during the consultation conducted as part of the current project. Consideration of constraints to development is particularly important, as reflected in the Renewables Advisory Boards response to the Marine Bill (585), where the following comment was made:

> 'The current stage of marine renewable development can not afford any further barriers if the UK is retain its lead in this industry and fulfil its potential'

7.1.2 A number of constraints have been identified that have the potential to affect the development of wind, wave and tidal power projects. These have been grouped under the following headings:

- **Practical constraints** – these relate to issues around financing, sourcing of materials, equipment and personnel (including regulator) together with issues such as moving equipment to site and linking the resulting power to the point of use;
- **Site Specific Issues** – relate to issues such as resource, water depth, distance from shore, geology and environmental conditions such as weather;
- **Support** – these include support ranging from local interest to government level and cover issues such as financing, research and provision of test sites;
- **Legislative Considerations** – covering legislative issues such as SEA, sustainability, climate change, the consenting process, public inquiry and nature conservation legislation;
- **Existing Use** – relates to existing human use of the environment; and
- **Data Requirements** – quantity and quality of available data, ownership issues, cost of acquisition, academic literature and the precautionary principle.

7.2 Practical Constraints

Financing

7.2.1 The issue of financing tends to be raised less for offshore wind farms than for wave and tidal devices; probably because the technology is proven and potential financial returns for investors are clearer. Having said that, financing is still an issue for wind farm developments, something reiterated recently in the EEC/Deloitte report on 'Delivering the Low Carbon Economy', which stated that 'offshore wind is not currently economically viable without financial support' (266). Key concerns regarding financing for all technology types include the following:

- Grid connection costs, including cable from device to shore and connection with the national grid (provided grid connection is available and at sufficient capacity). It was commented during consultation that data on power output from wave and tidal devices is particularly important to gaining funding, however if the grid connection available does not carry sufficient capacity it can be difficult to demonstrate true power offtake from a device;
- Monitoring and mitigation costs. These are unknown costs at the start of a project when budgets are drawn up but as experience has demonstrated can represent a considerable additional financial cost to a developer, potentially increasing uncertainty for financial backers;
- Decommissioning costs. These can be difficult to assess, but as a legal requirement to ensure decommissioning and site remediation at the 'end of life' of a device is understood in some circumstances to be part of a consent, these costs are an important factor;
- Capital construction costs – the literature suggests this is the main part of a project;
- Requirement to have all funding in place prior to commencing a project;
- Perception of financial backers;
- Uncertainty regarding the cost in pence per kWh of generating power by wave and tide;
- Delays in the application process can lead to uncertainty for financial backers (see section below); and

- Requirement for and magnitude of monitoring and mitigation.

7.2.2 A recent study by Metoc for the South West Regional Development Agency (477) included some limited consultation with potential financial backers for wave and tidal devices. The report labeled wave and tidal devices as high risk investments, with financial interest viewed as being limited to certain investors such as venture capitalists. Requirements for investment included the involvement of financially strong companies (e.g. a utility) and a significant interest in the company. The requirements of banks were similarly stringent. The outcome of these requirements was considered to be a need for significant financial commitment from Government.

7.2.3 Lack of certainty in monitoring and mitigation requirements was highlighted during the consultation process as being a potential issue. In particular, it was stated that uncertainty about such a potentially large part of the final budget could deter some investors from becoming involved in marine renewable developments, specifically wave and tidal.

7.2.4 The MREDS programme (www.icit.hw.ac.uk/MREDS.htm#workpackage1) includes a work package that is specifically looking at the implications of grid constraints in the short, medium and long term.

Wind Energy Specific Issues

7.2.5 The United Kingdom currently has an installed capacity of 2547MW onshore and 404MW offshore. Within Wales, there is currently around 302.6MW installed generation capacity on shore, with a further 60MW installed offshore. Wales also has 106.3MW capacity under construction of which 90MW is offshore, together with a further 295.6MW consented, 108MW of which is offshore. The market in the UK has a strong development framework together with the added benefits of a skills base available from experienced personnel from existing offshore industries such as oil and gas, with the associated support mechanisms.

7.2.6 Whilst the Round 1 offshore wind farm projects were developed at a rate of only one per year (744), there are two possible scenarios for subsequent development: first to continue at the same pace for Round 2, or second to develop policies that will facilitate increased project capacity through an improved economic environment. If the same level of production as in Round 1 is continued, the predictions show that the supply chain for the industry has the capacity to deliver targets (744). However, several

problems may arise with the second option to increase the number of projects due to supply chain limitations for increased production.

7.2.7 In Europe, Denmark and Germany are leading the market in wind turbine production. In contrast there are only 3 turbine manufacturers in the UK, and these companies are currently not able to provide the volume of production to meet the demands of the national market. Even with supply from Europe it is anticipated that the projected growth targets of the offshore market between 2009 and 2012 will struggle to be met. The limit is likely to be in the order of 600 MW in 2009 rising to 1200 MW in 2012 (749).

7.2.8 Subcomponents of wind turbines, such as gearboxes, generators, and blades may also be supply chain limiting factors. For example, there is concern over the future of blade manufacture due to global constraints on the raw materials used to produce the carbon fiber blades (746).

7.2.9 The recent EEF and Deloitte report on the low carbon economy (266) presented information on the wind turbines deployed at Scroby Sands, and found that UK share in the component value of each turbine was only 43%. Most of this came from the piles (24% of the total value per turbine), with limited input to the high value components particularly the nacelle.

7.2.10 These constraints on turbine production and supply are causing a significant bottleneck in the industry, which is further compounded by the demand from the ever-growing onshore market; thereby causing shortages and significant price increases. Future production of 5MW class turbines is also likely to become a key issue as more projects seek to use this class of turbine in the future (749).

Wave and Tidal Power Specific Issues

7.2.11 As discussed in Section 5.7, devices that harness wave and tidal energy are at an earlier stage in development than wind farms, with a limited number of developments in the water. Interest in Welsh waters is highlighted in Section 3.6. Besides developing a workable system capable of surviving the rigours of the environment, the main obstacle to date has been in balancing the costs of production with the price of energy to the consumers (747). However, as technology becomes optimised, some manufacturers have succeeded in reducing costs of production by 80%.

7.2.12 Recent developments in the UK include the European Marine Energy Centre (EMEC) on Orkney. This is essentially a test site for wave and tidal devices, with the added

bonus of being able to supply electricity to the grid. A further wave device test site has been approved off north Cornwall, termed the Wave Hub, which will supply enough electricity to support 7,500 homes (www.southwestrda.org.uk). Both these facilities provide a test bed for devices without the added costs, both in time and money, associated with cabling power to shore and the consenting process.

7.2.13 Supply chain issues for wave and tidal devices are more complicated than for wind, as the industry is characterised by different technologies. In addition, a limited number have been constructed to a scale comparable to commercial deployment and it is likely that such construction was undertaken on a custom build basis. However, as more devices are constructed, it is anticipated that issues may arise, potentially including the following:

- Supply of raw materials;
- Availability of companies with the facilities and resources capable of manufacturing what is currently for many devices a novel technology at sufficient scale in the required time period;
- Depending on the scale of devices, the locations of manufacture and deployment, and the logistics of transporting devices to site.

Subsea Cables

7.2.14 The supply of subsea cables is a common supply chain concern raised by developers (746). The two specific cabling requirements for offshore wind are medium voltage (MV) intra-turbine array cables (typically around 33kV for Round 2) and high voltage (HV) substation to shore cables (132kV+ for Round 2). It is likely that the cables to be used in commercial scale wave and tidal developments will be similar. The oil and gas industry and subsea interconnects places additional supply demands on the manufacturers of these cables and even with maximum production the lead-time for supply is estimated at 12 months (746). Anecdotal information suggests that a delay in placing orders for cables can lead to a requirement for shorter lead-time, with the potential for a bottleneck in the supply of subsea cables.

Structural Steelwork

7.2.15 The prices of raw material for the manufacture of steel are currently high due to the global demand. This has been driven by rapid infrastructure growth in China. In 2007, the Iron and Steel Statistic Bureau reported that Asia accounted for 56% of the global

steel market, with China alone at 36% (www.issb.co.uk). Such high demand is not restricted to steel, with import demands from China of many raw materials currently driving commodity prices up (Money Week, 2008). This demand has required some suppliers to work at full capacity to keep up with demand – potentially leaving little room for additional demand.

7.2.16 As before, the supply/demand balance may cause a bottleneck in the supply chain and have consequences for the renewables industry.

Installation Vessels

7.2.17 During 2006, in the UK, there were indications that the slow pace of offshore renewables development was pushing vessels back into the oil and gas sector and limiting investment in vessels suitable for 5MW plus wind turbines (746). Sufficient availability of vessels depends on the size and style of device used; water depth and whether the vessel is available to the renewables industry sector or contracted to oil and gas (746).

7.2.18 Vessel availability has had recent implications for the consented tidal turbine for Strangford Lough, which was initially scheduled for deployment in 2007. However, difficulties in securing a suitable vessel delayed deployment until 2008. Anecdotal information also suggests that developers may pay a retainer to vessel owners to ensure availability when ready to construct. This has the potential to have a knock on effect for other developers, by creating additional difficulties in ensuring a vessel through extending the duration a vessel is attached to a particular project.

7.2.19 The competing global oil and gas industry is placing high demands on the supply of suitable vessels for the additional oil platforms (fixed and floating), drilling rigs and increased offshore construction activities. Currently this demand from the oil and gas industry is outstripping supply with the consequence that day rate prices are being pushed up, reducing availability for the offshore renewables industry.

7.2.20 The two main types of vessel required for the offshore market are Anchor Handling Towing Supply (AHTS) and Offshore Supply Vessels (OSV), which together make up 80% of the market (745). Many of the vessels built between 1970-1980 in response to the oil industry boom are still in commission today and constitute the main supply to the offshore market; but with the expected life of a boat at 25 years there could soon be a deficit as boats become decommissioned. However, the new wave of vessels offer

greater technology and capacity: boats are up to 300ft longer and have the capacity to carry 2-4 times the load.

7.2.21 Whilst the utilisation for deepwater vessels is estimated at over 90% for the oil and gas sector alone, enabling supply and demand to be met for the offshore renewables industry may therefore depend on how many new boats are being built. In 2005, the number of new boats being built was greater than number being decommissioned (745).

7.2.22 It should be noted that for deployment of arrays, more than one vessel may be required, for example where water depths vary across the site.

Issues Connected to the Existing Grid

7.2.23 One of the most significant factors influencing the success of any generation project located remote from a major centre of demand is their ability to obtain a timely and economic grid connection. This has become increasingly difficult since the 'dash for wind' as a result of the transition to the British Electricity Trading and Transmission Arrangements ('BETTA') in the latter half of 2004, which in turn gave rise to the 'GB queue', and the prior implementation of the 'plugs' transmission connection charging methodology. The GB queue comprises of a significant backlog of generation projects, the majority of which are wind farms in Scotland, that require major transmission investment before they can be connected.

7.2.24 Connection to distribution systems has also become increasingly challenging as generation projects have connected to infrastructure that was installed as passive 'fit and forget' infrastructure. As more generation has connected to these networks, the capabilities of the existing distribution system have been reached and the necessary upgrades would only be completed at the cost (at least in part and often in whole) to the developer.

7.2.25 Grid access is a widely used term within the electricity generation environment in Great Britain. Broadly speaking, grid access is a generator's right to export a specified amount of power to the grid from a given point in time. In attempting to quantify the extent of their access rights a generator will need to know how much power they are permitted to export, how soon they can connect and their right to compensation in the event of constraint by the relevant system operator (if a generator has the right to compensation, their connection is often referred to as 'firm').

7.2.26 The key regulatory documents that govern the granting of grid access are the Connection and Use of System Code (CUSC), the Distribution Connection and Use of System Agreement (DCUSA) and the Security and Quality of Supply Standards (SQSS).

7.2.27 The SQSS set out the minimum standards to which transmission licensees must plan and develop their systems. Included within these standards are the assumptions that transmission licensees should make in respect of network conditions in determining levels of infrastructure required.

7.2.28 The Grid Code is the technical document that specifies the connection, operation and planning conditions that generators must comply with in order to connect to and use the GB transmission system.

7.2.29 The CUSC sets out the procedures to be followed by National Grid Electricity Transmission Ltd (NGETL) in developing offers of terms for connection and use of system and the standard forms of bilateral agreement that generators are required to enter into with NGETL. The CUSC also defines the unit of transmission access, Transmission Entry Capacity (TEC). Bilateral Connection Agreements (BCA), which generators connecting directly to the transmission system enter into, and Bilateral Embedded Generation Agreements (BEGA), which certain generators connecting into a distribution system enter into, include a TEC entitlement that is expressed in MW.

7.2.30 The DCUSA is a recent addition to the electricity industry's regulatory framework. It is intended to introduce a framework to bring about a consistent approach to terms for connection and use of distribution systems. There are currently still discrepancies between the approaches adopted by distribution network operators but, broadly speaking, offers of terms for connection tend to be non-firm and include loosely defined capacity rights expressed in MW.

7.2.31 The arrangements governing distribution network access are less prescriptive but the general principle is that there is more flexibility in the development of the physical connection but connections are typically 'non-firm' i.e. disconnection by the system operator will not result in the payment of compensations. Generators who received offers of terms for connection received after April 2005 now pay Generation Distribution Use of System (GDUoS). All DNOs publish statements that set out their GDUoS charges although certain DNOs will only calculate charges on a site specific basis for larger generation connections.

7.2.32 For certain distribution connected generators, there is a requirement for assessment for impact on the transmission system by NGET and, on occasion, to enter into a formal agreement with NGET. For distribution connected generators defined as 'large' by the Grid Code are required by the CUSC to enter into a bilateral agreement with NGET. The Grid Code definition of 'large' varies depending on the location of the generation site. In England and Wales, generators with a maximum generating capacity of 100MW are large. In addition to this, DNOs are required to refer applications for connection of small generations that they consider likely to impact on the transmission system to NGET for a statement of works. Under both of these arrangements, NGET has the opportunity to assess the implications of the distribution connected generator in question and, should they see fit, make the connection of that generation conditional upon completion of transmission reinforcements.

7.2.33 There is little doubt that the current 'invest and connect' transmission access regime has been one of the major contributing factors to the advent of the GB queue, which has recently started to impact more on small distributed generation projects. Anecdotal evidence would indicate that NGET is now attempting to assess almost all distribution connected projects in Scotland where the surfeit of generation in relation to demand and the relative weakness of the grid has given rise to a dramatic increase in energy balancing costs.

7.2.34 There is currently a wide range of change being proposed to the transmission access regime, which is considered in greater detail in the next subsection, but it is worth noting that Ofgem and BERR have initiated the Transmission Access Review which is considering fundamental long term change to the transmission access regime.

Industry Review

7.2.35 Review of the industry regulatory framework governing access to the transmission grid can be split into short and medium term change and long term change.

Industry Review: Short Term Change - STAG

7.2.36 Following the publication of the Energy White Paper in May 2007, joint Ofgem and BERR groups were established to consider optimum grid access arrangements in the short / medium term and in the longer term. The longer term change review is considered in the following sub-section. Short and medium term review has been progressed by the Short Term Access Group (STAG), which has split its deliberations into 4 main areas that are considered in turn below.

GB Queue Management

7.2.37 This area has focused on contractual issues between NGET (as GB system operator) and potential generation users of the GB transmission system.

7.2.38 NGET have consulted and concluded upon a new, more practical approach, to managing change to the GB queue as set out in their June 2007 conclusions document which advocates a tougher approach to progression of projects on the basis of 'ability to use the system soonest', irrespective of initial queue position or date of entering into the original contract. This approach would involve NGET taking into account the obtaining of planning consents in determining the order in which transmission access rights are allocated to new connectees. The only caveat is that sufficient transmission capacity needs to be available before a project should be allowed to connect.

Commercial framework development

7.2.39 This area has focused on changes to existing regulated codes. Several such changes have been proposed since the instigation of STAG, most of which are aimed at introducing additional flexibility into the current 'invest and connect' regime. The most far reaching of these change proposals is proposed CUSC amendment proposal (148) – 'Deemed Access Rights to the GB Transmission System for Renewable Generators', which attempts to invoke direct influence of EU law on the GB regulatory framework. European Union (EU) Directive 2001/77/EC ('The RES-E Directive') imposes an overall EU target of 12% of gross domestic energy consumption from renewable sources by 2010. The Directive breaks this overall target into levels to be attained by individual member states includes a specific target of 10% by 2010 for the United Kingdom. Article 7 of the RES-E Directive states;

> 'Without prejudice to the maintenance of the reliability and safety of the grid, Member States shall take the necessary measures to ensure that transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable energy sources. They may also provide for priority access to the grid system of electricity produced from renewable energy sources. When dispatching generating installations, transmission system operators shall give priority to generating installations using renewable energy sources insofar as the operation of the national electricity system permits.'

7.2.40 In order to allow NGET to better facilitate the satisfaction of this requirement, Wind Energy (a wind farm developer signatory to the CUSC) have proposed CAP 148, which attempts to introduce arrangements into the CUSC whereby renewable generators are given a form of firm access ('Deemed TEC') to the GB transmission system, subject to the consent and commission of local connection works, from the later of the date; three years from the date in which the project in question received planning consent or the date from in which the relevant connection offer was accepted. The intended effect is to limit the amount of time for which a renewable generation project can be delayed as a result of the need for reinforcement of the wider transmission system.

7.2.41 At the time of writing, CAP 148 was at the draft amendment report stage of the CUSC change management procedure. Unsurprisingly, NGET are not supporting its implementation. An Authority decision on CAP 148 is expected in spring of 2008.

Review of system operation arrangements

7.2.42 Ofgem initiated the Transmission System Operation Review Group (TSORG) in order to assess the possibilities for freeing up more transmission capacity in operational timescales using existing infrastructure. The TSORG report was published in October 2007 and suggested some improvements that could bring potential benefits, for example real time plant ratings, improvements to system monitoring arrangements and greater use of intertrips. However, these proposals require further investigation and the potential benefits have not been fully developed.

Review of the GB Security and Quality of Supply Standards (GB SQSS)

7.2.43 The purpose of the review of the GB SQSS is to assess the appropriateness of the GB SQSS agreed as part of the implementation of BETTA in light of a changing generation profile and in particular, in light of the increased penetration of intermittent sources of generation such as wind, wave and tidal. This work is still in progress and is expected to conclude in spring 2008.

Industry Review: Long Term Change

7.2.44 Longer term changes to the current transmission access arrangements are being progressed through the Ofgem/BERR transmission access review (TAR). The following paragraphs set out the main points of the TAR documentation published to date.

7.2.45 The only significant TAR publication to date has been the August call for evidence and consultation document ("the August consultation"). The following are the main points raised in the document and, most significantly, an outline of the models for change.

7.2.46 The TAR call for evidence provides;

- A summary of the issues giving rise to the need for change (investing in areas remote from existing grid, uncertainty of new projects obtaining consent, uncertainty of disconnection of existing projects, rising constraint costs, security of supply and appropriateness of planning standards).
- A view of the areas to be considered, and
- The projected timelines for the consultation.

7.2.47 It should be noted that Ofgem / BERR are planning to conclude the TAR in May 2008, the outcomes being recommendations for "change and proposed processes". The implication of this is that, once the TAR process has concluded, there will be further delay while the necessary changes to regulatory framework are progressed. Given the commercial sensitivity of these changes, it is likely that this could take upwards of nine months to complete and even longer if significant change to market arrangements is required.

Options for Change

7.2.48 The following is a summary of the three models for change to the transmission access arrangements proposed in the August consultation. It should be noted that the TAR review is focused on longer term changes to the transmission access arrangements aimed at better delivering the government's energy policy, as expressed in its May 2007 White Paper (which includes the aspiration of 20% from renewable sources by 2020) and better meeting Ofgem's statutory objectives. The TAR review does not cover planning issues, which are being handled as part of a yet to be tabled separate parliamentary bill.

7.2.49 Option 1 is titled 'Incremental change'. As the name suggests, the incremental change approach is along the lines of evolution rather than revolution, based substantially on the existing trading arrangements but with incremental changes focused primarily on providing more short term flexibility in the provision of grid access.

7.2.50 The following are the types of change envisaged:

- Change Balancing Services Incentive Scheme (BSIS) such that there are better incentives to connect generation before all transmission system reinforcements have been delivered;

- Make Transmission Entry Capacity (TEC) more tradable by creating geographic zones where a 1:1 exchange rate could apply;
- Create TEC reallocation arrangements, potentially by auction, to support the transfer of TEC from projects without consents to projects who don't have TEC but who are otherwise ready to use the system;
- Create overrun arrangements in which connected parties can exceed their TEC, system parameters permitting, and be charged on the basis of short run marginal cost (SRMC);
- Review standards such that they better reflect the demands of a more "variable" generation profile; and
- Allow financial commitment from potential generator connectees, rather than the security and quality of supply standards (SQSS), play a bigger role in guiding future investment.

7.2.51 Option 2 is titled 'Connect and Manage' and, as the name suggests, the model proposes that connection should only be conditional upon completion of construction of connection assets and plant being commissioned and available. Access rights would commence on a given date or after a period of time following completion of the connection. Once connected, it would be the responsibility of the GB system operator's (currently National Grid Electricity Transmission Limited) to manage constraints, such that the system was operated within rated capabilities. The aspects of this model that need to be refined include the question of:

- Whether this should apply to all generators or just renewables; and
- Whether access rights should be fully firm or non-firm. If Access is firm, are ROCs issued for constraints? If access is to be non-firm, what is the appropriate degree of non-firmness?

7.2.52 As part of the assessment of CAP 148, NGET provided a very high level assessment of the impact of moving the connection of all renewable generators currently in the GB queue forward by 3 years under the current access arrangements. The outcome was an increase in predicted constraint payments over the period of 2011/12 to 2018/19 of £542 million. This was something of a worst case, as it assumes that all projects currently in the queue will connect, which they will not, for many reasons not least of which would be planning constraints. However, it gives a clear indication of the issue that Ofgem, in light of their primary statutory duty to protect the interests of the

consumer, will be likely to have at the top of their agenda in considering the appropriateness of this model.

7.2.53 The third option is an 'Access Auction'. Under this approach "strips" of transmission access (an allocation of capacity rights over a period of time e.g. 5 years) could be put up for auction and market participants would submit bids for that access based on the value they place on that capacity. Capacity made available would be financially firm, "unmodifiable" during the period that it is in effect, which is in contrast to TEC that is loosely defined in the CUSC, a regulated code subject to frequent change. The following is a brief description as to how an auction would work.

- Parties would have the opportunity to bid in a window ahead of time for a particular connection date;
- Envisaged that this would take place at regular intervals or on a one off basis when specific circumstances emerge;
- Generators bid the value associated with their date, and commit to use the system for a period of time;
- At the end of the window, the bids are assessed and an investment plan devised by the relevant transmission owners and a £/kW investment cost created; and
- Parties that have bid above this level are entitled to their connection dates.

7.2.54 Ofgem note that this approach would be likely to be supported by other shorter term products including possible "overrun" arrangements i.e. allowing generators to output beyond their allocation in specific circumstances.

7.2.55 Recognising that an auction approach could be open to abuse from dominant market players looking to hoard capacity, Ofgem have proposed that any auction arrangements would be subject to "use it or lose it" rules.

Transmission Arrangements for Distributed Generators (TADG)

7.2.56 Electricity suppliers can obtain certain commercial benefits by entering into agreements with distributed generators relative to the terms that they could obtain with a transmission connected generator. These benefits arise as a result of the treatment of embedded generation within the energy settlement process as negative demand. This reduces the amount of demand energy attributable to that supplier's energy account and is commonly referred to as "netting off", which in turn brings about benefits to the

contracted supplier. These benefits, commonly referred to as “embedded benefits” arise through reductions in TNUoS, transmission losses and BSUoS.

7.2.57 Generation connecting at distribution voltages has increased significantly in recent years. In certain parts of the country this increase has brought about sufficient generation to meet demand in the section of distribution system emanating from a connection with the transmission system (commonly referred to as a Grid Supply Point (GSP). In such instances, the flow of power is reversed back up on to the transmission system (the phenomenon is often referred to as an exporting GSP). It is often the case that distributed generators within exporting GSP groups have no contractual relationship with NGETL, so, it could be argued that these distributed generators are effectively using the transmission system for free and outside the control of NGET. The phenomenon of exporting GSPs also called into question the appropriateness of embedded benefits.

7.2.58 In order to examine all of the issues associated with transmission access and charging for distributed generators, Ofgem set up the TADG Working Group in July 2006 (the TADG Group). THE TADG Group did not have decision making powers, rather it provided a forum for industry users to consider models for change, most of which included employment of an agent to assume responsibility for interactions between distributed generation and NGETL. The final TADG Group report was published in July of 2007. The introduction of change would require the proposal of changes to regulated codes and as yet no such changes have been proposed although it should be noted that NGET have committed to reviewing the cost reflectivity of the transmission charging arrangements for distributed generators with a view to implementing enduring change by the end of May 2009.

People

7.2.59 In Europe, there is generally a deficit in the number of skilled people working in the offshore industry. Denmark is feeling the pinch at present with simultaneous demand from the 6th oil and gas licensing round and two offshore windfarms approaching fabrication and offshore wind (POWER 2007).

7.2.60 In the UK the number of skilled personnel is greater than in Demark, but with competition across the industries and an increased growth of renewables there may still be a deficit; particularly if skilled workers are moving overseas to fulfill the demand from other countries. Anecdotal evidence suggests that while the number of recent graduates is high, it can be difficult to find qualified, experienced staff across a wide

range of sectors, including survey, marine consultancy, regulator and developer. This is particularly important when concerns raised during the consultation process are taken into account, namely that insufficient staff at the right level and with adequate and appropriate experience can lead to potentially significant delays.

7.2.61 There is a global variation in the safety standards required for offshore development, thus personnel from overseas may need additional training to meet UK standards. A solution to this problem may be through the development of common safety training standards for offshore wind engineers across Europe in order to support the development of a European wide offshore wind supply chain (POWER 2006).

Port Facilities

7.2.62 Pushing Offshore Wind Energy Regions (POWER) was a European project that investigated issues in the North Sea. The project included a study which looked at supply chain issues relating to port facilities, including 7 ports on the east coast of the UK. The study found that there is a lack of suitable harbour facilities for the supply of materials to the UK and these are unlikely to meet the demands required by the renewables industry under the increased production scenario (POWER 2006).

7.2.63 A number of ports and harbours are located around the Welsh coastline, with the larger ports including the following:

- Port of Newport (south Wales);
- Port of Cardiff (south Wales);
- Port of Barry (south Wales);
- Port of Swansea (south Wales);
- Pembroke Dock (Pembrokeshire);
- Milford Haven (Pembrokeshire);
- Fishguard Harbour (Pembrokeshire);
- Holyhead (Isle of Anglesey);
- Port Penrhyn (north Wales); and
- Port of Mostyn (north Wales).

7.2.64 There are a number of further ports and harbours around Wales, primarily catering to recreational pursuits and commercial fishing, which have the potential to provide shore based facilities or a launch point for construction. In addition, a number of large ports are located along the English coast in close proximity to Welsh waters, including Liverpool and Bristol.

7.3 Site Specifics

The Requirement for Energy

7.3.1 A key factor in site selection is the available energy, whether that is wind, wave or tide. Specifically, a site needs to have sufficient resource for the purposes of the project, whether that is for a test site, pre-commercial demonstrator or to enable a commercially viable project to be developed. Energy requirements vary between devices and for some devices on a site by site basis, for example some devices can be constructed to operate at peak efficiency in a variety of conditions and hence can be tailored to suit a specific site. Energy requirements also tend to change as devices become more established, for example it is anticipated that energy levels being targeted by Round 3 offshore wind farms will be greater than in the previous 2 rounds.

7.3.2 Information on energy requirements for different device types has been sourced from publicly available literature and during the consultation process, with the data collected presented in Section 8. It should be noted that information is not available for all devices and where information is available, it is not always apparent if the figures available are up to date or relate to prototypes or commercial scale devices. There is therefore a degree of caution attached to the information. The grouping of devices described in Section 5.7 requires additional caution, as it makes an assumption that all devices in that group have requirements in the same range. While this is broadly true, there are some differences and this should be noted when using the data.

7.3.3 When areas that have the wind, wave or tidal resource required for economic development are mapped, it is apparent that these do not necessarily (and in fact rarely) sit adjacent to areas of high energy demand. Such locational issues mean increased costs and difficulties in getting electricity generated at sea onshore, and on to the end user. This issue is discussed in more detail within this section.

The Practicalities of Depth and Distance

7.3.4 During the consultation process, information was sought from device developers as regards where they would look to deploy devices, particularly information on water depth and distance from shore. The data collected is presented in Section 8. Such information was not always available for all devices, and where data was provided it often covered a fairly wide range. It was unclear whether this wide range represents a true commercially exploitable area or simply a desire to ensure all potential areas for future deployment were included. In particular for offshore wind, a desire to move further offshore was specified in one case, at least in part by a decision to reduce or remove visual impact issues.

7.3.5 When considering depth and distance, a key point made was that it is not necessarily depth and distance that are the constraining factors, but financial cost. Such costs are primarily associated with cabling from device to shore and increasing infrastructure costs of installing in deeper water (e.g. longer monopiles mean more primary resources). Increasing depth and distance also bring increasing technical difficulties, not least in the availability of vessels capable of deployment beyond a certain depth. This is a particular issue for devices that require 'deep water', which for marine renewables tends to be greater than 50m. Other issues with regard to distance from shore come in beyond the 12nm limit, however this is beyond the scope of the current project.

7.3.6 As such, the depth and distance constraints identified are not considered fixed and are anticipated to change in time, for example as construction methods change and become cheaper or as electricity prices rise. Such changes have the potential to open up greater areas of sea to development. For example, it was noted during the consultation process that potential sites under investigation for offshore wind currently include those where water depths are in general 30-40m, but with an area with water depths 50-60m. It is understood that the potential to combine an offshore wave farm (in the deeper areas) with an offshore wind farm (in the shallower areas) is being considered.

Physical Constraints

7.3.7 Some device types are more restricted by physical constraint than others, with some issues being common to all. Physical constraints identified include the following:

- Substrate – cables cannot be buried in hard rock substrate and armouring is therefore required, with associated risks of damage and financial cost of the rock armouring. Some substrates provide better conditions for fixing devices to the seabed (dependant on the method used), while others bring additional problems e.g. mobile sand. It was commented during consultation that substrate was not an issue provided devices could be fixed appropriately, with substrate type potentially determining the fixing method used. Where a preference was stated, it generally related either to avoiding certain substrates particularly sand, or for a preference for a hard substrate or rock;
- Onshore wave devices require either natural hard rock substrate or a manmade structure;
- Severity of the environment (including weather and tides/waves/currents/sediment transport) and implications for device design, deployment windows and durability. The ability of devices to survive the storm conditions typical of a site was cited during consultation (with the experiences of some test devices in storm conditions reinforcing this concern); and
- Seabed topography and the implications for ease of fixing a device to the seabed and laying the cable to shore.

7.3.8 Physical constraints are therefore both site and device specific, with few being 'show stoppers', instead tending to represent additional financial costs. It is the financial cost set against the value of the electricity that appear to be most likely to dictate which physical constraints will apply to a particular development.

Development Risks

7.3.9 Offshore wind is well established as being a commercial prospect, providing investors and government with a degree of certainty that when backing a proposal, a financially viable development will result. For wave and tidal projects, in some cases there is currently considered to be less certainty. This can lead to concerns that a development could sterilise a site for an alternative device or not provide sufficient financial return. Such uncertainty may bring a degree of hesitation to financial backers and regulators, potentially resulting in delays in achieving financing and the subsequent requirement for consent. It may also result in requirements for decommissioning (including funding) being included in a development consent.

7.4 Support

Government Support

7.4.1 The need for Government support at all levels to enable a thriving marine renewables industry is cited in numerous documents and was raised during the consultation process. Such support can include the following:

- Financial support to remove or reduce financial uncertainty;
- Clarity in the legislative and planning requirements;
- Grid connection and capacity – existing grid frequently does not match the location of offshore energy, and upgrades etc are expensive and subject to the planning process, frequently suffering delays; and
- Public funding for research and development.

7.4.2 Initiatives such as the Renewables Obligation Certificates provide some of the support required, through placing a legal obligation on utilities to source a specified and increasing proportion of the electricity they supply from renewable sources. Additional funding for offshore wind has come from the Capital Grant Scheme.

7.4.3 In 2004 the UK Government announced the £50 million 'Marine Renewables Deployment Fund' (MRDF) specifically for wave and tidal devices. Although financial support for marine renewables is naturally welcomed by the industry, the consultation process undertaken for the current project did highlight concerns regarding the fund and how it can be tapped. It is understood that to date (February 2008) only 2 applications have been made under the fund, both of which having been rejected. In addition, comments have been made in the wider literature that the fund is insufficient.

7.4.4 The Environmental Transformation Fund (ETF), which began operation on 1 April 2008, is aimed at low carbon energy and energy efficiency technologies, and will include the Offshore Wind Capital Grants programme and the MRDF. The ETF has an overall budget of £400 million for the period 2008/09 to 2010/11.

7.4.5 The primary barrier to applying for funding through the MRDF identified during consultation and in the broader literature relates to the time a device has been in the water, where there are differences between UK government and commercial requirements. Essentially, developers often use deployments of pre-commercial devices as an opportunity to refine, tune and fix devices, which in practice means

devices are frequently lifted. To qualify for the fund, a device needs to have been in the water for a set time period. It is understood that the requirements for funding from the Scottish Executive require devices to have spent less time in the water.

7.4.6 Public funding for research in the UK is provided at a number of levels and for a number of reasons. The main sources include the following:

- BERR (The RAG programme, Capital Grant Scheme, Marine Renewable Deployment Fund, Environmental Transformation Fund);
- The Crown Estate (COWRIE);
- Nature conservation bodies (CCW, Natural England, SNH and the Environment and Heritage Service);
- The Carbon Trust (Marine Energy Accelerator, Marine Energy Challenge);
- Npower Juice Fund;
- Scottish Executive (wave and tidal deployment fund);
- Scottish Governments £10 million 'Saltire Prize' for marine renewable energy, announced in April 2008;
- Marine Foresight Panel;
- Defra; and
- Regional development agencies (e.g. Wave Hub).

7.4.7 There are also a number of research groups based in various universities around the UK that undertake research into marine renewables. Such research includes projects directly funded by developers but also individual and 'umbrella' projects with more central funding, for example from the UK Government or via Europe. University and 'umbrella' research groups identified during the project are highlighted in Table 7.1.

Table 7.1 UK University Renewable Energy Research Groups

University	Research Group	Website	Relevant Research Topics
University of Aberdeen	Aberdeen University Energy Group (in connection with RGU and Aberdeen City Council)	www.aberdeenrenewables.com/index.php?id=146	Involvement in an offshore wind farm project
University of Aberdeen	School of Biological Science	http://abdn.ac.uk/biologicalsci/staff/details.php?id=b.	Interest in ecological impacts of tidal devices

University	Research Group	Website	Relevant Research Topics
		e.scott&filt=	
University of Belfast	Hydraulics Research Group	www.qub.ac.uk/eerc/index.htm	Tank testing, device development, hydrodynamic modeling, power take off design, wells turbine design, hydraulics, structural engineering, environmental, coastal engineering
Cardiff University	Centre for Integrated Renewable Energy Generation and Supply	www.cf.ac.uk/engin	Recently established
Universities of Cardiff, Swansea, Glamorgan, Bangor and the Institute of Grassland and Environmental Research	Welsh Energy Research Centre	www.welshenergy.org	Established at the start of 2007, with marine research related to tidal stream and understood to relate to feasibility, environmental impact modelling, wake modelling, benthic monitoring and assessment of potential impact, baseline hydrographic surveys, design and layout effects
Cranfield University	Cross department	www.cranfield.ac.uk	Technology, structure and design testing, environmental and ecological issues (including EMF)
University of Durham	New and Renewable Energy Group	www.dur.ac.uk/engineering/nareg	Wind and wave power devices
University of East Anglia	Climatic Research Unit	www.cru.uea.ac.uk	Research into the impacts of climate change, predictions and modelling of offshore wind
University of Edinburgh	Institute for Energy Systems (including links to Supergen)	www.see.ed.ac.uk/research/IES/research/marine.html	Wave energy, tidal stream. tank testing, hydrodynamic modeling, design of electrical power take off systems, design of novel electrical machines, renewable resource modeling, impact of climate change on the resource, chemical conversion using renewables
European Ocean Energy Association	EU-OEA	www.eu-oea.com	Including research into wave, tide and wind
European Wave Energy Thematic Network	EWEN	www.wave-energy.net/Welcome.htm	
Universities of Exeter and Plymouth	Peninsula Research Institute for Marine Renewable Energy (including links to Supergen)	www.ex.ac.uk/cornwall/academic_departments/csm/research/renewable-energy/index.shtml	Involvement in Wave Hub (including surfing issues), wave and tidal resource assessment and numerical modelling; hydrodynamics; wave, wind and tide device testing and modelling
Glasgow University	Marine Energies Technology Network	www.eng.gla.ac.uk/marine/metn_x.htm	Construction issues, biofouling and antifoul methods, corrosion
Herriot-Watt University	The International Centre for Island Technology (including links to Supergen) and Marine Renewable Energy Development (MREDS)	www.icit.hw.ac.uk and www.icit.hw.ac.uk/MREDS.htm#workpackage1	Mooring lines on wave energy converters, European Artificial Reef Research Network (EARRN, co-ordinated by Southampton University), feasibility of tidal power, non-physical fish deterrents, various work packages under MREDS

University	Research Group	Website	Relevant Research Topics
Lancaster University	Renewable Energy Group (including links to Supergen)	www.engineering.lancs.ac.uk/lureg/research	Tank testing, hydrodynamic modeling, power take off design, control of wave devices
Liverpool University	Marine, Environmental and Water Systems Group	www.liv.ac.uk/engdept/research_groups/mews/coastal.htm	Maritime coastal modeling, coastal zone management, sea defences, sediment transport, 2-D and 3-D flow and sediment models, coastal and marine pollution, computational fluid dynamics, hydrological assessment, flow controls & hydrodynamics, lattice boltzmann method, water quality management, water & sediment contamination, water system & advanced WWT, GIS, HIS & remote sensing, object-oriented & OpenGIS Hydro Info System (3OHIS), tidal energy, traffic management & accident data analysis, generalised linear modeling
University College, London	Environmental Fluids and Coastal Engineering	www.civeng.ucl.ac.uk/research/fluids	Including wave and tidal devices, wave energy dissipation, fluid forces on offshore structures
University of Manchester	Energy, Environment and Climate Change Group and the Power Conversion Group	www.mace.manchester.ac.uk/research/groups/energy and www.umari.manchester.ac.uk/research/areas/power/index.html	
University of Newcastle	School of Marine Science and Technology and the New and Renewable Energy Centre (NaREC)	www.ncl.ac.uk/marine/research/environmen and www.narec.co.uk	Narec offers research, testing and development facilities including wave, wind and tide, University work includes efficiency and control of robotic devices, marine power plant and marine vehicles whilst minimising environmental impact, biofouling, and the UK carbon capture and storage consortium
North Highland College, Thurso	Environmental Research Institute	www.erionline.co.uk	Wind, wave and tidal resource analysis, environmental impact assessment of marine developments
University of Nottingham	Power Electronics Group	http://research.nottingham.ac.uk/ResearchFocus/display.aspx?Id=1035&pid=206	Including wind farm design
Offshore Wind Energy Network (OWEN)	OWEN	www.owen.eru.rl.ac.uk	Provides a focus for offshore wind energy research, including identification of projects
Oxford University	Department of Engineering Science	www.civil.eng.ox.ac.uk/research/offshore/wind.html	Wind turbine foundations, investigations into Rigs,
Pushing Offshore Wind Energy Regions	POWER	www.offshore-power.net/information.asp?Page=7&menu=1&type=menu&print=print	Investigation of offshore wind in the North Sea
Robert Gordon University	Centre for Research in Energy and the Environment (including the	www.rgu.ac.uk/cree/general/page.cfm?pge=10768	Resource Assessment, hydrodynamic modeling, performance optimization, design review, environmental Impact

University	Research Group	Website	Relevant Research Topics
	Supergen Consortium)		
University of Southampton	Sustainable Energy Research Group	www.energy.soton.ac.uk	Hydrodynamics of marine current turbines and tidal stream resource
Strathclyde University	Energy Systems Research Unit	www.esru.strath.ac.uk	Tidal stream and wave energy
Swansea University	Engineering Department	www.swan.ac.uk/engineering/Research/CivilandComputationalEngineeringCentre	Primarily tidal energy and a specific tidal device
UK Energy Research Centre		www.ukerc.ac.uk/Home.aspx	
Wave Train		www.wavetrain.info	European wide wave energy research

7.4.8 As part of the site selection process that developers undertake prior to submitting an application, there are comments in the literature and from the consultation process that suggest that Government support is an important factor, together with suggestions that certain countries or regions are viewed as being more attractive as a result of the regulatory framework and level of government support provided. This implies that when comparing potential regions or even countries for site selection, a lack of high level support, which needs to filter down to local level, has the potential to prejudice developers against investigations in certain areas.

Importance of Test Sites

7.4.9 The offshore wind industry has succeeded in developing commercial scale facilities at a number of locations in the UK, with more to be developed. However, for wave and tide there is as yet no commercial scale deployment in the UK. As a key barrier to achieving commercial deployment is the financial cost of testing at sea, test sites are being established. These sites provide benefits to developers in that grid connection is available and environmental studies have been conducted, thus shortening the consenting process and reducing the financial outlay required to enable a demonstrator device to be deployed. Sites in the UK include the EMEC centre in Orkney (www.emec.org.uk) and the Wave Hub in Cornwall (www.wavehub.co.uk). Although not enabling testing in the open sea, the NaREC facility in Northumberland (www.narec.co.uk) enables large scale testing in seawater.

Public Support

7.4.10 Although not a legal constraint, the attitude of the public, particularly the local population, is often a very important factor in gaining consent. For example at Scroby Sands on the east coast of England, early and broad involvement of stakeholders and interested charities, together with the provision of an information centre, has been credited with achieving high public acceptance. Such acceptance is of particular interest given that the project is located just 2.5km from the coast, and in an area where local interest in offshore industry (notably the marine aggregate industry) is high.

7.4.11 For Wales, it could be argued that public perception was a factor in both Rhyl Flats and Scarweather Sands applications, with each project experiencing different public responses and differences in the work required to achieve consent. Some of the associated issues are discussed further in Section 7.5 under 'Public Inquiries'.

7.5 Legislative Considerations

Strategic Environmental Assessment

7.5.1 The term Strategic Environmental Assessment, or SEA, is used in connection to the European Directive 2001/42/EC on 'the assessment of the effects of certain plans and programmes on the environment'. It essentially places an obligation on Government at a broad scale, which in practice translates into regional or national, to assess the environmental impact of overarching developments, programmes, plans or sectors, and is therefore important in the drive for sustainable development. SEAs tend not to address project or site specific issues, but take a broader picture as an aid to overall decision making, providing an overview of the potential environmental impacts, enabling strategies to be formed. Examples in the UK include the SEA undertaken for Round 2 Offshore wind (123), which looked at the issues around offshore wind in 3 distinct areas, the Oil and Gas SEAs (www.offshore-sea.org.uk), an ongoing national project and the proposed SEA for tidal power in the Severn. A recent SEA has been published in Canada, which looked at tidal power in the Bay of Fundy (364).

7.5.2 An SEA therefore provides information to both regulators and potential developers on the existing broad scale environment of a given area (both natural and human environments) together with potential impacts associated with particular types of development. The information can help government address sustainable development and to facilitate broadscale planning, while providing information for developers when considering site selection and identifying the issues that will need to be addressed in

order to gain consent. It can also help by informing research topics at a broad scale level that would be beneficial in understanding potential impacts.

7.5.3 SEA and the SEA process were mentioned during the consultation process and, although opinions did differ, the majority of criticisms leveled against the SEA process were primarily related to timing. Similar issues were raised as regards Marine Spatial Planning (MSP). The main comments raised either followed the view that the lack of a marine renewable SEA or an overarching MSP for Welsh waters increased uncertainty and represented a constraint on development or, conversely, that site selection was either in progress or complete for a number of projects and hence an SEA would not necessarily be of benefit. However, as regards the progress of site selection outside a SEA/MSP process, it was also noted that such an approach may have implications for other industries. It should also be noted that a similar situation exists for much of the rest of the UK.

Sustainability and the 'Bigger Picture'

7.5.4 The issue of climate change is high on the UK Governments agenda, with the current commitment for a target of renewable energy generation expected to increase. However, development of renewable energy is not without environmental impact and this can bring it into conflict with other international commitments, notably issues such as the Birds and Habitats Directives. The recent Sustainable Development Commission reports on the Severn Barrage (116) included consideration of the requirements of these Directives concluding, amongst others, the following:

> 'Full compliance with European Directives on habitats and birds is vital, as is a long-term commitment to creating compensatory habitats on an unprecedented scale'

7.5.5 Set against the background of legislative requirements, calls have been made in the general literature for a consideration of these different government commitments to be made when granting consents for marine renewable energy developments, including weighing localised and potentially short term impacts against long term and global benefits that can be gained for example issues connected to climate change and the goal of a low-carbon economy. The issue has also been raised during the consultation process.

7.5.6 While it is acknowledged that there are often a number of international requirements and obligations on the UK government that may have a bearing on and potentially form

part of a marine renewable application, with issues connected to climate change being the main issue raised, one obligation does not necessarily override another. However, while international commitments need to be met, marine renewable developments do represent a route towards helping meet UK Government commitments on sustainable development and targets for reducing greenhouse gas emissions.

7.5.7 Issues connected to sites designated under the Habitats and Bird Directives are discussed further within this section (7.5.25-31).

Achieving Consent

7.5.8 It should be noted that the existing consenting process may be subject to change following several recent Government Bills. These may involve changes in licensing requirements together with the relevant consenting authority. These issues are discussed further in Section 3.

7.5.9 In order for a development to progress, consents are required for a number of aspects of a proposal to enable it to be deployed in the water. Section 3.3 presents an overview of the existing consenting process for marine renewables. It should be noted that the licensing process has been flagged previously as representing a potential significant constraint on marine renewables, with one of the main driving forces behind EMEC identified during the consultation process as being a way round the requirement for detailed consents applications for small scale device deployments for testing. Particular issues identified during the literature review and the consultation process have been summarised below.

7.5.10 Early discussion with key stakeholders was highlighted during the consultation process as being particularly beneficial to a project. Such early consultation has been used to highlight potential issues before significant costs have been incurred, thus enabling proposals to be modified. The approach also helps to develop good working relationships.

7.5.11 The time taken between commencing an application and gaining consent can be lengthy, something compounded by the current necessity to apply for more than one licence from more than one consenting authority. Lengthy delays are not unusual in the consenting process for marine industries in general, for example it may take 5-10 years for a marine aggregate site to gain consent. Such a timescale can bring additional financial costs, which combined with the uncertainty of such a lengthy process can be seen as an additional constraint on development. Feedback from marine renewable

developers on this issue were mixed, with some viewing the process as relatively quick and others seeing it is a significant hurdle. Specific issues raised include the following:

- Overall time between commencing an application and achieving consent (examples range from months to years, excluding work required prior to the consenting process starting);
- Requirement of additional data prior to consents being granted (and the associated uncertainty regarding the potential cost of these);
- Requirement for more than one licence;
- Delays in the application process can lead to uncertainty for financial backers;
- Lack of or insufficient resources or experience of a new industry in statutory consultees can increase the timescale for response and comment; and
- Lengthy delays can result in a project being subject to changes in market conditions, with potential implications for the financial viability of a project.

7.5.12 It was commented during the consultation process that although there is considerable support for government targets for renewable energy generation by 2010 and 2020, there is concern that these will not be reached. In particular, it was commented that for the current targets to be met, there would need to be changes to the planning system, including the implementation of a Planning and/or Marine Bill together with Marine Spatial Planning. It was also commented that there are sometimes differences between local and national government views as regards planning for marine renewables.

7.5.13 A particular issue that may arise for developments in Welsh waters relates to trans boundary issues, i.e. where proposed developments are located across the England/Wales Median Line. Experience from the marine aggregate industry has demonstrated that although a lead consenting authority is involved (which for marine renewables, as for other industries to date, would be expected to be BERR), the number of statutory consultees will be greater, potentially bringing additional complications.

7.5.14 It is understood that the Welsh Energy Research Centre is currently undertaking a project that is investigating the requirements that need to be met in order to gain consent for a tidal stream project. In particular, the project is looking at navigation, stakeholder requirements and the scope and cost of the EIA process.

7.5.15 It was noted during the consultation process that there is a concern that once consent for a demonstration site has been granted, there is an assumption that the site can be expanded to a commercial scale. It was commented that this was not necessarily the case. Instead, it was noted that there would be a requirement to consider the level of environmental impact of the device when decisions were made.

Potential for Changes to the Consenting Process

7.5.16 As regards the current consents process, and as discussed in Section 3, the Marine Bill is proposing changes that are, in part, aimed at streamlining and simplifying the application process. This may result in a reduction in the number of licences required and a reduction in the number of consenting bodies. During the consultation process it was noted that removing the requirement for a separate consent for the onshore aspects as part of this process would be viewed by some consultees as being beneficial (the requirement for separate licences for onshore and offshore lead to problems for a Round 2 wind farm).

7.5.17 The Planning Bill is set to bring in additional changes, primarily the proposed Infrastructure Planning Commission, which will decide on nationally significant infrastructure projects. However, it should be noted that it only intended for IPC consents on matters that are not devolved and currently decided by the Secretary of State. The production of National Policy Statements (NPS), which are expected to be issued for each type of development, will state how much of that type of development is required. It is understood that NPS documents will be produced by the UK Government, with consultation with the WAG.

7.5.18 A particular concern raised during the consultation process related to the potential for a single consenting body. Essentially, the concern related to the responsibilities and priorities of that consenting body and the potential for conflicts between Government commitments. Addition concerns were raised by a stakeholder, where it was commented that any change in the consenting regime should ensure adequate inclusion of relevant stakeholders during the consultation process.

Public Inquiry

7.5.19 For some applications where there is difficulty in a decision being reached, a Public Inquiry may be called. Such a process can add considerably to the timescales and financial burden for developer and regulator alike. Experience of Public Inquiry for

marine renewable energy developments is currently restricted to offshore wind. Examples are discussed below.

7.5.20 Scarweather Sands offshore wind farm was progressed through Round 1, and is proposed to be located in Swansea Bay. The proposal progressed through the Transport and Works Act route, which is a wholly devolved process. The Environmental Statement was produced in January 2003, and the intention to take the proposal to Public Inquiry announced by the WAG in March 2003. The Public Inquiry took place in November 2003. The resulting report produced by the Inspector made a recommendation that the Order should not be made and planning permission is refused. The basis for the Inspectors conclusion included reference to localised visual impact, which the Inspector considered to be significant and harmful, with sufficiently strong concerns to warrant not making the order.

7.5.21 Following publication of the Inspectors report, it falls to the Planning Committee of the WAG to make a formal decision on the application, which was made in July 2004. In this instance, the Committees decision went against that of the Inspector, based on the following reasons (drawn from the decision letter, ref. A-PP153-99-003):

- Needs and benefits – the Inspector concluded that the proposal would have considerable benefits, and the WAG 'will support renewable energy proposals which are economically attractive and environmentally acceptable';
- Alternative Sites – the Inspector concluded that it would be impossible to reconfigure the wind farm further into Swansea Bay, a decision agreed with by the Committee, who took the view that 'although the matter of alternative sites was considered at the inquiry, it is necessary only for it to consider the merits or otherwise of this specific proposal at this particular site'; and
- Visual Impact – It was the Committees view that although the wind farm will have a visual effect, these will be outweighed by the significant benefits in terms of renewable energy.

7.5.22 Discussions on the FEPA licence for Scarweather are currently on hold.

7.5.23 At the time the Scarweather Sands proposal was submitted, applications could follow one of two legislative routes. These centered either on the Transport and Works Act (as at Scarweather) or the Electricity Act 1989. The Electricity Act was subsequently amended in 2004 and the intention is that this will represent a preferable consenting route to the transport and Works Act, although applications can still follow both routes.

This amendment has affected the potential for a Public Inquiry, in that local authorities can now only object to the onshore infrastructure, such as substations or cables. Such an objection would not automatically lead to a Public Inquiry.

7.5.24 The only Public Inquiry for an offshore renewables proposal that we are aware of subsequent to Scarweather was undertaken for the London Array. The project applied for its various consents in June 2005. Planning consent was divided between the onshore and offshore elements, with planning for the onshore substation refused by the local council in June 2006 and planning for the offshore elements granted by the Government in December 2006. A Public Inquiry was then held in March 2007, with a favourable Government decision following in August 2007. Final go-ahead came in November 2007.

Ecological Features and Natura 2000

7.5.25 The baseline ecology of a site can affect the progress of a proposed development through the application process, with the presence of designated sites and protected species being of particular legal significance. The level of protection afforded habitats and species ranges from non-statutory sites through to international legal protection and it should be noted that lack of designation does not necessarily mean lack of value or that a site does not contain sensitive species or habitats. Issues connected to mobile species, i.e. marine mammals, birds and fish, can be particularly complicated given the protection afforded some species.

7.5.26 In practice, the main constraint on development as regards nature conservation relates to sites designated under the Habitats and Birds Directives (as implemented under the Conservation (Natural Habitats &c.) Regulations, 1994) and therefore relates to Special Areas of Conservation (SAC) and Special Protection Areas (SPA), collectively termed Natura 2000 sites. Ramsar sites are also included here.

7.5.27 The environmental sensitivity and additional burden of proof required to gain consent within or near a Natura 2000 site has raised the issue of locating appropriate developments in appropriate sites. Essentially, the additional sensitivity of Natura 2000 sites, combined with the level of legislative protection, increases the burden of proof required if consent is to be achieved, although consent is of course not guaranteed. In practice, such an increased burden of proof can lead to increased costs and timescales. The practical outcome is either to avoid such sites or to be aware of the protected habitats and species within a site and the potential issues that may arise as a result of the proposals, potentially modifying the proposal to minimise potential impact.

However, it is important to note that avoidance of Natura 2000 sites by developers was not a purpose of the legislation and, in any case, it does not necessarily follow that potential impacts associated with a proposal would be significant or adverse. Further, it is perhaps inevitable that a degree of overlap between such sites and marine renewable developments will occur, given the distribution of Natura 2000 sites around the Welsh coast, the potential for additional such sites offshore and the wind, wave and tidal energy resource that is currently exploitable. It is therefore considered likely that the Habitats Regulations will be a factor for at least some applications. It should be noted that the consultation process highlighted difficulties encountered when identifying potential development sites in Welsh waters due to the presence of constraints, with military training areas and SACs viewed in some instances as being preventative to deployment.

7.5.28 Where a proposed development falls in or near to a Natura 2000 site, there is a requirement for the Competent Authority (i.e. the lead consenting authority, taking advice from CCW) to make a decision regarding Likely Significant Effect (LSE). The decision on LSE is essentially a screening decision to confirm whether an Appropriate Assessment is required. The purpose of an Appropriate Assessment is essentially to assess the potential for a proposed development to result in adverse effect to the features for which a site has been designated. Where adverse effect is identified, and in order to progress through the legislative requirements, a lack of alternatives would need to be established and the proposed development would then need to qualify under 'IROPI', or Imperative Reasons of Overriding Public Interest.

7.5.29 If a lack of alternatives has been determined and IROPI accepted, there then follows a requirement to compensate for the adverse effect. Compensation schemes undertaken in the UK typically relate to habitat creation, to re-create habitat lost. In addition to the cost of progressing through the Appropriate Assessment process, it is the potential requirement for compensation that can lead to a significant increase in time scale and financial cost of a project.

7.5.30 It is understood that to date in the UK, a number of offshore wind farms and two tidal power projects have been subjected to Appropriate Assessment. For example, the Wave Dragon project, for which an EIA has been submitted, is located in the Pembrokeshire Marine/Sir Benfro Forol SAC. To our knowledge, none of these Assessments concluded adverse effect and as such no requirement to progress through the alternative/IROPI/compensation route. No such projects for wave power

have been identified, although the Lunar Energy project at Pembrokeshire, for which a Scoping report is available, is located within an SPA and SAC.

7.5.31 Although not a marine development, the proposed 181 turbine onshore wind farm on the Isle of Lewis was recently turned down by the Scottish Government, on the basis that it would 'have a serious impact on the Lewis Peatlands Special Protection Area, which is designated under the EC Birds Directive and protected under the EC Habitats Directive' (www.scotland.gov.uk). The decision letter concluded with the following statement 'that the tests in Regulation 49 of the 1994 Regulations (which transposes Article 6(4) of the Habitats Directive) have not been met in that there are alternative solutions to the development proposed…. the application must be refused on those grounds'.

7.5.32 For SSSI's, every site notification contains a list of potentially damaging operations (PDOs) which identify operations and activities considered likely to affect the designated features at the site. Where an owner or occupier wishes to carry out an activity listed in the notification paper (as a 28g authority), written notice of the proposal are required to be submitted to WAG to request an assent.

7.6 Existing Use

Access to Sites and Existing Use of the Seabed

7.6.1 Human use of the marine environment is increasing, both for commercial and leisure purposes. Such use has lead to projects such as the Marine Spatial Planning Pilot project, which researched options for 'developing, implementing and managing marine spatial planning in the UK' (471). Existing use of the seabed has placed restrictions and constraints on marine renewable development proposals and will continue to do so. It was noted during consultation that although a particular site may offer benefits in terms of one constraint, e.g. Milford Haven in terms of grid connection, the reason for the benefit may introduce additional constraints, e.g. shipping lanes.

7.6.2 Such restrictions that have been cited by specific developments have included the following:

- Cables and pipelines, e.g. telecommunications, oil, gas, water, sewage – general application of a 500m exclusion zone (legal restriction zones are 250m either side for dredging and a works restriction zone 250m either side for waters up to 55m deep, increasing to 500m either side in waters greater than 55m deep);

- Shipping and navigation – presence of clearways (or their successor, as the term is understood to be no longer in use), capital/maintenance dredging, shipping routes, anchorage areas etc may have associated restrictions, with 500m exclusion zones again mentioned;
- Ministry of Defence – e.g. military and exercise areas;
- Marine aggregate extraction (potential prohibition on new sites within 500m of a wind turbine);
- Oil and gas installations – general application of a 500m exclusion zone however navigational issues between the Gwynt y Môr and the Douglas Oil Field Platform lead to a 2.6nm exclusion zone between the two sites to ensure safe navigation. A 6nm air exclusion/consultation zone has also been raised during the consultation process;
- Marine disposal sites including access by vessel;
- Shellfish waters;
- Commercial fishing grounds (wind farm sites may include a restriction on fishing activities such as trawling and drift netting within 500m of any turbine);
- Protected wrecks – variable, however 100m-500m exclusion zone is not uncommon;
- Other marine renewable energy proposals/developments;
- Marine Environmental High Risk Areas; and
- Exclusion zones around a marine renewable structure – typically quoted at 500m.

7.6.3 The degree of constraint imposed by each of these will vary, but at the very least are likely to bring a requirement for additional work and consultation prior to gaining consent. Nature conservation and Natura 2000 issues are considered in Section 7.5. The location and extents of these features are depicted in Figures 2 to 21.

7.7 Data Requirements

Data Ownership and Availability

7.7.1 In order to adequately assess potential impacts associated with a proposed development, it is necessary to have sufficient information on the existing baseline environment, the predicted changes during construction, operation and decommissioning and the known or predicted impacts associated with such changes. The process therefore has a demand for data. As discussed in Sections 6.2 and 6.3, significant gaps in knowledge exist as regards baseline environment and potential impacts. Such gaps can either be filled from existing sources where available or through additional work, with the issue taken further in Sections 8 and 9. Where data cannot be found, a more conservative approach to impact assessment may be required (as discussed within this section under 'Uncertainty and the Precautionary Principle'). It should be noted that the burden of proof required when assessing potential impact is also related to issues such as the sensitivity of the environment and the degree of legislative protection. For example, proposals in or in close proximity to Natura 2000 sites generally require a greater burden of proof than proposals which are remote from such areas.

7.7.2 Difficulties can arise when data ownership becomes an issue. Data collection can sometimes be a lengthy and costly process, with some of the data considered to be commercially sensitive. Where projects are funded by public money (whether undertaken by a Government funded body or by a private institution with Government funding), it is generally assumed that the information is in the public domain and therefore freely available, although this does not always follow through in practice. For example, it can be difficult to discover the work that has been undertaken, who holds it and whether the data is transportable, e.g. data format, storage etc. Availability of data collected by or on behalf of developers in particular can be a grey area. These issues apply to wind, wave and tide, particularly for baseline data. It should be noted that the MEDIN (formerly MDIP) processes, together with the UK process for data archiving (DACs) and the data standards that are being developed by Defra, will ultimately provide a significant proportion of data requirements on a UK wide basis.

7.7.3 Even where documents are fully anticipated to be public domain, such as Environmental Impact Statements, considerable difficulties can arise when attempting to acquire the document. In some cases, these were categorised as confidential reports, with others being difficult to source due to the financial cost of hard copy

reports (production of which can have considerable financial cost) and the unavailability of reports following the completion of the consultation period. This was less of an issue for developments which published such reports freely on project websites.

7.7.4 Particular issues can arise when data is considered either to be commercially sensitive or where it could provide a commercial advantage, with this issue tending to occur mainly for wave and tidal data. Release of such information may be viewed as being beneficial to the industry as a whole but not necessarily to the developer who paid to collect the data. For example, it is understood that for the Verdant tidal power project currently in the water in New York, approximately one third of the overall budget is directed at monitoring fish, a considerable investment by the developer. Where data is collected at nationally managed sites data may also be subject to controls and it will not necessarily be widely publicly available.

7.7.5 During the consultation process comments were made regarding the need for data on wave and tidal devices in-situ, with for small scale deployments highlighted as a potential route to enabling such data to be gathered. It was noted that where demonstration devices are deployed in less sensitive environments the monitoring data may not be directly transferable to more environmentally sensitive sites, however a balance is needed as consenting in more environmentally sensitive environments is likely to be more difficult.

7.7.6 For wave and tidal devices in particular, there is a concern among some that the gaps or limitations in our understanding of potential impacts when undergoing the EIA process may lead to demands for monitoring that may be viewed as disproportionate, having time and cost implications for a development. This is of particular concern for the 'first past the post' projects. For offshore wind, developments have proceeded concurrently and as such data requirements appear to be more evenly distributed. The intrinsically more piecemeal approach being taken by the wave and tidal industries does not enable this. This is not intended to be a criticism of the approach, merely a practical outcome of the commercial realities of the market.

7.7.7 Data collection for the offshore wind industry was perhaps less complicated than it currently seems to be for wave and tide. This is a reflection of the types of devices and pace of development (offshore wind is progressing in rounds, whereas wave and tide is by necessity more piecemeal). Indeed, licence conditions for Round 2 included the requirement that monitoring data be made public, thus increasing the data available for all developers. That requirement has also benefited the current project through the use

of the COWRIE data management website (http://data.offshorewind.co.uk/catalogue/). Although not yet complete, the website provides the most complete collection of offshore wind literature for the UK. A wider ranging website is being established through OSPAR, to provide 'a mechanism for the sharing of knowledge and experience and to promote the exchange of environmental information', specifically regarding environmental impacts of marine renewable energy (www.environmentalexchange.info). Additional sources of similar information are summarised in Table 5.1 in Section 5.1.

7.7.8 Additional comments made during consultation on data availability included reference to broad scale data, which tends to be insufficient on a site specific basis, often necessitating primary data gathering. While this is true, and a common issue for all marine industries, broad scale information is required to enable individual projects to be placed in context and to facilitate wider planning e.g. through SEA or MSP.

7.7.9 Comments were made during the consultation process that to date research undertaken in the academic sector can sometimes run parallel to that undertaken in the commercial sector. While it was reiterated that both strands of research are important and the science itself was not being questioned, it was commented that there are some difficulties with including some of the academic research on a practical level and that greater collaboration may be beneficial. Indeed, identifying academic research of relevance to marine renewables was found to be a fairly convoluted process during the current project, with information not always available to those outside the academic field, and is it likely that not all research has been sourced. As a number of universities have a marine renewable project and/or team, a centralised database of these together with outputs would be beneficial. The UK Energy Research Map being established by the UK Energy Research Centre should help here (www.ukerc.ac.uk/NERN/Energymap/Energymap.aspx).

Natural and Climate Induced Change

7.7.10 The marine environment is inherently changeable in the short, medium and long term. Change can be a result of both natural processes (as evidenced by the geological record) and, more recently, driven by anthropogenic induced changes in the climate. When determining the impact of wind, wave and tidal devices on the environment, it is important to consider such impacts against the context of background change. To do so fully requires an understanding at the system level of ongoing and natural change, together with adequate predictions of climate induced change.

7.7.11 The importance of considering natural change is evidenced by the Habitats Regulations. In the UK, under Regulation 33(2) of the Habitats Regulations, there is a requirement to provide advice for each European marine site on the conservation objectives for that site together with any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site was designated. Such documents clearly state that natural change to a site does not require action. As regards climate induced change, the implications are less clear. However, the development of marine renewables does offer an option to mitigate or offset on a broadscale the effects of climate induced change.

7.7.12 Consideration of the different causes of change also requires an understanding of how such changes may interact – for example will they be cumulative (e.g. if natural, device and climate induced change all have the potential to cause 2mm of erosion, will we get 6mm?) or will they counter each other out (e.g. will the sea level rise predicted to occur as a result of climate change negate the 2mm of erosion from a device?). These types of issue are difficult to assess and understand which may be part of the reason for the limited inclusion in site specific studies.

7.7.13 Particular issues that may arise as a result of climate change relate to potential changes in the energy resource, sea levels and weather (e.g. storminess). These have the potential to affect developments in terms of economic viability, cumulative impact issues and device viability. Current projects of relevance here include the UK Climate Impacts Programme (www.ukcip.org.uk), the Marine Climate Change Impacts Partnership (www.mccip.org.uk) and research at the University of Edinburgh, with the latter looking at climate change and the marine energy resource.

Uncertainty and the Precautionary Principle

7.7.14 The term ‘precautionary principle’ is subject to considerable discussion, with opinion often divided over its meaning and application. There are numerous definitions given for the precautionary principle, with the following given on the WAG website:

> ‘that cost-effective measures to prevent possibly serious environmental damage should not be postponed just because of scientific uncertainty about how serious the risk is’

7.7.15 Of particular note is the EC Communication on the Precautionary Principle (761), which discussed when and how to use the precautionary principle. In particular, the document highlights the need to take a risk based approach and not purely to apply

caution to scientific data. The document summarised that decisions based on the precautionary principle should be:

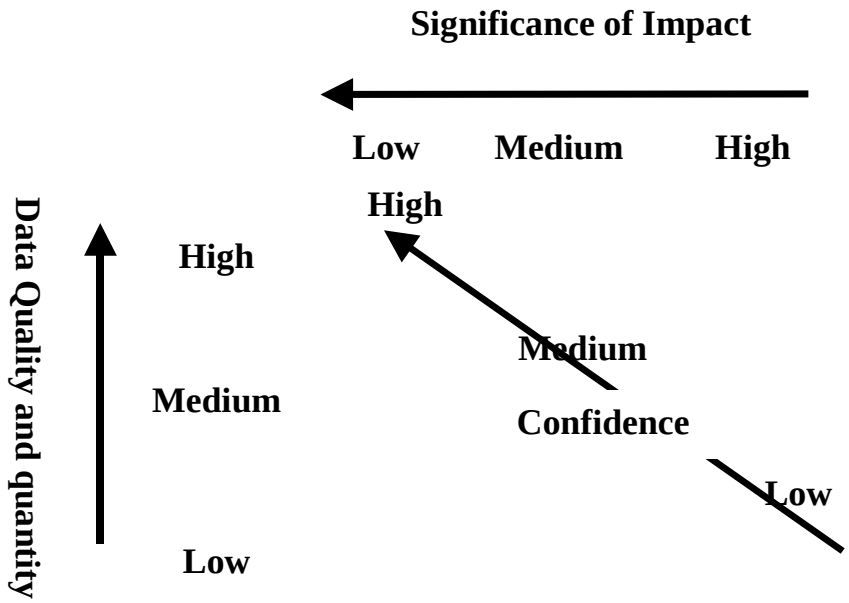
- Proportional to the chosen level of protection;
- Non-discriminatory in their application;
- Consistent with similar measures already taken;
- Based on an examination of the potential benefits and costs of action or lack of action (including, where appropriate and feasible, an economic cost/benefit analysis);
- Subject to review, in the light of new scientific data; and
- Capable of assigning responsibility for producing the scientific evidence necessary for a more comprehensive risk assessment.

7.7.16 In extreme examples, use of the precautionary principle has lead to calls for a moratorium of certain activities until certainty is available as regard environmental impact. In practice, a degree of uncertainty is inevitable and needs to be addressed if consent is to be achieved.

7.7.17 During the consultation for the current project, particular comments were made regarding this issue, with a preference for a more risk based approach stated by some consultees (mainly developers) and a more 'cautious' approach advocated by others (mainly NGOs). In a similar manner, reporting on the consultation process for the Scottish wave and tidal power SEA (292) noted that feedback on the degree of caution applied differed, with developers in general finding the process too precautionary, with a potential negative effect on investor confidence, and statutory stakeholders not finding it precautionary enough.

7.7.18 As a result of uncertainty, the consenting process in the marine environment is inherently tied to the degree of understanding of potential impact, the quality of the data on which the assessment is based and how confident an assessor (be it developer or regulator) can be in that assessment. The diagram below depicts this at a basic level. In an ideal world, the results of an impact assessment would fall towards the top left of the diagram. However, in reality, practical issues tend to push the assessment outside this area and, in broad terms, the further an impact assessment is from the ideal, the harder it can be to gain consent. For projects that fall further towards the bottom right

and where consent is granted, experience has shown that the quantity and detail of work required (e.g. monitoring) is likely to be higher.



7.7.19 It is clear that the precautionary principle has the potential to represent a particular concern for a fledgling industry, such as wave and tidal power, while the greater amount of information for offshore wind means that for subsequent rounds this is less likely to be an issue.

7.7.20 To help address the issue for wave and tidal power, monitoring data from devices in the water is required to provide information on actual effects. Such a requirement will need to be balanced against the difficulties of acquiring consent due to a lack of data. There is also a concern among some consultees that the first wave and tidal developers to arrive at the end of the consenting process will be unduly (or as some consider unfairly) burdened with monitoring requirements to address issues that concern the whole industry.

7.7.21 A further point raised during the consultation process was the question of whether it would be possible to have a greater understanding of the type and level of monitoring likely to be required for a consented development at an early stage. If such information was combined with indicative project costs and timescales, it was felt that this would be beneficial to developers when securing financial backing.

8 Potential Sites for Development

8.1 Introduction

8.1.1 The intention of this section of the report is to provide GIS mapping of potential sites for wind, wave and tidal stream development in Welsh waters. The approach taken is two stages. The first is to identify the current economic requirements for each device type described in Table 8.1 (as identified through the consultation process and the literature search) and plot the potential resource free of constraints. For some devices, data does exist on where devices may be economically sited in the near future and, where such information is available, this is also included. The second stage is to take the issues identified in Section 5 and, where feasible, determine the degree of constraint offered by each. This information will be used to remap the potential resource, taking into consideration existing constraints on development.

8.2 Economic Siting Constraints

8.2.1 The economic siting constraints identified for each device type were primarily based on the following:

- Deployment distance from shoreline;
- Water depth; and
- Energy requirement.

8.2.2 It should be noted that these requirements are based on known economic siting constraints on a device, both current and in the near future (i.e. around 5 years time). From an engineering perspective, devices may technically be deployed outside these constraints (e.g. deeper or further offshore) with economically viable locations potentially subject to change, for example as the technology improves or the price of electricity alters. Issues such as grid connection availability and capacity will also have a significant influence on the siting and economics of a potential development – such issues are discussed in Section 7.2.

8.2.3 Section 5.7 summarises the information sourced on device types. For offshore wind, the device used is consistent across developments, although there can be differences e.g. between fixings to the seabed. For wave and tidal power, there are considerable

differences, with numerous designs available. As discussed in Section 5.7, the wave and tidal devices have been grouped according to the manner in which they generate power and deployment location (broadly related to depth and distance from shore). The grouping was undertaken partly for simplicity, but also to ensure confidentiality as each device type tends to be specific to a particular developer. The groupings follow on from those made in previous studies, being updated to reflect the advancement of the industry and the greater amount of information now available. However, there are difficulties behind such groups, primarily due to data availability and the subtle variations in energy or site requirements between devices and as such the information should be viewed at the broadscale only.

8.2.4 Table 8.1 is drawn from Table 5.11 in Section 5.7 of this report, and summarises the device types, but includes the additions of known energy and site requirements. In some instances, depth ranges are given to reflect differences either in device or consultee feedback. Where sufficient information is available for these to be mapped, this is noted in the table.

Table 8.1 Site Requirement Criteria for Device Types (where known)

Energy Type	Device Type	Economic Energy Requirement	Depth	Distance from Shore	Figure
Wave	Oscillating water column	15-30kW/m	5-15m	0m	Figure 22 (all onshore devices)
	Hydraulic pressure				
	Overtopping				
	Oscillating water column	-	-	-	Insufficient data
	Collector	>16kW/m	20-30m and 20-80m	-	Figure 23
	Individual point/buoy	>20kW/m	30-50m and 30-100m	500m-8km	Figure 24
	Orbital wave velocity	-	-	-	Insufficient data
	Multiple buoy	>2m wave height	15-30m	-	Figure 25
	Oscillating wave surge converter	-	-	-	Insufficient data
	Oscillating water column	-	-	-	Insufficient data
	Collector	-	-	-	Insufficient data
	Individual point/buoy	15-60kW/m	30-100m	2-20km	Figure 26
	Attenuator	25-50kW/m	>50m	2-15km	Figure 27
Tidal stream	Rotating turbine	>2m/s	-	-	Figure 28
	Hydroplanes, hydrofoils and sails	>2m/s	10-60m	-	Figure 29
	Single blade	-	-	-	Insufficient data
	Venturi effect	-	-	-	Insufficient data

Energy Type	Device Type	Economic Energy Requirement	Depth	Distance from Shore	Figure
Wind	Three bladed wind turbine	>5-25m/s	5-35m and 5-50m	0-12 nautical miles	Figure 30

8.2.5 The potential economic resource for wind, wave and tidal power, based on current knowledge, is therefore depicted in Figures 22-30. From these, it is clear that for wind power (Figure 30), large areas of Welsh inshore waters hold an economic resource, with the main constraint appearing to be water depth.

8.2.6 The picture is more patchy for both wave and tide, with rotating turbine devices (Figure 28) and the grouped tidal devices (Figure 29) having a similar resource distribution, although the actual economic resource extent for rotating devices is somewhat larger. The main areas highlighted for tidal stream devices are to the north west of Anglesey, off the tip of the Lleyn Peninsula, around west Pembrokeshire and in the inner Bristol Channel/outer Severn Estuary.

8.2.7 For wave devices, some 6 Figures have been produced (22-27). For offshore devices, no economic resource was found within the study area for attenuators (Figure 27), primarily due to device specified water depth requirements, whereas for offshore buoys (Figure 26) a fairly broad area of economic resource has been mapped in the outer Bristol Channel and to the west of Pembrokeshire. Potential resource for nearshore devices tends to be in the same broad area, with marked differences in the overall extent. For nearshore collectors (Figure 23), the economic resource extends across the outer Bristol Channel and west Pembrokeshire, however less area is available for nearshore multibuoys (Figure 25), which cover a similar area but patchily, with even less economic resource available for nearshore single point buoys (Figure 24), being restricted to an area to the west of Pembrokeshire. The potential economic resource for onshore wave devices (Figure 22) was heavily constrained by the available geology and does not take into consideration to the potential for new man made structures. Potential economic resource highlighted is restricted to areas around Pembrokeshire.

8.3 External Siting Constraints

Mapping of External Siting Constraints

8.3.1 Section 5.8 identified potential environmental impacts related to wind, wave and tidal devices. Each of the 'receptors' identified, i.e. natural or human environmental features, have the potential to be affected by deployment of a device, with the significance of such impacts assessed on a site by site basis. The presence of such

receptors could therefore be seen as constraints on development, the degree of constraint related to a number of aspects (in no particular order) that includes the following:

- Degree of legislative protection;
- Stakeholder involvement;
- Significance of impact; and
- Importance of receptor (e.g. military, strategic, public value).

8.3.2 The degree of the constraint that each receptor may represent can be difficult to determine at a strategic level. This is particularly the case for spatially and temporally variable receptors, primarily biological features, where site specifics will be a key determining factor. For some of these receptors, the known distribution of the feature is mapped for informative purposes only and constraint mapping will not be applied. The issue is clearer for fixed features, particularly features such as an existing licensed activity or site, where legal exclusion zones or a legal framework may apply. However, it is likely that as additional data becomes available, some of the constraint subjects currently categorised as informative may be sufficiently informed to enable a full assessment. An example would be seascape, for which a regional seascape assessment for Wales is currently in preparation. It is anticipated that, when available, the report should enable seascape constraints to be mapped (e.g. variable distances from shore). At present, for those listed as informative the category would require site specific assessment.

8.3.3 For offshore wind Round 2, a precautionary exclusion zone was established around the coastline at a distance of 8km, extended to 13km in places of particular environmental sensitivity, with the aim of reducing visual impact. However, at the request of the Steering Group, currently this exclusion zone will not be applied in subsequent constraint mapping exercises.

8.3.4 Potential constraints on development have been identified based on the baseline literature search described in Section 5.2 together with the experience of the project team as regards the practical constraint applied. The potential constraints for wind, wave and tidal stream devices have been presented in Table 8.2, including a comment regarding whether GIS data is held to map the known extent of the potential constraint. The degree of potential constraint that each feature may represent has been based on the following criteria:

	Receptor distribution is presented for informative purposes only and no firm constraint value can be ascribed at the broadscale
1	No likely constraint
2	Constraint assessment/study required, but low likelihood of delay
3	Constraint will require assessment and delay likely, but unlikely to stop development
4	Significant issue/constraint – delay and could possibly stop the project
5	Likely to preclude development

8.3.5 It should be noted that using the term 'delay' takes into consideration issues such as potential sensitivity/significance, together with issues such as a requirement for additional data.

8.3.6 However, it should be noted that even where a feature represents a level five constraint, there may remain the potential for development for example if the constraint in question can be relocated, if the activity ceases and potential for seasonality in the degree of impact to be used to avoid times of significant impact. Other factors that may influence the level of constraint in the future include the future requirements of other sectors and increasing understanding of environmental impacts. The likelihood that the degree of constraint for at least some of the receptors will vary with time reinforces the need of the MRESF to be periodically updated.

Table 8.2 Constraints Weighting – Preliminary Scoring for Quantifying Degree of Constraint

Parent Data Set	Data Layer	GIS Data?	Buffer	Weighting				
				Wind	Tide (Surface Piercing)	Tide (Wholly Submerged)	Wave (Surface Piercing)	Wave (Wholly Submerged)
Water and sediment quality	Contaminants			Informative	Informative	Informative	Informative	Informative
	Water Quality Data			Informative	Informative	Informative	Informative	Informative
	Water Discharge licences			Informative	Informative	Informative	Informative	Informative
	Pollution Control Zones	Held		Informative	Informative	Informative	Informative	Informative
	Source Protection Zones			Informative	Informative	Informative	Informative	Informative
	Bathing water, OSPAR, WFD, Shellfish waters, UWWTD			Informative	Informative	Informative	Informative	Informative
	IPPC and IPC			Informative	Informative	Informative	Informative	Informative
Visual and Landscape	Seascape, Landscape and Visual Impact Assessments			Informative	Informative	Informative	Informative	Informative
	Welsh Historic landscape			4	3	1	3	1
	Landscape designations	Held		4	3	1	3	1
	AONB	Held		4	3	1	3	1
	National Park	Held		4	3	1	3	1
Marine Mammals	BAP Species			2	2	2	2	2
	Cetaceans	Held		3	3	3	3	3
	Grey Seal Pupping and Haul Out Sites			5	5	5	5	5
	Grey Seal Distribution	Held		3	3	3	3	3
Seabirds	Important Bird Areas	Held		4	4	4	4	4
	Waders and wildfowl	Held		Informative	Informative	Informative	Informative	Informative
	Wetland Birds	Held		Informative	Informative	Informative	Informative	Informative
	Seabird nesting sites	Held		1	1	1	1	1
	Seabirds vulnerable to oil spill	Held		Informative	Informative	Informative	Informative	Informative
	SPA and Ramsar species			Informative	Informative	Informative	Informative	Informative
	BAP species			2	2	2	2	2
	Scoter distribution	Held		4	3	3	3	3

Parent Data Set	Data Layer	GIS Data?	Buffer	Weighting				
				Wind	Tide (Surface Piercing)	Tide (Wholly Submerged)	Wave (Surface Piercing)	Wave (Wholly Submerged)
	Swans and geese			4	2	1	2	1
	Aerial survey seabird data	Held		4	3	3	3	3
	Seabird Colonies	Held		3	3	2	3	2
Fish Ecology	Nursery and spawning areas	Held		4	4	4	4	4
	BAP species			2	2	2	2	2
	Shellfish beds/Harvesting Areas	Held		4	4	4	4	4
Benthic Ecology	BAP species			2	2	2	2	2
	Intertidal biotopes	Held		Informative	Informative	Informative	Informative	Informative
	Subtidal biotopes	Held		Informative	Informative	Informative	Informative	Informative
Designated Sites	Sites of special scientific interest	Held		4	4	4	4	4
	Local Nature Reserves	Held		3	3	3	3	3
	Marine Nature Reserves	Held		4	4	4	4	4
	National Nature Reserves	Held		4	4	4	4	4
	Special Area of Conservation	Held		4	4	4	4	4
	Special Protection Area	Held		4	4	4	4	4
	Ramsar sites	Held		4	4	4	4	4
	Regionally important Geological sites (Geosites)			4	4	4	4	4
Shipping	Shipping Lanes & TSS	Held		5	5	5	5	5
	Shipping Routes	Held		4	4	4	4	4
	Shipping Density	Held		Informative	Informative	Informative	Informative	Informative
	Port and harbour Limits	Held		4	4	4	4	4
Tourism and Recreation	Marinas and slipways	Held		4	4	4	4	4
	RYA Clubs & Training Centres	Held		Informative	Informative	Informative	Informative	Informative
	Recreational sailing routes	Held		2	2	2	2	2
	Recreational sailing and racing areas	Held		2	2	2	2	2
	Diving areas	Held		2	2	2	2	2
	EC Bathing beaches	Held		Informative	Informative	Informative	Informative	Informative

Parent Data Set	Data Layer	GIS Data?	Buffer	Weighting				
				Wind	Tide (Surface Piercing)	Tide (Wholly Submerged)	Wave (Surface Piercing)	Wave (Wholly Submerged)
	Pleasure boat restriction zones			Informative	Informative	Informative	Informative	Informative
	Power boat racing zones	Held		2	2	2	2	2
	Surfing areas	Held		Informative	Informative	Informative	2	2
	Recreational fishing areas	Held		2	2	2	2	2
	Coastal Path/cycle routes	Held		Informative	Informative	Informative	Informative	Informative
Archaeology	Wreck sites	Held		3	3	3	3	3
	Protected wreck sites	Held	Variable	4	4	4	4	4
	Heritage coast	Held		3	3	3	3	3
	World heritage site	Held		4	4	2	4	2
	Historic parks and gardens			2	2	1	2	1
	Scheduled Ancient Monuments	Held		Informative	Informative	Informative	Informative	Informative
	Prehistoric archaeological remains			Informative	Informative	Informative	Informative	Informative
	Maritime archaeology			Informative	Informative	Informative	Informative	Informative
Commercial Fisheries	Fishing grounds/Activity	Held		3	3	3	3	3
	Restricted fishing zones			Informative	Informative	Informative	Informative	Informative
	Shellfish Waters/mariculture	Held		Informative	Informative	Informative	Informative	Informative
	Closed areas			Informative	Informative	Informative	Informative	Informative
	Surveillance Grid 2004	Held		Informative	Informative	Informative	Informative	Informative
	VMS Density 2004	Held		Informative	Informative	Informative	Informative	Informative
	Coastal fisheries			Informative	Informative	Informative	Informative	Informative
	Fish Landings	Held		Informative	Informative	Informative	Informative	Informative
Military Use	Danger Areas	Held		5	5	4	5	4
	MoD Establishments	Held		Informative	Informative	Informative	Informative	Informative
	Military exercise areas	Held		4	4	4	4	4
	Military radar			4	2	1	2	1
	Location of munitions			3	3	3	3	3
	Location of mine fields			3	3	3	3	3
Grid Infrastructure	Existing grid infrastructure	Held		Informative	Informative	Informative	Informative	Informative
Cables and	Existing locations and	Held	500m	3	3	3	3	3

Parent Data Set	Data Layer	GIS Data?	Buffer	Weighting				
				Wind	Tide (Surface Piercing)	Tide (Wholly Submerged)	Wave (Surface Piercing)	Wave (Wholly Submerged)
Pipelines	uses							
Renewable Energy	Existing and planned developments	Held	+ Round I Wind Farm Buffer	5	5	5	5	5
	Strategic Areas	Held		Informative	Informative	Informative	Informative	Informative
Aggregate Extraction	Existing licence areas	Held		5	5	5	5	5
	Dredging Areas	Held		5	5	5	5	5
Oil and Gas	Existing installations	Held		5	5	5	5	5
	Surface Installations	Held		5	5	5	5	5
	Subsurface Installations	Held		5	5	5	5	5
	Wells	Held	500m	5	5	5	5	5
	Existing Installations (6nm from Platform and FSPO)	Held	6nm from Platform and FSPO	3	3	1	3	1
	Licence Blocks	Held		3	3	3	3	3
Licensed Disposal Sites	Existing licensed grounds	Held	500m	2	2	2	2	2
Airspace	Radar (High Risk)	Held		3	2	1	2	1
	Radar (Medium Risk)	Held		2	2	1	2	1

8.3.7 When the constraint mapping is undertaken, the areas of potential economic wind, wave and tidal resource described and mapped in Section 8.2 will be overlaid on the distribution of the identified potential constraints. The results will be a series of figures that highlight firstly the extent of known resource (based on current information) together with the degree of potential constraint that may apply to such developments. The maps will provide clarity on areas where greater a constraint on development would be imposed, ranging through to areas where no likely constraint is identified. However, it should be noted that these will not take into consideration the literature and data listed in Table 8.2 as 'informative', which would need to be taken into consideration on a site specific basis.

Potential to Address Constraints

8.3.8 Once the presence of a potential constraint on development has been identified, there are various options available to assist in identifying a route forward. This is primarily relevant to constraints which are not anticipated to preclude development completely. Essentially, for the majority of potential constraints, there are differences both in how definitive each constraint is and the reason for the constraint, and hence differences in how each constraint can be addressed.

8.3.9 In order to grade each constraint, a number of potential approaches have been identified that have been used on previous projects (not necessarily all renewables) to address such issues. In a similar fashion to Table 8.2, a score of 0-5 has been assigned to each method for each siting constraint, to provide a subjective indication of the potential success or difficulty anticipated behind each approach. For example, for some constraints there may be a statutory legislative process to follow which, if successful, could enable consent, although success cannot be guaranteed. The assessment has been made on the potential constraints listed in Table 8.2 that have been assigned a weighting and not for those deemed informative only.

8.3.10 The definition of each grading is as follows:

0 Method not relevant

1 Method is highly applicable to the constraint and represents a good opportunity of enabling the development

2 Method can be applied to the constraint but the process of completing the method is likely to have time/cost implications

3 Method can be applied to the constraint but there are difficulties in doing so

4 Method has significant difficulties in applying to the constraint and success is unlikely

5 Firm constraint

Table 8.3 Approaches to Addressing Constraints – Preliminary Scoring for Quantifying Applicability

Siting Constraint Feature	Sub Category	Permitted or practical Distance	Undertake additional research	Amend existing Feature	Negotiation with owner /statutory authority	Exclusion Zone around Feature	Financial Compensation/ Payment	Follow legislative process
Visual	6km Visual Impact Zone	6km	0	4	4	1	0	1
	Landscape designations		2	5	3	1	0	3
Marine Mammals	Cetaceans		1-4	0	2-4	3	0	1
	Grey Seal Pupping and Haul Out Sites		1-4	0	2-4	1	0	1
Seabirds	Important Bird Areas		0	0	2-4	1	0	1
	Bird Reserves		0	0	2-4	1	0	1
	Seabird nesting sites		2-4	0	2-4	1	0	1
	Scoter distribution		2-4	0	2-4	3	0	1
	Swans and geese		2-4	0	2-4	3	0	1
	Offshore seabirds		2-4	0	2-4	3	0	1
	Inshore seabirds		2-4	0	2-4	3	0	1
	Aerial survey seabirds - Seabirds at Sea		2-4	0	2-4	3	0	1
	Seabird Colonies		2-4	0	2-4	1	0	1
Fish Ecology	Nursery and spawning areas		2-4	0	2-4	3	0	1
	Shellfish beds		4	4-5	2-4	1	2-4	1
	Bivalve Mollusc Harvesting Areas		4	4-5	2-4	1	2-4	1
Designated sites	Sites of special scientific interest		2	5	3	1	0	3
	Local Nature Reserves		2	5	2	1	0	2
	Marine Nature Reserves		2	5	3	1	0	3

Siting Constraint Feature	Sub Category	Permitted or practical Distance	Undertake additional research	Amend existing Feature	Negotiation with owner /statutory authority	Exclusion Zone around Feature	Financial Compensation/ Payment	Follow legislative process
	National Nature Reserves		2	5	3	1	0	3
	Special Area of Conservation		2-4	5	3-4	1	3-4	3-4
	Special Protection Area		2-4	5	3-4	1	3-4	3-4
	Ramsar sites		2-4	5	3-4	1	3-4	3-4
	Regionally important Geological sites (Geosites)		2	5	3	1	0	3
	AONB		2	5	2	1	0	2
	National Park		2	5	3	1	0	3
	Special Landscape Area		2	5	2	1	0	2
Shipping	Shipping route		2-4	3-5	2-5	1	0	1-4
	Shipping density		2-4	3-5	2-5	1	0	1-4
	Port and harbours		0	5	1-4	1	1-4	1-4
	Ports		0	5	1-4	1	1-4	1-4
	Clearway		2-3	4-5	3-5	1	0	3-5
Tourism and Recreation	Marinas and slipways		2-3	3-5	2-4	1	1-4	1
	Recreational sailing routes		2-4	3-5	2-4	1	1-4	1
	Recreational sailing and racing areas		2-4	3-5	2-4	1	1-4	1
	Diving areas		2-4	3-5	2-4	1	1-4	1
	Power boat racing zones		2-4	3-5	2-4	1	1-4	1
	Recreational fishing areas		2-4	3-5	2-4	1	1-4	1
Archaeology	Wreck sites		2-4	4-5	2-4	1	1-4	1
	Protected wreck sites	Variable	3-5	5	3-5	1	5	3-5
	Heritage coast		0	5	2-4	1	0	1

Siting Constraint Feature	Sub Category	Permitted or practical Distance	Undertake additional research	Amend existing Feature	Negotiation with owner /statutory authority	Exclusion Zone around Feature	Financial Compensation/ Payment	Follow legislative process
	World heritage site		0	5	2-4	1	0	1
	Welsh Historic landscape		0	5	2-4	1	0	1
Commercial Fisheries	Fishing grounds		1-3	3-5	1-4	3	1	0
	Shellfish beds and harvesting areas		2-4	5	5	1	1-4	2-4
	Fishing Activity		2-4	3-5	2-4	3	1-3	1
Military Use	Danger Areas		3-5	5	3-5	1	0	3-5
	Exercise area		3-5	5	3-5	1	0	3-5
	Military Radar		3-5	5	3-5	1	0	3-5
	Location of munitions		2-4	5	3-5	1	0	1
	Location of mine fields		2-4	5	3-5	1	0	1
Cables and pipelines	Existing locations and uses	500m	0-3	2-5	2-5	1	3-5	0-4
Renewable Energy	Existing and planned developments	None sourced	2-4	2-5	2-4	1	2-4	2-4
Aggregate Extraction	Extraction area	500m	0	3-5	3-5	1	3-5	2-4
	Dredging areas		0	3-5	3-5	1	3-5	2-4
	Dredging routes		2-4	3-5	3-5	1	3-5	2-4
Oil and Gas	Existing installations		3-5	5	3-5	1	3-5	3-5
	Surface Installations		3-5	5	3-5	1	3-5	3-5
	Subsurface Installations		3-5	5	3-5	1	3-5	3-5
	Wells		3-5	5	3-5	1	3-5	3-5
	Existing Installations	500m	3-5	5	3-5	1	3-5	3-5
	Licence Blocks	6nm from Platform and FSPO	3-5	3-5	3-5	1	3-5	3-5
Marine disposal sites	Licensed site	500m	2-4	5	2-4	1	0	2-4

Siting Constraint Feature	Sub Category	Permitted or practical Distance	Undertake additional research	Amend existing Feature	Negotiation with owner /statutory authority	Exclusion Zone around Feature	Financial Compensation/ Payment	Follow legislative process
Airspace	Radar (High Risk)		3-5	3-5	3-5	1	0	3-5
	Radar (Medium Risk)		3-5	3-5	3-5	1	0	3-5

9 Progress to Stage 2 – Focused Data Collection

9.1 Prioritisation of Data Gaps

9.1.1 Where data gaps have been identified in the previous sections, these are summarised in Table 9.1 below. The table highlights data gaps identified in the existing knowledge of the baseline environment, together with gaps in knowledge of the impact of the construction, operation and decommissioning phases. As such, it is important to note that the table is not intended to highlight either where impacts are likely/unlikely to occur or the potential significance of such impacts, instead being intended to highlight which issues present a greater degree of constraint on development in Welsh waters than others. Some issues that are significant, but where there is a reasonable body of work, may therefore not appear as highly ranked as issues where considerably less data informs assessments of potential impact.

9.1.2 It is clear from previous sections of the report that there are a number of data gaps; however the degree of constraint on development potentially imposed by each data gap will vary. In addition, some data gaps will represent a more significant issue for Welsh waters than others. Further, given the potential areas of economic resource identified in Figures 22-30, the requirement to address specific data gaps may be more pressing for individual areas or, where economic resource is limited, for specific device types. To this end, a priority rating has been applied to each data gap based on the following criteria:

-	Broad scale studies not appropriate, with issue to be addressed on a site by site basis
N/A	Issue not applicable to that particular device type
Low	The data gap is not considered to represent a significant constraint on development in Welsh waters for the areas identified in Figures 22-30
Medium	The data gap has the potential to delay some projects but does not represent a major constraint on development
High	The data gap represents a significant constraint for at least one of the areas identified in Figures 22-30 and significant financial and time constraints on development are anticipated

	N/A	Low	Low-Medium	Medium	Medium-High	High

Table 9.1 Prioritisation of Data Gaps

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
Physical Environment	Baseline	Increased definition of wave and tidal energy resource particularly in inshore/ constrained areas	Broadscale	N/A	Medium	Medium	Modelling at finer scale (using smaller mesh grid) to provide information for inshore areas and constrained coastal areas
		Potential limitations in baseline geology regarding rock and gravel areas	Broadscale but will require site specific	Medium	Medium	Medium	Additional broadscale data would improve understanding on the distribution and extent of rock and gravels, with particular relevance to benthic ecology
	Impact (construction and decommissioning)	None identified	-	-	-	-	-
	Impact (operation)	The effect of a change in wave or tidal energy	To a degree on a broadscale basis but will require site specific studies	N/A	High	High	Requires a review of the existing capabilities of models and whether sufficient base data exists as a starting point. To include the extent, magnitude and associated impact on coastal and sedimentary processes
		Vertical mixing	Uncertain if this is currently an issue – needs addressing at broadscale to prevent it unnecessarily delaying proposals	N/A	Low	Low	Desk based study in the first instance to assess whether this represents a genuine issue of potential concern

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
		How does energy extraction at the surface or mid column affect the seabed	To a degree on a broadscale basis but will require site specific studies	N/A	Medium	Medium	Requires a review of the existing capabilities of models and whether sufficient base data exists as a starting point
		Is there a critical amount of energy that can be extracted before a significant effect occurs	To a degree on a broadscale basis but will require site specific studies	N/A	Medium	Medium	Requires a review of the existing capabilities of models and the known energy extraction capabilities of devices. Will need an understanding of how much energy is extracted and over what area, together with potential for 'tuning' of devices Empirical data required in order that developed models are accurate
		Cumulative effects	Broadscale	High	High	High	Will require collation of modelling data for developments (including interactions between individual devices within a development) to enable an assessment of potential interaction between developments to be made. May also require SEA/MSP or similar
		Guidance on the methods for predicting and monitoring change	Broadscale	Medium	Medium	Medium	Guidance on the methods available for predicting and monitoring change, including the suitability of the different techniques, together with what actually needs to be measured. Desk based review to provide advice and guidance for all device types. To help ensure comparisons can be made between data and reports for different sites.
Water and Sediment Quality	Baseline	None identified	-	-	-	-	-
	Impact (construction and decommissioning)	Potential for sediment to be released during construction/removal of wave and tidal devices	Site specific	Low	Low	Low	Site specific assessment

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
	Impact (operation)	Antifoulants	Broadscale	N/A	Low-Medium	Low-Medium	Consultation with developers to determine likely need for antifoulants. Results of consultation to determine the need for further desk based work to determine suitability and environmental impact of various types of antifoulants on the market, including guidance on application and removal
		Potential impact on long sea outfalls through mixing and dilution	Site specific	N/A	Low	Low	Site specific modelling-
		Potential for sediment to be released during operation	Site specific	Low	Low	Low	Site specific study
		Vertical mixing	See under physical environment	N/A	See under physical environment		See under physical environment
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Landscape and Seascape	Baseline	Seascape	Awaiting information on project at scoping stage and publication of CCW work				
		Incomplete dataset in LANDMAP		High	Low-Medium	Low-Medium	Completion of existing dataset
	Impact (construction and decommissioning)	None identified	Site specific	-	-	-	-
	Impact (Operation)	Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
Marine Mammals	Baseline	Up to date GIS mapping of distribution of all species	Broadscale	High	High	High	Review of existing datasets to amalgamate disparate sources into up to date source. Potential to investigate seasonal variations. To include an examination of data density and coverage to examine data gaps or areas of poor coverage. Requires raw data collation from numerous sources and therefore data ownership issues may arise. Assessment of residence issues in an area and the degree of interchange between communities will need to be based on distribution across the whole year.
	Impact (construction and decommissioning)	Noise monitoring data	Site specific but requires public domain reporting.	Low	High	High	Review of methods of collecting and reporting noise data, with guidelines on best practice may assist in standardisation Collection of noise data prior to deployment, during construction, operation and decommissioning
	Impact (Operation)	Noise monitoring data	See construction impacts	Low	High	High	See construction impacts of noise
		Collision risk	Requires broadscale studies to help inform site specific issues	N/A	High	High	Baseline monitoring of existing use of the area, including movements, behaviour, distribution and seasonal changes In-situ monitoring to observe if species can detect devices, to monitor actual changes and the effects of avoidance/collision, with additional studies to translate any effects to the population level

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
		Attraction (*will be linked with Collision Risk work noted above*)	Combination of site by site data and broadscale information	N/A	Medium	Medium	Potential for devices to attract marine mammals and methods of deterrent. This issue is linked to collision risk, with the outcomes of collision risk studies to be use to inform the potential need for these studies. Desk based study of the methods available to deter marine mammals, the impact of such methods and their effectiveness. Public domain reporting of changes in marine mammal distribution post deployment to enable attraction/deterrent to be determined
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Birds	Baseline	Baseline distribution	Await outcome of current work	Await outcome of current work			Await outcome of current work
		Underwater bird behaviour	Broadscale study	N/A	High	High	Linked to potential collision risk below, but also to include use of the water column, hotspots, seasonal variations and dive depth
	Impact (construction and decommissioning)	None identified	-			-	-
	Impact (Operation)	Attraction	Broadscale study to inform potential need for site specific work	Low	Low	Low	The potential for birds to be attracted to devices by lights or for roosting. Lights can also lead to confusion, collision and exhaustion as birds circle lights. Literature review of the effect. To provide information on which aspects are most likely to lead to attraction and how this can be minimised
		Collision risk	Broadscale study	High	High	High	Linked to underwater bird behaviour above. Identification where possible of species that may be at risk, including ability to detect objects. Analysis of the effect on an individual and a population.
		Exclusion	Broadscale study	Medium-High	Medium-High	Medium-High	Ecological impact of exclusion from a given area (particularly hotspots). Combination of literature review and modelling for specific species identified to be of concern

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Fish Ecology	Baseline	Baseline data	Broadscale	Medium	Medium	Medium	Review of existing information to provide GIS maps for key species, especially sharks and rays. To use a combination of existing sources including Cefas trawl surveys, EA migratory fish data, recent site specific surveys and CCW marine and estuarine fish monitoring. Where more detailed site specific information is required, studies have used split-beam hydroacoustic mobile surveys to demonstrate actual fish distribution and abundance
	Impact (construction and decommissioning)	Noise monitoring data	Site specific but requires public domain reporting	Low	High	High	See comment under marine mammals
	Impacts (Operation)	Noise monitoring data	See construction	Low	High	High	See construction
		Collision risk	Will require a mixture of site specific and broadscale with public domain reporting	N/A	High	High	Review of existing methods for monitoring fish strike (e.g. those used in the RITE project), in-situ monitoring including the effect of variations for different species (e.g. schooling behaviour, detection/avoidance of devices) and devices (e.g. speed of moving parts), analysis of potential effect of collision at individual and population level
		Methods of deterrent	Deterrent methods can be reviewed on a broadscale basis but may need site specific testing as required	N/A	Medium	Medium	Requirement for this work will depend on the outcome of the collision risk issues discussed above. Desk based review of methods, the results and difference between species and location
		Potential damage to feeding, spawning and nursery areas	Broadscale review	Low	Low	Low	Review of monitoring data

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
		EMF	Broadscale	Low	Low	Low	Dependant on conclusions of current COWRIE reports. Confirmation of direct applicability for wave and tidal devices required
		Standard methods for survey	Broadscale	Low-Medium	Low-Medium	Low-Medium	Standard methods of determining baseline, monitoring change and determine effectiveness of mitigation (if possible to define). Desk based review to provide advice and guidance for all device types. To help ensure comparisons can be made between data and reports for different sites.
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Benthic Ecology	Baseline	Potential to fill apparent data gaps in Cardigan Bay, around Anglesey and in the Severn	Broadscale	Low	Low	Low	Desk based study initially to confirm the apparent gap is accurate. Requirement of additional data will be informed by the project outputs
	Baseline	Characterisation of habitats and species in areas subject to high tidal flows	Broadscale/site specific – determined by occurrence of high energy areas	N/A	N/A	Medium	Await outcome of current BERR RAG work
	Impact (construction and decommissioning)	The effect of methods of installation other than monopiles, such as gravity base, anchors and moorings	Broadscale desk review to inform requirement of site specific studies	Low	Low	Low	Desk-based review, potentially site-specific monitoring – could be accomplished using test site locations (EMEC) to inform particularly on more novel foundation techniques.
	Impact (Operation)	The effect of a reduction in energy associated with wave and tidal devices,	Broadscale data required together with site specific studies available in the public domain	N/A	Medium	Medium,	Determination of what degree of change is significant and how capable/reliable are the methods available for predicting such change and its significance.

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
		Assessment of the geographic extent of change associated with wave and tidal devices	Broadscale desk review to inform requirement of site specific studies	N/A	Medium	Medium,	Using modelling/monitoring data to allow interpretation and prediction of effect significance for biological communities
		How do devices that extract energy at the surface or mid depth affect the seabed	Broadscale desk review to inform requirement of site specific studies	N/A	Medium	Medium,	Using modelling/monitoring data to allow interpretation and prediction of effect significance for biological communities (e.g. from changes to habitat stability, sediment regime)
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Plankton	Baseline	Requirement for data currently uncertain	Broadscale	Low	Low	Low	Await outcome of physical processes work on vertical mixing
	Impact (construction and decommissioning)	Requirement for data currently uncertain	Broadscale	Low	Low	Low	Await outcome of physical processes work on vertical mixing
	Impact (Operation)	Requirement for data currently uncertain	Broadscale	Low	Low	Low	Await outcome of physical processes work on vertical mixing
Designated Sites	Baseline	Dependant on the identification of offshore sites	Broadscale	Dependant on the identification of offshore sites			Dependant on the identification of offshore sites
	Impact (construction and decommissioning)	None identified	-	-	-	-	To be addressed by habitats/ species and not individual sites
	Impact (Operation)	None identified	-	-	-	-	To be addressed by habitats/ species and not individual sites

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
Shipping	Baseline	Clearways (although the term is understood to be no longer in use, no replacement is yet available)	Broadscale	High	High	High	Consultation to provide clarity on shipping clearways (or subsequent successor), e.g. their location and the implications for development
	Impact (construction and decommissioning)	Increase in carbon emissions due to vessel re-routing	Site specific	-	-	-	-
	Impact (Operation)	Collision risk – fixed structures	Primarily site specific but a degree of broadscale work would be beneficial	Low	High	High	Navigation risk assessment to determine potential collision risk with wave and tidal devices that are on the surface or subsurface, including consultation with interested parties
		Collision risk - devices that break free	Site specific	-	-	-	-
		Increase in carbon emissions due to vessel re-routing	Site specific	-	-	-	-
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Tourism and Recreation	Baseline	None identified	-	-	-	-	-
	Impact (construction and decommissioning)	None identified	-	-	-	-	-
	Impact (Operation)	Requirement for exclusion areas	Broadscale	Low-Medium	Low-Medium	Low-Medium	Consultation

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
		Justification and tailoring of exclusion zones	Broadscale	Medium-High	Medium-High	Medium-High	Understanding of the justification for exclusion zones proposed together with how these could be tailored for different recreational activities.
		Public perception	Broadscale (but predominantly for inshore areas)	High	High (LOW if offshore)	High (LOW if sub surface)	Consultation to discover the general opinion and public perception, to provide accurate and up to date information on potential impacts of wind, wave and tide. To include the use of visual images for all devices – including markings, lights etc, together with photomontage type information. Opportunity for promotion of the industry
		Potential benefits	Broadscale	Low-Medium	Low-Medium	Low-Medium	Depending on recreational activity being investigated, there are potential linkages to commercial fish studies and research on artificial reefs
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Archaeology	Baseline	Locations of wrecks in apparent 'gap' areas of Cardigan Bay and areas offshore	Broadscale	Medium	Medium	Medium	Geophysical survey within areas of high potential for marine renewable developments. Detailed desk based assessment of recorded losses in specific areas
	Impact	Understanding of the implications on physical process alteration arising from wave and tidal devices	Broadscale	N/A	low	low	See physical processes
Commercial Fisheries	Baseline	None identified	Dependant on the outputs from current work	Dependant on the outputs from current work			Dependant on the outputs from current work

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
	Impact (construction and decommissioning)	None identified	-	-	-	-	-
	Impact (Operation)	Potential impact of exclusion zones	Broadscale	High	High	High	Consultation with developers, regulators and fishing interests. To identify the type and extent of exclusion zones currently in place on offshore wind farm sites (including the types of fishing activity affected), whether these zones are effective and what type of exclusion zones are planned or are likely to be planned for Round 3 and for wave and tide. Consultation with fishermen is best conducted face to face and not via questionnaires.
		Potential benefits of exclusion zones	Broadscale	Medium	Medium	Medium	Desk based study in first instance to review benefits from projects such as the Lundy scheme. Identify potential data associated with renewable developments. Assess potential benefits based on issues such as scale and extent of exclusion zones, the type of fish etc.
		Sensitivity of different fishing activities to displacement	Broadscale	High	High	High	To cover both transit routes and fishing grounds. To include issues such as vessel size, distance from port, extent of available fishing grounds, value of catch, benefits from exclusion zones and any differences in the exclusion imposed between fishing activities. Consultation with fishermen is best conducted face to face and not via questionnaires.
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Military Use	Baseline	None identified	-	-	-	-	-
	Impact (construction and decommissioning)	None identified	Site specific	-	-	-	-
	Impact (Operation)	Potential conflict with existing use	Regional	High	-	-	Potential conflict between MoD interests in Cardigan Bay and the potential wind energy resource

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
		Potential effects of wave and tidal devices	Broadscale	N/A	High	High	Combination of consultation and desk based study to determine whether there is potential for an effect and if so what aspect of devices or sites may cause it and how can it be mitigated. What are the potential implications of cumulative effects?
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Grid Infrastructure	Baseline	None identified (gap relates to infrastructure supply and not knowledge)	-	-	-	-	-
	Impact (construction and decommissioning)		-	-	-	-	-
	Impact (Operation)		-	-	-	-	-
Cables and Pipelines	Baseline	Outfall positions and dilution requirements	Site specific	Low	Low	Low	Site specific assessment
	Impact (construction and decommissioning)	None identified	Site specific	Low	Low	Low	Site specific assessment
	Impact (Operation)	Initial dilution issues	Site specific	Low	Low	Low	Site specific assessment
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Renewable Energy	Baseline	None identified	-	-	-	-	-
	Impact (construction and decommissioning)	None identified	-	-	-	-	-
	Impact (Operation)	Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Aggregate dredging	Baseline	None Identified	-	-	-	-	-
	Impact (construction and decommissioning)	Aggregate wharf locations and transit routes	Broad scale and site specific	Low-Medium	Low-Medium	Low-Medium	Best addressed at the broadscale via an SEA or MSP or site specific by a navigation risk assessment

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
	Impact (Operation)	Aggregate wharf locations and transit routes	Broad scale and site specific	Low-Medium	Low-Medium	Low-Medium	Best addressed at the broadscale via an SEA or MSP or site specific by a navigation risk assessment
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Oil and Gas	Baseline	Dependant on current interests in Cardigan Bay	Broadscale	Await progress of current interest in Cardigan Bay			Await progress of current interest in Cardigan Bay
	Impact (construction and decommissioning)	None identified	-	-	-	-	-
	Impact (Operation)	Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Licensed disposal sites	Baseline	None identified	-	-	-	-	-
	Impact (construction and decommissioning)	None identified	-	-	-	-	-
	Impact (Operation)	Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
Aviation and Radar	Baseline	None identified	-	-	-	-	-
	Impact (construction and decommissioning)	None identified	-	-	-	-	-
	Impact (Operation)	Radar	Broadscale	Medium	High	High	Clarification that wave and tidal devices are unlikely to present an issue for radar. Through consultation in the first instance.
		Cumulative effects	Broadscale	High	High	High	May require SEA/MSP or similar
CO2 Sequestration	Baseline	Acquisition of existing data	Broadscale	N/A	N/A	N/A	Further work to identify potential targets for further evaluation will necessitate the acquisition of existing seismic and well data and geophysical work done to date. Only when an area of possible sequestration has been identified would it be recommended to acquire new data, if needed, because of the high cost of data acquisition.

Issue	Baseline or impact?	Summary of Information Required	Level at which Issue can be addressed	Priority			Potential method for collection
				Wind	Wave	Tide	
		Identification of source and volume of CO_2 for sequestration	Broadscale	N/A	N/A	N/A	The source of the volumes of CO_2 identified for sequestration (as this will potentially have implications for the location of sequestration sites).
	Impact	None identified	-	-	-	-	-

9.2 Proposed Work Areas

9.2.1 Table 9.1 provides an overview of the data gaps highlighted during the current project, together with an indication of the priority for Welsh waters that can be attached. Where data gaps are considered high, these have been taken further in the sections below, to provide more information on potential methods available that could be used to fill the gaps, together with indicative project timescales. The information is provided under the following headings:

Data Gap:	Brief title
Baseline or impact:	Does the data gap relate to the baseline environment or potential impact
Industry:	Wind, wave and/or tide
Extent of relevant data:	To highlight work available to date
Purpose of research:	To highlight what the proposed work is looking to address
Geographic extent:	National – relevant across Welsh waters
	Regional - e.g. restricted to south Wales
	Local - up to 10km from site
	Development Scale - within development footprint
Project timescale:	Indicative timescales based on up to 3 months, 3-6 months, 6-12 months, 12-24 months and 24 months plus
Proposed methodology:	Brief description of the potential project methodology

9.2.2 As the purpose of the current report is to develop a Strategic Framework for Wales, when considering the geographic extent of potential research projects, the term 'national' is considered to cover the whole of Wales. However, in practical terms, it is likely that a number of these issues will have wider applications, and may benefit from a coordinated and collaborative across the UK. It is anticipated that the potential for such an approach would best be explored during Stage 2 of the project.

9.2.3 Some 19 high priority data gaps have been identified, which are presented below, in no particular order of priority.

Large Scale Interactions

Data Gap:	Large scale interactions
Baseline or impact:	Impact
Industry:	Wind, wave and tide
Extent of relevant data:	Projects such as existing SEAs for oil and gas, offshore wind and marine renewables, together with the Marine Spatial Plan for the Irish Sea
Purpose of research:	To gain a greater understanding of how the development of wind, wave and tidal stream in Welsh waters will interact with both the existing human interests (including the need for existing interests to develop) and the

	natural environment.
Geographic extent:	National
Project timescale:	12-24 months
Proposed methodology:	Dependant on whether the route taken is SEA or MSP. However, is likely to require extensive consultation and discussion with interested parties, significant GIS mapping of existing interests and likely changes, together with medium to long term planning at a strategic level.

Positive Effects

Data Gap:	Positive Effects
Baseline or impact:	Impact
Industry:	Wind, wave and tide
Extent of relevant data:	Disparate data sources that provide information in general (e.g. benefits for climate change) down to site specific (e.g. benefits for individual fish species)
Purpose of research:	To increase understanding and awareness of known and predicted positive impacts associated with marine renewables.
Geographic extent:	National
Project timescale:	3-6 months
Proposed methodology:	Although not highlighted in the section on data gaps, a need to understand the positive impacts associated with marine renewable developments has been highlighted during the literature review and the consultation process. It is proposed that the work encompass an initial workshop, to enable input and discussion from a wide variety of individuals, with the aim of highlighting firstly assumed positive impacts together with potential positive impacts. Depending on the workshop outputs, follow up may be required in the form of consultation. The work will then require a literature search and reporting phase to collate the information and to identify potential positive impacts, the level at which the effects may be felt (e.g. local to international), if/how such impacts can be measured together with the significance of such impacts both on a site specific level but also at an industry level. The report will include a review of methods to maximise such positive impacts and, where feasible, an assessment will then be made to determine if/how such positive impacts could be used as mitigation.

Monitoring Requirements

Data Gap:	Monitoring requirements post consent
Baseline or impact:	Impact
Industry:	Wind, wave and tide
Extent of relevant data:	Current monitoring requirements attached to consents for Round 1 and Round 2 wind farms and for the tidal turbine at Strangford Lough
Purpose of research:	To provide advice and guidance to developers at an early stage on the potential monitoring requirements that may be attached to a development consent. Intended to provide greater certainty on project costs and timescales at the beginning of a project
Geographic extent:	National
Project timescale:	3-6 Months
Proposed methodology:	The initial aspects of the project will involve the collation of monitoring requirements attached to consented marine renewable developments (provided these are public domain – there may be confidentiality issues), followed by a review of the purpose behind the monitoring – i.e. why was that monitoring requirement imposed. An assessment will then be made of the typical reasons for monitoring to be imposed, what that monitoring entails, its scale and duration. The final part of the project is likely to involve a review of predicted and known impacts associated with marine renewable developments to identify those that represent the greater significance or uncertainty, followed by a combination of this information with the monitoring literature to summarise the potential monitoring requirements, when these may be imposed, methods of fulfilling the requirements and an indication of the scale and extent of work involved.

Physical Processes

Data Gap:	Understanding of the effect of a change in wave or tidal energy
Baseline or impact:	Impact
Industry:	Wave and tide
Extent of relevant data:	Currently primarily restricted to modelling studies with limited in-situ monitoring. Includes site specific studies (e.g. for MCT, Wave Hub, Wave Dragon etc) but also research for individual devices and occasionally arrays of devices. Currently difficult to use the data widely in assessments of potential impact, partly due to its disparate nature but also due to confidentiality issues
Purpose of research:	More research is required to understand the degree and extent of change, both in the vertical and horizontal. This is important in order to understand associated issues such as the effect of energy extraction at different

	depths in the water column, the resulting extent of change in energy and the device wake
Geographic extent:	Local to regional
Project timescale:	3-6 Months
Proposed methodology:	A review of the existing capabilities of models and whether sufficient base data exists as a starting point. To include the extent, magnitude and associated impact on coastal and sedimentary processes and including the vertical and horizontal change in energy within the water column.
Data Gap:	Cumulative effects on the physical environment
Baseline or impact:	Impact
Industry:	Wind, wave and tide
Extent of relevant data:	Site specific studies undertaken for offshore wind. Limited studies have been undertaken that model potential interaction between wave or tidal devices, primarily academic papers or conference proceedings, with few deployments of more than one device to date.
Purpose of research:	To increase understanding of the potential for interaction between devices within a development and between industries
Geographic extent:	Development scale to regional
Project timescale:	3-6 months, but dependent on availability if information on device interaction within an array
Proposed methodology:	Collation of modelling data for developments (including interactions between individual devices within a development) to enable an assessment of potential interaction between developments to be made.

Water and Sediment Quality

Data Gap:	Antifoulants
Baseline or impact:	Impact
Industry:	Wave and tide
Extent of relevant data:	Highly limited data is currently available for wave and tide devices, being restricted to an investigation into the effect of antifouling on device efficiency together with some information for deployments. A considerable body of work is available in the wider literature for both commercial and recreational applications. Some on-going research of relevance to marine renewables.
Purpose of research:	To identify the need for antifoulants, to identify which methods that are available which may be appropriate for the requirements of the industry, to

	consider the environmental impacts of application, use and removal of the antifoulant method and ideally to include best practice and guidance.
Geographic extent:	Development scale
Project timescale:	Up to three months
Proposed methodology:	The potential need for antifoulants on wave and tidal devices has been raised by numerous authors; however there is little information available regarding the actual needs of the industry. It is therefore considered that an appropriate first step would involve consultation with developers with the intention of identifying the potential need for antifoulants, to discuss experience of biofouling on devices in the water and to determine whether particular methods have been investigated. Once industry requirements are better understood, a desk based study would be required to compare the various methods available and to consider the conditions under which each method is appropriate. The information will then ideally be taken forward to provide recommendations on methods of antifoulant to use and how to apply/maintain the antifoulant

Marine Mammals

Data Gap:	Distribution of marine mammals
Baseline or impact:	Baseline
Industry:	Wind, wave and tide
Extent of relevant data:	Data on the distribution of marine mammals is widely available, including several reviews that are now out of date. Limited information is available as regards marine mammal behaviour, seasonal distribution or use/importance of particular areas. There may be issues associated with data ownership, which will need to be addressed if a complete dataset that is to be publicly available can be achieved
Purpose of research:	To provide an up to date baseline of marine mammal distribution against which change can be measured. Ideally to include seasonal change, use and importance of areas.
Geographic extent:	National
Project timescale:	3-6 months
Proposed methodology:	Initial work will involve collation of datasets, together with any associated restrictions on the use of the data. The information will require mapping in GIS. Data ownership issues may mean that the data can be available to view (e.g. on a web portal) but not downloaded or held by external organisations. Metadata associated with the information that will be of particular relevance will include information on how the sighting was made (e.g. opportunistic or standardised survey), date and any note on behaviour. One of the main challenges is likely to be how or if numerous

	disparate datasets can be amalgamated to produce a workable dataset. Ideally project outputs will include maps for individual species providing information on species distribution, density of sightings/survey (including data coverage/extent), seasonal change, behaviour/use of areas and hotspots.
Data Gap:	Collision Risk – marine mammals
Baseline or impact:	Impact
Industry:	Wave and tide
Extent of relevant data:	The potential for marine mammals to collide with wave or tidal devices is raised fairly routinely as a concern. Some studies have taken a scientific approach to predictions of potential impact (for example work for the Scottish Marine SEA) with the acknowledged uncertainty leading some developments to instigate monitoring (e.g. SeaGen).
Purpose of research:	To help provide information on a generic level as regards the potential for collision risk, together with methods of reducing risk (if applicable) and an understanding of the potential significance for individuals and populations
Geographic extent:	Development scale
Project timescale:	Less than three months for the workshop, with timescales of subsequent work to be decided
Proposed methodology:	There is considerable uncertainty regarding the potential for marine mammals to collide with wave or tidal devices. There also appears to be uncertainty and differing opinions as regards the appropriate methods available to assess the risk, i.e. whether desk based studies and/or models can provide additional information or whether in-situ monitoring is the only option. It is therefore proposed to hold a workshop to enable these issues to be discussed prior to devising detailed proposals. To gain maximum benefit from such a workshop, it should comprise developers, regulators, consultants, academics and NGOs, including those with knowledge of biological and physical processes (including modelling and in-situ survey).

Noise

Data Gap:	Measurements of noise during construction and operation (also decommissioning, but this is even more dependant on the stage of the industry)
Baseline or impact:	Impact
Industry:	Wave and tide
Extent of relevant data:	Numerous studies provide baseline data (although not necessarily site specific), several studies are available on development noise in the marine

	environment that is useful, including work for offshore wind, piling and geophysical survey, however only limited (confidential) data exists for tidal devices and no data has been sourced for wave devices
Purpose of research:	To provide data on noise associated with construction and operation of wave and tidal devices (and, if possible, decommissioning)
Geographic extent:	Development scale
Project timescale:	Less than three months for each aspect of the proposed methodology
Proposed methodology:	There is limited potential for desk based work to address this issue, however a review of installation methods planned to be used for wave and tidal devices would be useful to aid in identifying relevant datasets (where available) of noise associated with such activities. To collect data on construction and operation of devices will require monitoring of a deployment at sea, preferably at commercial scale. Once a greater understanding has been gained of the level and frequency of noise associated with wave and tidal devices, a more detailed assessment can be made of the potential extent and duration of impact together with the potential significance for sensitive species, generally fish and marine mammals.

Seabirds, Wildfowl and Waders

Data Gap:	Underwater bird behaviour and potential collision risk
Baseline or impact:	Baseline
Industry:	Wave and tide
Extent of relevant data:	The potential for birds to become entangled with surface structures or to collide with submerged devices is raised fairly routinely as a concern. Limited data is currently available as regards bird behaviour below the surface, with the most complete recent review contained in the Scottish Marine Renewable SEA. Some information is available in the academic literature and potentially from oil and gas installations, with research currently being undertaken by MREDS on Orkney. The information available tends to relate to issues such as energy use by birds in different activities, approaches taken for prey capture, together with some in-situ data logging experiments, e.g. Wanless et al (1998, ref 793).
Purpose of research:	To provide baseline data on how birds behave when underwater, to aid in understanding potential for interaction with devices
Geographic extent:	National
Project timescale:	**Desk-based review**– less than three months **In-situ monitoring** – requirement for and timescales to be determined by desk-based review

Proposed methodology:	Detailed review of wider literature regarding bird behaviour underwater, to determine which species have been studied and the extent of the information. Such a review will also assist in determining which species have the potential to be affected and by which devices (e.g. rafting behaviour on the water surface, depth of dive, dive profile, underwater vision etc when compared to device type and positioning in water column). The outcomes of such a review will need to consider whether any particular species is at potential risk (primarily those found in Welsh waters), how that risk may vary between device type and whether field data is required for any species. It will also help inform the potential need for in-situ monitoring of devices, if these are deployed in areas used by such birds, or whether in-situ monitoring of specific bird species is required

Fish Ecology

Data Gap:	Collision risk - fish
Baseline or impact:	Impact
Industry:	Wave and tide
Extent of relevant data:	The potential for fish to collide with submerged devices is raised fairly routinely as a concern. Some studies have taken a scientific approach to predictions of potential impact (for example work for the Scottish Marine SEA) with the acknowledged uncertainty leading some developments to instigate monitoring (e.g. SeaGen, Roosevelt Island Tidal Energy project). The RITE devices were installed between 2006 and 2007 and although no monitoring data is currently available, it is understood that the programme includes 18 months of hydro acoustic fish monitoring, which if the information is public domain should provide the first in-situ monitoring data of fish and tidal turbines. The data is currently with the relevant authorities, with confirmation of the confidential status pending.
Purpose of research:	To provide an objective assessment for potential for fish to impact on wave or tidal devices, including monitoring data where available
Geographic extent:	Development scale
Project timescale:	3-6 months for the desk based work
Proposed methodology:	The assessment of fish collision risk is subject to the same limitations as the above proposed work on marine mammals and birds, in that published work to date has been limited to desk-based studies. It is proposed that a detailed review of the work completed to date (i.e. the predictions of impact together with the reasonings behind the predictions) be undertaken, to be accompanied by a review of the in-situ monitoring planned and in progress. The review of monitoring needs to look both at the methods proposed/used, survey design, applicability to different sites and (if possible) the appropriateness and success of such methods.

	The review will also need to take detailed consideration of the underwater structure of wave and tidal devices, primarily related to issues such as the positioning of parts within the water column (and hence the species that may be involved), overall device scale and scale/movement pattern/speed of the moving parts. Following completion of the desk based work, and hopefully the public domain reporting from the RITE project (confirmation of the confidentiality status is pending), it may be necessary to consider in-situ monitoring of further devices.

Shipping

Data Gap:	Clearways (although the term is understood to be no longer in use, no replacement is yet available)
Baseline or impact:	Baseline
Industry:	Wind, wave and tide
Extent of relevant data:	Historic interest in mapping and defining clearways, however recent information suggests that the idea is no longer in use. Several datasets exist to provide information on shipping routes, including density.
Purpose of research:	To understand the needs of the shipping industry, areas of priority and the degree of constraint that may be imposed on different marine renewable technologies.
Geographic extent:	National
Project timescale:	For initial work, less than three months
Proposed methodology:	It is proposed to start the process with a workshop to bring together interested parties from shipping, navigation, safety and device developer groups. The workshop will be intended to disseminate information and to stimulate discussion. Information to be disseminated will need to include data on devices and shipping routes. For devices, the type of information that will be required will include potential development sites in Welsh waters, different devices and comparisons between devices that are surface piercing and those that are fully submerged. For shipping, information on the routes used, density of shipping, safety requirements and which locations/issues are no-gos and those which may be amenable to negotiation. It is intended that the workshop and subsequent reporting will provide clarity on the degree of constraint posed by different shipping routes and how compromise may be reached in certain areas.
Data Gap:	Collision risk - navigation
Baseline or impact:	Impact
Industry:	Wave and tide
Extent of relevant data:	Navigation risk assessments undertaken for offshore wind and to a lesser

	extent for wave and tide
Purpose of research:	To provide information on the potential risk associated with fixed devices and devices should they become loose, together with information on methods to minimise or mitigate such risks
Geographic extent:	Development scale to local
Project timescale:	3-6 months
Proposed methodology:	Initial desk based review of navigation risk assessments available for wave and tidal devices, to identify which aspects of devices have raised concerns to date and how these concerns have been addressed. The desk based review will then be extended to include a review of guidance and best practice for devices deployed at sea (including wave and tidal devices) to determine how current practice minimises the risk to navigation from devices fixed to the seabed.

Tourism and Recreation

Data Gap:	Public perception
Baseline or impact:	Impact
Industry:	Wind, wave and tide
Extent of relevant data:	The views of the public, whether positive or negative, have to date had a marked effect on the consenting of renewable energy developments, both on land and at sea. Several reviews have been undertaken to determine public opinion, primarily for onshore and offshore wind.
Purpose of research:	The purpose of the project is two fold. The first is to assess public opinion in Wales as regards wind, wave and tidal power, with the second to provide an opportunity to disseminate accurate information to the general public.
Geographic extent:	National
Project timescale:	6 months to 1 year
Proposed methodology:	Public consultation to be undertaken by a combination of approaches, e.g. public meetings/displays, information boards at tourist sites/information offices, television/radio broadcasts, and web based information. The aim is to understand issues such as why members of the public support (both in general and for specific proposals) or oppose proposals, together with which aspects of developments are of interest and why. The project will also be used to provide accurate and up to date information relevant to Wales, helping to dispel misinformation and to promote a genuine understanding of the need for marine renewables, the alternatives to such development, their benefits and impacts.

Commercial Fishing

Data Gap:	Exclusion zones
Baseline or impact:	Impact
Industry:	Wind, wave and tide
Extent of relevant data:	Consultation with the fishing industry and assessments of potential impact as a matter of course for proposals, specific consultation for research projects such as potential socio-economic impacts, a BERR Rag project in progress looking at fishing in and around offshore wind farms
Purpose of research:	To gain a better understanding of the actual impacts of fisheries exclusion zones
Geographic extent:	National
Project timescale:	3 to 6 months for initial work, possible extension if field work is required
Proposed methodology:	Initial desk based review to firstly identify what fishery exclusion zones exist or are proposed in the UK and aboard, together with the reasons for the zone, which fishing activities are excluded, the perception of such zones and any data to provide an insight into the impact of such zones, including environmental, social and economic issues. As GIS mapped commercial fishing data becomes available for Welsh waters, a comparison of known and potential exclusion zones will be made against existing fishing activity.
Data Gap:	Sensitivity of different fishing activities to displacement
Baseline or impact:	Impact
Industry:	Wind, wave and tide
Extent of relevant data:	Limited
Purpose of research:	To assess how different types of fishing activity and different scales of fishing operation are affected by displacement (including transit to fishing ground and actual fishing ground)
Geographic extent:	National
Project timescale:	3 to 6 months
Proposed methodology:	A combination of desk based review and face to face consultation with fishing interests to assess the potential impact of marine renewable developments on commercial fishing, both directly (e.g. exclusion zones) and indirectly (e.g. displacement of activities or interference with transit routes). The aim will be to determine if there are differences between fishing activity type and/or scale of operation/size of vessel. Issues to consider include vessel size, number of vessels in a fleet, distance from port, extent of available fishing ground, adaptability, value of catch, differing restrictions imposed by exclusion zones etc.

Military

Data Gap:	Potential effects of wave and tidal devices on military interests
Baseline or impact:	Impact
Industry:	Wave and tide
Extent of relevant data:	Publicly available information on project specific consultation with the MoD, limited public domain research
Purpose of research:	To determine if wave and tidal devices represent a particular concern for the MoD (other than physical presence) with the aim of assessing the potential for MoD interests to represent a constraint on development, and the degree of constraint that it may represent
Geographic extent:	Development scale to local
Project timescale:	Up to three months
Proposed methodology:	Prepare a summary of existing wave and tidal devices, particularly those that are looking to deploy in Welsh waters. The summary will need to include issues such as scale, positioning (e.g. surface piercing, mid-column or seabed), array density, scale markings and lighting etc. The information will then be used during consultation with the MoD to discuss the type and scale of marine renewable energy deployments. It is anticipated concerns will be site specific, but it is intended to determine at a broadscale which issues may arise together with any device/site specifics that may be of relevance. The potential for cumulative effects will also need to be addressed.
Data Gap:	Military interests in Cardigan Bay
Baseline or impact:	Baseline and impact
Industry:	Primarily wind
Extent of relevant data:	Public domain mapping of the extent of military interests
Purpose of research:	The degree of constraint posed by military interests is often site specific, however based on the extent of military interest in Cardigan Bay (particularly issues such as low flying) and the large potential for offshore wind, it is necessary to determine if the military interest is a definite 'show stopper' or if the issue can be resolved
Geographic extent:	Regional
Project timescale:	3 to 6 months
Proposed methodology:	It is anticipated that much of the project would involve consultation and discussion with interested parties, primarily the MoD, to ascertain the degree of constraint the military interests in the area may impose of potential marine renewable development (primarily wind). It is anticipated that these discussions may be confidential but if the potential for wind

power in Cardigan Bay is to be made available then the issue needs to be addressed.

Aviation and Radar

Data Gap:	Radar
Baseline or impact:	Impact
Industry:	Wave and tide
Extent of relevant data:	Significant research undertaken to date for offshore wind, to determine the potential for impact but also methods of mitigation
Purpose of research:	To confirm whether concerns may exist as regards wave and tidal devices
Geographic extent:	National
Project timescale:	Up to three months
Proposed methodology:	Prepare a summary of existing wave and tidal devices, particularly those that are looking to deploy in Welsh waters. The summary will need to include the same information as that prepared for the MoD (see above) and as such if both projects are run at the same time, the same information can be used. The summary will need to include issues such as scale, positioning (e.g. surface piercing, mid-column or seabed), array density, scale markings and lighting etc. The information will then be used during consultation with the aviation interests to discuss the type and scale of marine renewable energy deployments. It is intended to use the consultation to provide information to generate comment and input at an early stage and to assess whether the issue can be 'scoped out' for wave and tidal devices.

9.3 Where Do We Go From Here?

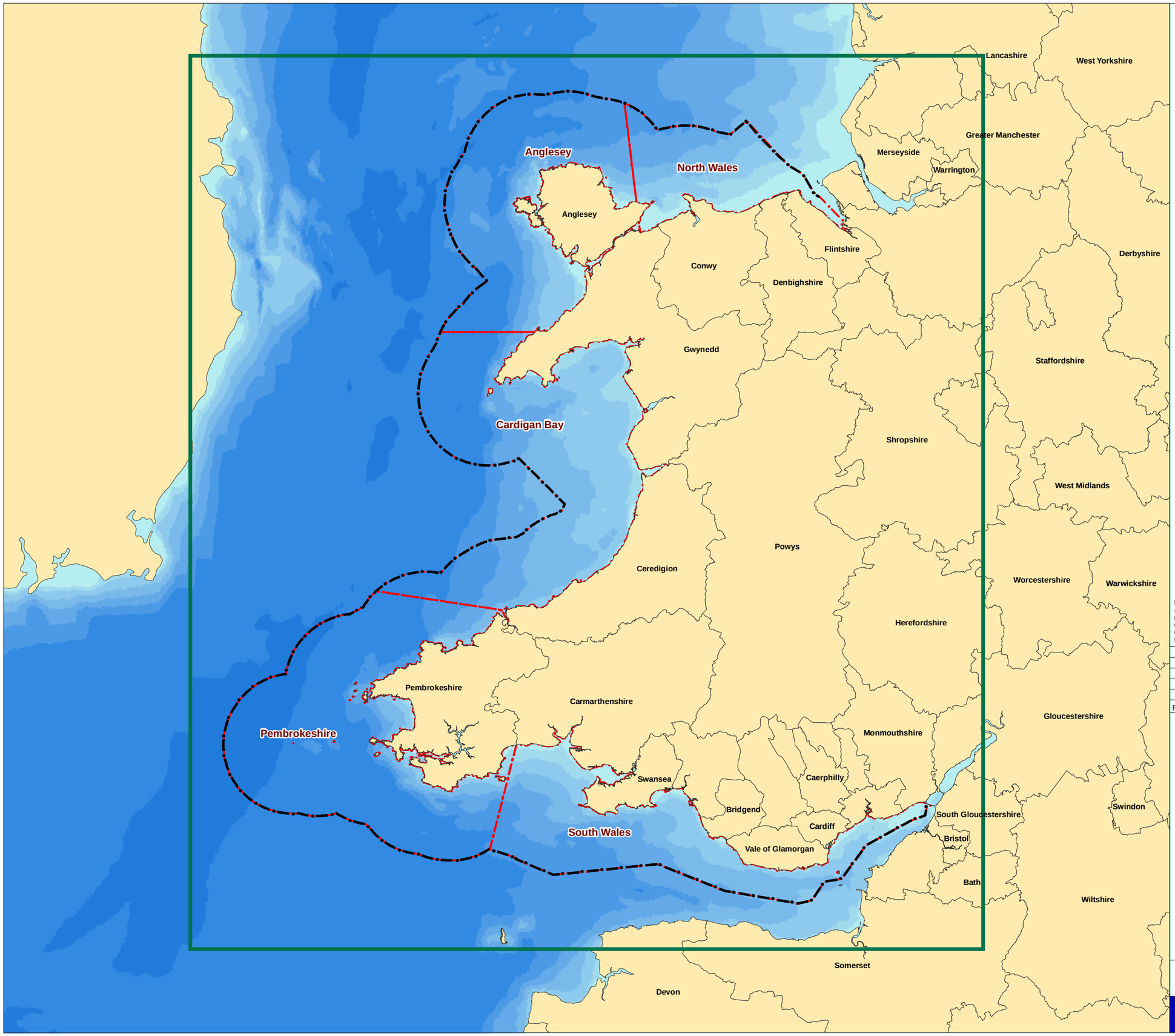
9.3.1 As highlighted in Section 1, the WAG is aiming to develop the strongest economic development policies to underpin sustainable growth and prosperity in Wales. Part of the overall aim is the recognition of the importance of evidence based evaluation of clean energy developments, both as an economic driver and for sustainable development. Marine renewables were identified in WAGs Energy Strategy as a method offering potential to achieve the renewable energy benchmark target of 7TWH by 2020, while establishing an indigenous industry to benefit Welsh business.

9.3.2 The overall aim of the current project is to develop a Marine Renewable Energy Strategic Framework, covering sustainable energy extraction and CO_2 storage. The process has followed the overriding aim of evidence based evaluation of clean energy, with the following having been achieved:

- Desk based collation of existing data and information, including the resource in Welsh waters, grid capacity, limitations and environmental baseline;
- GIS mapping of data where available;
- Determination of current understanding of potential/known impacts;
- Identification of development constraints; and
- Summary of the gaps in current understanding in terms of baseline data and potential/known impacts.

9.3.3 The work presented in the current report represents the output from Stage 1 of the MRESF. The final output, the list of research topics that are highlighted as being 'high' in terms of potential constraint on development in Welsh waters (Section 9.2), will form the basis of discussions for work to be conducted in the subsequent stages of the project. The next stage, Stage 2, subject to discussion and agreement with the Steering Group, will be to address the key data gaps identified within Stage 1. The subsequent Phase 3 is anticipated to be a desk-based exercise that will build on the knowledge base formed during Stages 1 and 2 and will generate proposals for the optimum location of marine renewable energy technologies in Welsh waters. It is noted from the original tender document that such development scenarios should be based on the 7TWH target for 2020 but that 'it will be necessary to ensure that the carrying capacity of the environment is not exceeded to ensure that proposals are sustainable'. Stage 3 will therefore culminate with a strategic approach to the deployment of marine renewable energy technologies, aimed at meeting the targets in a sustainable manner.

Figures



Legend

- 12nm Territorial Waters Limit (SeaZone)
- Spatial Units
- Study Area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Study Area and Spatial Units**

Scale: A3 @ 1:1,200,000

0 30 60 km

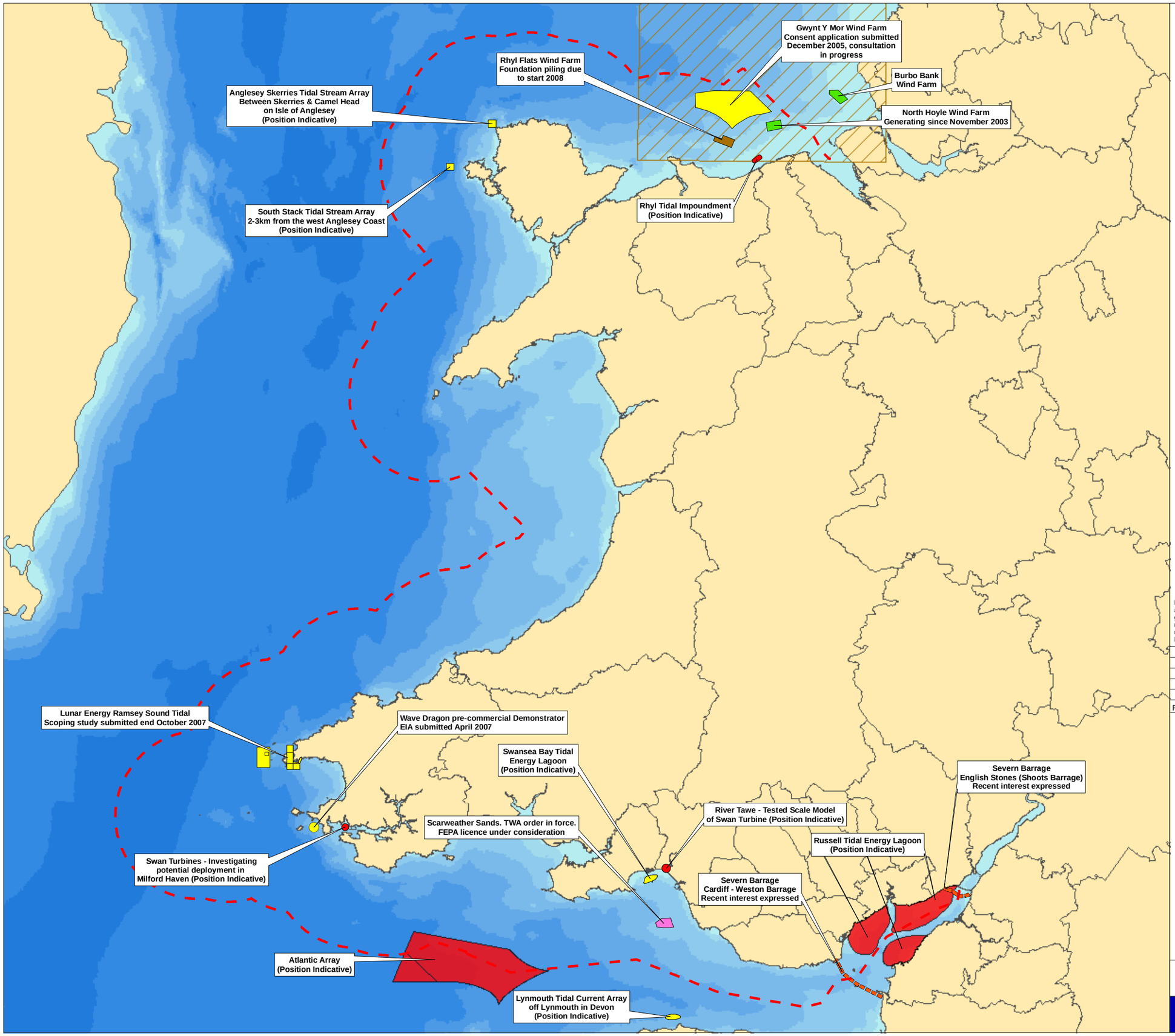
N

Date: 24/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **1** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\JER3688-Figure_01_StudyArea.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)
- Strategic Areas

Operational Projects

Projects under Construction

Consented Projects

Projects in Planning

Proposed/Potential Projects

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, Seazone, DTI

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Renewable Energy Interests in Welsh Waters

Scale: A3 @ 1:1,000,000

0 25 50 km

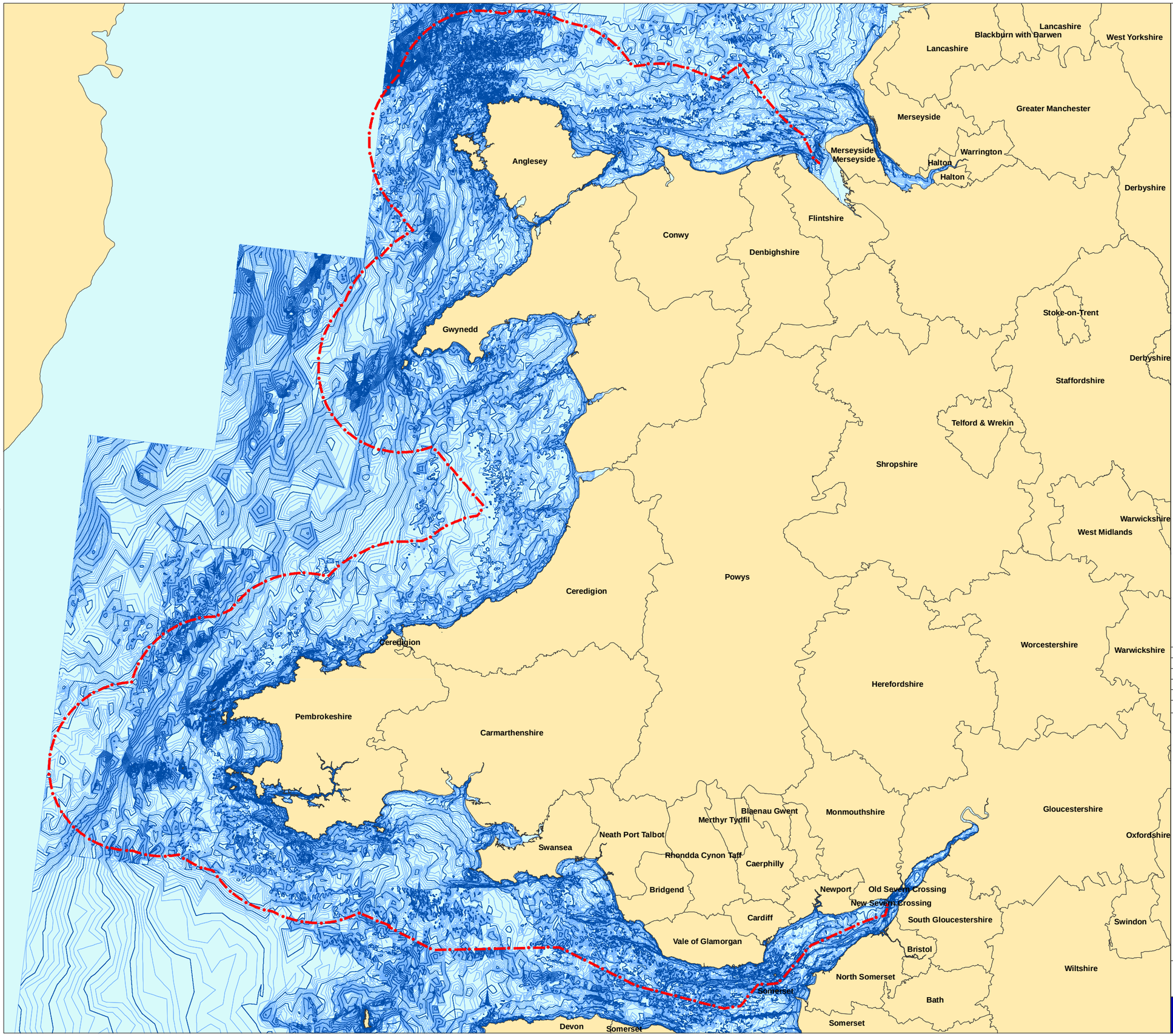
N

Date: 03/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 2 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\14_RenewableEnergy\JER3688-Figure_02_RenewableEnergy.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)
- 5m Bathymetry Contours (RPS Derived from SeaZone)
- 1m Bathymetry Contours (RPS Derived from SeaZone)

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, SeaZone Hydrospatial

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: **Physical Environment Bathymetry**

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **3** Revision: **-**

Project Ref: J:\Drawings\JER3688\U\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\PhysicalEnvironment\JER3688-Figure_03_Bathymetry.mxd

West Yorkshire
Lancashire
Greater Manchester
Merseyside
Warrington
Halton
Derbyshire
Anglesey
Flintshire
Conwy
Denbighshire
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
West Midlands
Powys
Ceredigion
Worcestershire
Warwickshire
Herefordshire
Pembrokeshire
Carmarthenshire
Monmouthshire
Gloucestershire
Swansea
Neath Port Talbot
Caerphilly
Bridgend
Newport
Cardiff
South Gloucestershire
Vale of Glamorgan
Bristol
Swindon
North Somerset
Wiltshire
Bath
Devon
Somerset

Legend

12nm Territorial Waters Limit

Phase 1 Intertidal Substrata (CCW)

- Exposed Rock
- Moderately Exposed Rock
- Sheltered Rock
- Mixed Rock & Sediment
- Exposed Sand
- Moderately Exposed Sand
- Muddy Gravel
- Sheltered Mud

Intertidal Substrata (Coastal Assesment, Liason & Monitoring - CALM)

- Mud
- Mud/Shingle
- Rock
- Rock/Shingle
- Sand
- Sand/Shingle
- Shingle
- Sand dune
- Saltmarsh
- Seagrass

Note CALM Data:
Digitised polygons of substrata in 8 categories: Rock, Shingle, Sand, Sand/shingle, Mud, Mud/shingle. Part prepared from CCW Phase 1 biotope data (reclassified to show substrata type only), collected between 1996 and 2002. Areas not yet surveyed have been digitised from 1:50,000 scale OS maps.

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, CALM, CCW

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Physical Environment
Intertidal Substrata

Scale: A3 @ 1:1,000,000
0 25 50 km
N

Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **3i** Revision: -

Project Ref. J:\Drawings\JER3688\U\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\JER3688-Figure_03i_IntertidalSubstrata.mxd

Lancashire
Merseyside
Greater Manchester
Merseyside
Warrington
Halton
Anglesey
Flintshire
Conwy
Denbighshire
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
West Midlands
Powys
Ceredigion
Worcestershire
Herefordshire
Pembrokeshire
Carmarthenshire
Monmouthshire
Gloucestershire
Neath Port Talbot
Swansea
Caerphilly
Bridgend
Newport
Cardiff
South Gloucestershire
Vale of Glamorgan
Bristol
Wiltshire
North Somerset
Bath
Devon
Somerset

Legend

- 12nm Territorial Waters Limit

Subtidal Geology (BGS - SeaZone Hyrospatial)

- Diamicton
- Mud
- Sandy Mud
- Slightly Gravelly Sandy Mud
- Gravelly Mud
- Sand
- Muddy Sand
- Slightly Gravelly Sand
- Slightly Gravelly Muddy Sand
- Gravelly Muddy Sand
- Gravelly Sand
- Gravel
- Muddy Gravel
- Muddy Sandy Gravel
- Sandy Gravel
- Rock

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, BGS - SeaZone Hyrospatial

Status: FINAL

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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Physical Environment
Subtidal Geology

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **3ii** Revision: -

Project Ref: J:\Drawings\JER3688\U\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\JER3688-Figure_03ii_SubtidalGeology.mxd

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West Yorkshire
Greater Manchester
Merseyside
Warrington
Merseyside
Halton
Derbyshire
Anglesey
Flintshire
Conwy
Denbighshire
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
West Midlands
Powys
Ceredigion
Worcestershire
Warwickshire
Herefordshire
Pembrokeshire
Carmarthenshire
Gloucestershire
Monmouthshire
Neath Port Talbot
Swansea
Caerphilly
Newport
Swindon
Bridgend
South Gloucestershire
Cardiff
Bristol
Vale of Glamorgan
North Somerset
Wiltshire
Bath
Devon

Legend

12nm Territorial Waters Limit

Seabed Landscapes (JNCC)

- Aphotic rock
- Barrier beach
- Bay
- Canyon
- Cold deep-water coarse sediment
- Cold deep-water mixed sediment
- Cold deep-water mud plain
- Cold deep-water sand plain
- Continental slope
- Deep ocean rise
- Deep-water mound
- Embayment
- Estuary
- Lagoon
- Photic rock
- Ria
- Sealoch
- Shallow coarse sediment plain - moderate tide stress
- Shallow coarse sediment plain - strong tide stress
- Shallow coarse sediment plain - weak tide stress
- Shallow mixed sediment plain - moderate tide stress
- Shallow mixed sediment plain - strong tide stress
- Shallow mixed sediment plain - weak tide stress
- Shallow mud plain
- Shallow sand plain
- Shelf coarse sediment plain - moderate tide stress
- Shelf coarse sediment plain - strong tide stress
- Shelf coarse sediment plain - weak tide stress
- Shelf mixed sediment plain - moderate tide stress
- Shelf mixed sediment plain - strong tide stress
- Shelf mixed sediment plain - weak tide stress
- Shelf mound or pinnacle
- Shelf mud plain
- Shelf sand plain
- Shelf trough
- Sound
- Subtidal sediment bank
- Warm deep-water coarse sediment plain
- Warm deep-water mixed sediment plain
- Warm deep-water mud plain
- Warm deep-water sand plain

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, JNCC

Status: FINAL

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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: **Physical Environment**
Seabed Landscapes

Scale: A3 @ 1:1,000,000

0 25 50km

N

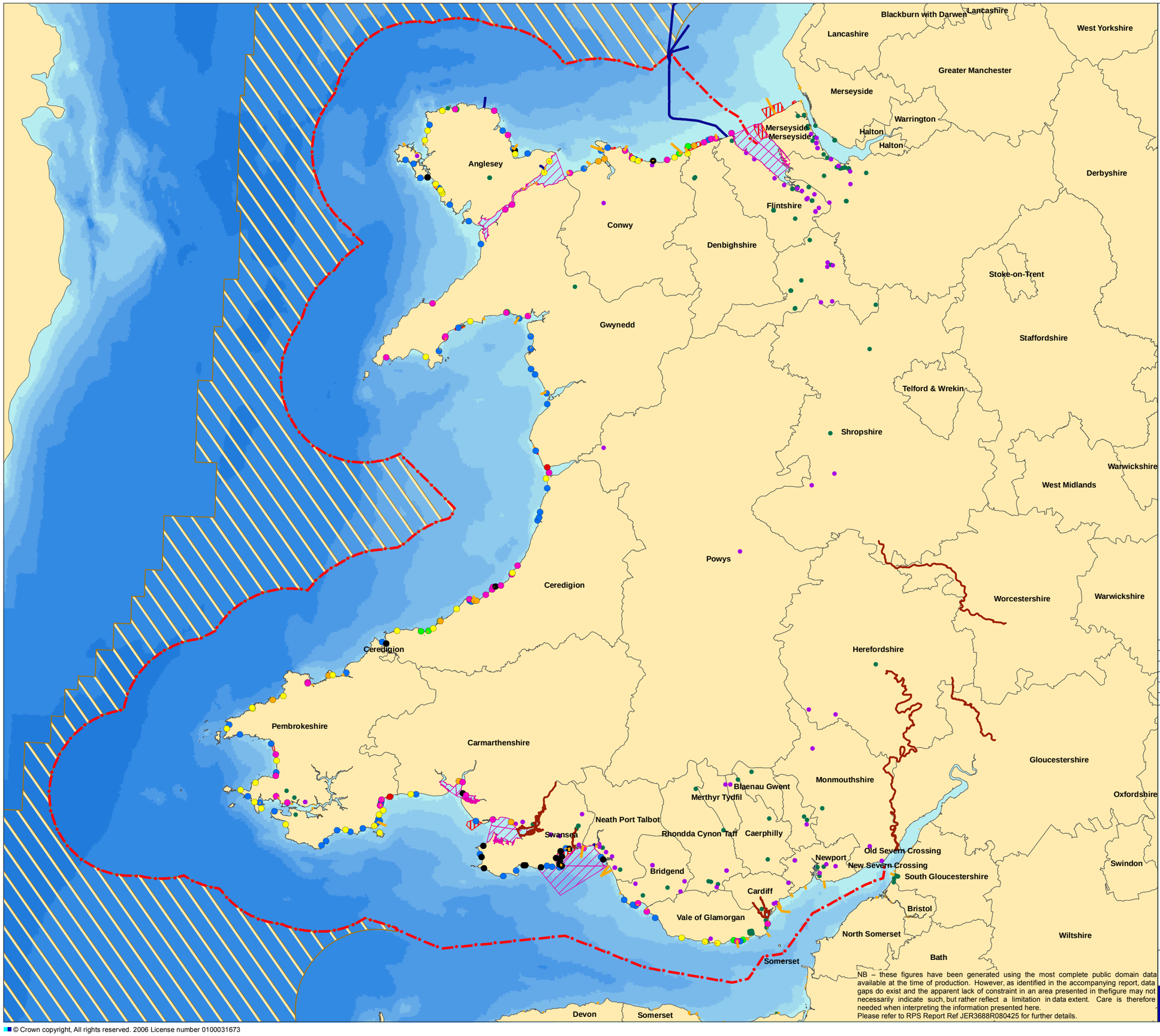
Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **3iii** Revision: **-**

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Project Ref: J:\Drawings\JER3688\J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\PhysicalEnvironment\JER3688-Figure_03iii_SeabedLandscapes.mxd



Legend

- IPPC (Environment Agency)
- IPC (Environment Agency)
- Designated Sensitive Areas (eutrophic) under the Urban Waste Water Treatment Directive in Wales (EA)
- 12nm Territorial Waters Limit (SeaZone)
- Bathing Waters in Wales Designated under the Urban Waste Water Treatment Directive as Sensitive Areas (EA)
- Marine Pollution Control Zones (Magic)
- Shellfish Waters in Wales designated as sensitive areas under the Urban Waste Water Treatment Directive (EA)

Locations of EC-Designated Bathing Waters in Wales and Historical Compliance against EC Bathing Waters Standards

- Not Sampled

2007 Compliance

- Fail
- Guideline
- Imperative

Locations of the Non EC Designated Bathing Water Sample Locations Containing Historical Compliance Data against the EC Bathing Water Standards (EA)

- Not Sampled

2007 Compliance

- Fail
- Guideline
- Compliance

Pipelines (SeaZone Data)

- Intake Pipe
- Outfall Pipe
- Sewer Pipe
- Supply Pipe

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, SeaZone, EA, Magic

Status: FINAL

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Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: **Water Quality**

Scale: A3 @ 1:1,000,000

0 25 50 km

N

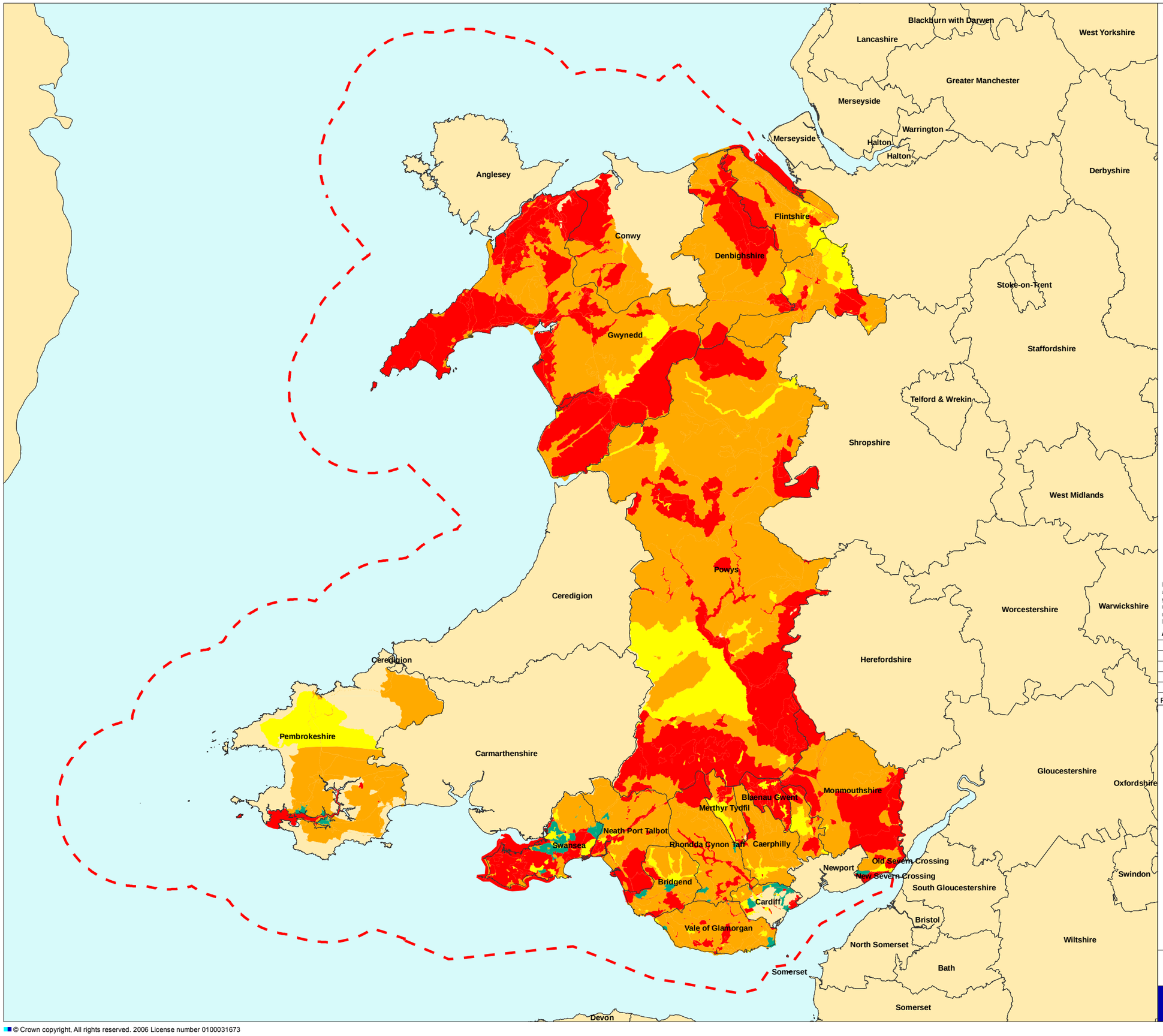
Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **4** Revision: -

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Project Ref: J:\Drawings\JER3688\J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\Water & Sediment Quality\JER3688-Figure_04_WaterQuality.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Cultural Landscape (CCW)

Overall Evaluation

- Outstanding - of International or National Importance to the Aspect
- High - of Regional or County Importance to the Aspect
- Moderate - of Local Importance to the Aspect
- Low - of Little or No Importance to the Aspect

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

All available Landmap Data as of August 2008

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, CCW Landmap

Status: DRAFT

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: **CCW Landmap Cultural Landscape**

Scale: A3 @ 1:1,000,000

0 25 50 km

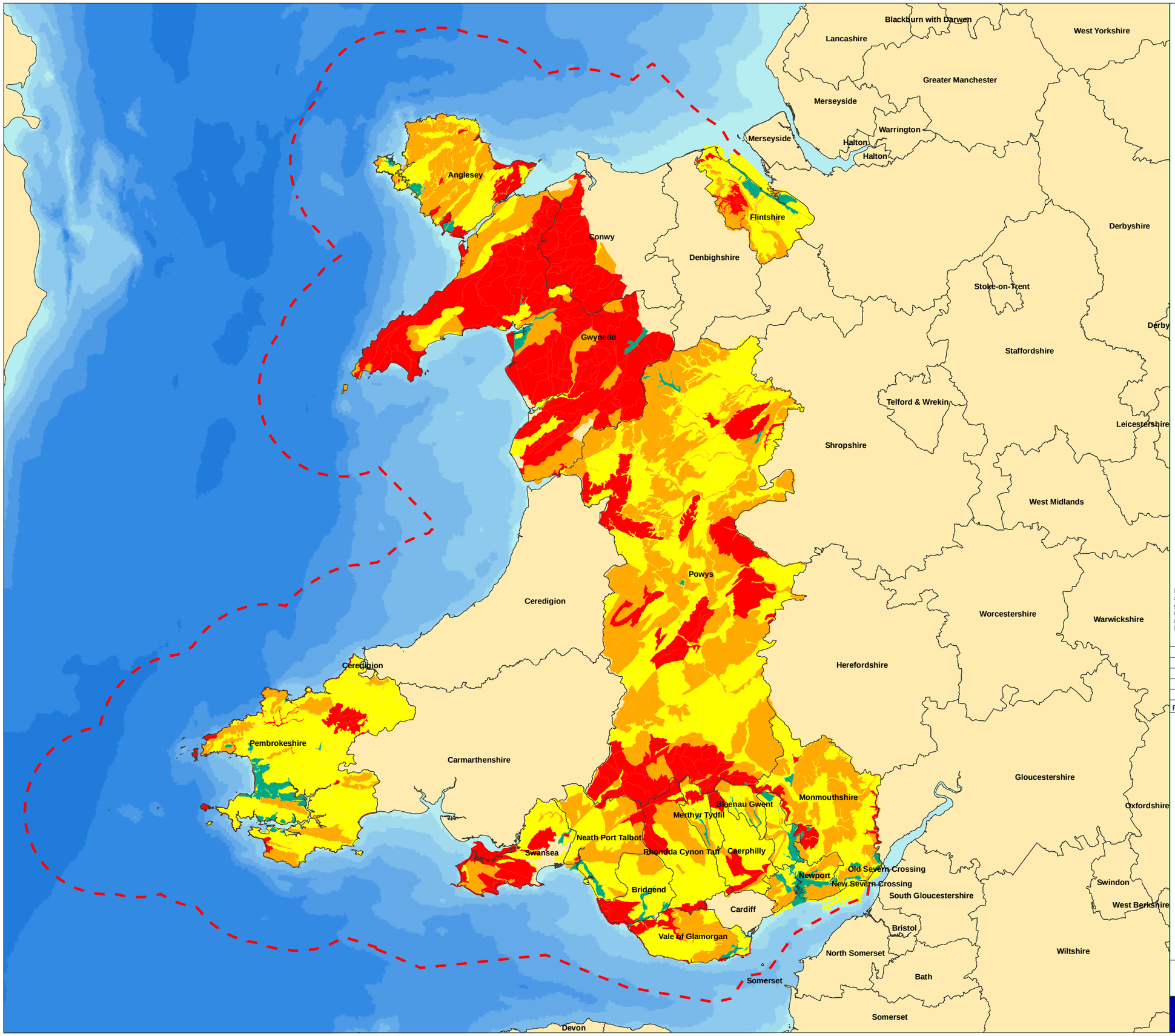
N

Date: 03/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **5** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\05_Landmap\JER3688-Figure_05_CulturalLandscape.mxd



Legend

12nm Territorial Waters Limit (SeaZone)

Geological Landscape (CCW)

Overall Evaluation

- Outstanding - of International or National Importance to the Aspect
- High - of Regional or County Importance to the Aspect
- Moderate - of Local Importance to the Aspect
- Low - of Little or No Importance to the Aspect

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

All available Landmap Data as of August 2008

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, CCW Landmap

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: CCW Landmap
Geological Landscape

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date: 03/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **5i** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\05_Landmap\JER3688-Figure_05i_GeologicalLandscape.mxd

Blackburn with Darwen
Lancashire
West Yorkshire
Greater Manchester
Merseyside
Warrington
Halton
Merseyside
Halton
Derbyshire
Anglesey
Flintshire
Conwy
Denbighshire
Stoke-on-Trent
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
West Midlands
Powys
Ceredigion
Worcestershire
Warwickshire
Ceredigion
Herefordshire
Pembrokeshire
Carmarthenshire
Gloucestershire
Monmouthshire
Oxfordshire
Blaenau Gwent
Merthyr Tydfil
Neath Port Talbot
Swansea
Rhondda Cynon Taff
Caerphilly
Old Severn Crossing
Newport
New Severn Crossing
Swindon
Bridgend
South Gloucestershire
Cardiff
Bristol
Vale of Glamorgan
North Somerset
Wiltshire
Bath
Somerset
Somerset
Devon

Legend

- 12nm Territorial Waters Limit (SeaZone)

Historic Landscape (CCW)

Overall Evaluation

- Outstanding - of International or National Importance to the Aspect
- High - of Regional or County Importance to the Aspect
- Moderate - of Local Importance to the Aspect
- Low - of Little or No Importance to the Aspect
- Unassessed - Insufficient information exists to evaluate this area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

All available Landmap Data as of August 2008

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, CCW Landmap

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: **CCW Landmap Historic Landscape**

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date: 03/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **5ii** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\05_Landmap\JER3688-Figure_05ii_HistoricLandscape.mxd

Blackburn with Darwen
West Yorkshire
Lancashire
Greater Manchester
Merseyside
Warrington
Halton
Merseyside
Halton
Anglesey
Derbyshire
Flintshire
Conwy
Denbighshire
Stoke-on-Trent
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
West Midlands
Powys
Ceredigion
Worcestershire
Warwickshire
Herefordshire
Ceredigion
Pembrokeshire
Carmarthenshire
Gloucestershire
Oxfordshire
Monmouthshire
Blaenau Gwent
Merthyr Tydfil
Neath Port Talbot
Swansea
Rhondda Cynon Taf
Caerphilly
Newport
Old Severn Crossing
New Severn Crossing
Swindon
Bridgend
South Gloucestershire
Cardiff
Bristol
Vale of Glamorgan
North Somerset
Wiltshire
Bath
Somerset
Somerset
Devon

Legend

12nm Territorial Waters Limit (SeaZone)

Landscape Habitat (CCW)

Overall Evaluation

- Outstanding - of International or National Importance to the Aspect
- High - of Regional or County Importance to the Aspect
- Moderate - of Local Importance to theAspect
- Low - of Little or No Importance to the Aspect
- Unknown - Insufficient information exists to evaluate this area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

All available Landmap Data as of August 2008

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, CCW Landmap

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: **CCW Landmap Landscape Habitat**

Scale: A3 @ 1:1,000,000

0 25 50 km

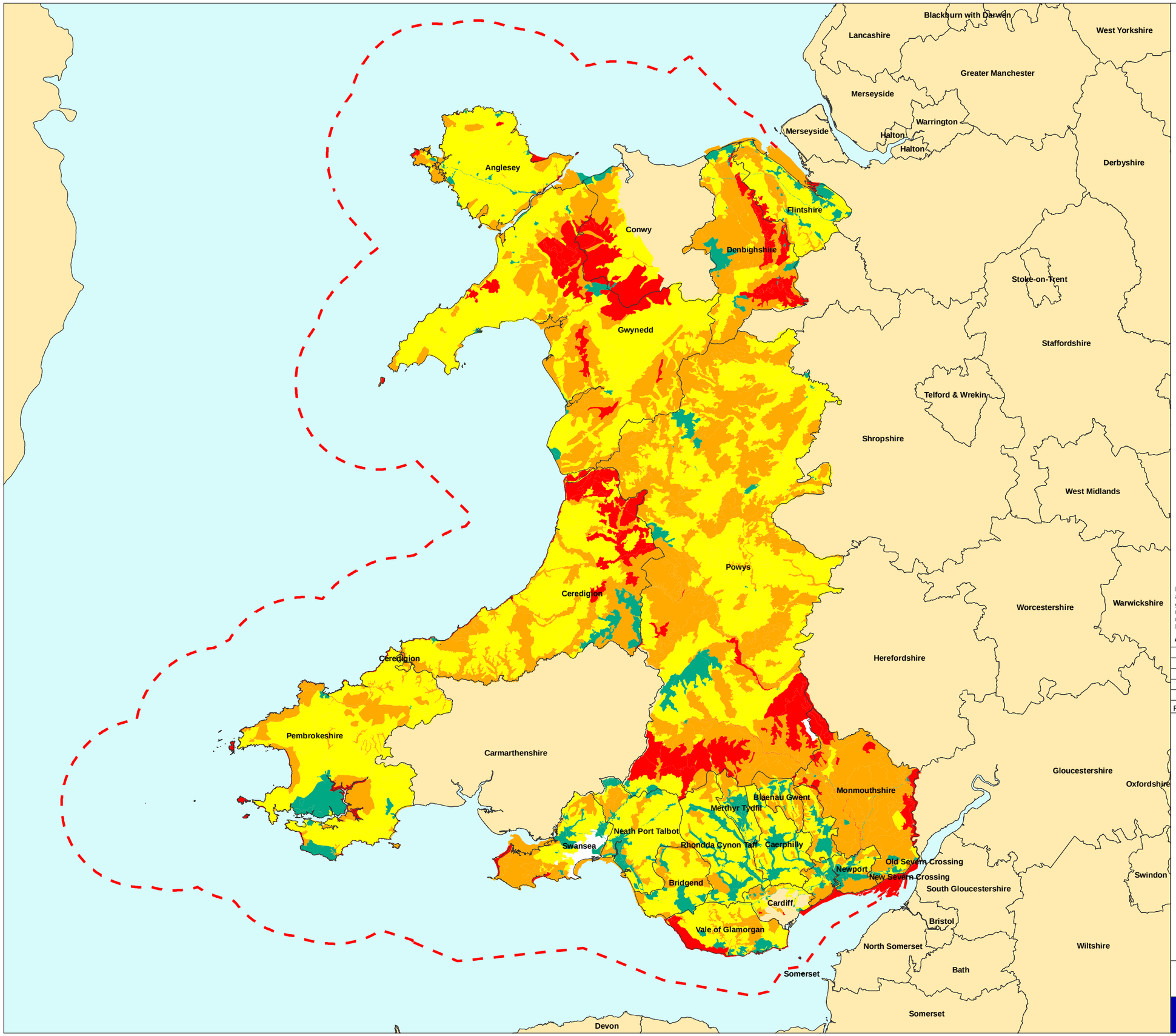
N

Date: 03/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **5iii** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\13_Landmap\JER3688-Figure_05iii_LandscapeHabitat.mxd



Legend

12nm Territorial Waters Limit (SeaZone)

Visual & Sensory (CCW)

Overall Evaluation

- Outstanding - of International or National Importance to the Aspect
- High - of Regional or County Importance to the Aspect
- Moderate - of Local Importance to the Aspect
- Low - of Little or No Importance to the Aspect
- Unassessed

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

All available Landmap Data as of August 2008

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, CCW Landmap

Status: DRAFT

RPS
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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: **CCW Landmap Visual and Sensory**

Scale: A3 @ 1:1,000,000

0 25 50 km

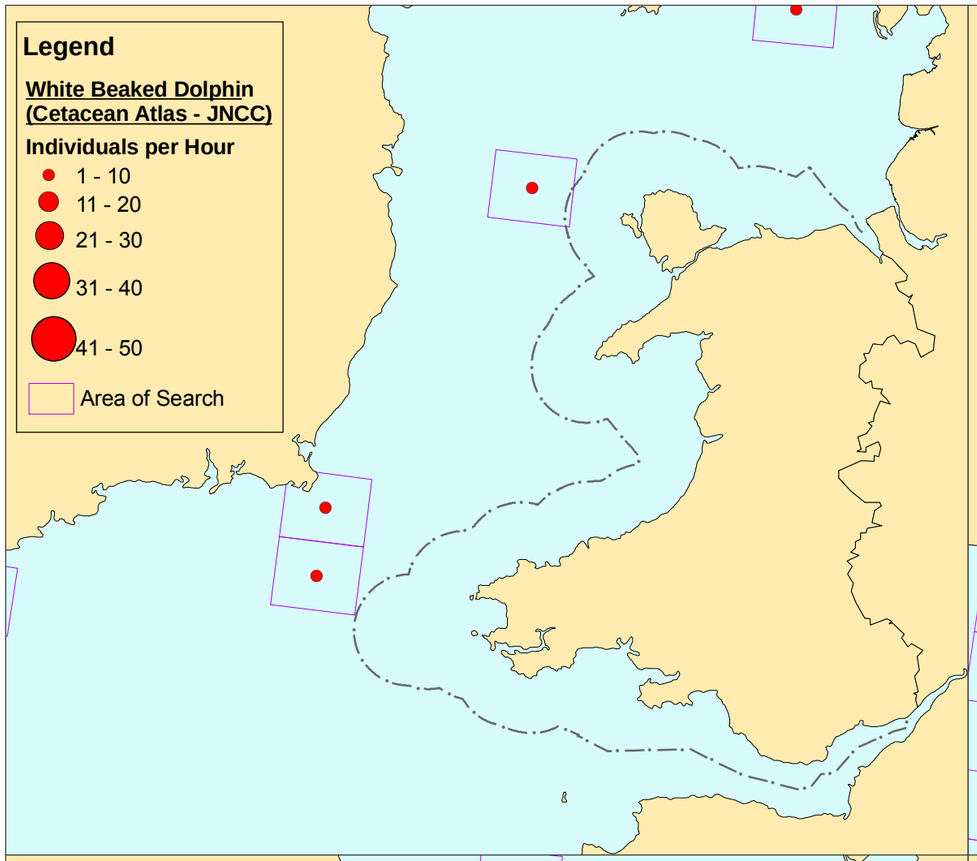
N

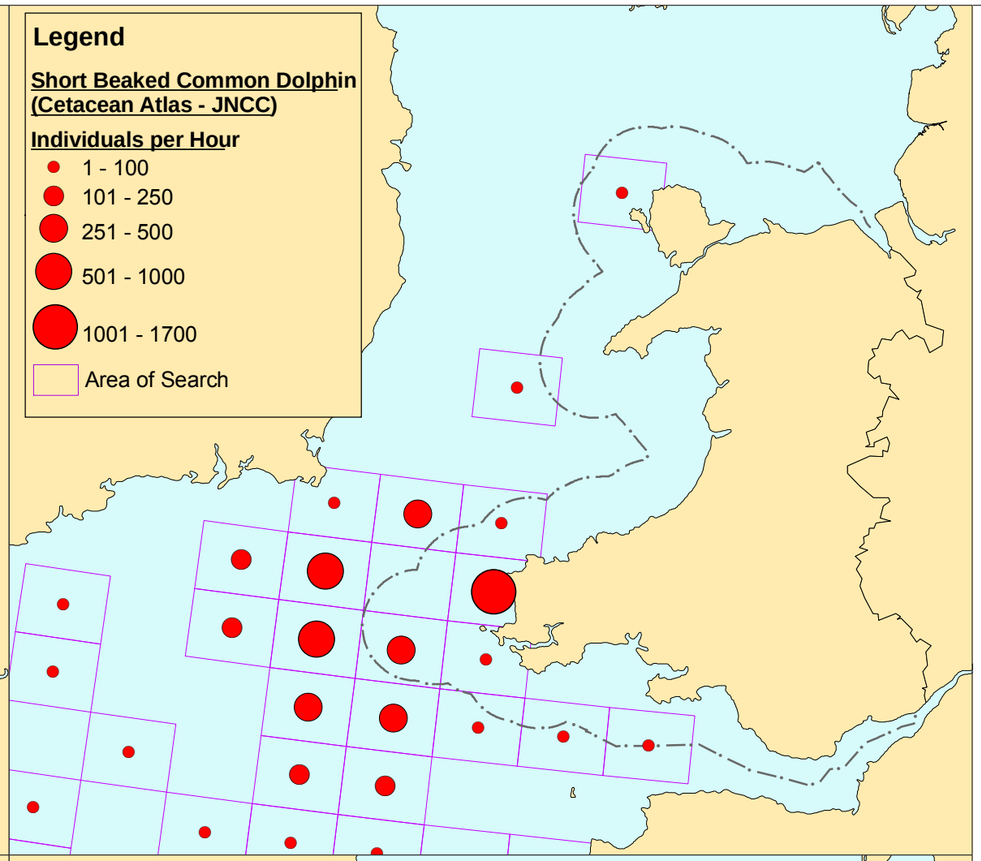
Date: 03/03/2008 Datum: OSGB36 Projection: BNG

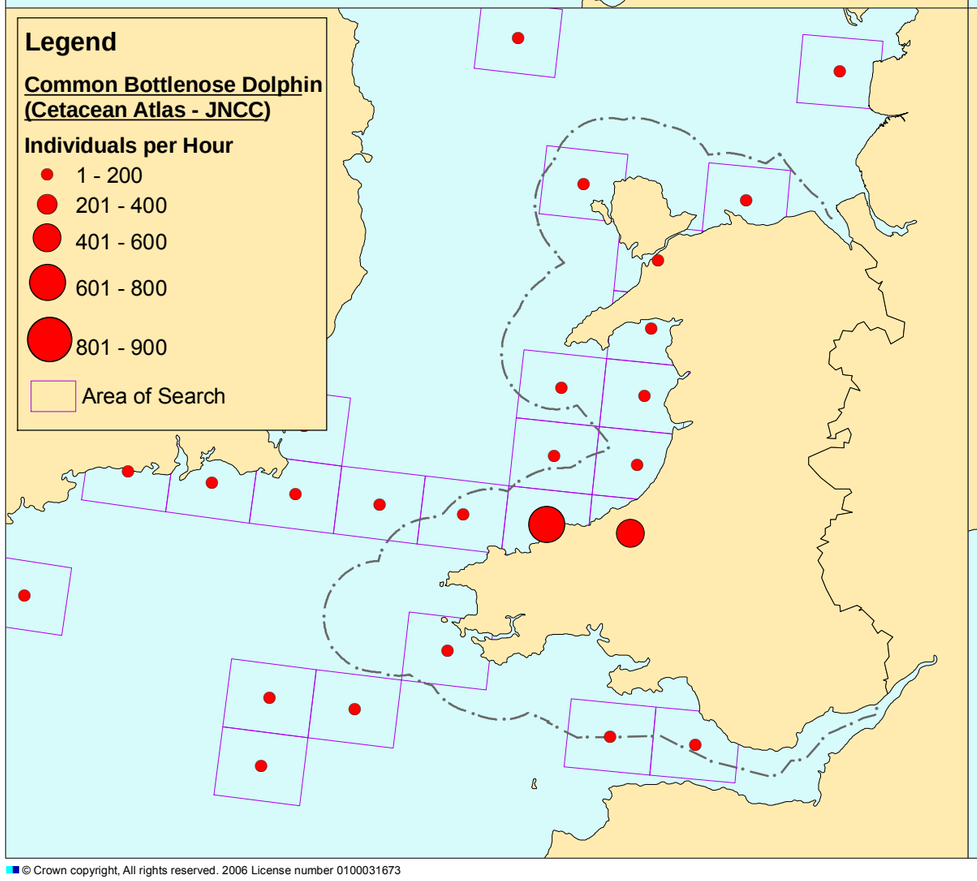
Drawn: M Angove Checked: T Golding Job Ref: JER3688

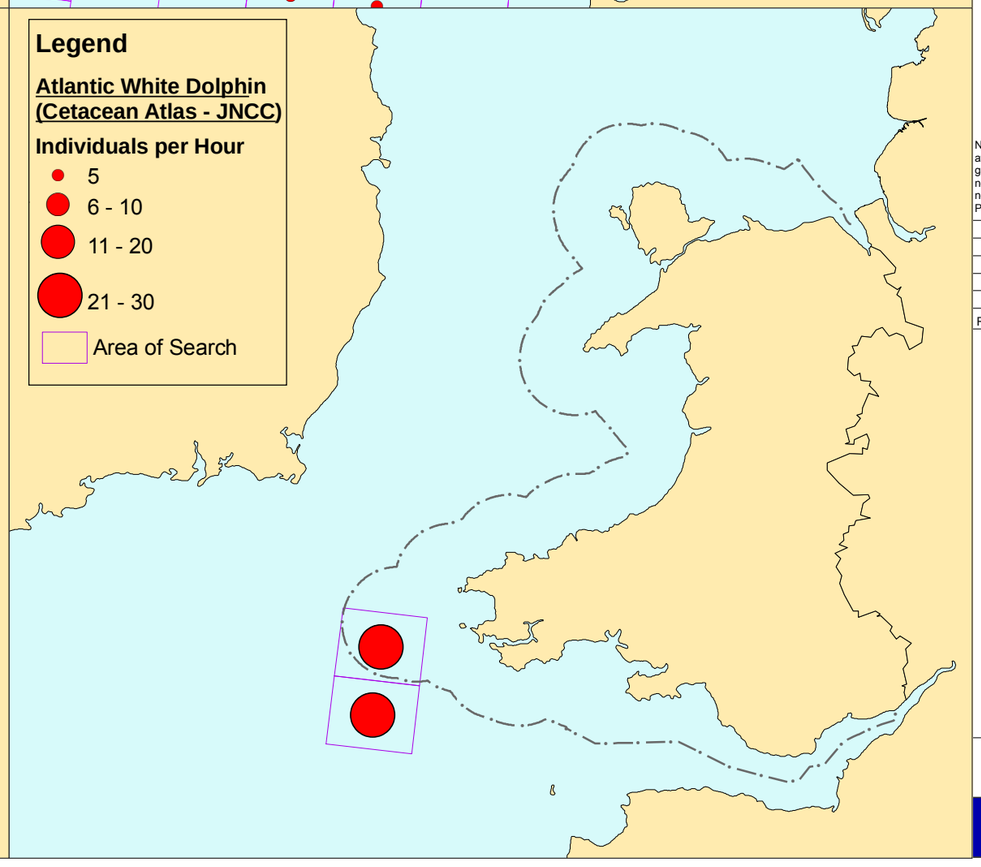
Figure No: **5iv** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\05_Landmap\JER3688-Figure_05iv_Visual&Sensory.mxd









Legend

12nm Territorial Waters Limit

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, JNCC

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Marine Mammals

Scale: A3 @ 1:2,500,000

0 50 100 km

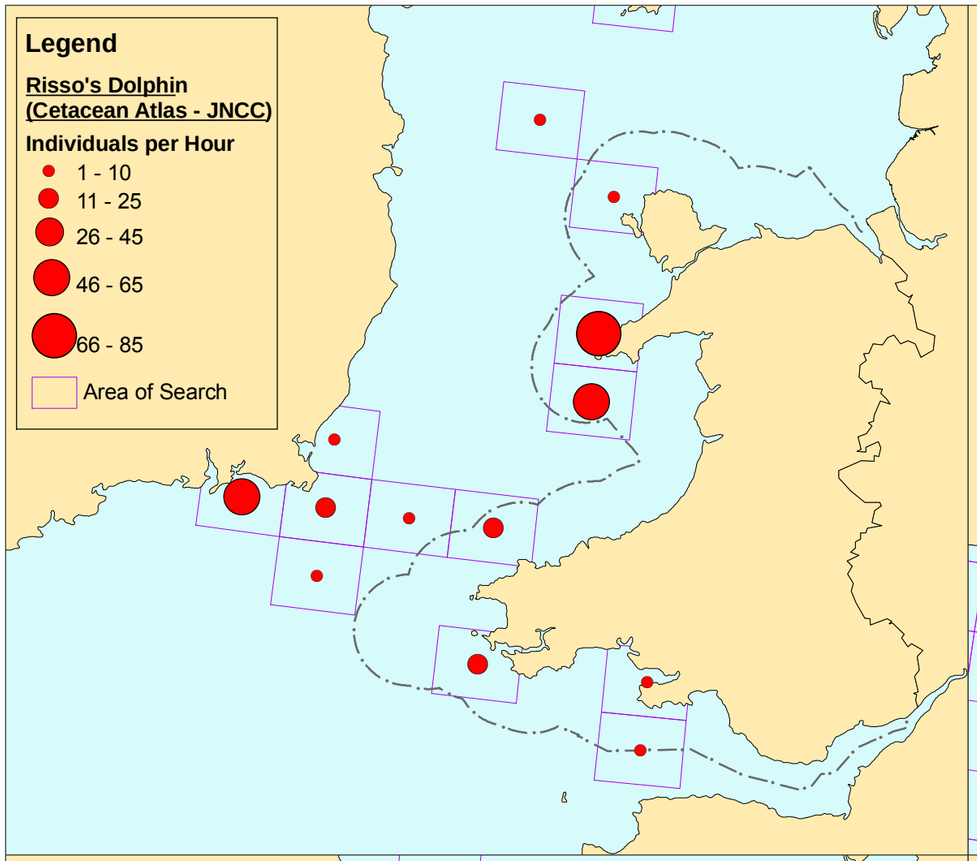
N

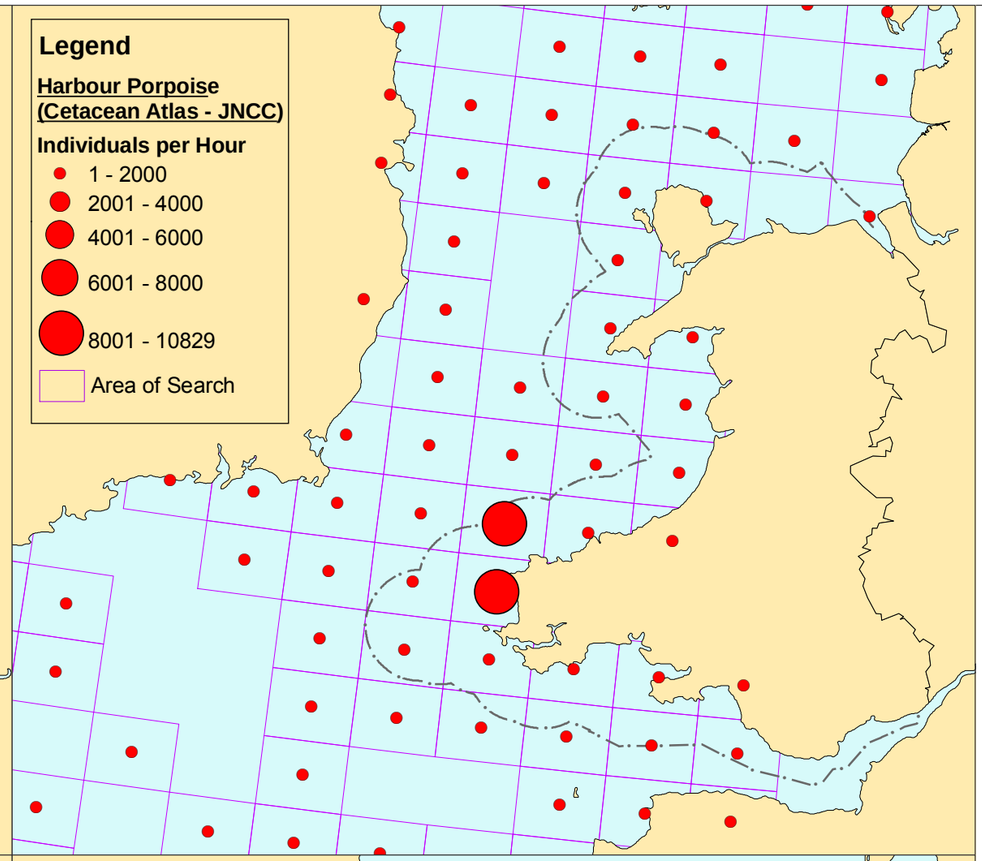
Date: 02/02/2008 Datum: OSGB36 Projection: BNG

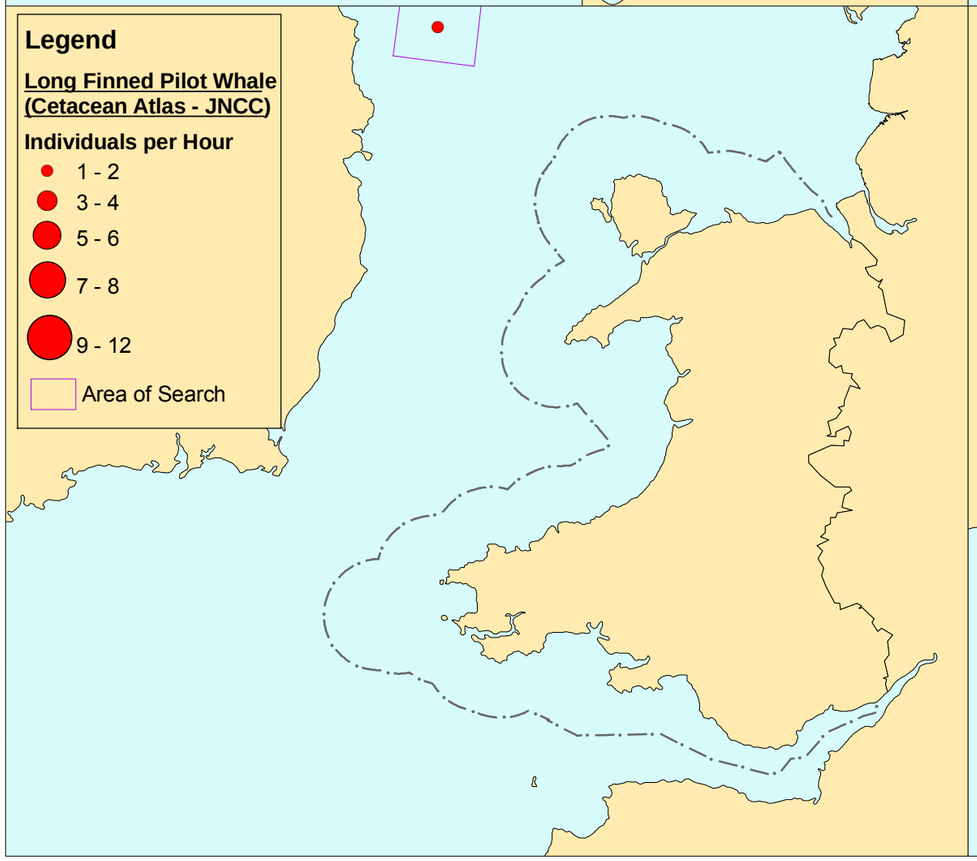
Drawn: M Angove Checked: T Golding Job Ref: JER3688

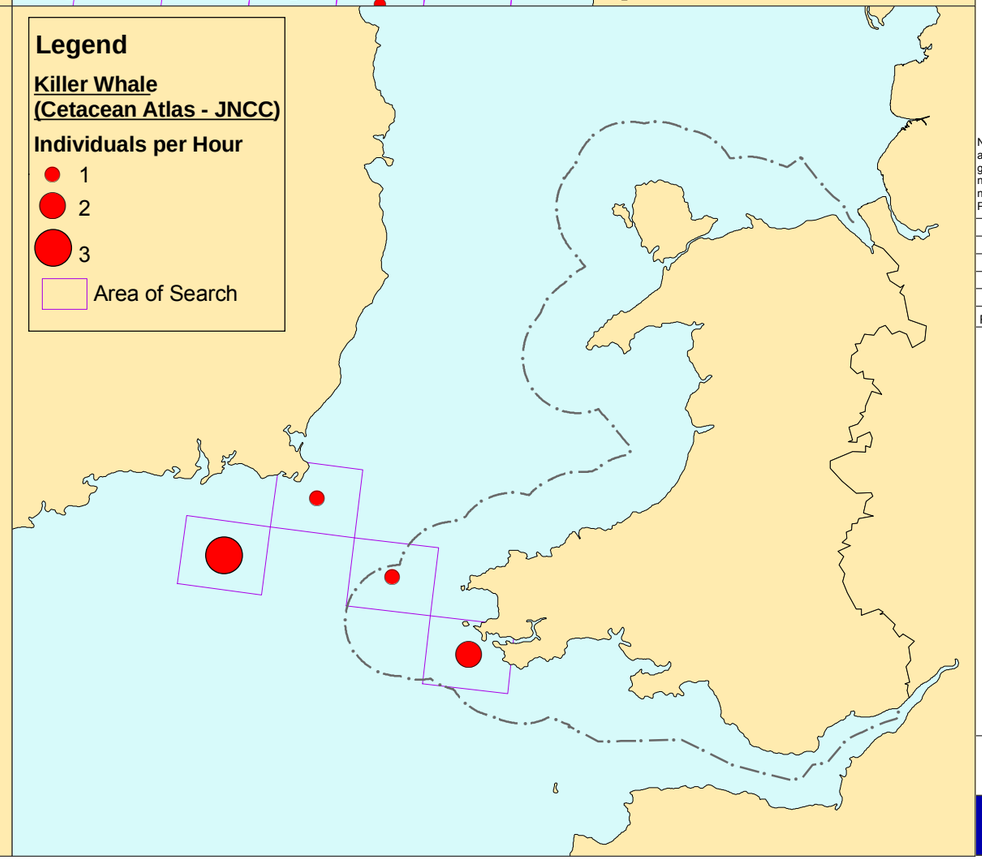
Figure No: **6** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\03_MarineMammals\JER3688-Figure_06_MarineMammals.mxd









Legend

12nm Territorial Waters Limit

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, JNCC

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Marine Mammals

Scale: A3 @ 1:2,500,000

0 50 100 km

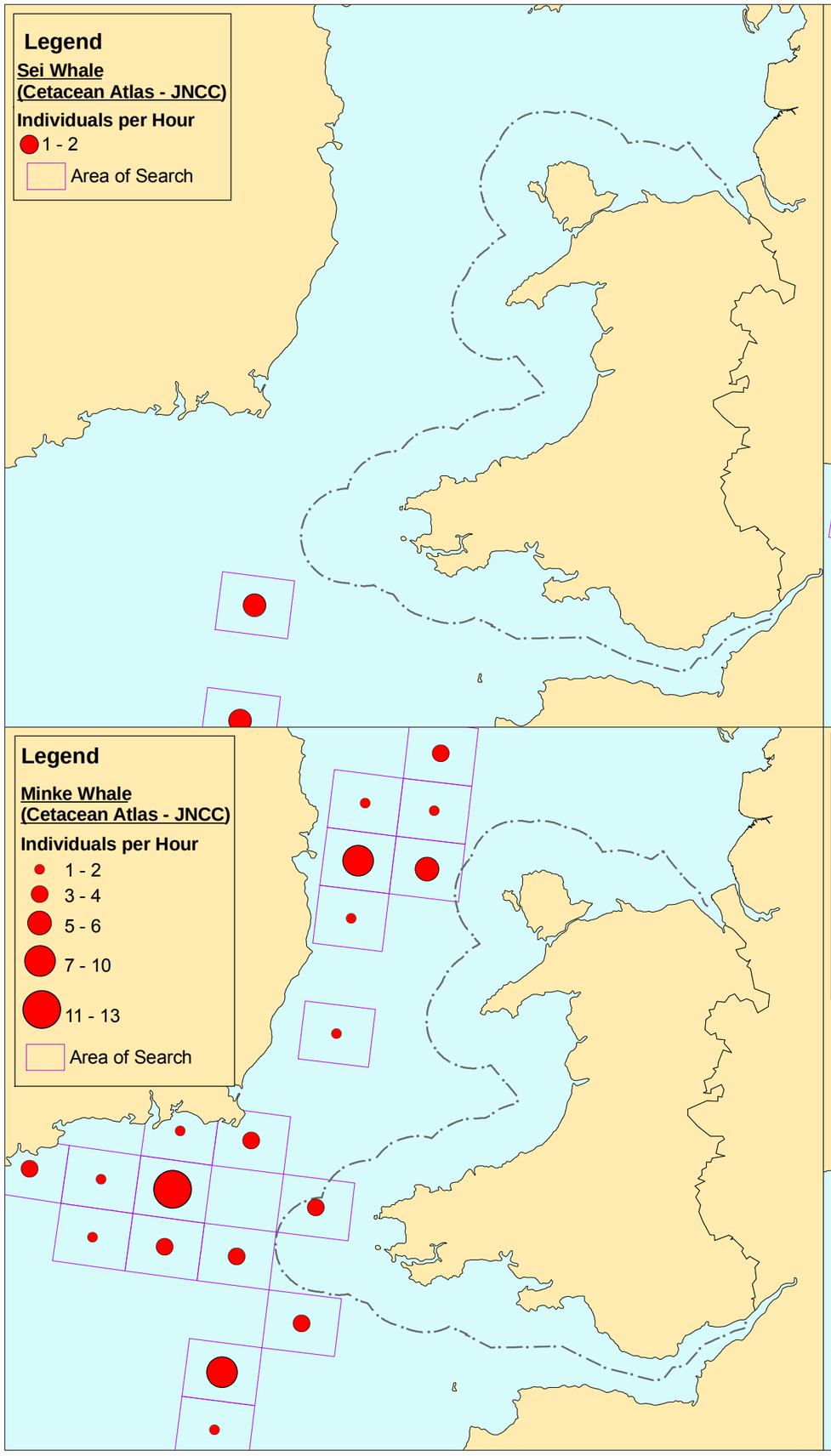
N

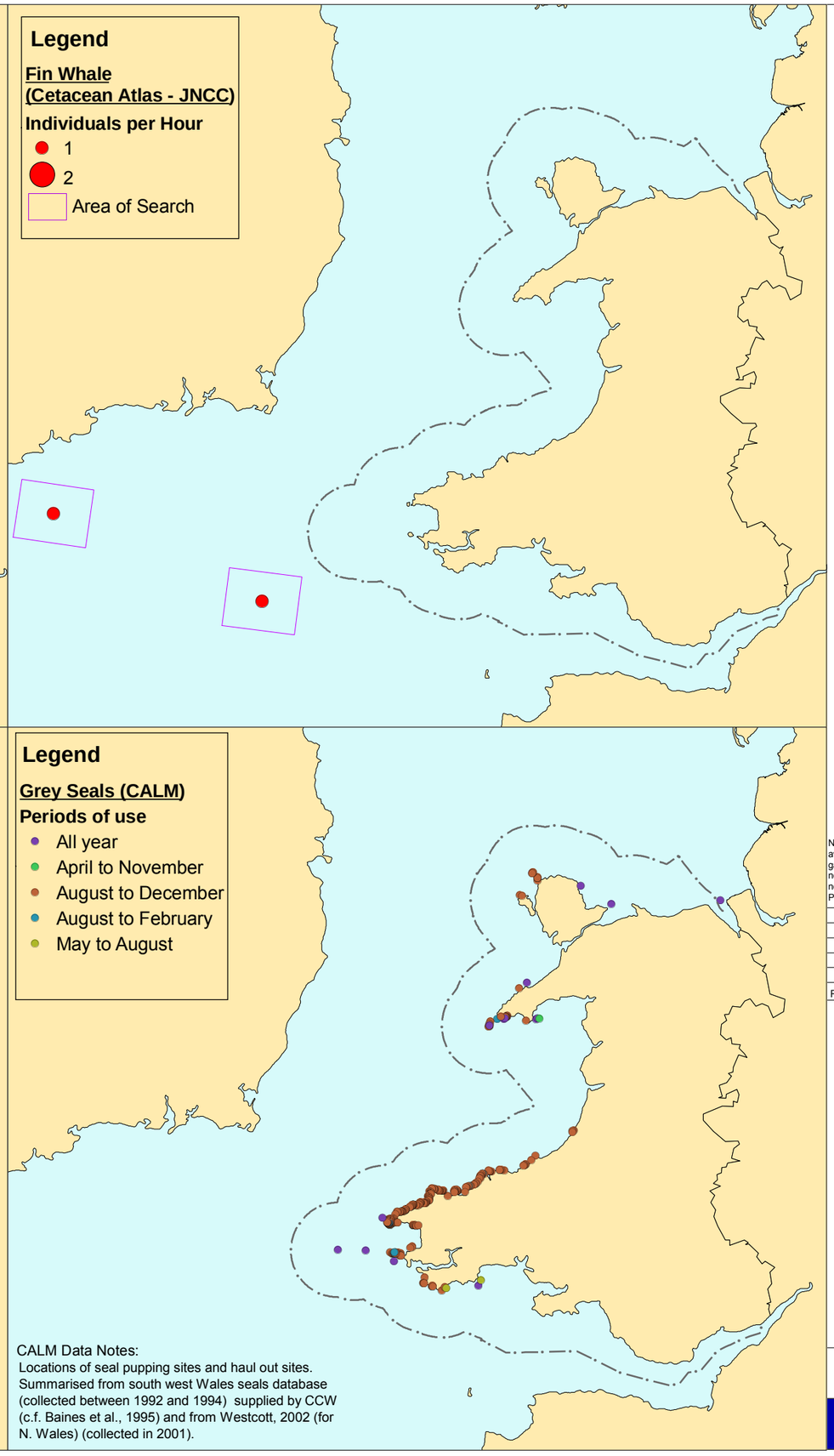
Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **6i** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\-- DRAWINGS --\03_MarineMammals\JER3688-Figure_06i_MarineMammals.mxd





CALM Data Notes:
Locations of seal pupping sites and haul out sites. Summarised from south west Wales seals database (collected between 1992 and 1994) supplied by CCW (c.f. Baines et al., 1995) and from Westcott, 2002 (for N. Wales) (collected in 2001).

Legend

12nm Territorial Waters Limit

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, JNCC

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Marine Mammals

Scale: A3 @ 1:2,500,000
0 50 100 km

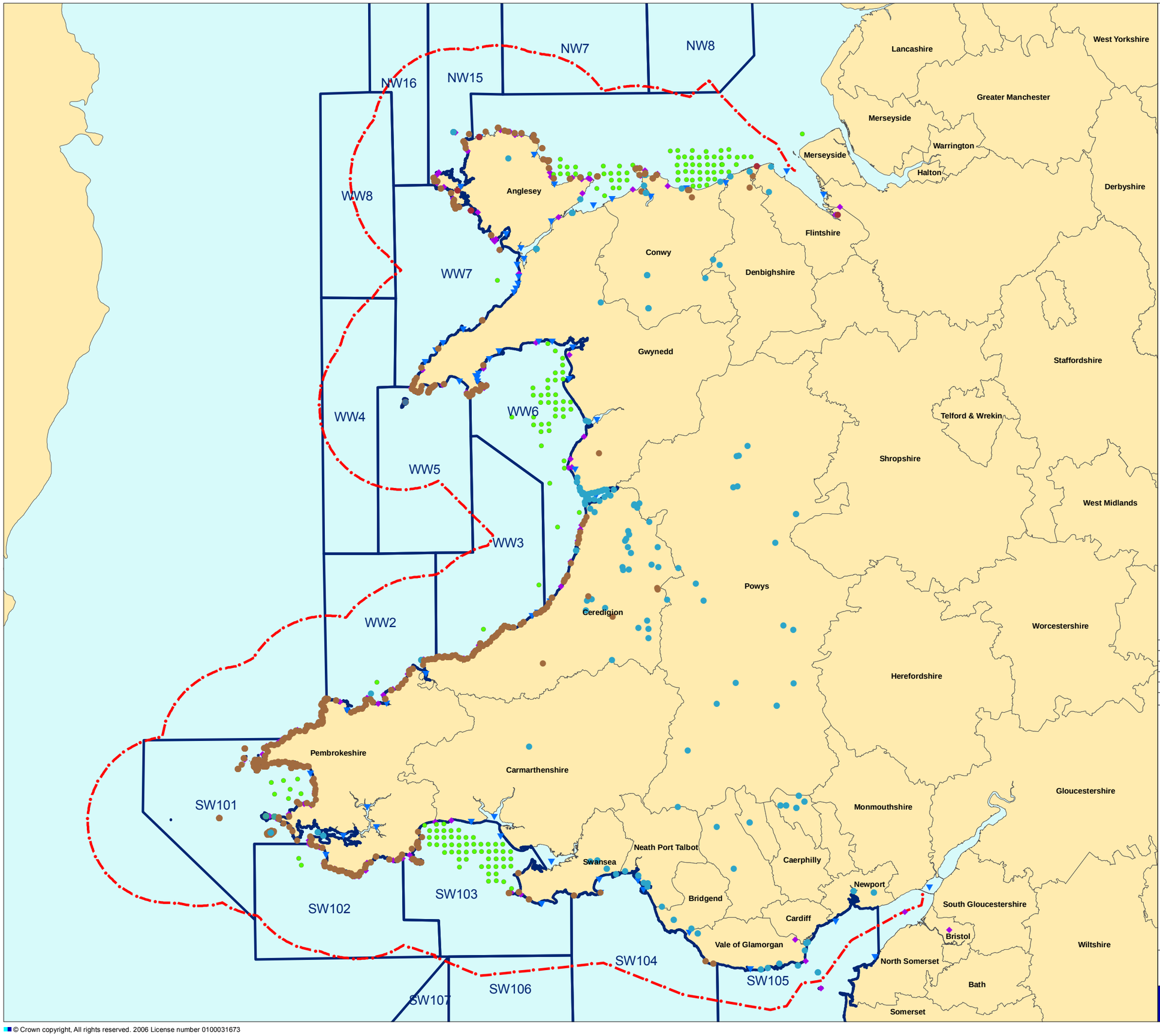
N

Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **6ii** Revision: -

Project Ref. J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\03_MarineMammals\JER3688-Figure_06ii_MarineMammals.mxd



Legend

- 12nm Territorial Waters Limit
- DTI Winter Survey Blocks 2007 & 2008
- Common Scoter (CALM)
- Wetland Birds Data (CALM)
- Seabird Colonies (JNCC)

Seabird 2000 (JNCC)

- Fulmar
- Puffins
- Gulls
- Terns
- Black Guillemots
- Manx
- Storm and Leachs Petrel

CALM Data Notes:
Locations of main concentrations of scoter. Summarised from data supplied by CCW (c.f. Cranswick et al., 2003.) for N.Wales, Tremadog Bay and Carmarthen Bay (collected between November 2000 and February 2002); and additional locations in southwest and west Wales that are indicated on 1991 NCC sensitivity maps (NCC, 1991). Distribution of wetland bird populations during low tide within certain estuaries only, collected between 1996 to 2000. One-off counts – no seasonality. Prepared from data supplied by BTO.

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, CALM, JNCC, DTI

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Seabirds

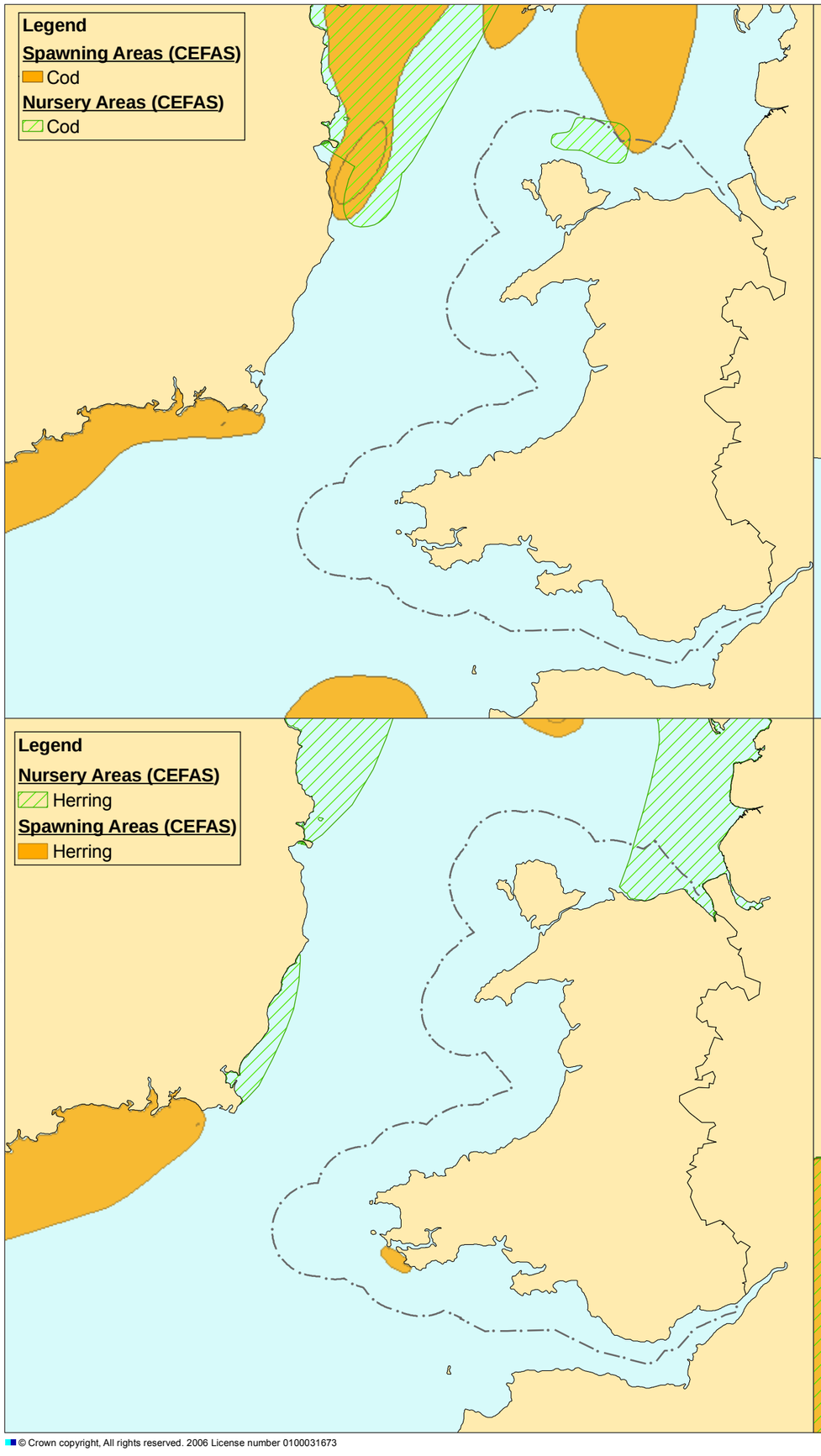
Scale: A3 @ 1:1,000,000
0 25 50 km
N

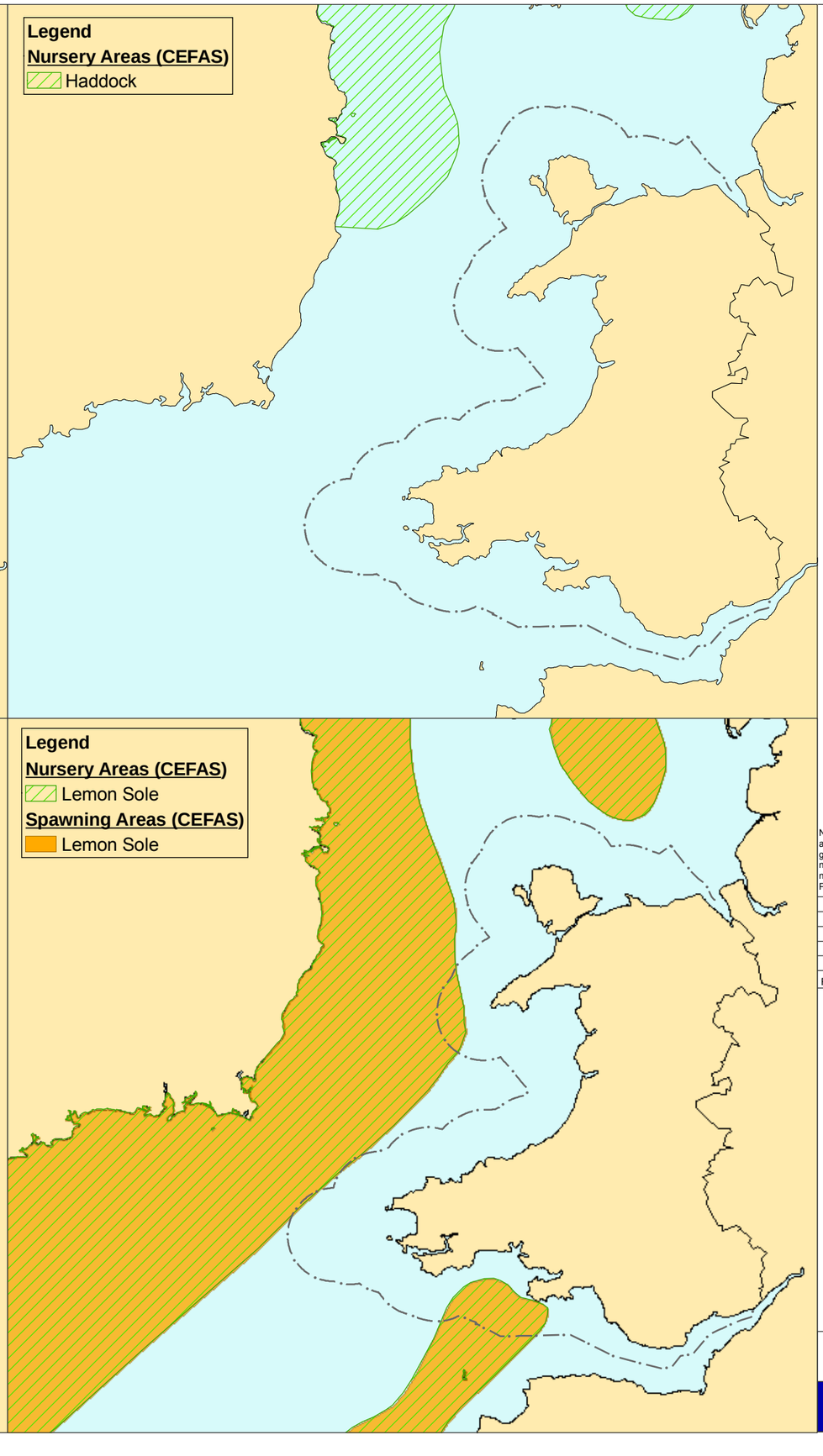
Date: 04/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 7 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\-- DRAWINGS --\07_SeaBirds\JER3688-Figure_07_Seabirds.mxd





NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, CEFAS

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Fish Ecology

Scale: A3 @ 1:2,500,000

0 50 100 km

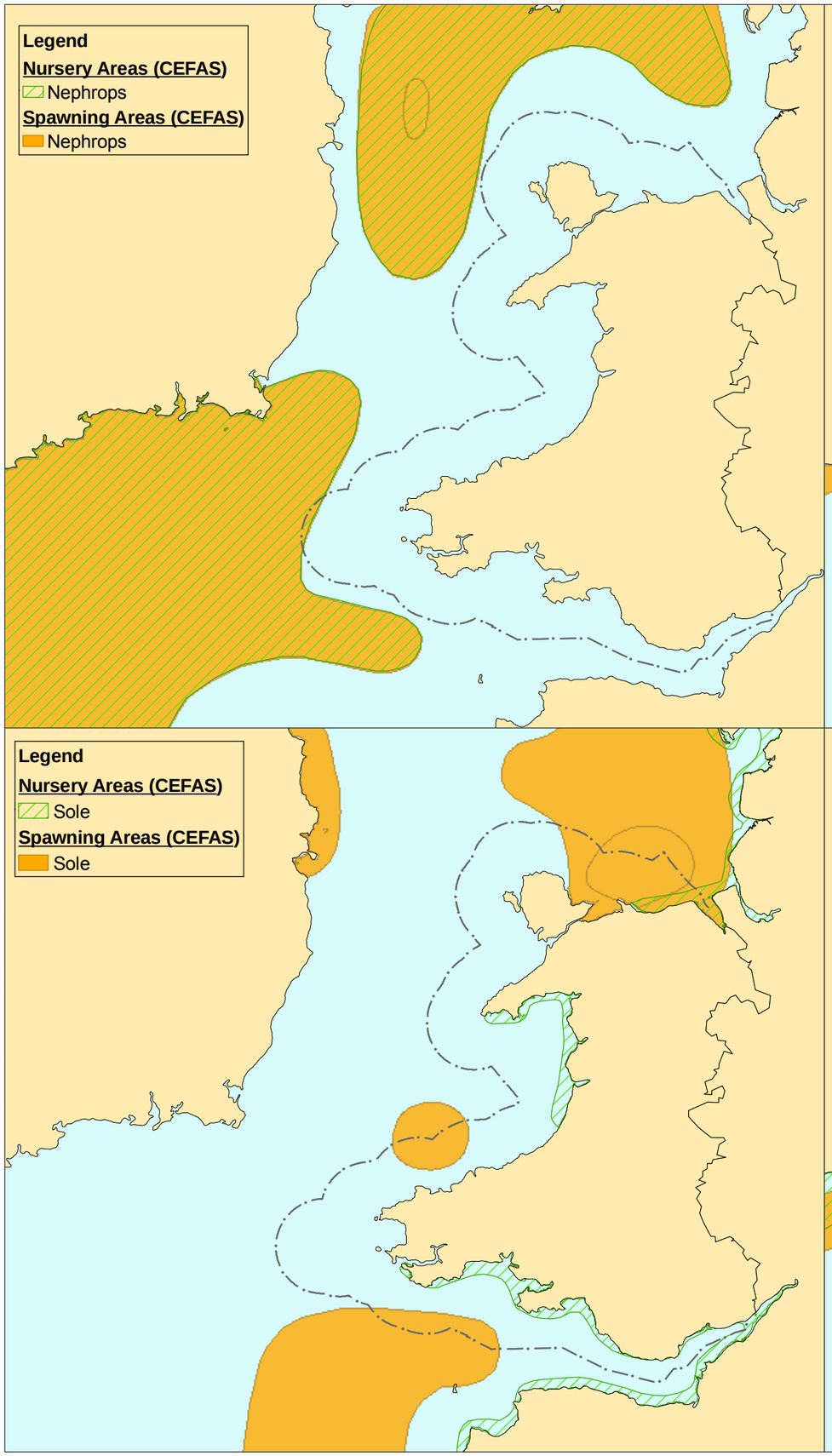
N

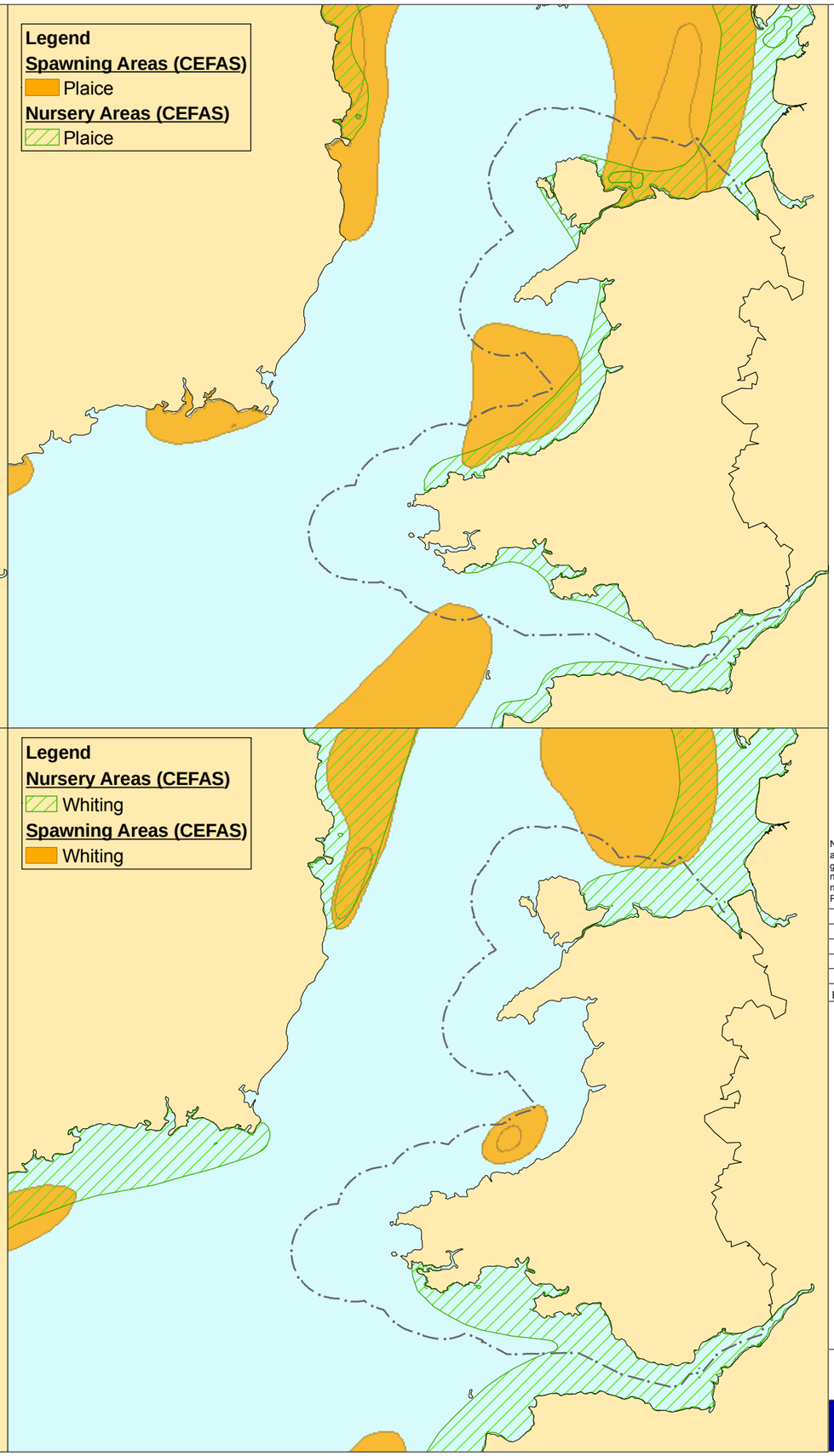
Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 8 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\08_FishEcology\JER3688-Figure_08_FishEcology.mxd





NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, CEFAS

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Fish Ecology

Scale: A3 @ 1:2,500,000

0 50 100 km

N

Date: 02/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **8i** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\08_FishEcology\JER3688-Figure_08_FishEcology.mxd

Legend

CCW Phase 1 Intertidal Biotopes

Lifeform

- Algal Turf
- Faunal and algal turf
- Biogenic sand reefs
- Fucoids
- Kelp
- Lichens & algae
- Mud
- Muddy sandy shore
- Mussel beds
- Mussels & Barnacles
- Saltmarsh
- Sand
- Sea grass beds
- Shingle, coarse sand, mixed sediments
- Short faunal turf

Subtidal Biotopes (Habmap)

- CR.HCR - Circalittoral Rock. High Energy Circalittoral Rock
- CR.MCR - Circalittoral Rock. Moderate Energy Circalittoral Rock
- IR.HIR - Infralittoral Rock. High Energy Infralittoral Rock
- IR.MIR - Infralittoral Rock. Moderate Energy Infralittoral Rock
- IR.LIR - Infralittoral Rock. Low Energy Infralittoral Rock
- SS.SBR - Sublittoral Sediment. Sublittoral Biogenic Reefs
- SS.SCS - Sublittoral Sediment. Sublittoral Coarse Sediment
- SS.SMp - Sublittoral Sediment. Sublittoral Macrophyte Dominated Sediment
- SS.SSa - Sublittoral Sediment. Sublittoral Sand

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Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, CCW, Habmap

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Benthic Ecology

Scale: A3 @ 1:1,000,000
0 10 20 km

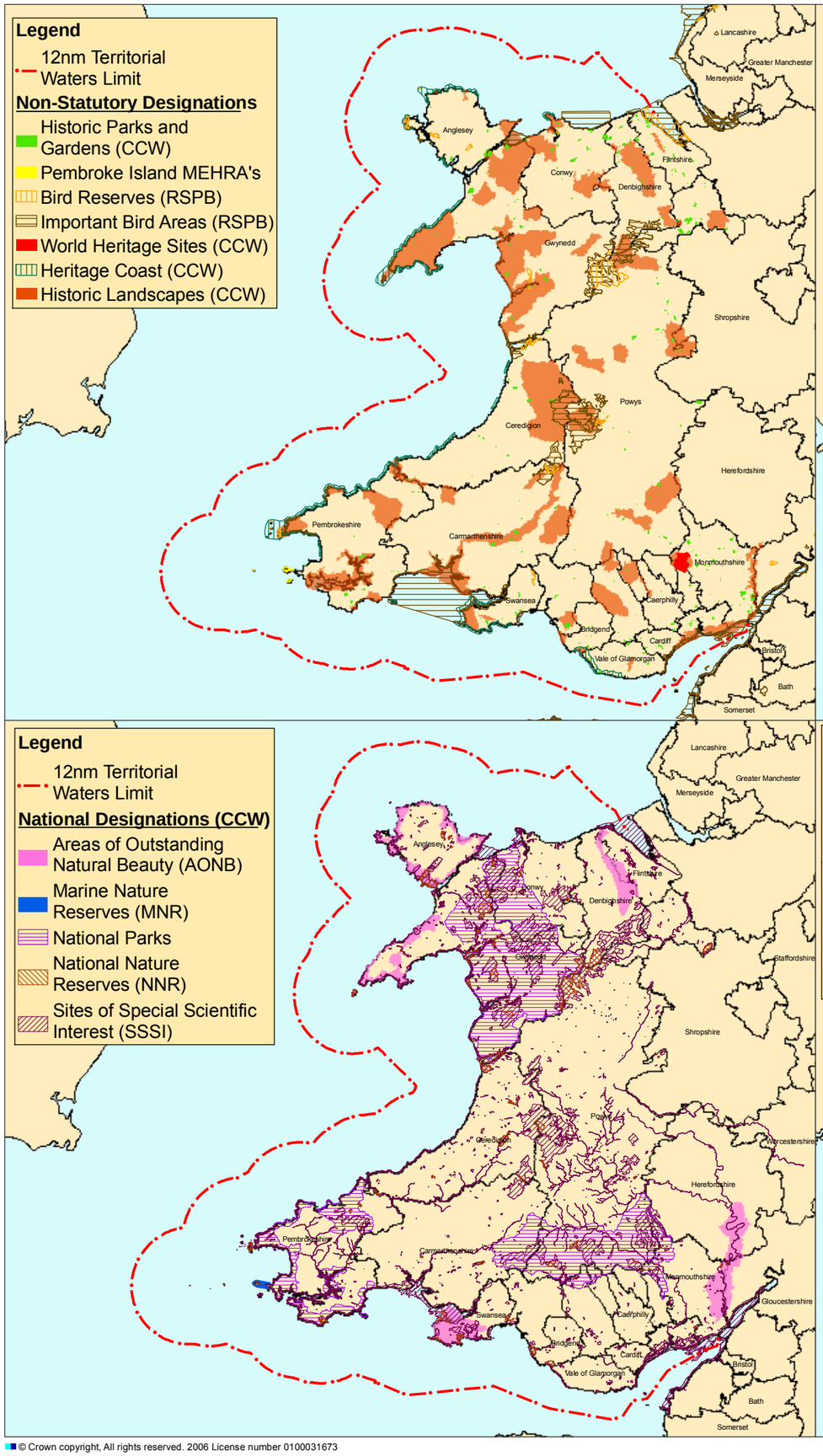
N

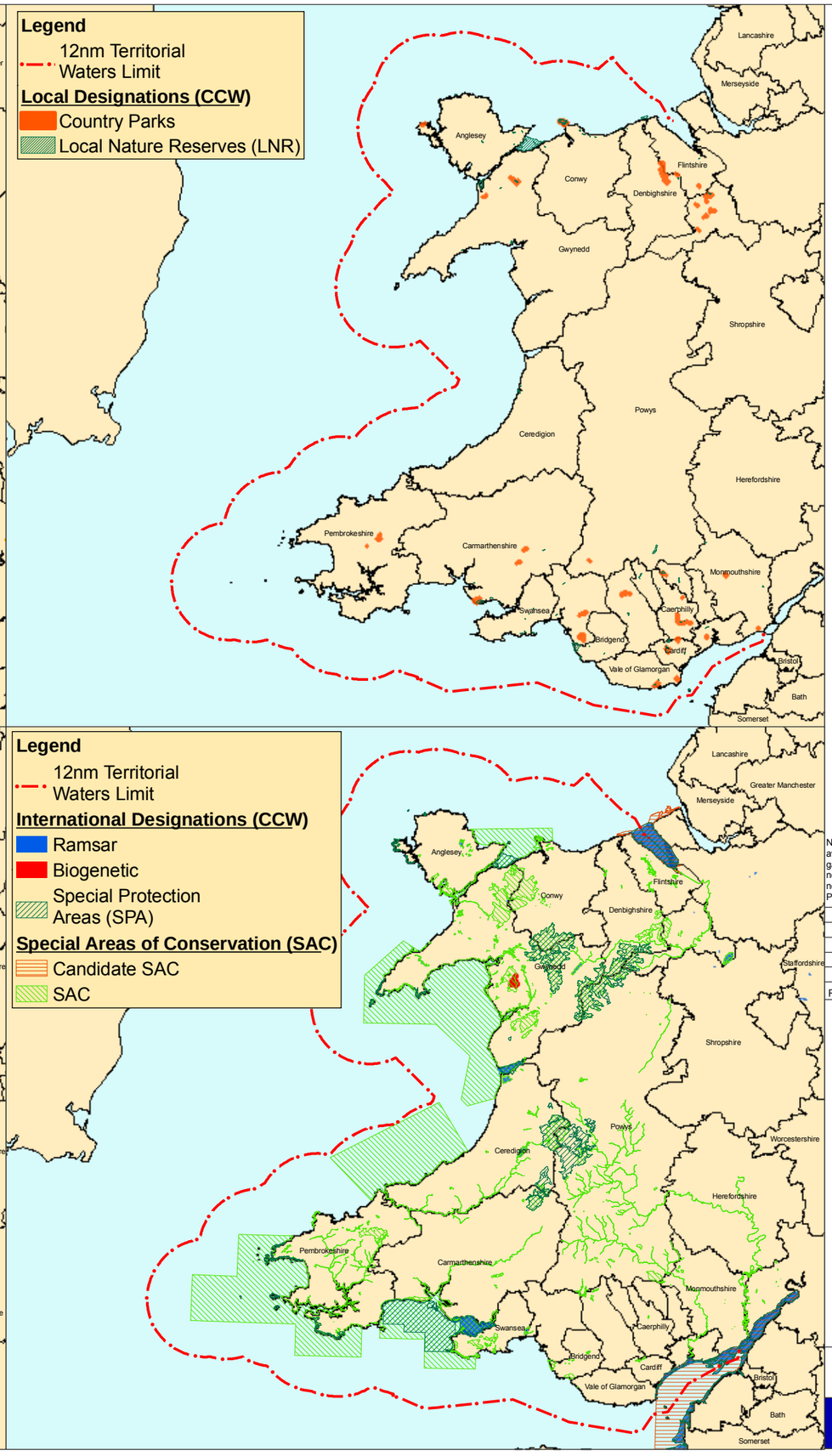
Date: 04/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **9** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\09_BenthicEcology\JER3688-Figure_09_BenthicEcology.mxd





NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, CCW, RSPB

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Designated Areas

Scale: A3 @ 1:2,000,000

0 40 80km

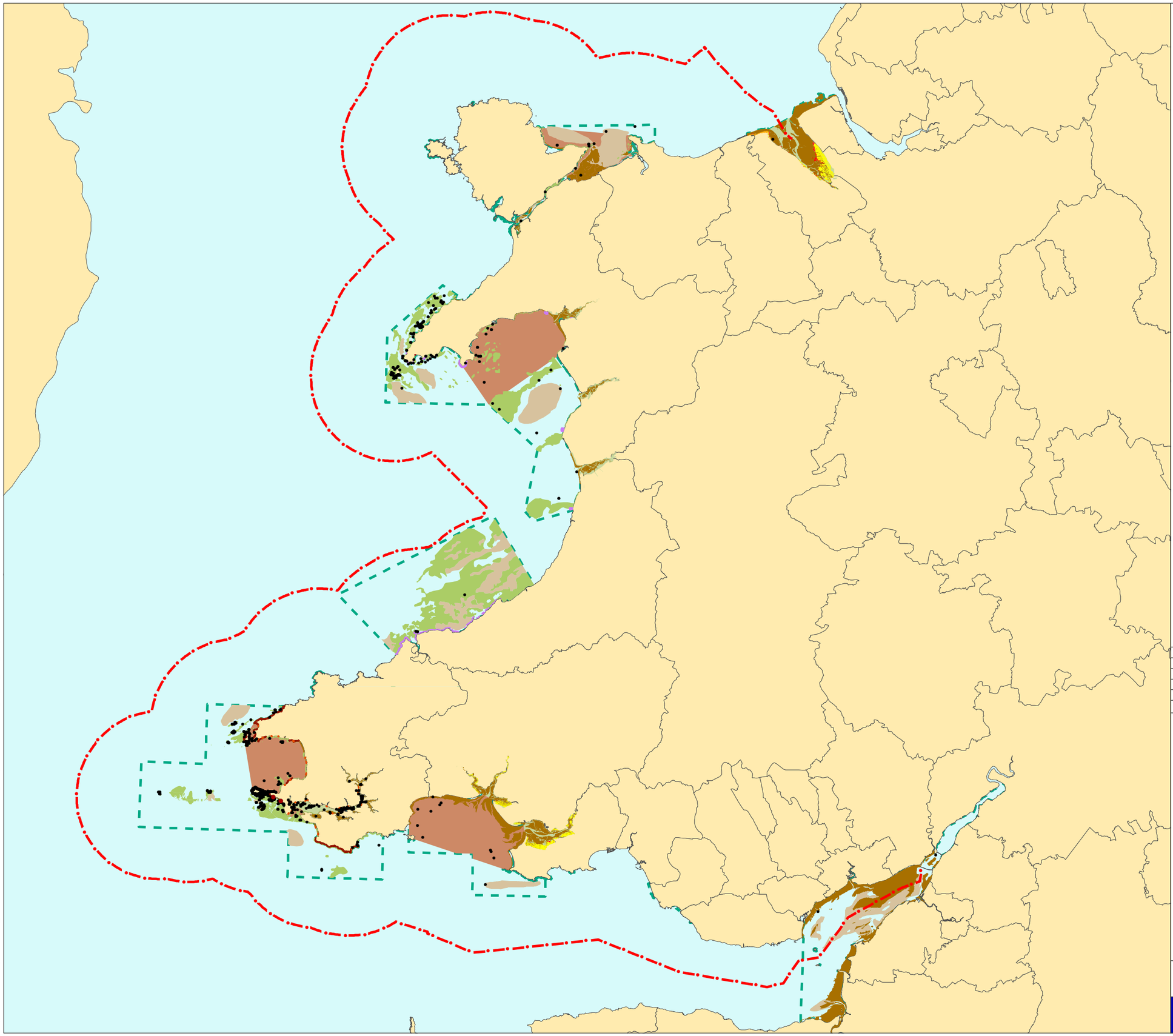
N

Date: 04/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 10 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\---DRAWINGS ---\10_Designations\JER3688-Figure_10_Designations.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)
- Special Areas of Conservation (SAC)

CCW SAC Designations

- Shoredock
- Notable Species
- Reefs
- Otter
- Grey Seal
- Dunes
- Salicornia
- Sea Caves
- Lagoons
- Vegetated Sea Cliffs
- Reefs
- Mud & Sandflats
- Sandbanks
- Atlantic Salt Meadows
- Estuaries
- Shallow Inlets & Bays

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, CCW

Status: DRAFT

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: CCW SAC Designations

Scale: A3 @ 1:1,000,000

0 20 40km

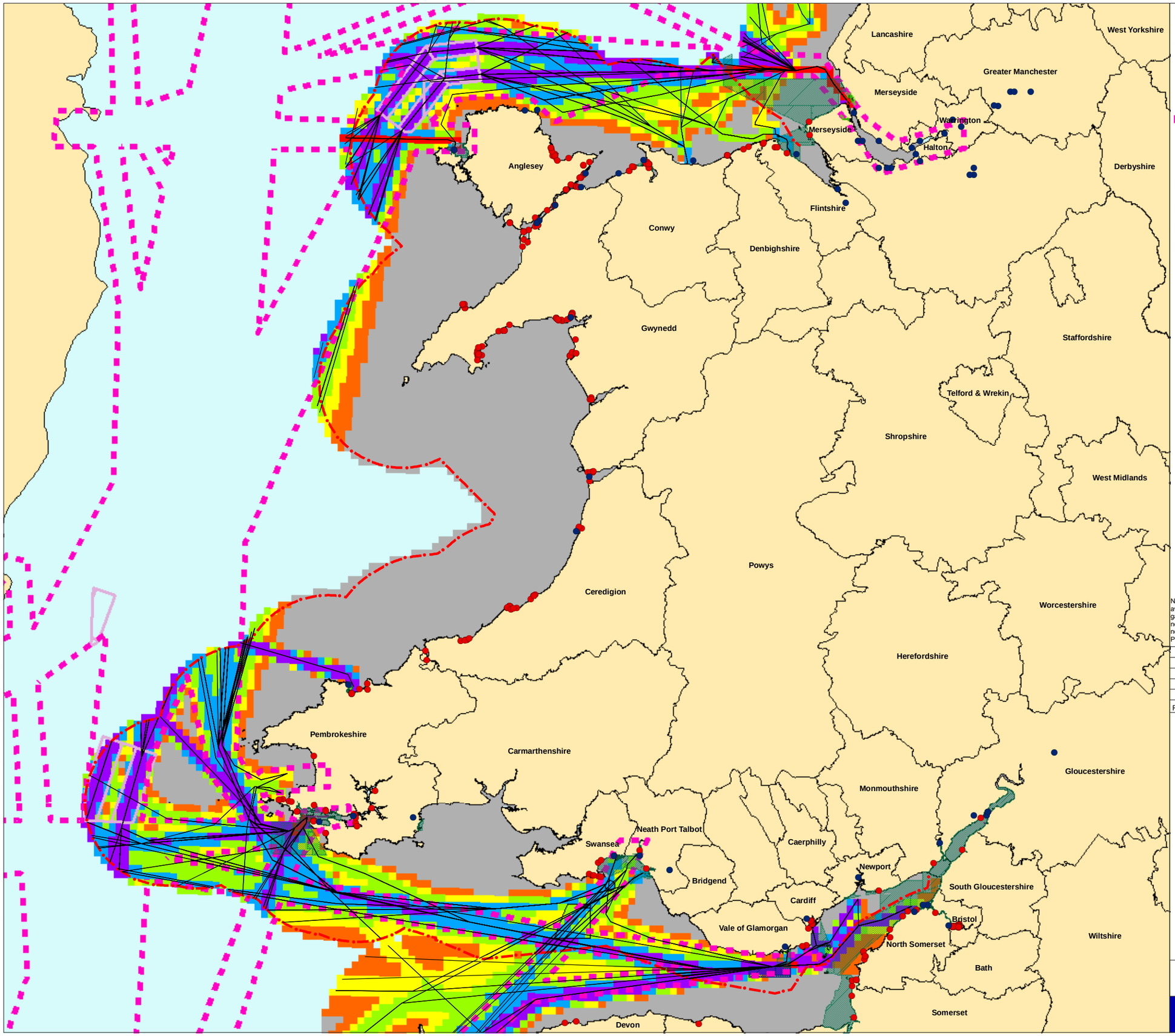
N

Date: 03/03/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **10i** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\10_Designations\JER3688-Figure_10i_SAC_Designations.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)
- Ports & Harbour Facility (SeaZone)
- Shipping Routes (Anatec)
- Small Craft Facility (SeaZone)
- Clearways
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Anchor Area, Berths, Dock Area, Small Craft Facility (SeaZone)
- Fairway (SeaZone)
- Pilot Boarding Place (SeaZone)
- Traffic Separation (SeaZone)

Shipping Density (Anatec)

Total Ships per Year

- >5000
- >1000 - 5000
- >250 - 1000
- >50 - 250
- >10 - 50
- >0 - 10
- 0

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, Anatec, Seazone

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Shipping

Scale: A3 @ 1:1,000,000

0 25 50 km

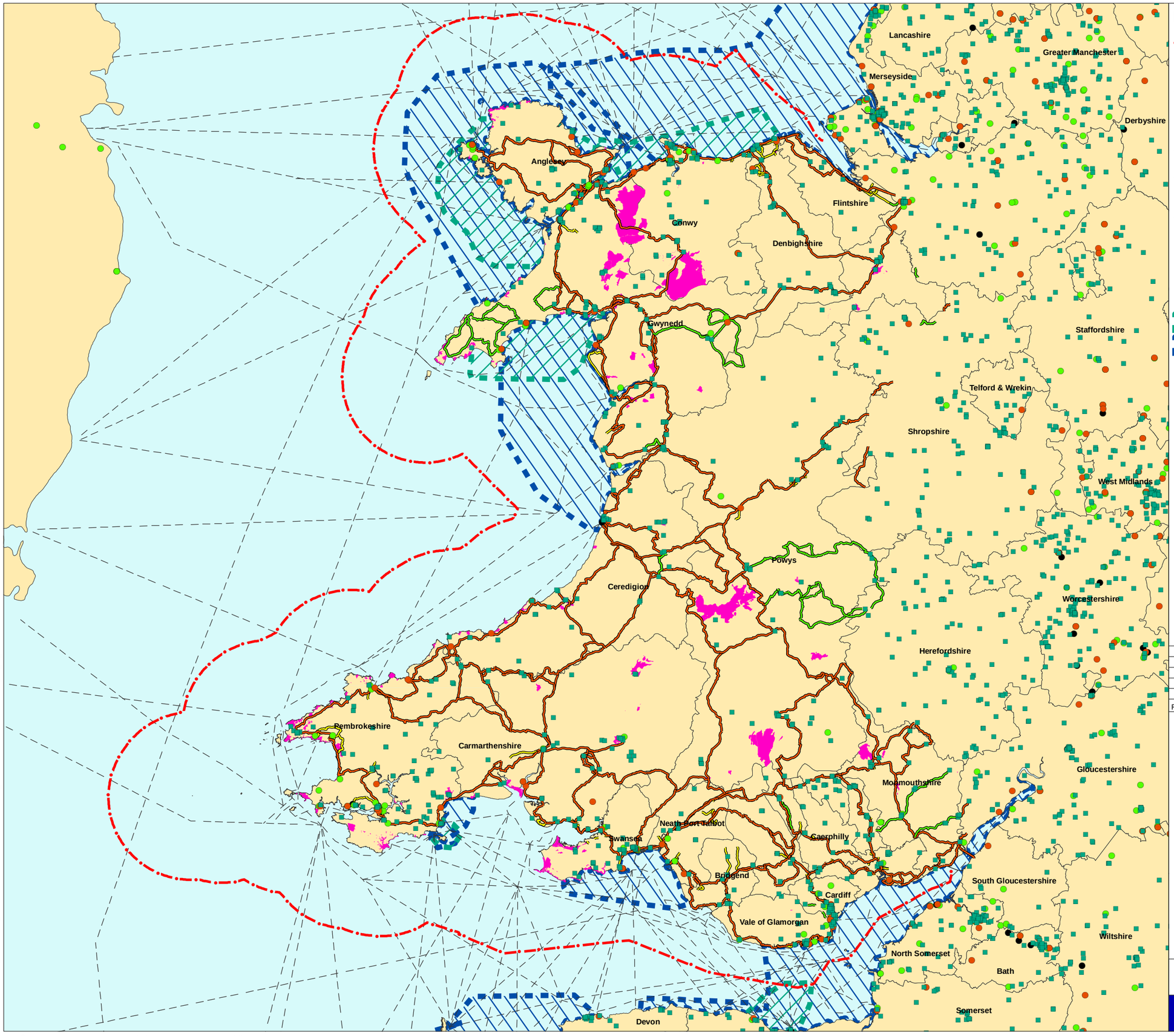
N

Date: 03/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 11 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\11_Shipping\JER3688-Figure_11_Shipping.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)
- Tourist Attractions (Visit Britain)

Sustrans Cycle Routes

- Regional Route
- National Route
- NCN Link

National Trust

- Properties

Royal Yachting Assosiation (RYA)

- Clubs
- Training Centres
- Marinas
- Cruising Routes
- Racing Areas
- Sailing Areas

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, RYA, Visit Britain

Status: DRAFT

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Tourism and Recreation

Scale: A3 @ 1:1,000,000

0 25 50 km

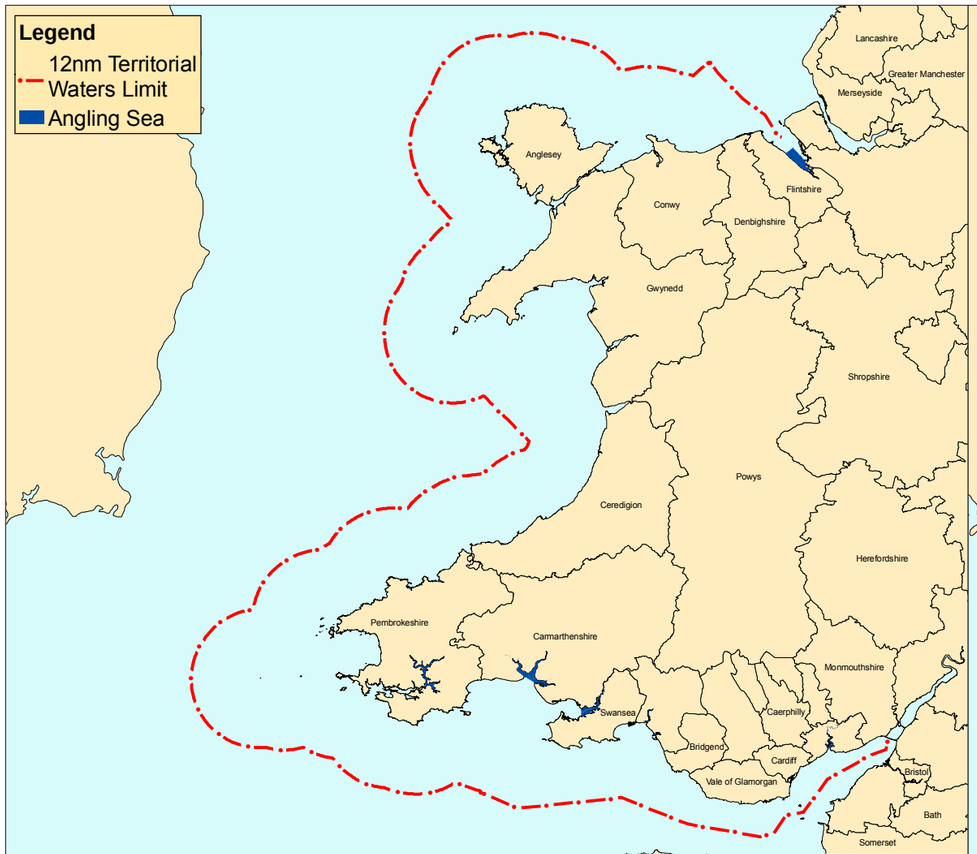
N

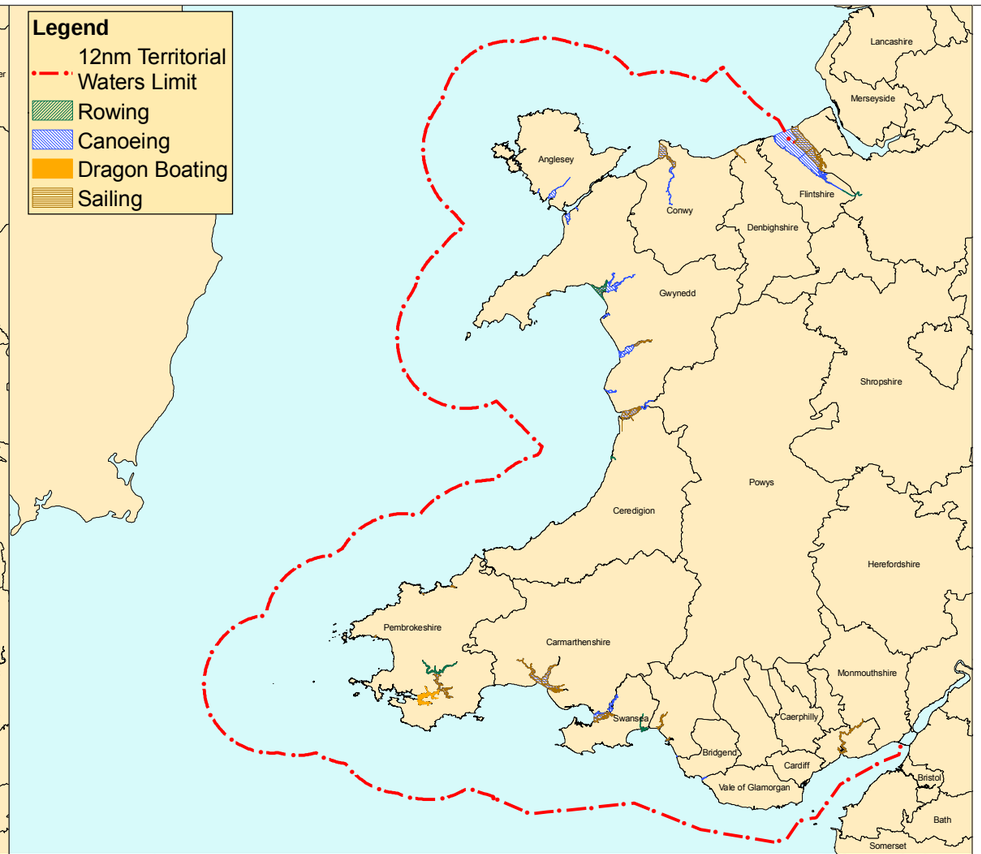
Date: 03/02/2008 Datum: OSGB36 Projection: BNG

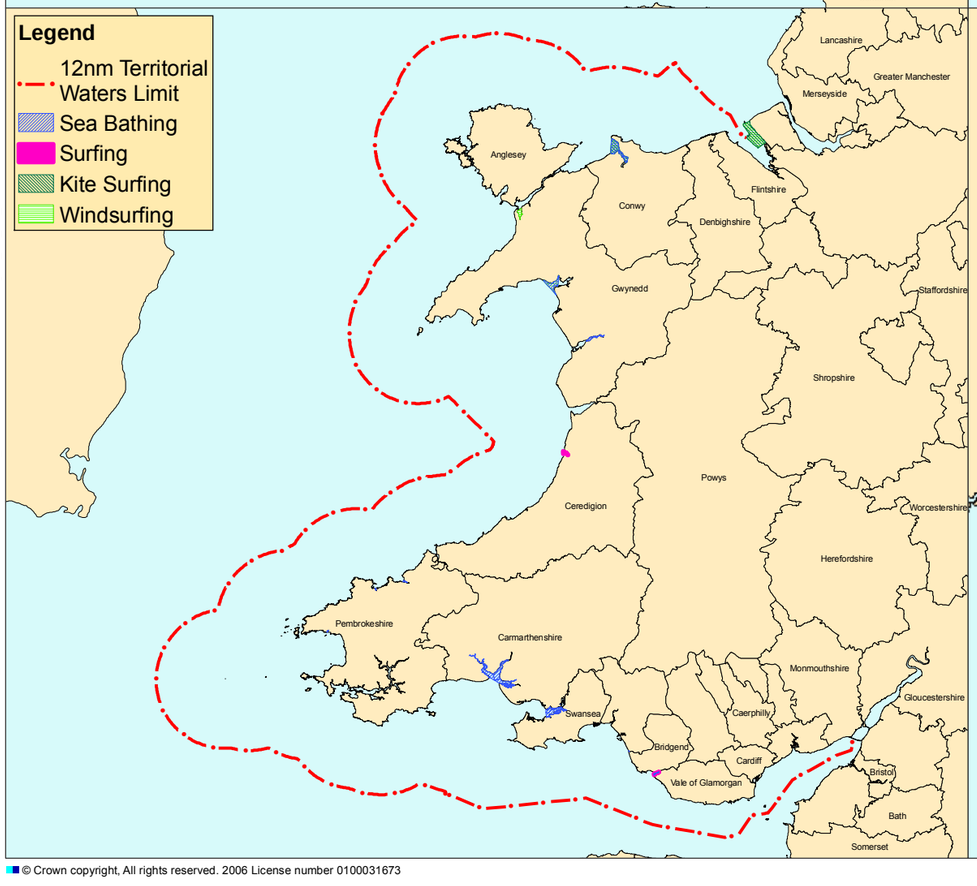
Drawn: M Angove Checked: T Golding Job Ref: JER3688

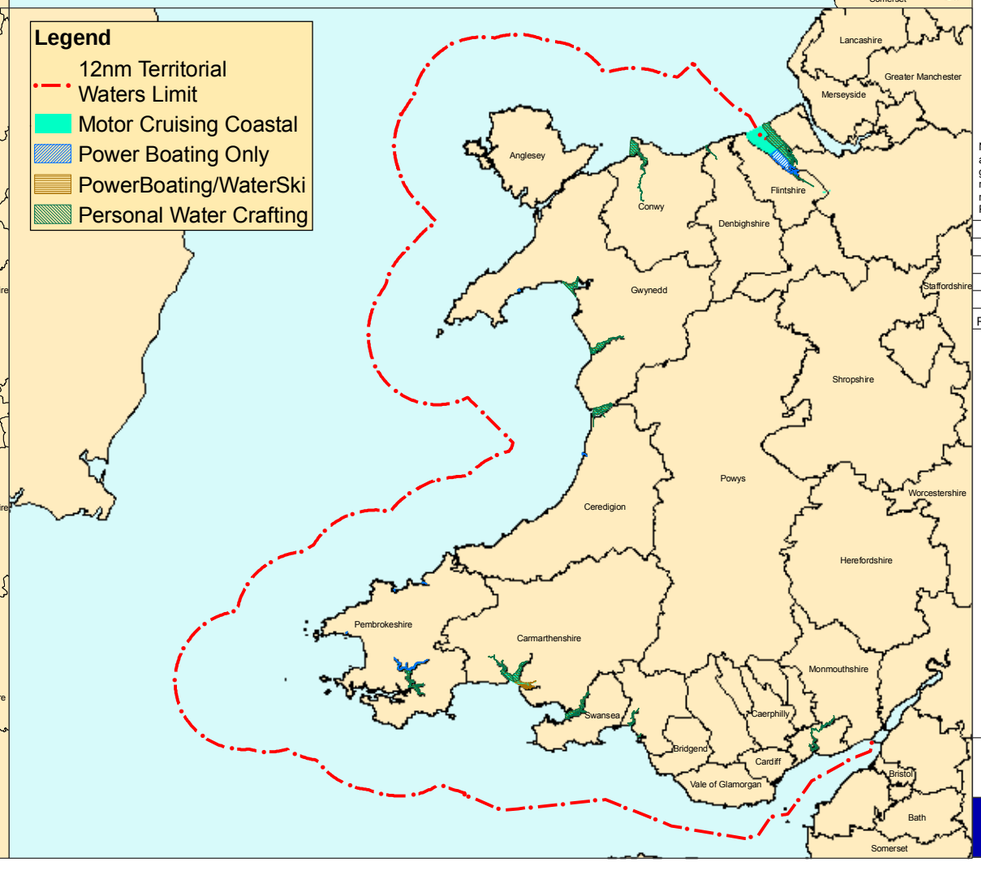
Figure No: 12 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\12_Tourism&Recreation\JER3688-Figure_12_Recreation.mxd









NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, EA

Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Environment Agency Recreation Data

Scale: A3 @ 1:2,000,000

0 40 80 km

N

Date: 04/02/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **12i** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\12_Tourism&Recreation\JER3688-Figure_12i_EA_Recreation.mxd

INSET 2
Scale : Not to Scale

INSET 1
Scale : Not to Scale

Ceredigion
Pembrokeshire
Carmarthenshire
Anglesey
Gwynedd
Conwy
Merseyside
Flintshire
Denbighshire
Shropshire
Powys
Herefordshire
Monmouthshire
Swansea
Cardiff
Somerset

SS Castilian
Royal Yacht Mary
Resurgam
Pwll Fanog
HM Submarine H5
Diamond
Tal-y-Bont
The Smalls
Louisa

See Inset 1
See Inset 2

Legend

- 12nm Territorial Waters Limit (SeaZone)
- Scheduled Ancient Monuments (CCW)

Protected Wrecks (Wessex)

- Protection Military Remains Act
- Scheduled Ancient Monument Wreck

Protection Wrecks Act

- Section 1
- Section 2

Wrecks (SeaZone)

- Wreck
- Wreck, dangerous wreck
- Wreck, distributed remains of wreck
- Wreck, non-dangerous wreck
- Wreck, wreck showing any portion of hull or superstructure
- Wreck, wreck showing mast/masts

Non-Statutory Designations

- Historic Parks and Gardens (CCW)
- Historic Landscapes (CCW)

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, Wessex, Seazone, CCW
Status: FINAL

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government
Project: Marine Renewable Energy Strategy Framework

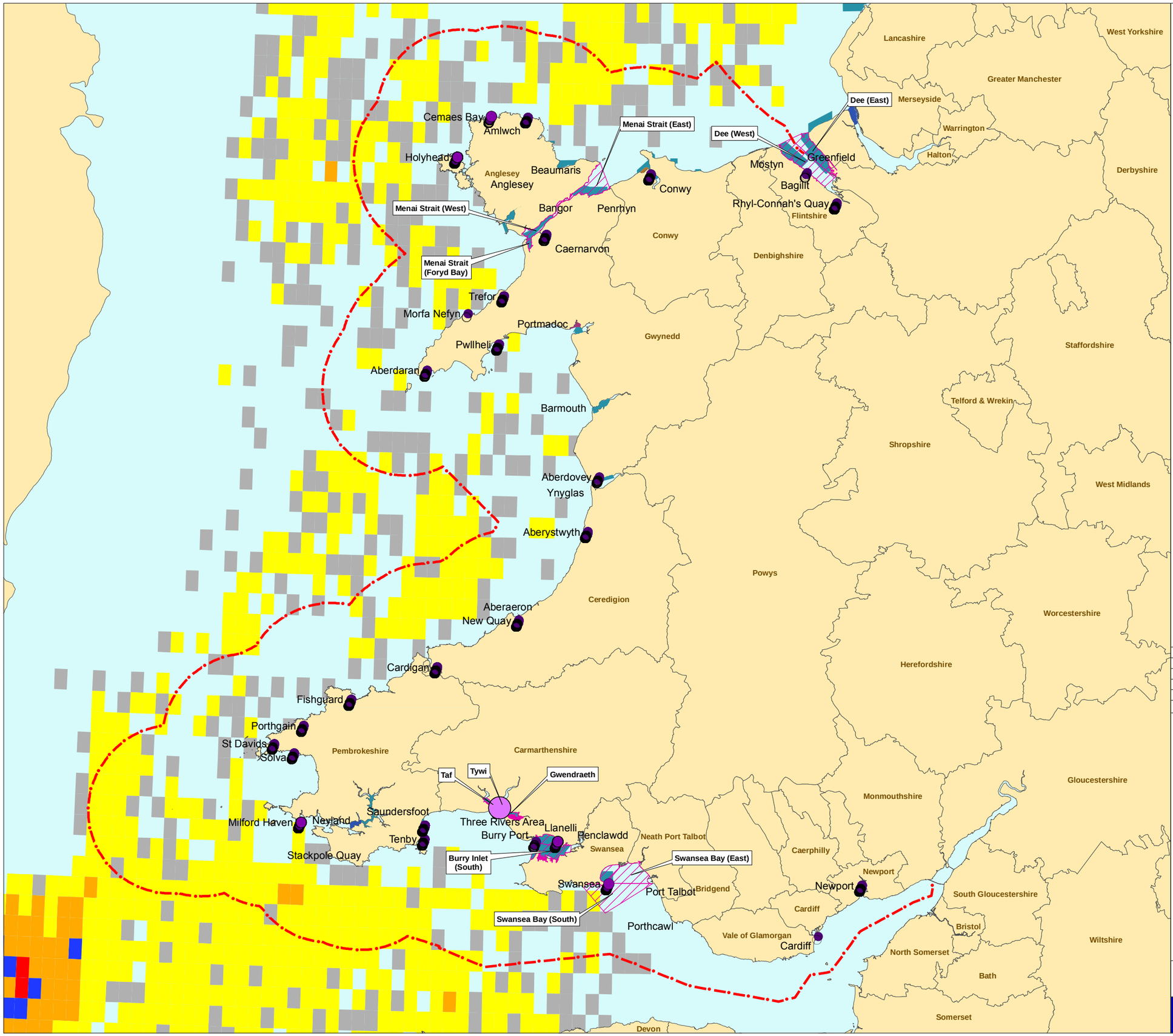
Title: Archaeology

Scale: A3 @ 1:1,500,000
0 37.5 75 km
N

Date: 03/02/2008 Datum: OSGB36 Projection: BNG
Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 13 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\13_Archaeology\JER3688-Figure_13_Archaeology.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)
- Designated Shellfish Waters (EA)

Fish Landings (MFA)

Live Weight (Tonne)

- 2001 - 3111
- 1001 - 2000
- 501 - 1000
- 101 - 500
- 0 - 100

Shellfish Waters (Magic)

- Unclassified
- Class A
- Class B
- Class C
- Prohibited

ALL Observed Active Fishing Vessels (>15m) (MFA)

- >45 - 70
- >30 - 45
- >15 - 30
- >1 - 15
- 1

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, MFA, Magic

Status: DRAFT

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Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Commercial Fisheries

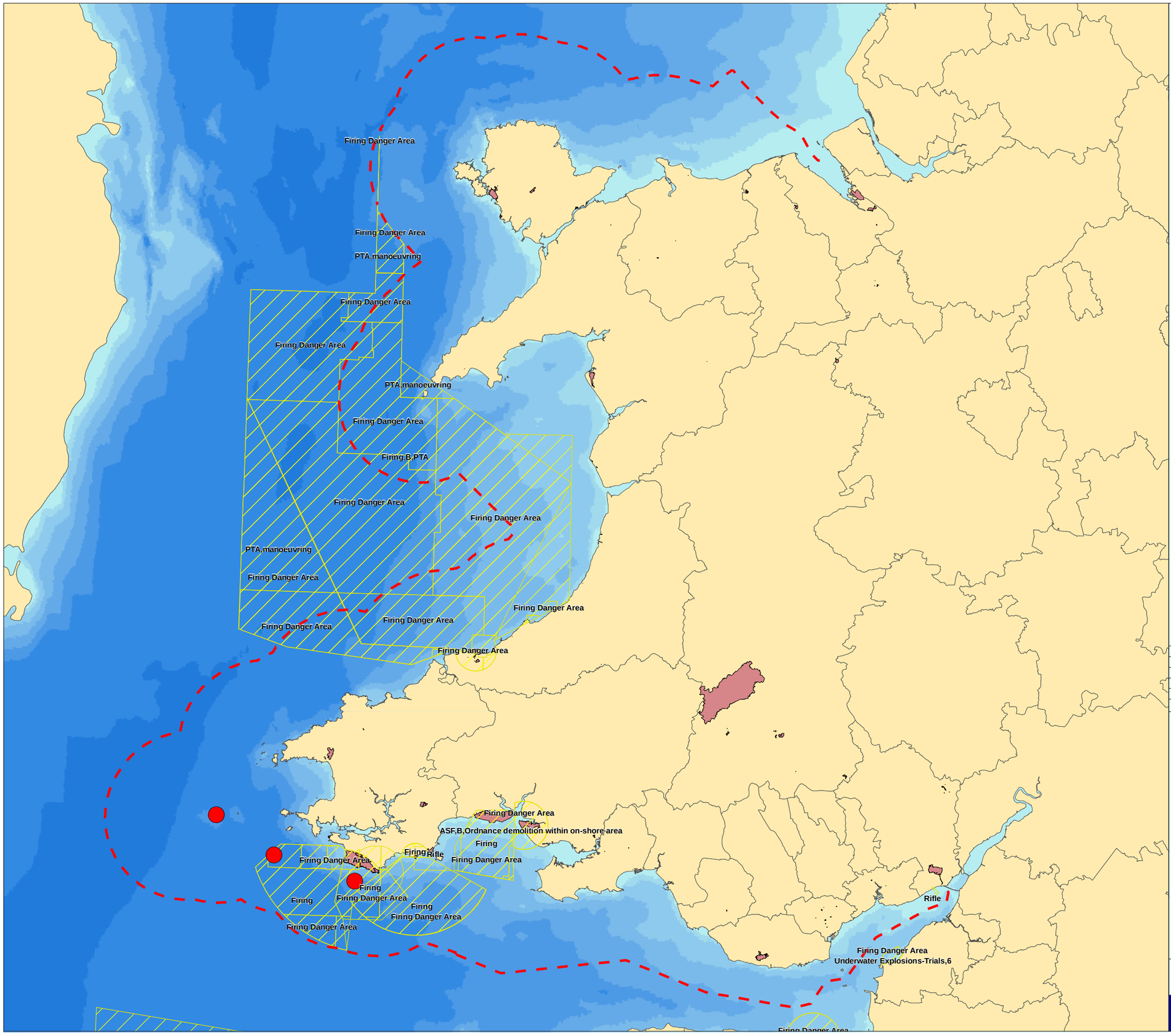
Scale: A3 @ 1:1,000,000
012km

Date: 03/02/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 14 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\---DRAWINGS ---\14_CommercialFisheries\JER3688-Figure_14_CommercialFisheries.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)
- Marine Military Practice Areas (SeaZone)
- MoD Establishments Wales

Explosives Dumping Sites (MoD)

- Milford Haven

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, SeaZone, MoD

Status: FINAL

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Military Use

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date: 03/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 15 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\15_MilitaryUse\JER3688-Figure_15_MilitaryUse.mxd

Legend

Aerodromes

- Civil
- Disused/Abandoned
- Glider Launch Site
- Government
- Heliport - Civil
- Heliport - Government
- Microlight Flying Site
- 12nm Territorial Waters Limit (SeaZone)
- Aerodrome Traffic Zones
- Military Aerodrome Traffic Zones

Radar 140m Blade Length

Areas which will, or may affect NATS En Route Plc ("NERL") operation, depending on the blade tip height of the project

- High
- Medium

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Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, BWEA - Aviation & Wind Energy

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Aviation

Scale: A3 @ 1:1,000,000

0 25 50 km

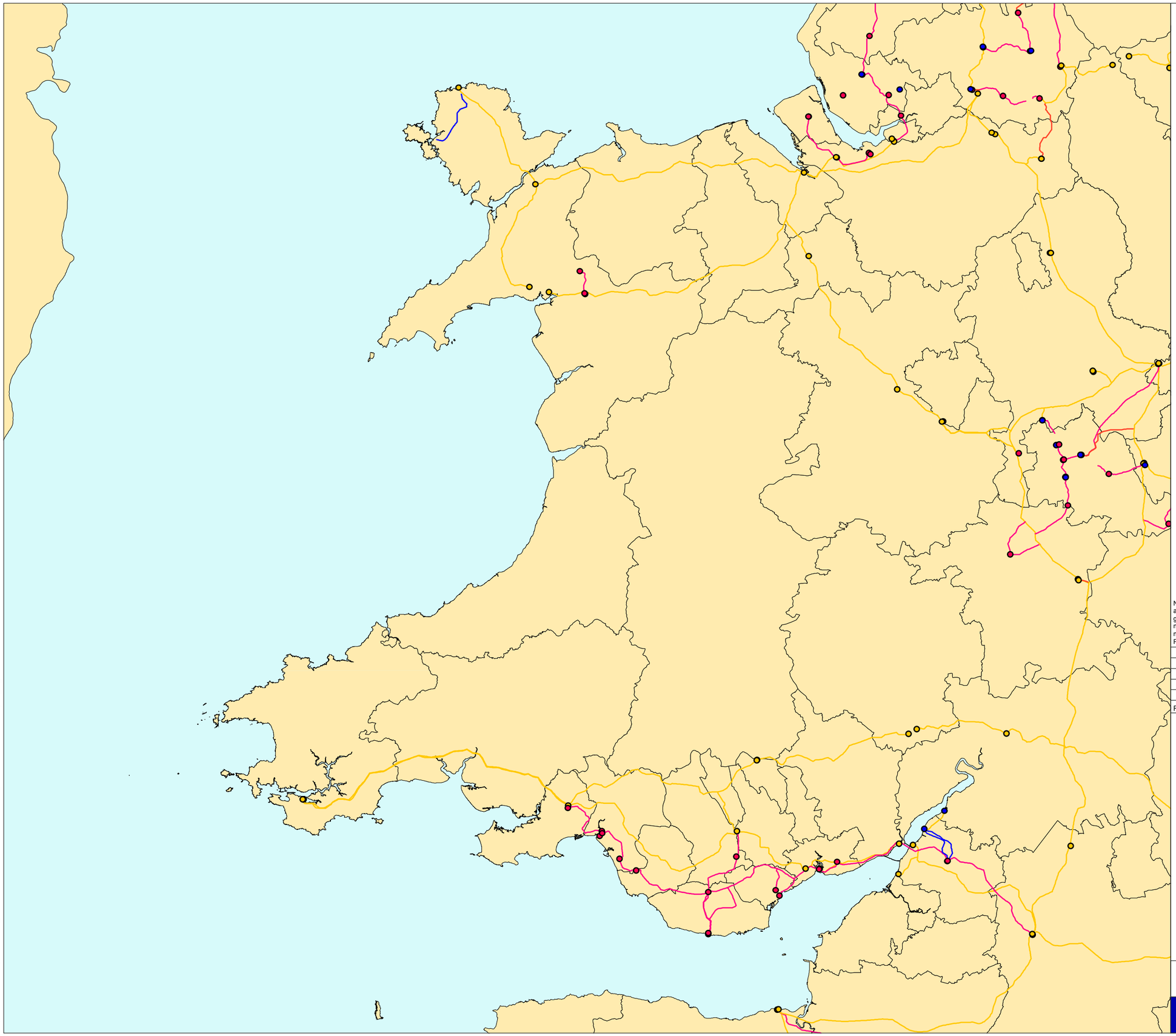
N

Date: 03/02/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **16** Revision: -

Project Ref. J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\16_Aviation\JER3688-Figure_16_Aviation.mxd



Legend

Substations

- 132kv
- 275kv
- 400kv

Overhead Lines

- 132kv
- 275kv
- 400/275kv
- 400kv

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, Seazone, DTI

Status: DRAFT

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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: National Grid

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date: 03/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 17 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\-- DRAWINGS --\17_NationalGrid\JER3688-Figure_17_NationalGrid.mxd

HIBERNIA 'C'
SIRIUS SOUTH
BT-FE1
ESAT 2
HIBERNIA 'D'
IW/IRELAND CROSSING
SOLAS
VSNL ATLANTIC NORTH
GEMINI NORTH - Seg 2
PTAT
VSNL W/EUROPE UK-PORTUGAL
TAT 11
SWANSEA/BREAN

Legend

- Submarine Cables and Pipelines (Kisca)
- 12nm Territorial Waters Limit (SeaZone)

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, Kisca, Seazone

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Cables & Pipelines

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date:17/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **18** Revision: -

Project Ref: J:\Drawings\JER3688\A_MarineRenewables\--- DRAWINGS ---\18_Cables&Pipelines\JER3688-Figure_18_Cables&Pipelines.mxd

Mersey Sand Supplies
Mersey Sand Supplies
Mersey Sand Supplies
Mersey Sand Supplies
not in use
not in use
not in use
not in use
South Coast Shipping
Lancashire
West Yorkshire
Greater Manchester
Merseyside
Warrington
Merseyside
Halton
Anglesey
Derbyshire
Flintshire
Conwy
Denbighshire
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
West Midlands
Powys
Ceredigion
Worcestershire
Warwickshire
Herefordshire
Pembrokeshire
Carmarthenshire
Gloucestershire
Monmouthshire
Neath Port Talbot
Swansea
Caerphilly
Newport
Bridgend
South Gloucestershire
Cardiff
Bristol
Vale of Glamorgan
Wiltshire
North Somerset
Bath
Somerset

Legend

- 12nm Territorial Waters Limit (SeaZone)
- Dredging Routes
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Royal Haskoning)
- Dredging Licence Areas (Seazone - Crown Estate)

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, Seazone, Crown estate

Status: FINAL

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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Aggregate Dredging Areas

Scale: A3 @ 1:1,000,000
0 25 50 km
N

Date:17/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: 19 Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\-- DRAWINGS --\19_Dredge&Aggregate\JER3688-Figure_19_Dredge&Aggregate.mxd

Legend

- 12nm Territorial Waters Limit (SeaZone)
- Wells (UK Deal)

Infrastructure (UK Deal)

- Surface Installations
- Subsurface Installations
- All Pipelines

Licence Areas (UK Deal)

- DTI Licence - Current
- 25th Round blocks on offer
- License Blocks

DTI Licence History

- Extant
- Surrendered

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007, UK Deal, DTI, Seazone

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Oil and Gas

Scale: A3 @ 1:1,000,000

0 20 40km

N

Date: 03/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **20** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\-- DRAWINGS --\20_Oil&Gas\JER3688-Figure_20_Oil&GasLicenceAreas.mxd

Lancashire
West Yorkshire
Greater Manchester
Merseyside
Warrington
Halton
Anglesey
Derbyshire
Flintshire
Conwy
Denbighshire
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
West Midlands
Powys
Ceredigion
Worcestershire
Warwickshire
Herefordshire
Pembrokeshire
Carmarthenshire
Gloucestershire
Monmouthshire
Neath Port Talbot
Swansea
Caerphilly
Newport
Bridgend
South Gloucestershire
Cardiff
Bristol
Vale of Glamorgan
Wiltshire
North Somerset
Bath
Somerset

not in use
not in use
not in use
not in use

Legend

12nm Territorial Waters Limit (SeaZone)

Disposal Sites (Seazone)

Explosives Dumping Ground

Spoil Ground

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008, Seazone, Crown estate

Status: FINAL

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy Framework

Title: Licenced Disposal Sites

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date:17/03/2008 Datum: OSGB36 Projection: BNG

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **21** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\-- DRAWINGS --\21_DisposalSites\JER3688-Figure_21_LicencedDisposal.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	TidalRange
Wave	Shoreline	OWC, Hydraulic Pressure, Overtopping	0m	5 - 15m	15kW/m	30kW/m	>1m	8 - 12 seconds	0 - 4m (neap)

Lancashire
Greater Manchester
Merseyside
Warrington
Merseyside
Halton
Anglesey
Flintshire
Conwy
Denbighshire
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
Powys
Ceredigion
Worcestershire
Herefordshire
Pembrokeshire
Carmarthenshire
Gloucestershire
Monmouthshire
Neath Port Talbot
Swansea
Caerphilly
Newport
Bridgend
South Gloucestershire
Cardiff
Bristol
Vale of Glamorgan
Wiltshire
North Somerset
Bath
Somerset

Legend

12nm Territorial Waters Limit

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Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Resource Area**
Wave Shoreline - Neap Tide
OWC, Hydraulic Pressure, Overtopping

Scale: A3 @ 1:1,000,000
0 25 50 km
N

Date: 05/02/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **22** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveA_WaveShorelineOWC\22_WaveShorelineOWC_Resource\JER3688-Figure_22_WaveShorelineOWC.mxd

Type	Group	Device Type	Depth	Min Wave Energy
Wave	Nearshore	Collector A	20 - 30m	>16kW/m
		Collector B	20 - 80m	>16kW/m

For more information on the device type please refer to the main report (JER3688R080425), in particular Tables:
5.11 (Categories and Criteria used for Device-Type Groupings Wave and Tide)) and
8.1 (Site Requirement Criteria for Device Types (where known))

Lancashire
Greater Manchester
Merseyside
Warrington
Merseyside
Halton
Anglesey
Flintshire
Conwy
Denbighshire
Gwynedd
Staffordshire
Telford & Wrekin
Shropshire
Powys
Ceredigion
Worcestershire
Herefordshire
Pembrokeshire
Carmarthenshire
Monmouthshire
Gloucestershire
Neath Port Talbot
Swansea
Caerphilly
Newport
Bridgend
South Gloucestershire
Cardiff
Bristol
Vale of Glamorgan
North Somerset
Wiltshire
Bath
Somerset
Devon

Legend

12nm Territorial Waters Limit

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Resource Area - Wave Nearshore Collector**

Derived from Atlas of Marine Renewable Energy Resources - BERR

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date: 19/03/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **23** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\---DRAWINGS---\ConstraintsMapping\1_Wave\B_WaveNearshoreCollector\23_WaveNearshoreCollector_ResourceJER3688-Figure_23_WaveNearshoreCollector.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	WaveHeight	WavePeriod
Wave	Nearshore	Single Point/Bouy A	500m - 5km	30 - 50m	>20kW/m		
		Single Point/Bouy B	500m - 5km	30 - 100m	>20kW/m	0.5-7m	6-8 seconds

For more information on the device type please refer to the main report (JER3688R080425), in particular Tables:
5.11 (Categories and Criteria used for Device-Type Groupings Wave and Tide)) and
8.1 (Site Requirement Criteria for Device Types (where known))

Lancashire
Merseyside
Merseyside
Warrington
Halton
Anglesey
Flintshire
Conwy
Denbighshire
Gwynedd
Shropshire
Powys
Ceredigion
Herefordshire
Pembrokeshire
Carmarthenshire
Monmouthshire
Neath Port Talbot
Swansea
Caerphilly
Newport
Bridgend
Cardiff
Vale of Glamorgan
Bristol
North Somerset
Bath
Somerset
Devon

Legend

12nm Territorial Waters Limit

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007

Status: DRAFT

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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Resource Area - Wave Nearshore Single Point/Bouy**

Derived from Atlas of Marine Renewable Energy Resources - BERR

Scale: A3 @ 1:1,000,000

0 25 50km

N

Date: 19/03/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **24** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIC_WaveNearshoreSPBouy\24_WaveNearshoreSPBouy_ResourceUJER3688-Figure_24_WaveNearshoreSPBouy.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod
Wave	Nearshore	Multi-Bouy		15 - 30m			>2m	

Lancashire
Merseyside
Merseyside
Halton
Anglesey
Flintshire
Conwy
Denbighshire
Gwynedd
Shropshire
Powys
Ceredigion
Herefordshire
Pembrokeshire
Carmarthenshire
Monmouthshire
Neath Port Talbot
Swansea
Caerphilly
Newport
Bridgend
Cardiff
Vale of Glamorgan
North Somerset
Bath
Somerset
Devon

Legend

12nm Territorial Waters Limit

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2007

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Resource Area**
Wave Nearshore
Multi-Bouy

Scale: A3 @ 1:1,000,000

0 25 50 km

N

Date: 03/02/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **25** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveID_WaveNearshoreMultiBouy\25_WaveNearshoreMultiBouy_Resource\JER3688-Figure_25_WaveNearshoreMultiBouy.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Single Point/Bouy	2 - 20km	20 - 100m	15kW/m	60kW/m	2 - 4m
		Single Point/Bouy	2 - 20km	50 - 100m	15kW/m	60kW/m	2 - 4m

For more information on the device type please refer to the main report (JER3688R080425), in particular Tables:
5.11 (Categories and Criteria used for Device-Type Groupings Wave and Tide)) and
8.1 (Site Requirement Criteria for Device Types (where known))

Lancashire
Merseyside
Merseyside
Halton
Anglesey
Flintshire
Conwy
Denbighshire
Gwynedd
Shropshire
Powys
Ceredigion
Herefordshire
Pembrokeshire
Carmarthenshire
Monmouthshire
Neath Port Talbot
Swansea
Caerphilly
Newport
Bridgend
Cardiff
Vale of Glamorgan
North Somerset
Bath
Somerset
Devon

Legend

12nm Territorial Waters Limit

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Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Resource Area - Wave Offshore Single Point / Bouy**

Derived from Atlas of Marine Renewable Energy Resources - BERR

Scale: A3 @ 1:1,000,000

0 25 50km

N

Date: 19/03/2008 Datum: WGS84 Projection: UTM30N

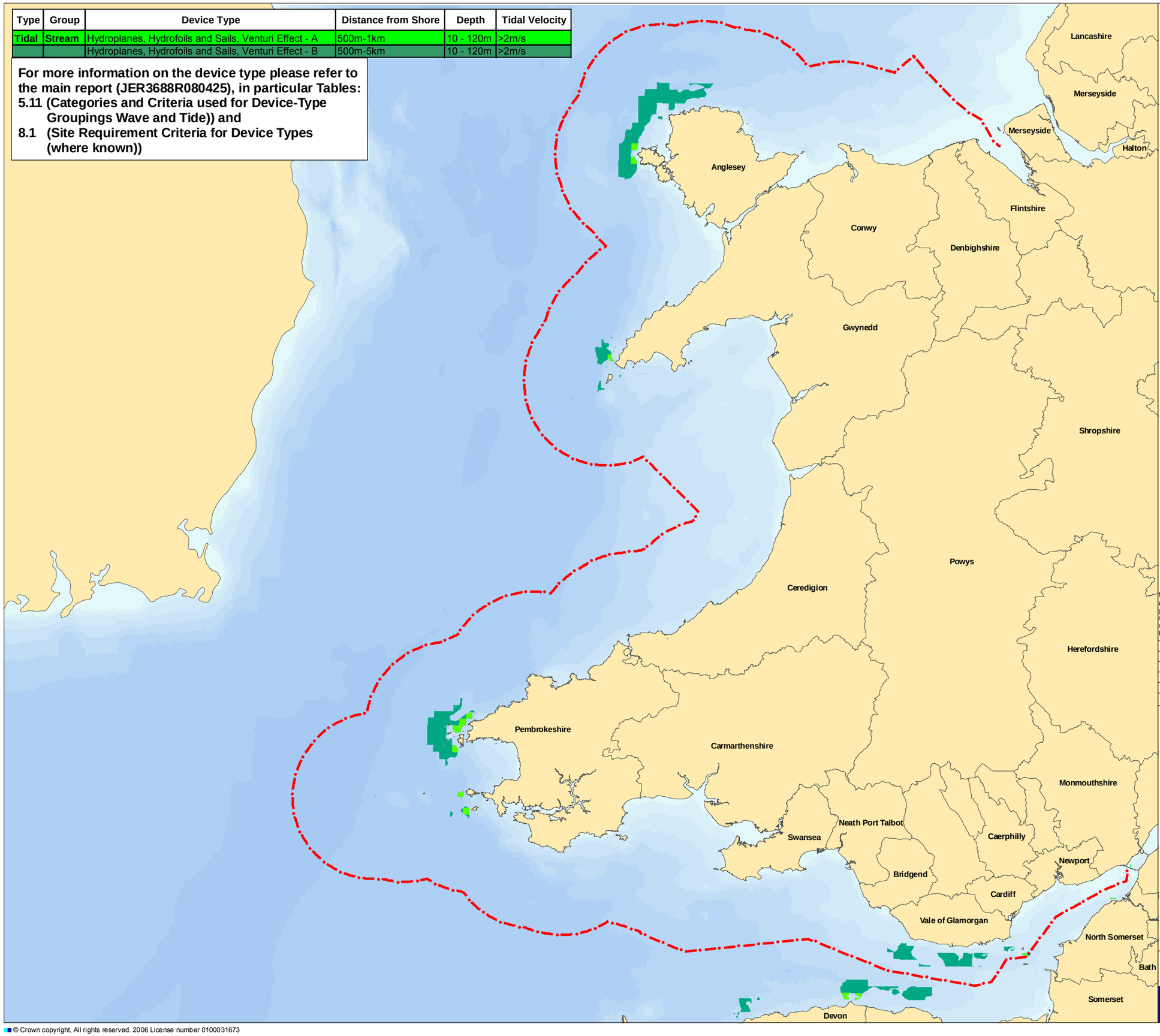
Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **26** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIE_WaveOffshoreSPBouy\26_WaveOffshoreSPBoy_ResourceJER3688-Figure_26_WaveOffshoreSPBouy.mxd

Type	Group	Device Type	Distance from Shore	Depth	Tidal Velocity
Tidal	Stream	Hydroplanes, Hydrofoils and Sails, Venturi Effect - A	500m-1km	10 - 120m	>2m/s
		Hydroplanes, Hydrofoils and Sails, Venturi Effect - B	500m-5km	10 - 120m	>2m/s

For more information on the device type please refer to the main report (JER3688R080425), in particular Tables:
5.11 (Categories and Criteria used for Device-Type Groupings Wave and Tide)) and
8.1 (Site Requirement Criteria for Device Types (where known))



Legend

12nm Territorial Waters Limit

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Resource Areas -Tidal Stream Hydroplanes, Hydrofoils & Sails, Venturi Effect**

Derived from Atlas of Marine Renewable Energy Resources - BERR

Scale: A3 @ 1:1,000,000 (0 – 25 – 50 km) N

Date: 19/03/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **29** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\2_TidalB_TidalStreamHHSVE\29_TidalStreamHHSVE_Resource\JER3688-Figure_29_TidalStreamHHSVE.mxd

Device	Distance from Shore	Depth	Wind Speed
	Seazone	Contours	DTI Atlas
Turbine A	0 - 12nm	5 - 35m	>5 - 25m/s
Turbine B	0 - 12nm	5 - 50m	>5 - 25m/s

For more information on the device type please refer to the main report (JER3688R080425), in particular Tables:
5.11 (Categories and Criteria used for Device-Type Groupings Wave and Tide)) and
8.1 (Site Requirement Criteria for Device Types (where known))

Legend

- 12nm_Territorial Waters Limit

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in thefigure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wind Turbine Resource Areas**

Derived from Atlas of Marine Renewable Energy Resources - BERR

Scale: A3 @ 1:1,000,000

0 25 50 km

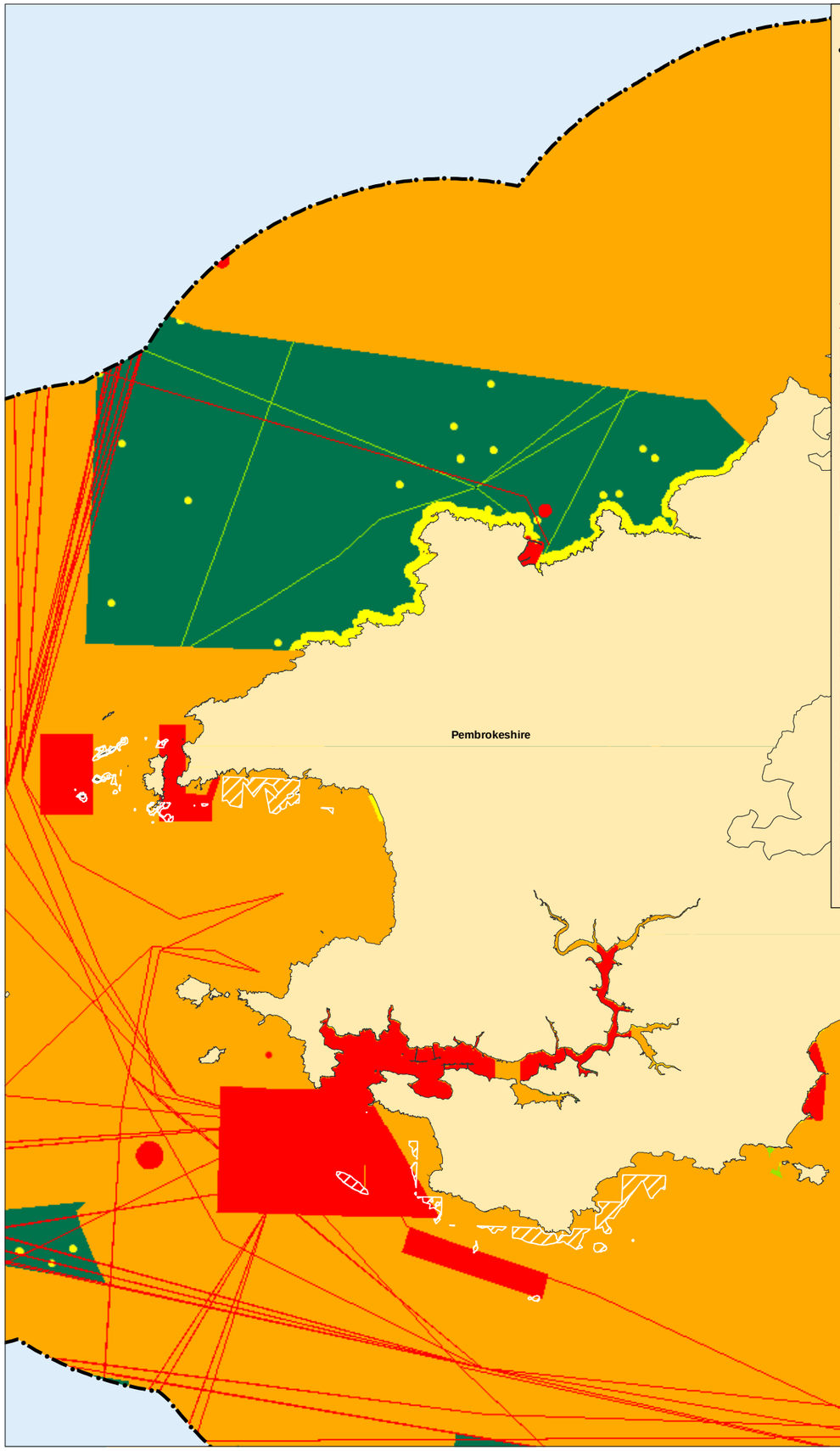
N

Date: 02/02/2007 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **30** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ContraintsMapping\3_Wind\30_Wind_DeviceResource\JER3688-Figure_30_WindTurbine.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Wave Shoreline OWC, Hydraulic Pressure, Overtopping - Fully Submerged - Neap Tide Resource Area

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- RPSWelshRoutes_WGS84_31N_shp
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Seabird Colonies (JNCC)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Wrecks (SeaZone)
- Submarine Cables and Pipelines (Kisca & Seazone)

- Bird Reserves
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- World Heritage Sites
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)

1 - no likely constraint

- AONB
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	Tidal Range
Wave	Shoreline	OWC, Hydraulic Pressure, Overtopping (fully subsurface)	0m	5 - 15m	15kW/m	30kW/m	>1m	8 - 12 seconds	0 - 4m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Shoreline - Neap Tide OWC, Hydraulic Pressure, Overtopping Fully Submerged**

Scale: A3 @ 1:350,000

0 10 20km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **31** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\DRAWINGS_Presentation_020708\ContraintsMapping\JER3688-012_ConstraintsWaveShorelineOWC_FullySubmerged_mxd

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveA_WaveShorelineOWC\31_WaveShorelineOWC_Constraints\JER3688-Figure_31i_ConstraintsWithinWaveShorelineOWC_FullySubmerged.mxd

Pembrokeshire

Carmarthenshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- RPSWelshRoutes_WGS84_31N_shp
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Gwynt Y Mor Wind Farm
- Lunar Energy Ramsey Sound Tidal
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)

4 - significant issue/constraint delay, possible stop project

- Special Areas of Conservation (SAC)
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Seabird Colonies (JNCC)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Firing Danger Areas
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes

1 - no likely constraint

- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	Tidal Range
Wave	Shoreline	OWC, Hydraulic Pressure, Overtopping (fully subsurface)	0m	5 - 15m	15kW/m	30kW/m	>1m	8 - 12 seconds	0 - 4m

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area**
Wave Shoreline - Neap Tide
OWC, Hydraulic Pressure, Overtopping
Fully Submerged

Scale: A3 @ 1:350,000

0 10 20 km

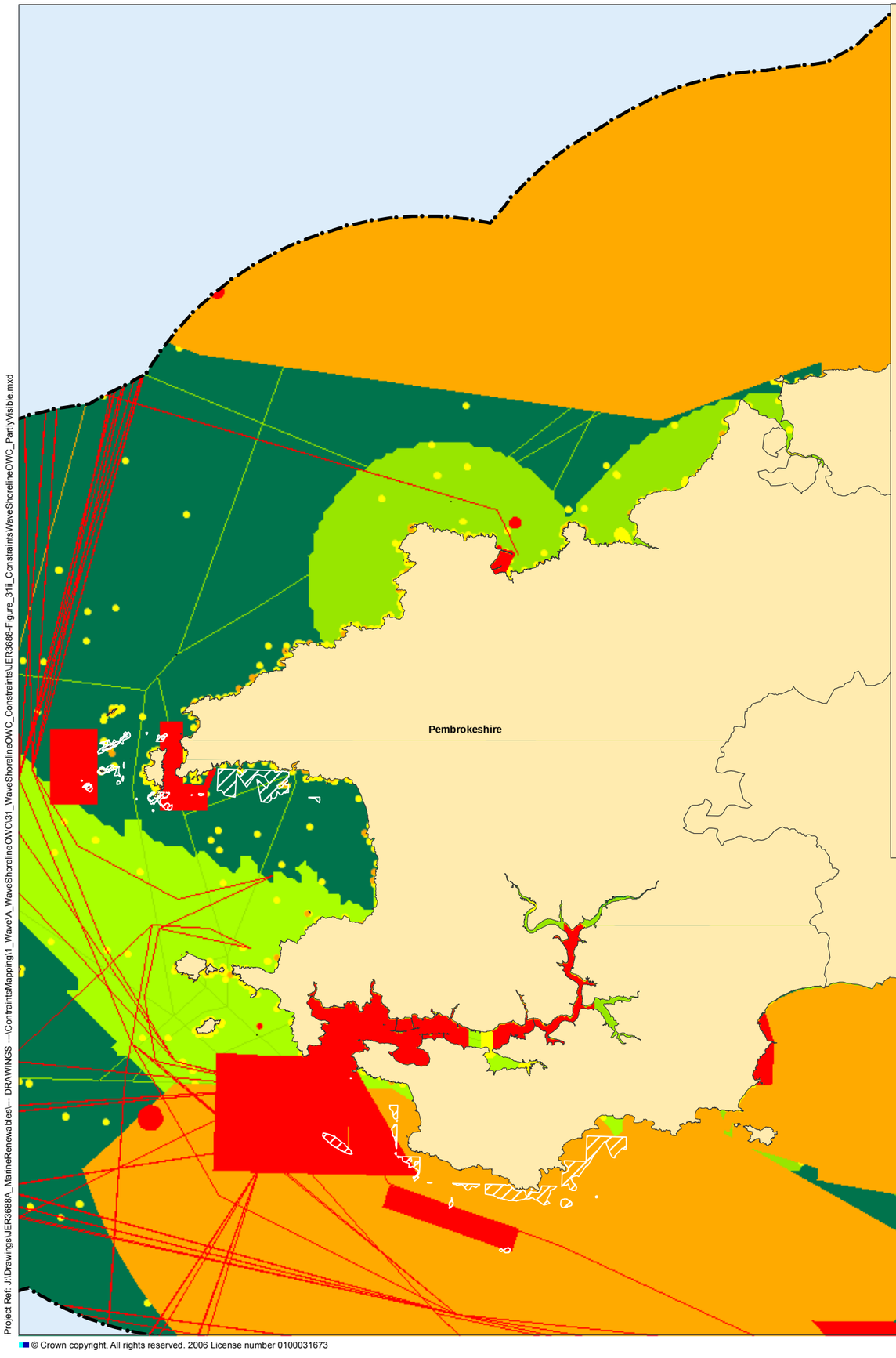
N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **31i** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveA_WaveShorelineOWC\31_WaveShorelineOWC\31_WaveShorelineOWC_Constraints\JER3688-Figure_31ii_ConstraintsWaveShorelineOWC_PartlyVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Wave Shoreline OWC, Hydraulic Pressure, Overtopping - Partly Visible - Neap Tide Resource Area

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- AONB
- Local Nature Reserves (LNR)
- National Parks

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	Tidal Range
Wave	Shoreline	OWC, Hydraulic Pressure, Overtopping (some visible structure at sea surface)	0m	5 - 15m	15kW/m	30kW/m	>1m	8 - 12 seconds	0 - 4m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Shoreline - Neap Tide OWC, Hydraulic Pressure, Overtopping Partly Visible**

Scale: A3 @ 1:350,000

0 10 20km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **31ii** Revision: -

Pembrokeshire

Carmarthenshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Firing Danger Areas
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	Tidal Range
Wave	Shoreline	OWC, Hydraulic Pressure, Overtopping (some visible structure at sea surface)	0m	5 - 15m	15kW/m	30kW/m	>1m	8 - 12 seconds	0 - 4m

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area**
Wave Shoreline - Neap Tide
OWC, Hydraulic Pressure, Overtopping
Partly Visible

Scale: A3 @ 1:350,000

0 10 20km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **31iii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ContraintsMapping\1_WaveA_WaveShorelineOWC\31_WaveShorelineOWC_Constraints\JER3688-Figure_31iii_ConstraintsWithinWaveShorelineOWC_PartlyVisible.mxd

Pembrokeshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Wave Nearshore Collector A Partly Visible

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy
Wave	Nearshore	Collector A (fully subsurface)		20 - 30m	>16kW/m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Nearshore Collector A Partly Visible Constraints Map**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **32** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIB_WaveNearshoreCollector\32_WaveNearshoreCollector_ConstraintsJER3688-Figure_32_ConstraintsWaveNearshoreCollectorA_PartVisible.mxd

Pembrokeshire

Carmarthenshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- North Hoyle Wind Farm
- Gwynt Y Mor Wind Farm
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)

4 - significant issue/constraint - delay, possible stop project

- Special Areas of Conservation (SAC)
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Scoter Distribution (CALM)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy
Wave	Nearshore	Collector A (fully subsurface)		20 - 30m	>16kW/m

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area**
Wave Nearshore Collector A
Partly Visible

Scale: A3 @ 1:350,000

0 5 10 km

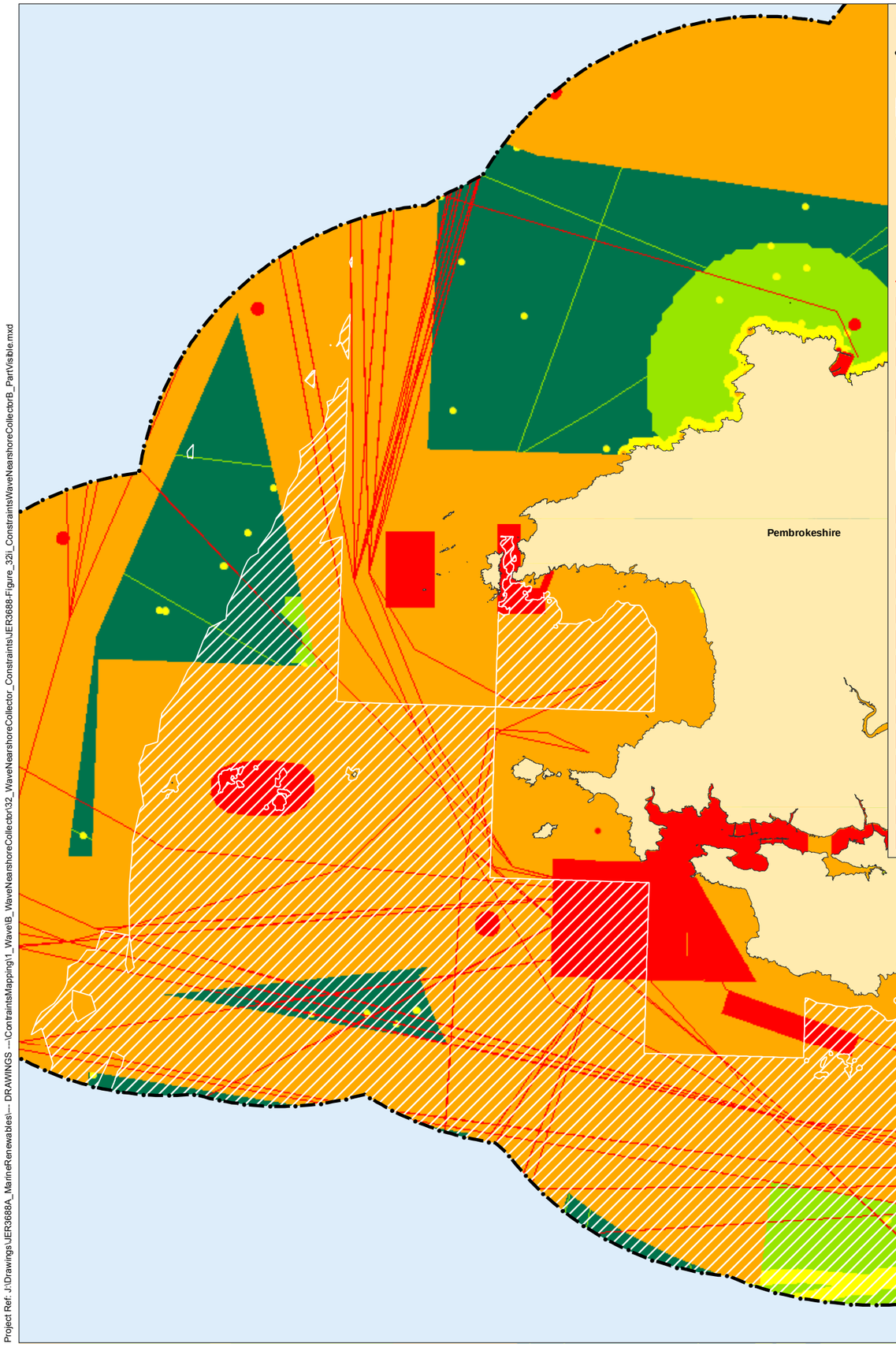
N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **32i** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveB_WaveNearshoreCollector\32_WaveNearshoreCollector_ConstraintsUJER3688-Figure_32i_ConstraintsWithinWaveNearshoreCollectorA_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Wave Nearshore Collector B Partly Visible

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy
Wave	Nearshore	Collector B (fully subsurface)		20 - 80m	>16kW/m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Nearshore Collector B Partly Visible Constraints Map**

Scale: A3 @ 1:350,000

0 10 20 km

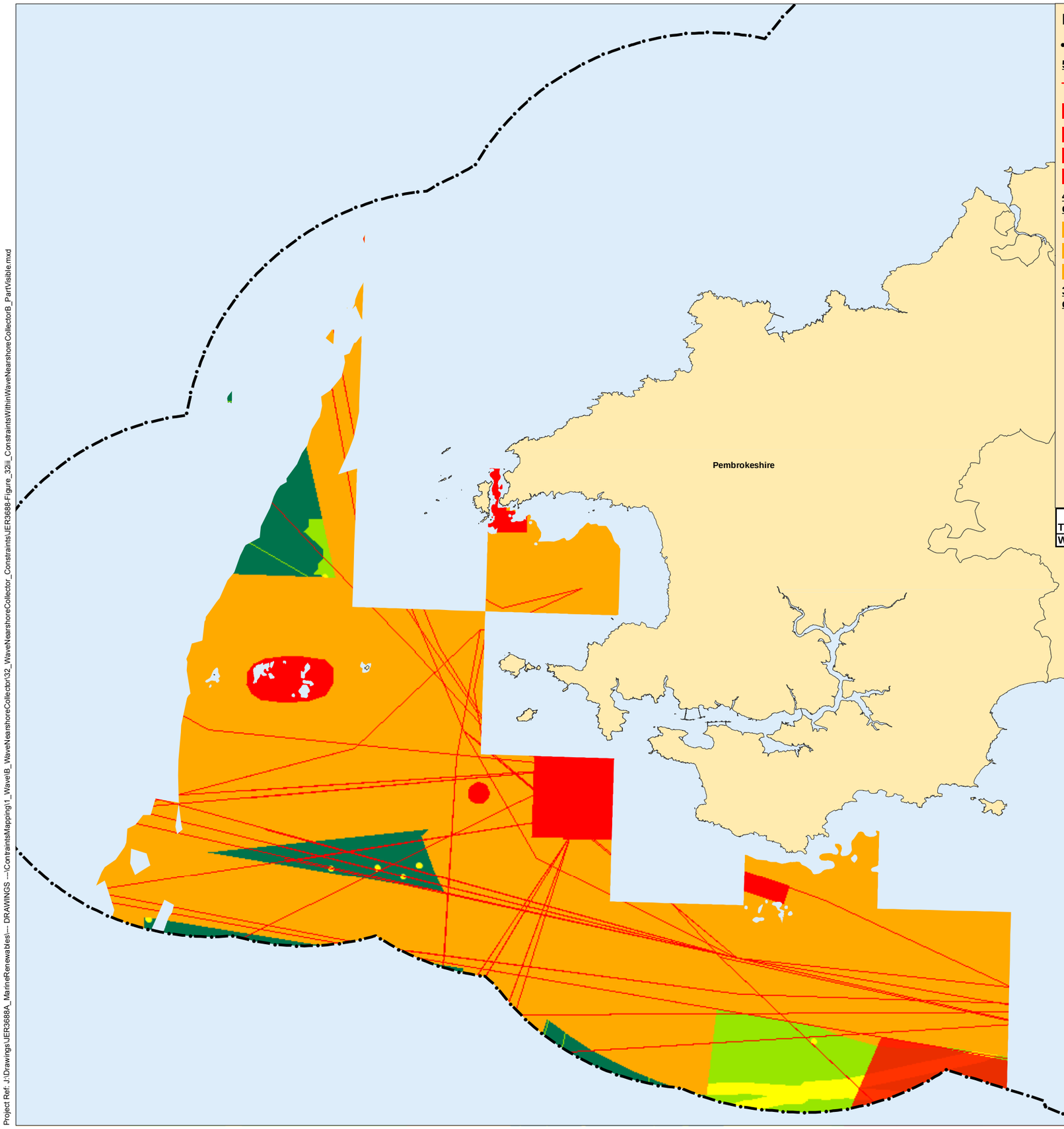
N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **32ii** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveB_WaveNearshoreCollector\32_WaveNearshoreCollectorB_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm

4 - significant issue/constraint - delay, possible stop project

- Special Areas of Conservation (SAC)
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy
Wave	Nearshore	Collector B		20 - 80m	>16kW/m

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Wave Nearshore Collector B Partly Visible**

Scale: A3 @ 1:350,000

0 10 20 km

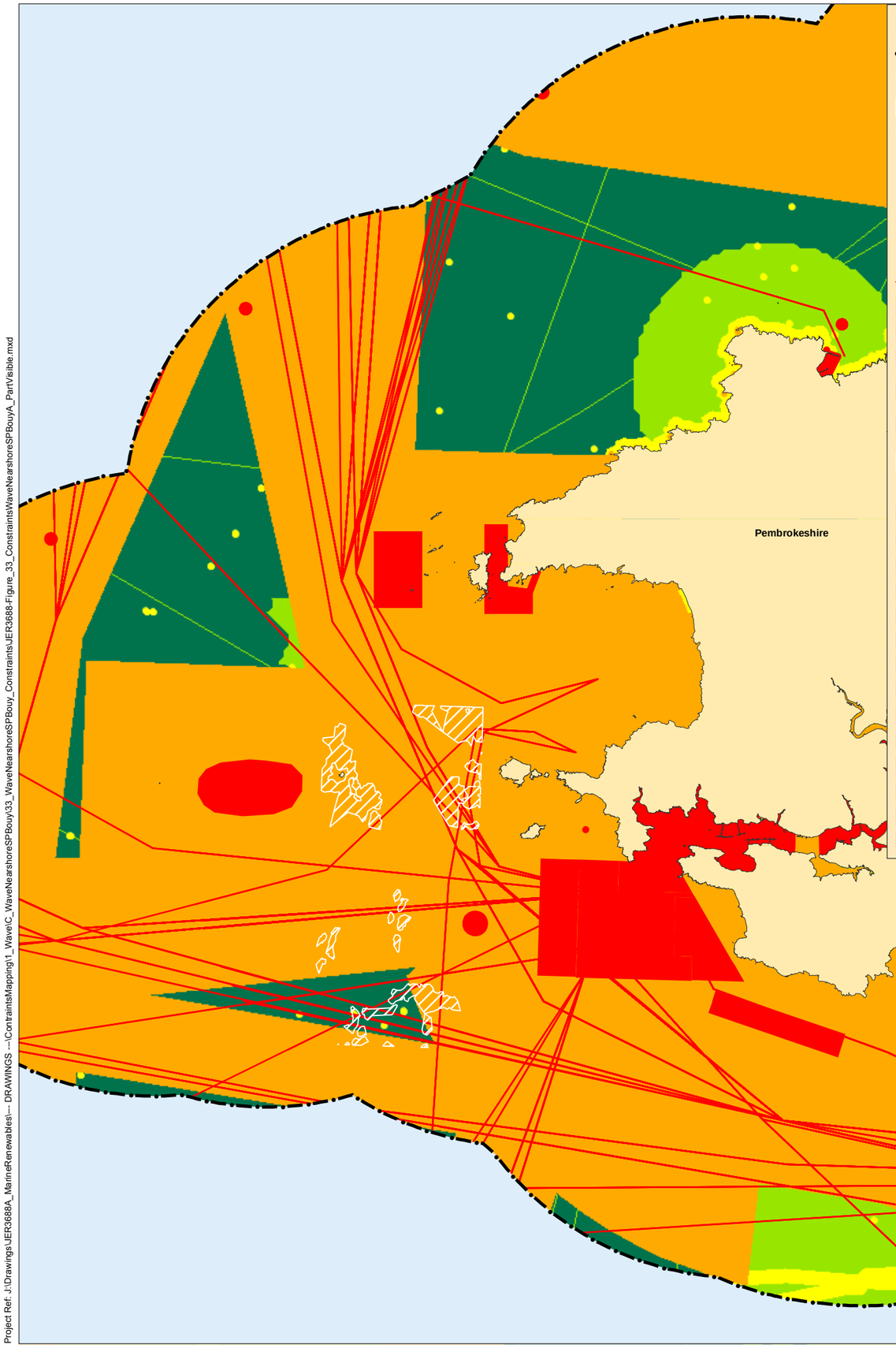
N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **32iii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIB_WaveNearshoreCollectb\32_WaveNearshoreCollector_ConstraintsUJER3688-Figure_32iii_ConstraintsWithinWaveNearshoreCollectorB_PartVisible.mxd



Legend

12nm Territorial Waters Limit (SeaZone)

Resource Area

Wave Nearshore Single Point/Bouy Partly Visible

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod
Wave	Nearshore	Single Point/Bouy A (fully submerged)	500m - 8km	30 - 50m	>20kW/m		>1.5m	5 - 15 seconds

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Nearshore Single Point/Bouy A Partly Visible Constraints Map**

Scale: A3 @ 1:350,000

0 10 20 km

N

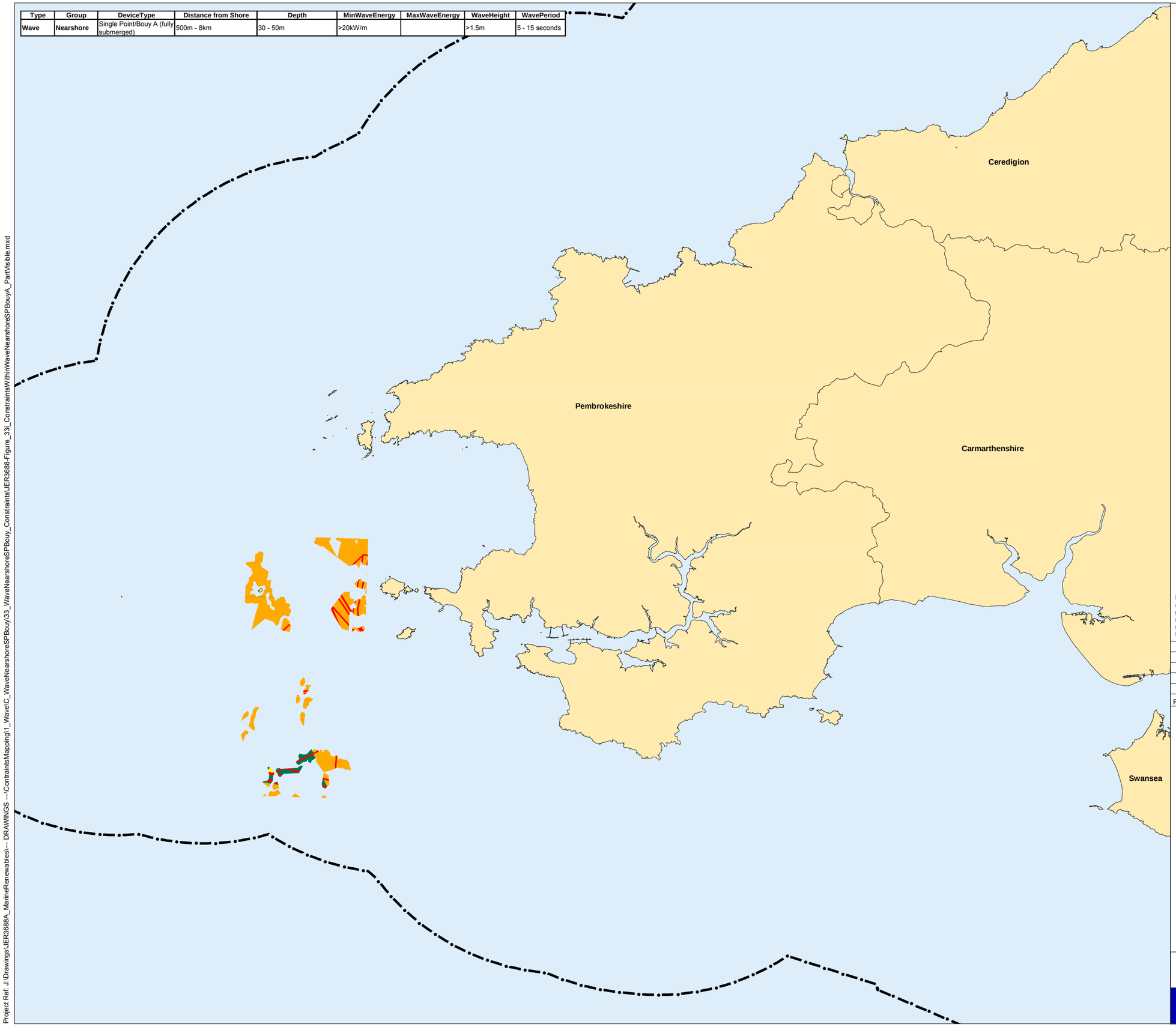
Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **33** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveC_WaveNearshoreSPBouy\33_WaveNearshoreSPBouy_ConstraintsJER3688-Figure_33_ConstraintsWaveNearshoreSPBouyA_PartVisible.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod
Wave	**Nearshore**	Single Point/Bouy A (fully submerged)	500m - 8km	30 - 50m	>20kW/m		>1.5m	5 - 15 seconds



Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)

4 - significant issue/constraint - delay, possible stop project

- Clearways
- Firing Danger Areas
- Special Areas of Conservation (SAC)

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Wrecks (SeaZone)
- Firing Danger Areas

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Wave Nearshore Single Point/Bouy A Partly Visible**

Scale: A3 @ 1:350,000

0 10 20 km

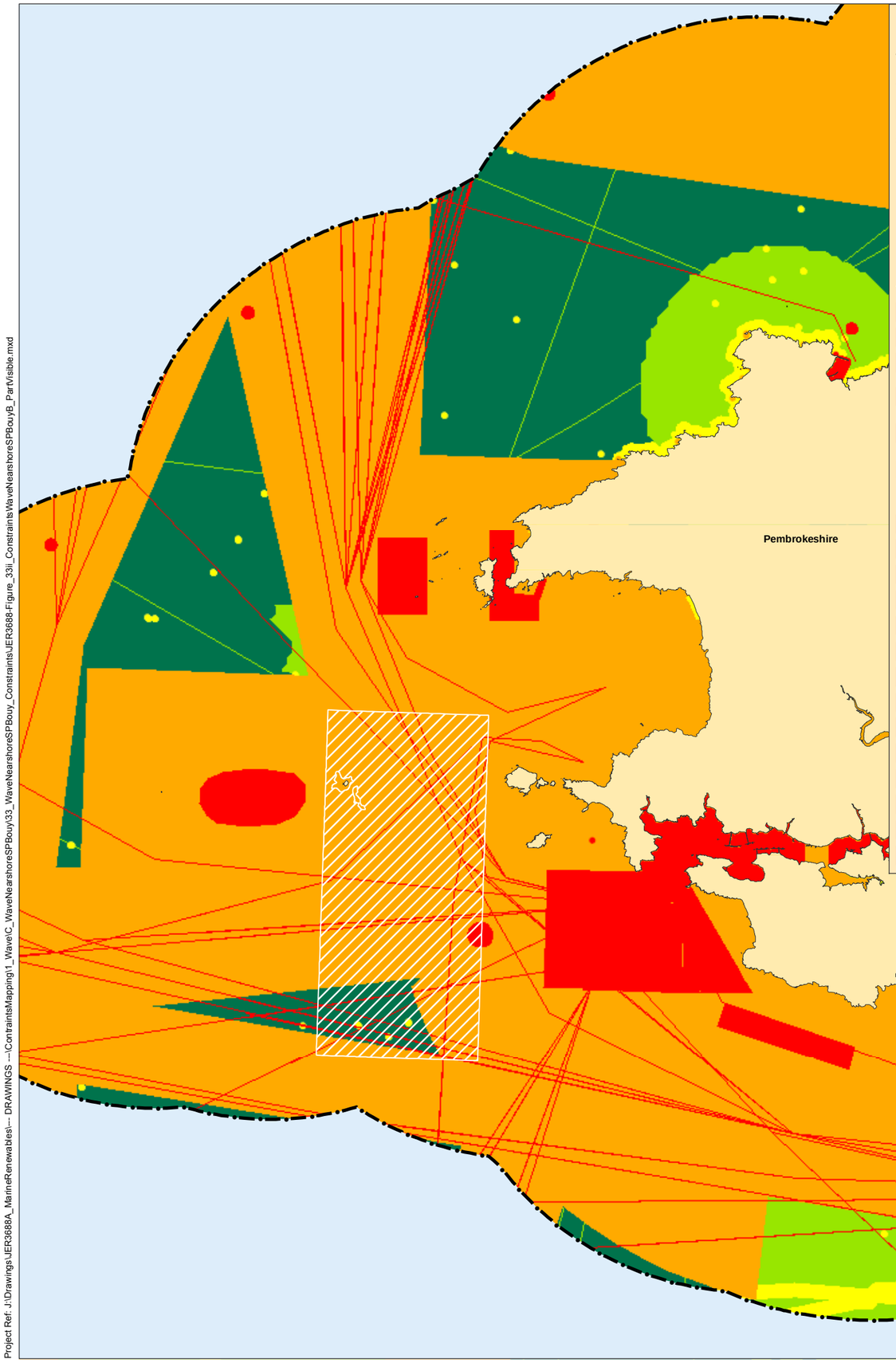
N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **33i** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_Wave\C_WaveNearshoreSPBouy\33_WaveNearshoreSPBouy_ConstraintsJER3688-Figure_33i_ConstraintsWithinWaveNearshoreSPBouyA_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Wave Nearshore Single Point/Bouy B Partly Visible

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	Tidal Range
Wave	Nearshore	Single Point/Bouy B (fully submerged)	500m - 8km	30 - 100m	>20kW/m		>1.5m	5 - 15 seconds	

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Nearshore Single Point/Bouy B Partly Visible Constraints Map**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **33ii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveC_WaveNearshoreSPBouy\33_WaveNearshoreSPBouy_ConstraintsJER3688-Figure_33ii_ConstraintsWaveNearshoreSPBouyB_PartVisible.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	Tidal Range
Wave	Nearshore	Single Point/Bouy B (fully submerged)	500m - 8km	30 - 100m	>20kW/m		>1.5m	5 - 15 seconds	

Ceredigion

Pembrokeshire

Carmarthenshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)

4 - significant issue/constraint - delay, possible stop project

- Clearways
- Special Areas of Conservation (SAC)
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Wrecks (SeaZone)
- Firing Danger Areas

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints Within Resource Area Wave Nearshore Single Point/Bouy B Partly Visible**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **33iii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_Wave\C_WaveNearshoreSPBouy\33_WaveNearshoreSPBouy_ConstraintsJER3688-Figure_33iii_ConstraintsWithinWaveNearshoreSPBouyB_PartVisible.mxd

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveID_WaveNearshoreMultiBouy\34_WaveNearshoreMultiBouy_Constraints\JER3688-Figure_34_ConstraintsWaveNearshoreMultiBouy_PartVisible.mxd

Pembrokeshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Wave Nearshore Multi-Bouy Partly Visible

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	Tidal Range
Wave	Nearshore	Multi-Bouy		15 - 30m			>2m		

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Nearshore Multi-Bouy Partly Visible Constraints Map**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **34** Revision: **-**

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight	WavePeriod	Tidal Range
Wave	Nearshore	Multi-Bouy		15 - 30m			>2m		

Ceredigion

Pembrokeshire

Carmarthenshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)

4 - significant issue/constraint - delay, possible stop project

- Clearways
- Special Areas of Conservation (SAC)
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Wave Nearshore Multi-Bouy Partly Visible**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 20/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **34i** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ContraintsMapping\1_WaveID_WaveNearshoreMultiBouy\34_WaveNearshoreMultiBouy_ConstraintsUER3688-Figure_34i_ConstraintsWithinWaveNearshoreMultiBouy_PartVisible.mxd

Pembrokeshire

Swansea

Legend

12nm Territorial Waters Limit (SeaZone)

Resource Area

Wave Offshore Single Point Bouy A Fully Submerged

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- 500m Buffer Wells
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- RPSWelshRoutes_WGS84_31N_shp
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Seabird Colonies (JNCC)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- Bird Reserves
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- World Heritage Sites
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)

1 - no likely constraint

- AONB
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Single Point/Bouy A	2 - 20km	20 - 100m	15kW/m	60kW/m	2 - 4m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Offshore Single Point Bouy A Fully Submerged**

Scale: A3 @ 1:350,000

0 10 20km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **35** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIE_WaveOffshoreSPBouy\35_WaveOffshoreSPBoy_ConstraintsJER3688-Figure_35_ConstraintsWaveOffshoreSPBoyA_FullySubmerged.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Single Point/Bouy A	2 - 20km	20 - 100m	15kW/m	60kW/m	2 - 4m

Ceredigion

Pembrokeshire

Carmarthenshire

Swansea

Legend

12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Atlantic Array Bristol Channel Wind Farm

4 - significant issue/constraint - delay, possible stop project

- Clearways
- Special Areas of Conservation (SAC)
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Wrecks (SeaZone)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes

1 - no likely constraint

- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Wave Offshore - Single Point Bouy A Fully Submerged**

Scale: A3 @ 1:350,000

0 10 20km

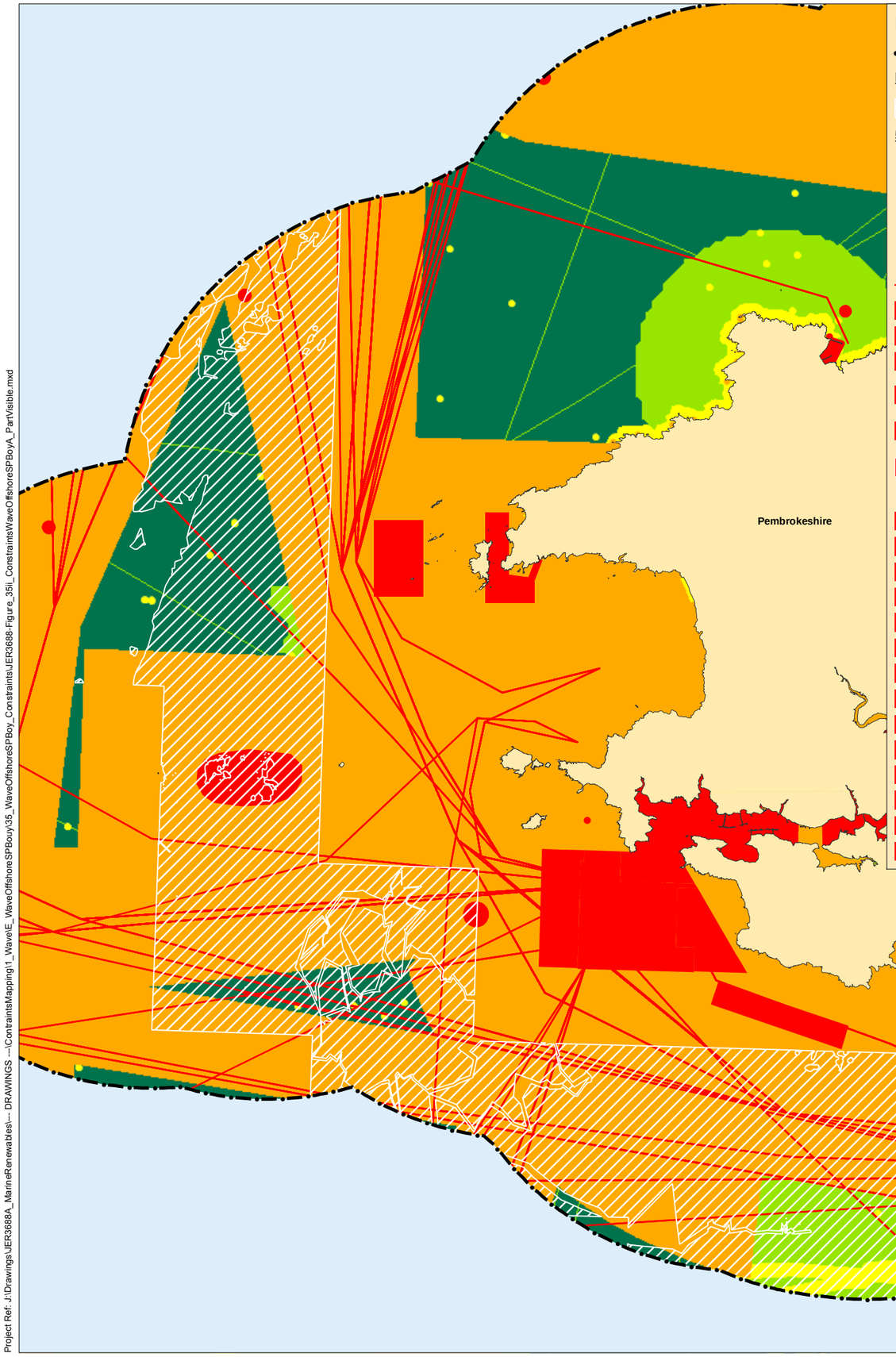
N

Date: 20/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **35i** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\-- DRAWINGS --\ConstraintsMapping\1_WaveIE_WaveOffshoreSPBouy\35_WaveOffshoreSPBouy_ConstraintsJER3688-Figure_35i_ConstraintsWithinWaveOffshoreSPBoyA_FullySubmerged.mxd



Legend

12nm Territorial Waters Limit (SeaZone)

Resource Area

Wave Offshore Single Point Bouy A Partly Visible

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Single Point/Bouy A	2 - 20km	20 - 100m	15kW/m	60kW/m	2 - 4m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Offshore Single Point Bouy A Partly Visible Constraints Map**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **35ii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIE_WaveOffshoreSPBouy\35_WaveOffshoreSPBoy_ConstraintsJER3688-Figure_35ii_ConstraintsWaveOffshoreSPBoyA_PartVisible.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Single Point/Bouy A	2 - 20km	20 - 100m	15kW/m	60kW/m	2 - 4m

Ceredigion

Pembrokeshire

Carmarthenshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Atlantic Array Bristol Channel Wind Farm

4 - significant issue/constraint - delay, possible stop project

- Clearways
- Special Areas of Conservation (SAC)
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Wrecks (SeaZone)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area
- 1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints Within Resouce Area Wave Offshore Single Point Bouy A Partly Visible**

Scale: A3 @ 1:350,000

0 10 20 km

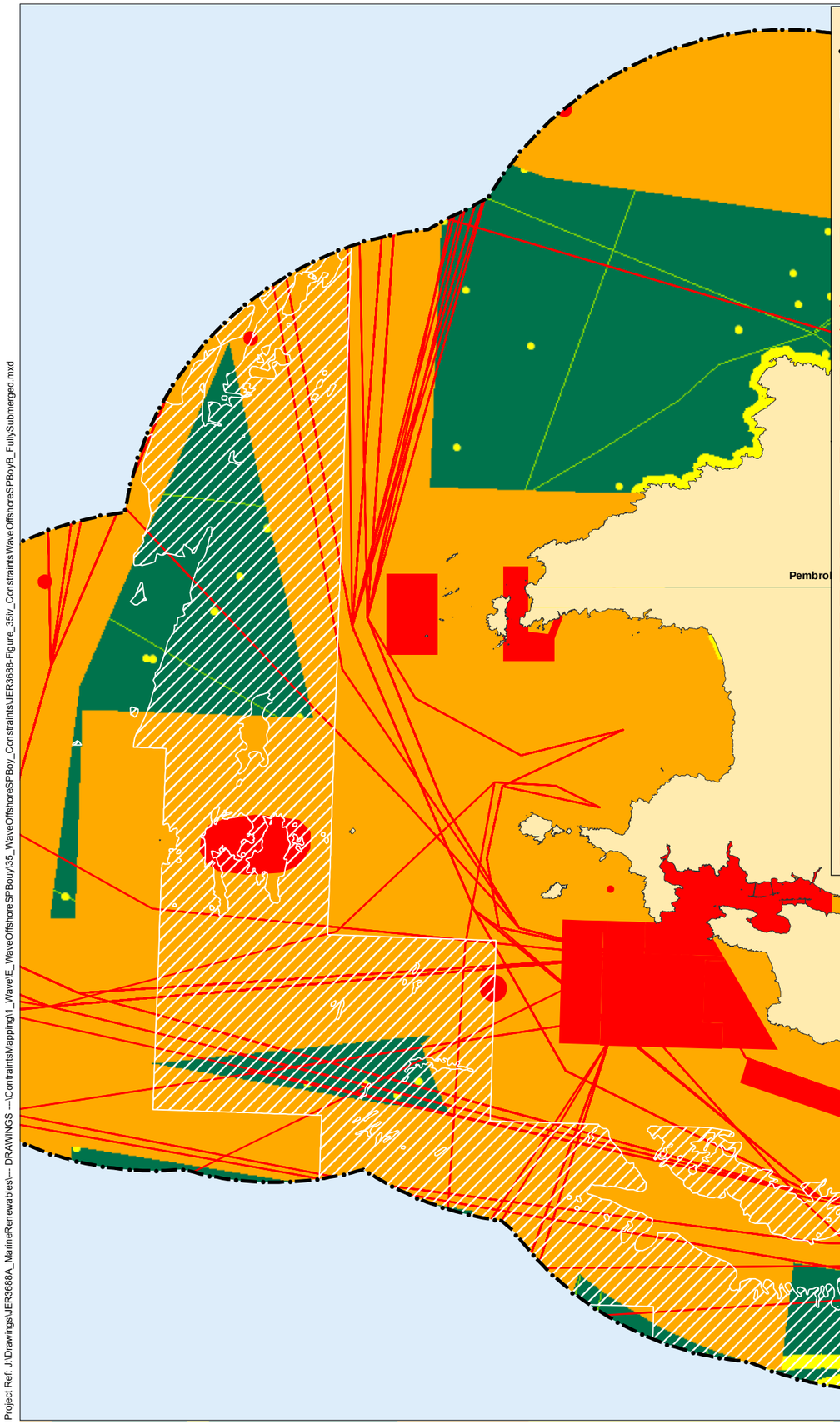
N

Date: 20/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **35iii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIE_WaveOffshoreSPBouy\35_WaveOffshoreSPBoy_ConstraintsJER3688-Figure_35iii_ConstraintWithinWaveOffshoreSPBoyA_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Wave Offshore Single Point Bouy B Fully Submerged

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- 500m Buffer Wells
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- RPSWelshRoutes_WGS84_31N_shp
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Seabird Colonies (JNCC)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- Bird Reserves
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- World Heritage Sites
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)

1 - no likely constraint

- AONB
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Single Point/Bouy B	2 - 20km	50 - 100m	15kW/m	60kW/m	2 - 4m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Offshore Single Point Bouy B Fully Submerged Constraints Map**

Scale: A3 @ 1:350,000

0 10 20km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **35iv** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveE_WaveOffshoreSPBouy\35_WaveOffshoreSPBoy_ConstraintsJER3688-Figure_35iv_ConstraintsWaveOffshoreSPBoyB_FullySubmerged.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Single Point/Bouy B	2 - 20km	50 - 100m	15kW/m	60kW/m	2 - 4m

Ceredigion

Pembrokeshire

Carmarthenshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Atlantic Array Bristol Channel Wind Farm

4 - significant issue/constraint - delay, possible stop project

- Clearways
- Special Areas of Conservation (SAC)
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Wrecks (SeaZone)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes

1 - no likely constraint

- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resouce Area Wave Offshore Single Point Bouy B Fully Submerged**

Scale: A3 @ 1:350,000

0 10 20km

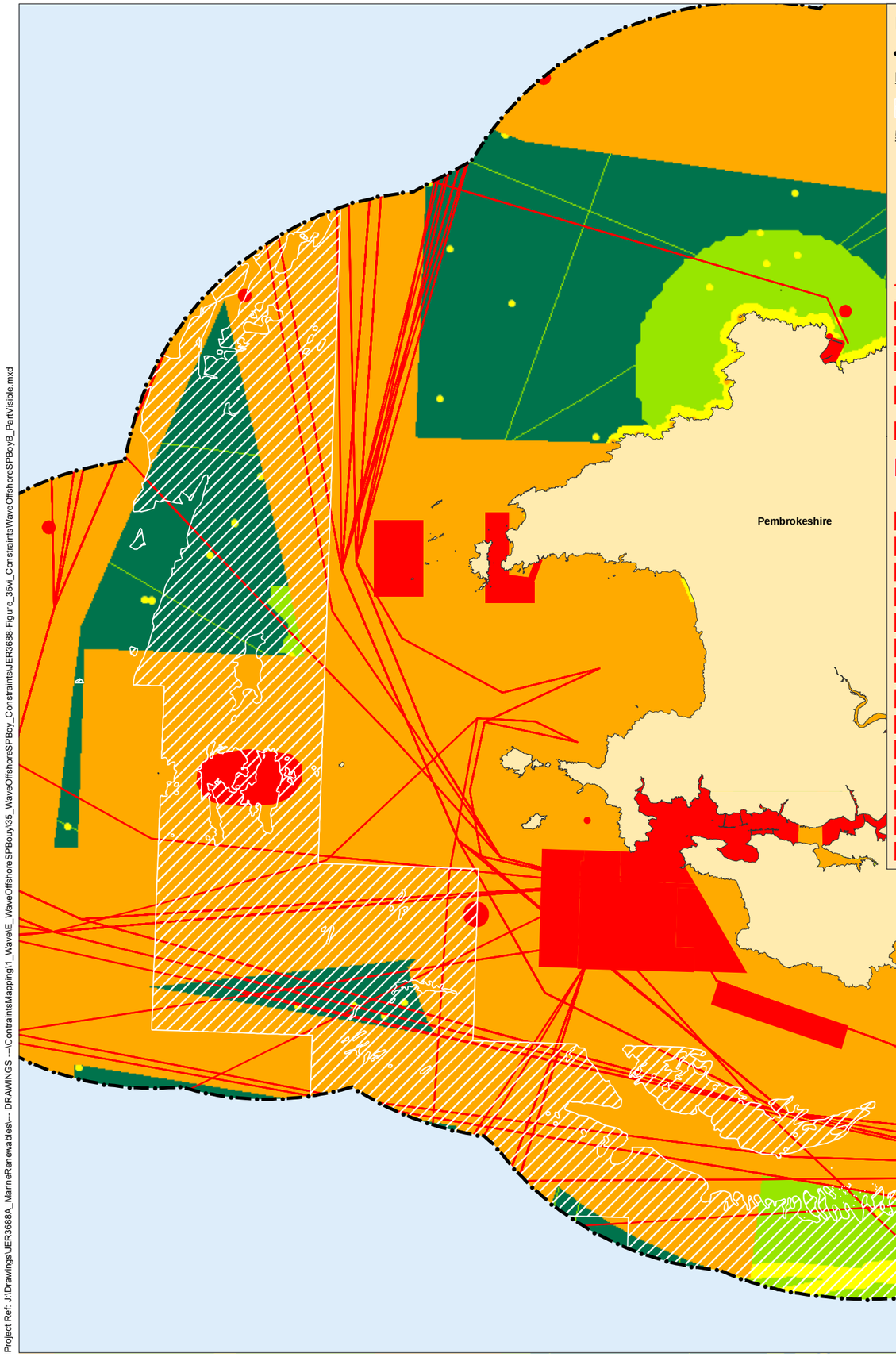
N

Date: 20/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **35v** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIE_WaveOffshoreSPBouy\35_WaveOffshoreSPBoy_ConstraintsJER3688-Figure_35v_-ConstraintsWithinWaveOffshoreSPBoyB_FullySubmerged.mxd



Legend

12nm Territorial Waters Limit (SeaZone)

Resource Area

Wave Offshore Single Point Bouy B Partly Visible

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Single Point/Bouy B	2 - 20km	50 - 100m	15kW/m	60kW/m	2 - 4m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Offshore Single Point Bouy B Partly Visible Constraints Map**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **35vi** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveIE_WaveOffshoreSPBouy\35_WaveOffshoreSPBoy_ConstraintsJER3688-Figure_35vi_ConstraintsWaveOffshoreSPBoyB_PartVisible.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	**Offshore**	Single Point/Bouy B	2 - 20km	50 - 100m	15kW/m	60kW/m	2 - 4m

Ceredigion

Pembrokeshire

Carmarthenshire

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Atlantic Array Bristol Channel Wind Farm

4 - significant issue/constraint - delay, possible stop project

- Clearways
- Special Areas of Conservation (SAC)
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Wrecks (SeaZone)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Wave Offshore Single Point Bouy B Partly Visible**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 20/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **35vii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ContraintsMapping\1_WaveIE_WaveOffshoreSPBouy\35_WaveOffshoreSPBoy_Constraints\JER3688-Figure_35vii_ConstraintsWithinWaveOffshoreSPBoyB_PartVisible.mxd

Note : No available resource for Wave Offshore Attenuators within study area

Pembrokeshire

Swansea

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area
- 1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Attenuators	2 - 15km	>50m	25kW/m	50kW/m	0.5 - 7m

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpsw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wave Offshore Attenuators Partly Visible Constraints Map**

Scale: A3 @ 1:350,000

0 10 20 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

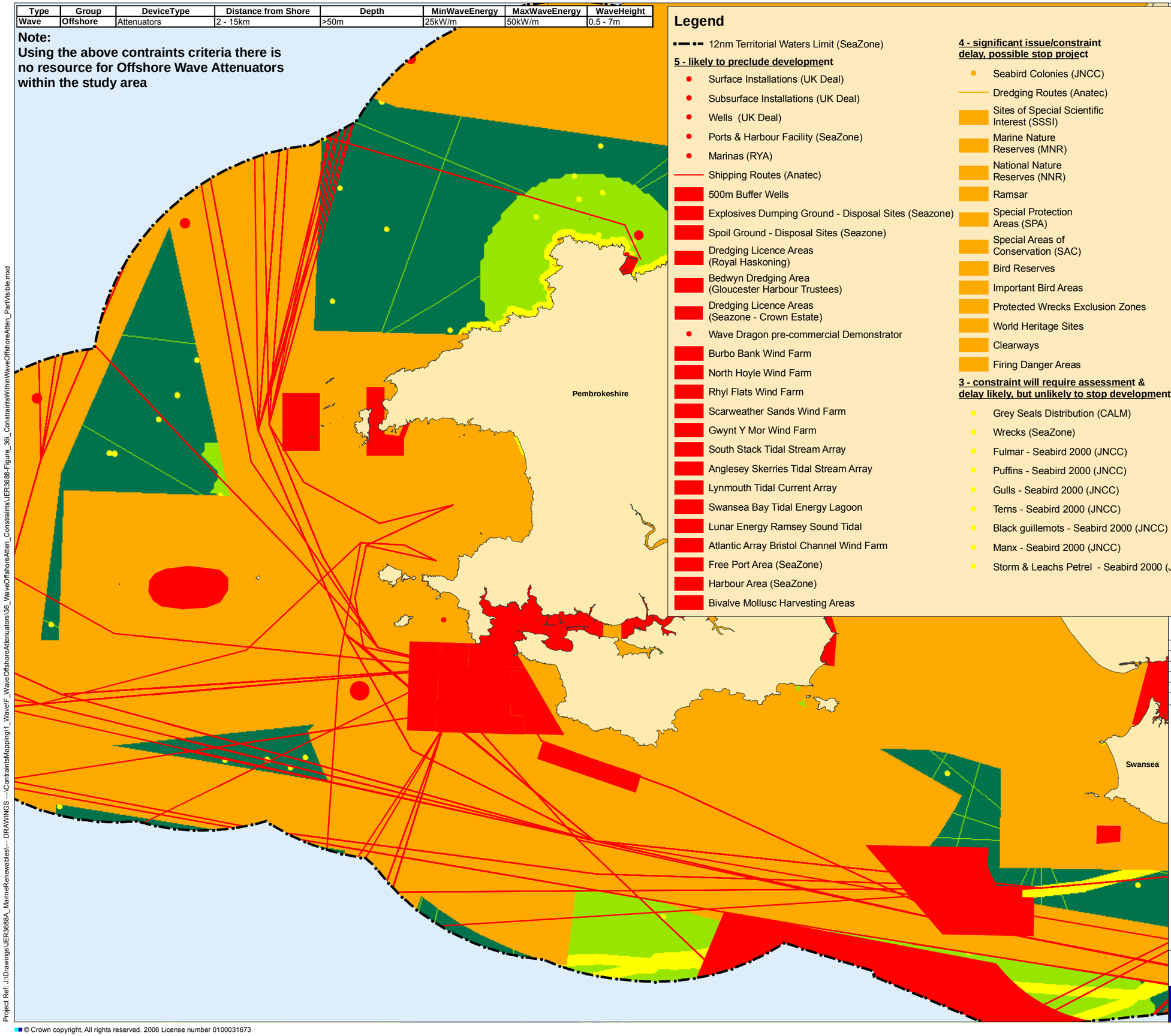
Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **36** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_WaveF_WaveOffshoreAttenuators\36_WaveOffshoreAtten_ConstraintsJER3688-Figure_36_ConstraintsWaveOffshoreAtten_PartVisible.mxd

Type	Group	DeviceType	Distance from Shore	Depth	MinWaveEnergy	MaxWaveEnergy	WaveHeight
Wave	Offshore	Attenuators	2 - 15km	>50m	25kW/m	50kW/m	0.5 - 7m

Note:
Using the above contraints criteria there is no resource for Offshore Wave Attenuators within the study area



Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area
- 1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

RPS
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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Contraints within Resource Area Wave Offshore Attenuators Partly Visible**

Scale: A3 @ 1:350,000

0 10 20 km

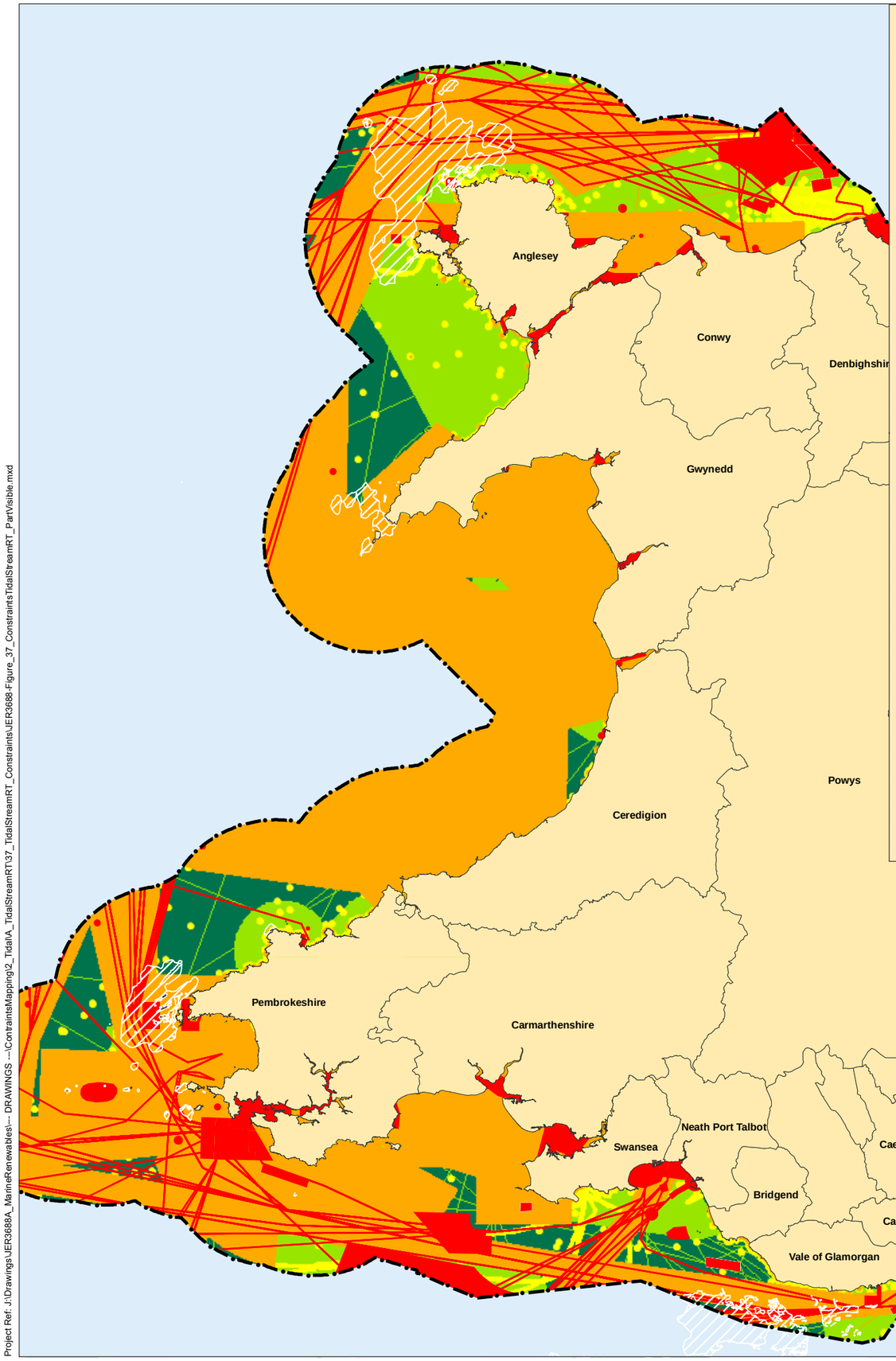
N

Date: 20/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **36i** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\1_Wave\F_WaveOffshoreAttenuators\36_WaveOffshoreAtten_Constraints\JER3688-Figure_36i_ConstraintsWithinWaveOffshoreAtten_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Tidal Stream Rotating Turbine - Partly Visable

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	Tidal_Velocity
Tidal	Stream	Rotating Turbine	Rivers, Estuary, Narrow Straits	20-80m	>2m/s

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Tidal Stream Rotating Turbine Partly Visible Constraints Map**

Scale: A3 @ 1:1,000,000

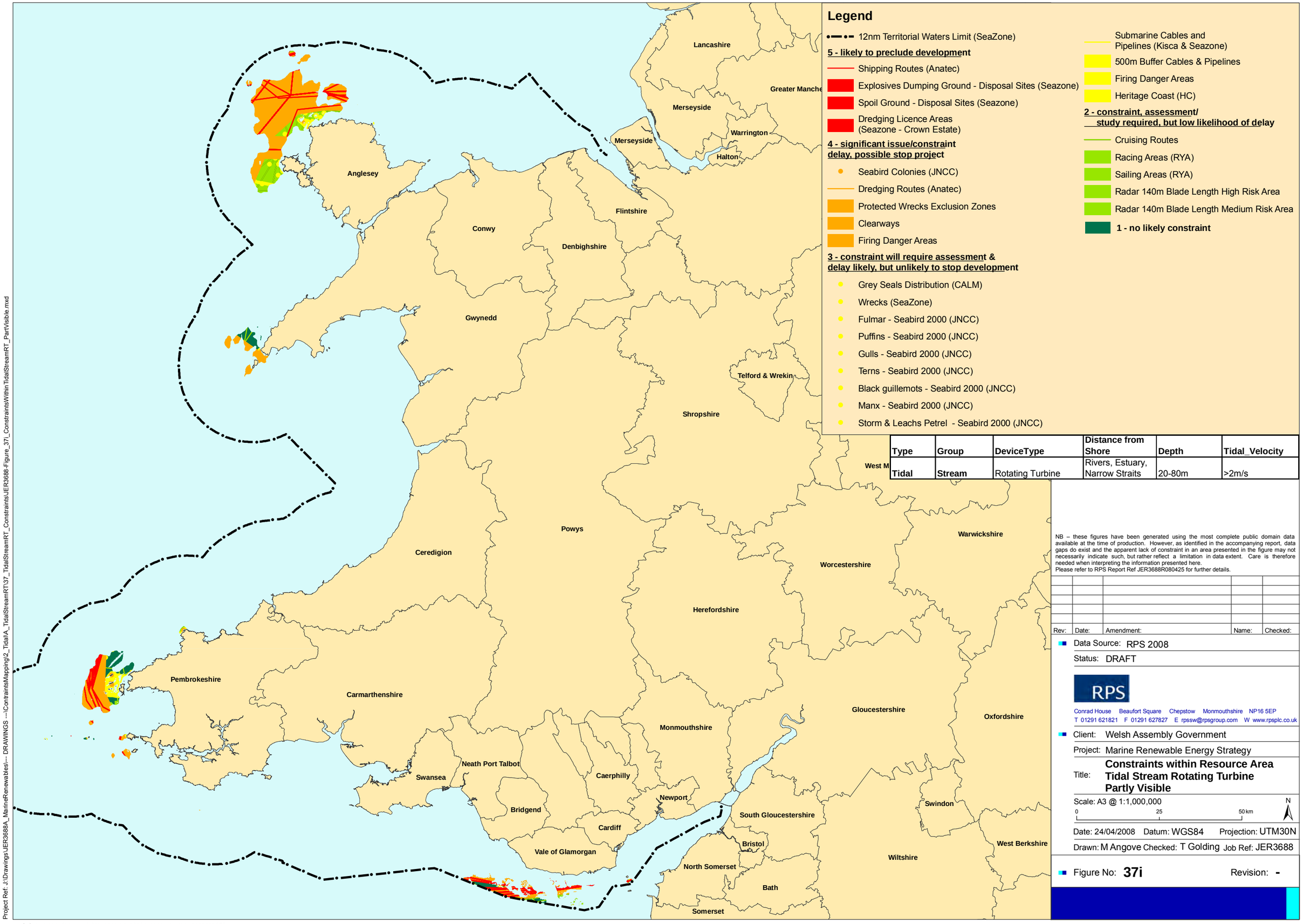
0 30 60 km N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **37** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\2_TidalA_TidalStreamRT\37_TidalStreamRT_ConstraintsJER3688A_MarineRenewables_Figure_37_ConstraintsTidalStreamRT_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Seazone - Crown Estate)

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Protected Wrecks Exclusion Zones
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)

- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

Type	Group	DeviceType	Distance from Shore	Depth	Tidal_Velocity
Tidal	Stream	Rotating Turbine	Rivers, Estuary, Narrow Straits	20-80m	>2m/s

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Tidal Stream Rotating Turbine Partly Visible**

Scale: A3 @ 1:1,000,000

0 25 50 km

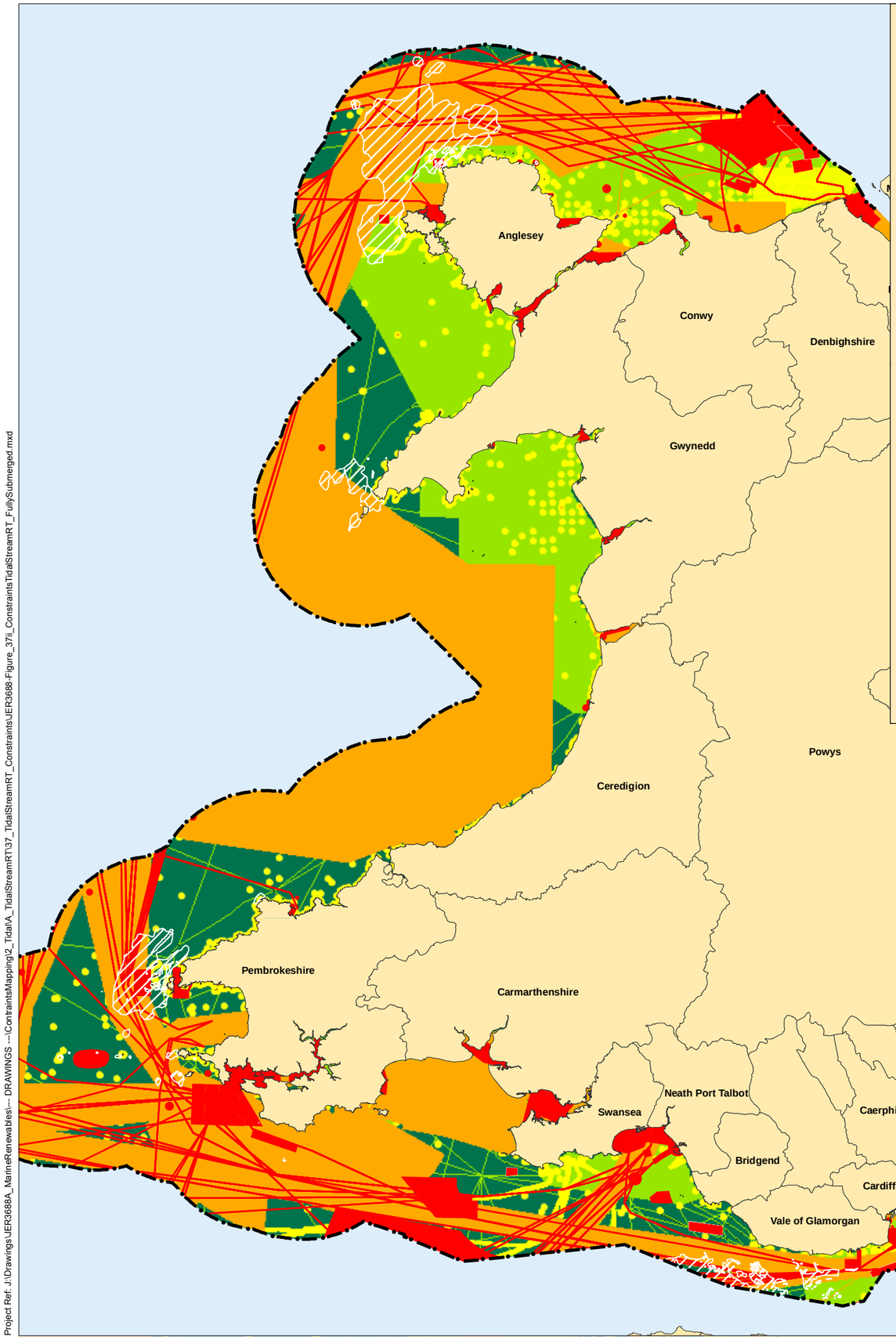
N

Date: 24/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **37i** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\2_TidalA_TidalStreamRT\37_TidalStreamRT_ConstraintsJER3688-Figure_37i_ConstraintsWithinTidalStreamRT_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Tidal Stream Rotating Turbine - Partly Visable

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- 500m Buffer Wells
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- RPSWelshRoutes_WGS84_31N_shp
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Seabird Colonies (JNCC)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- Bird Reserves
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- World Heritage Sites
- Surfing
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)

1 - no likely constraint

- AONB
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

Type	Group	DeviceType	Distance from Shore	Depth	Tidal_Velocity
Tidal	Stream	Rotating Turbine	Rivers, Estuary, Narrow Straits	20-80m	>2m/s

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Tidal Stream Rotating Turbine Fully Submerged Constraints Map**

Scale: A3 @ 1:1,000,000 N

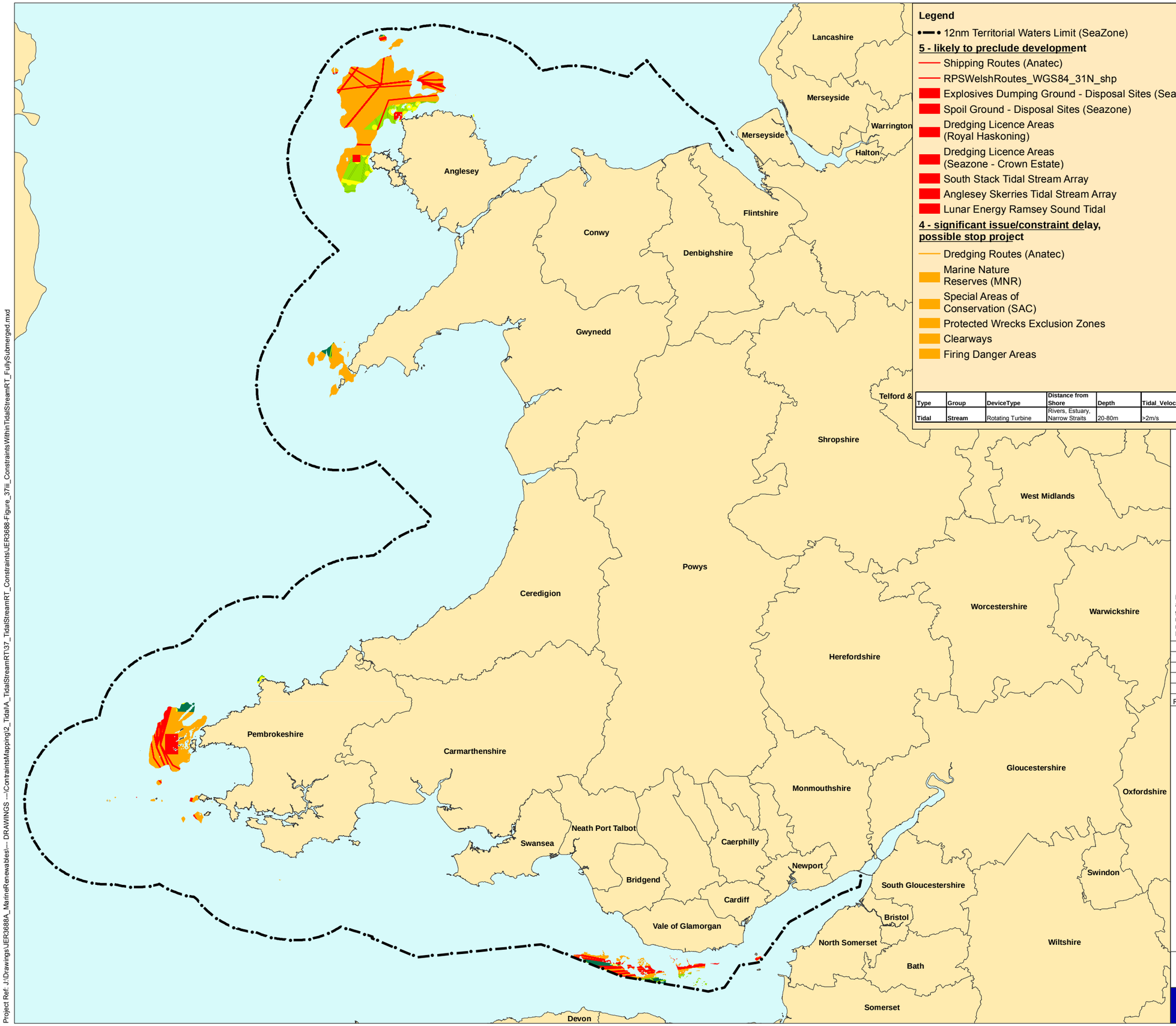
0 30 60 km

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **37ii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\2_TidalA_TidalStreamRT\37_TidalStreamRT_ConstraintsJER3688-Figure_37ii_ConstraintsTidalStreamRT_FullySubmerged.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- RPSWelshRoutes_WGS84_31N_shp
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Dredging Licence Areas (Seazone - Crown Estate)
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lunar Energy Ramsey Sound Tidal

4 - significant issue/constraint delay, possible stop project

- Dredging Routes (Anatec)
- Marine Nature Reserves (MNR)
- Special Areas of Conservation (SAC)
- Protected Wrecks Exclusion Zones
- Clearways
- Firing Danger Areas

Type	Group	DeviceType	Distance from Shore	Depth	Tidal_Velocity
Tidal	Stream	Rotating Turbine	Rivers, Estuary, Narrow Straits	20-80m	>2m/s

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Seabird Colonies (JNCC)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Racing Areas (RYA)
- Sailing Areas (RYA)

1 - no likely constraint

- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

RPS
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T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Tidal Stream Rotating Turbine Fully Submerged**

Scale: A3 @ 1:1,000,000

0 30 60 km

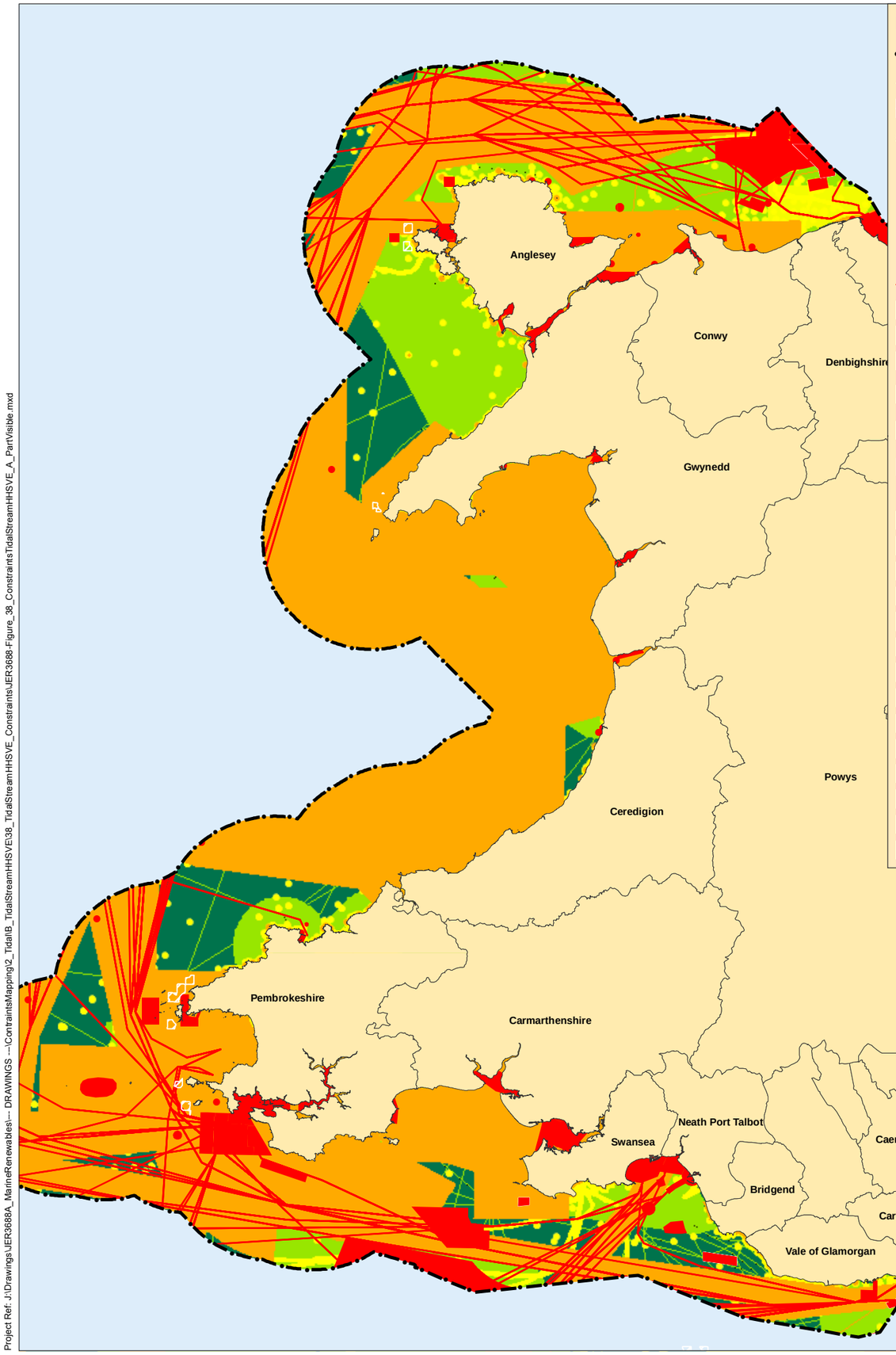
N

Date: 43/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **37iii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ContraintsMapping\2_Tidal\A_TidalStreamRT\37_TidalStreamRT_ConstraintsJER3688-Figure_37iii_ConstraintsWithinTidalStreamRT_FullySubmerged.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Tidal Stream Hydroplanes, Hydrofoils and Sails, Venturi Effect - A - Partly Visable

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
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- Gwynt Y Mor Wind Farm
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- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	Tidal_Velocity
Tidal	Stream	Hydroplanes, Hydrofoils and Sails, Venturi Effect - A	500m-1km	10 - 120m	>2m/s

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

RPS
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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Tidal Stream Hydroplanes, Hydrofoils and Sails, Venturi Effect - A - Partly Visible Constraints Map**

Scale: A3 @ 1:1,000,000

0 30 60 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **38** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\2_TidalB_TidalStreamHHSVE38_TidalStreamHHSVE_Constraints\JER3688-Figure_38_ConstraintsTidalStreamHHSVE_A_PartVisible.mxd

Type	Group	DeviceType	Distance from Shore	Depth	Tidal_Velocity
Tidal	Stream	Hydroplanes, Hydrofoils and Sails, Venturi Effect - A	500m-1km	10 - 120m	>2m/s

Lan
Greater Manchester
Merseyside
Warrington
Merseyside
Halton
Anglesey
Flintshire
Conwy
Denbighshire
Derbyshire
Gwynedd
Derby
Staffordshire
Telford & Wrekin
Leicestershire
Shropshire
West Midlands
Powys
Warwickshire
Ceredigion
Worcestershire
Herefordshire
Pembrokeshire
Carmarthenshire
Gloucestershire
Oxfordshire
Monmouthshire
Neath Port Talbot
Swansea
Caerphilly
Newport
Swindon
Bridgend
South Gloucestershire
Cardiff
Bristol
Vale of Glamorgan
West Berkshire
North Somerset
Wiltshire
Bath
Somerset

Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- Dredging Licence Areas (Royal Haskoning)
- Dredging Licence Areas (Seazone - Crown Estate)
- Lunar Energy Ramsey Sound Tidal

4 - significant issue/constraint - delay, possible stop project

- Special Areas of Conservation (SAC)
- Clearways

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Wrecks (SeaZone)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- 500m Buffer Cables & Pipelines
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area**
Tidal Stream Hydroplanes, Hydrofoils and Sails, Venturi Effect - A - Partly Visible

Scale: A3 @ 1:1,000,000

0 30 60 km

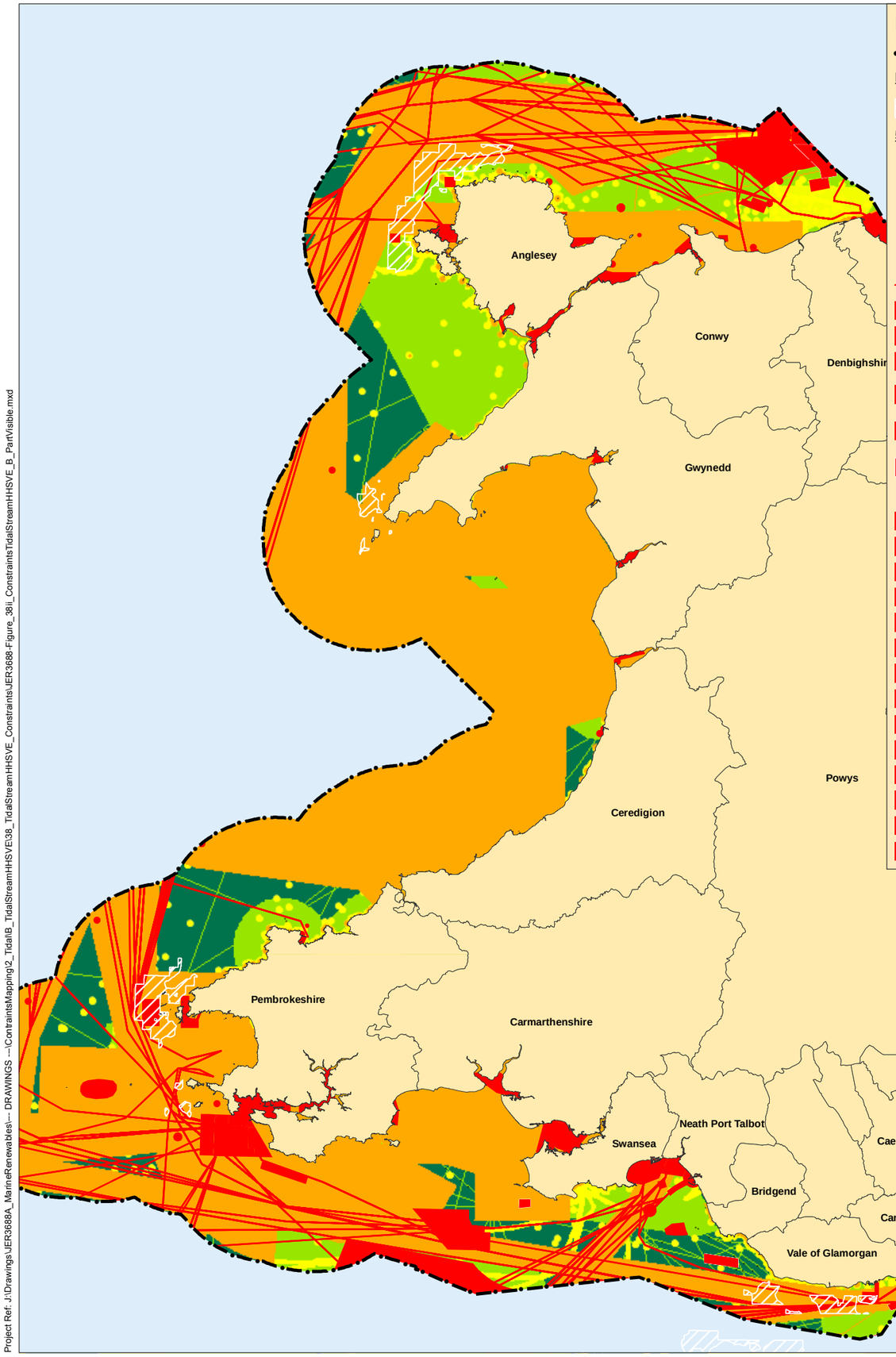
N

Date: 24/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **38i** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\2_TidalB_TidalStreamHHSVE\38_TidalStreamHHSVE_Constraints\JER3688-Figure_38i_ConstraintsWithinTidalStreamHHSVE_A_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Resource Area

- Tidal Stream Hydroplanes, Hydrofoils and Sails, Venturi Effect - B - Partly Visable

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Ports & Harbour Facility (SeaZone)
- Marinas (RYA)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Wave Dragon pre-commercial Demonstrator
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Bird Reserves
- Important Bird Areas
- Protected Wrecks Exclusion Zones
- World Heritage Sites
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- 500m Buffer Cables & Pipelines
- Firing Danger Areas
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- AONB

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Angling Sea (EA)
- Power Boating Only (EA)
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length High Risk Area
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Type	Group	DeviceType	Distance from Shore	Depth	Tidal_Velocity
Tidal	Stream	Hydroplanes, Hydrofoils and Sails, Venturi Effect - B	500m-5km	10 - 120m	>2m/s

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Tidal Stream Hydroplanes, Hydrofoils & Sails, Venturi Effect - B - Partly Visible Constraints Map**

Scale: A3 @ 1:1,000,000

0 30 60 km

N

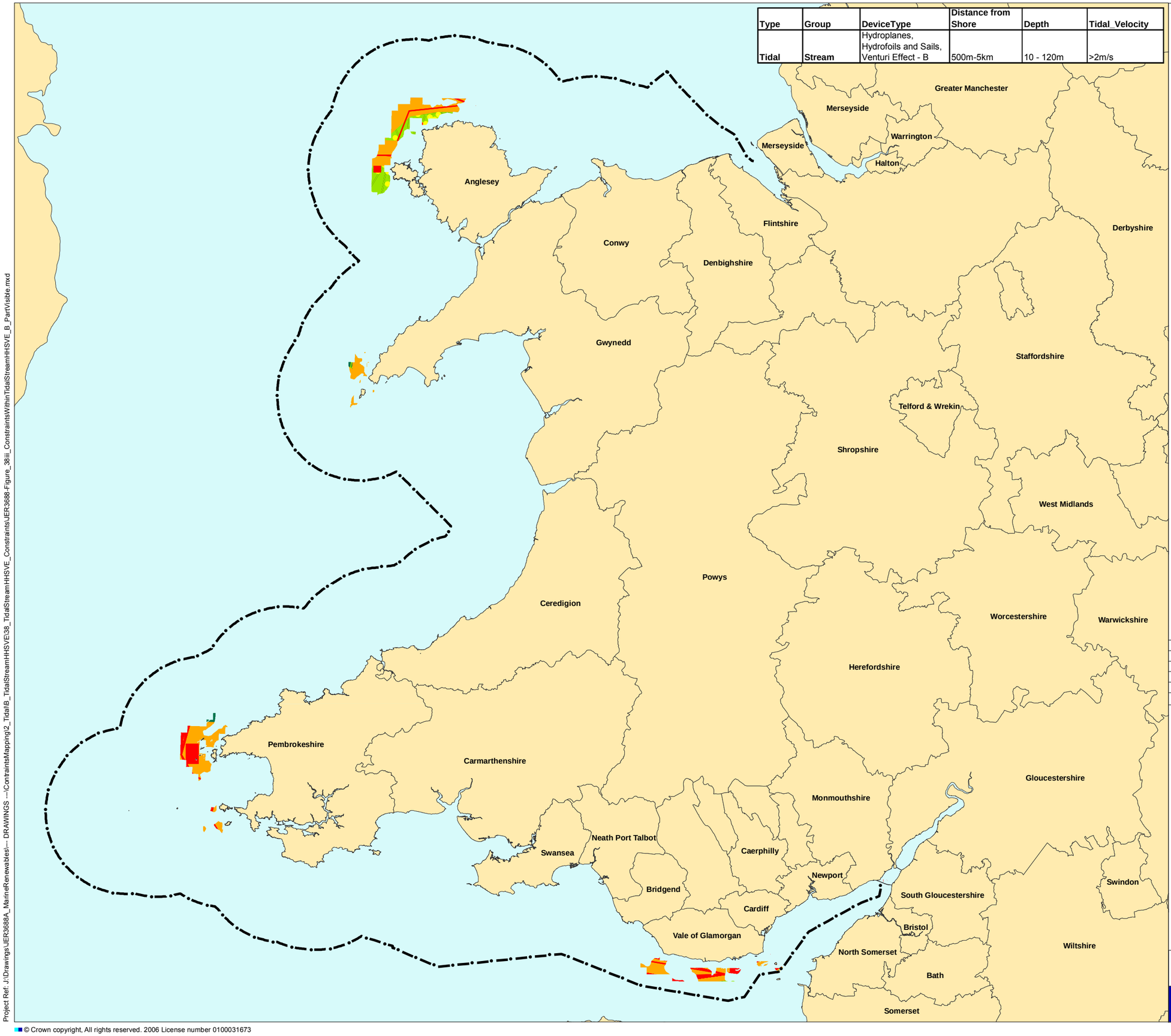
Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **38ii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\2_TidalB_TidalStreamHHSVE38_TidalStreamHHSVE_Constraints\JER3688-Figure_38ii_ConstraintsTidalStreamHHSVE_B_PartVisible.mxd

Type	Group	DeviceType	Distance from Shore	Depth	Tidal_Velocity
Tidal	Stream	Hydroplanes, Hydrofoils and Sails, Venturi Effect - B	500m-5km	10 - 120m	>2m/s



Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Shipping Routes (Anatec)
- Dredging Licence Areas (Royal Haskoning)
- Dredging Licence Areas (Seazone - Crown Estate)
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lunar Energy Ramsey Sound Tidal
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Dredging Routes (Anatec)
- Special Areas of Conservation (SAC)
- Clearways
- Firing Danger Areas

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Wrecks (SeaZone)
- Firing Danger Areas
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Radar 140m Blade Length Medium Risk Area

1 - no likely constraint

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Tidal Stream Hydroplanes, Hydrofoils & Sails, Venturi Effect - B - Partly Visible**

Scale: A3 @ 1:1,000,000

0 25 50 km

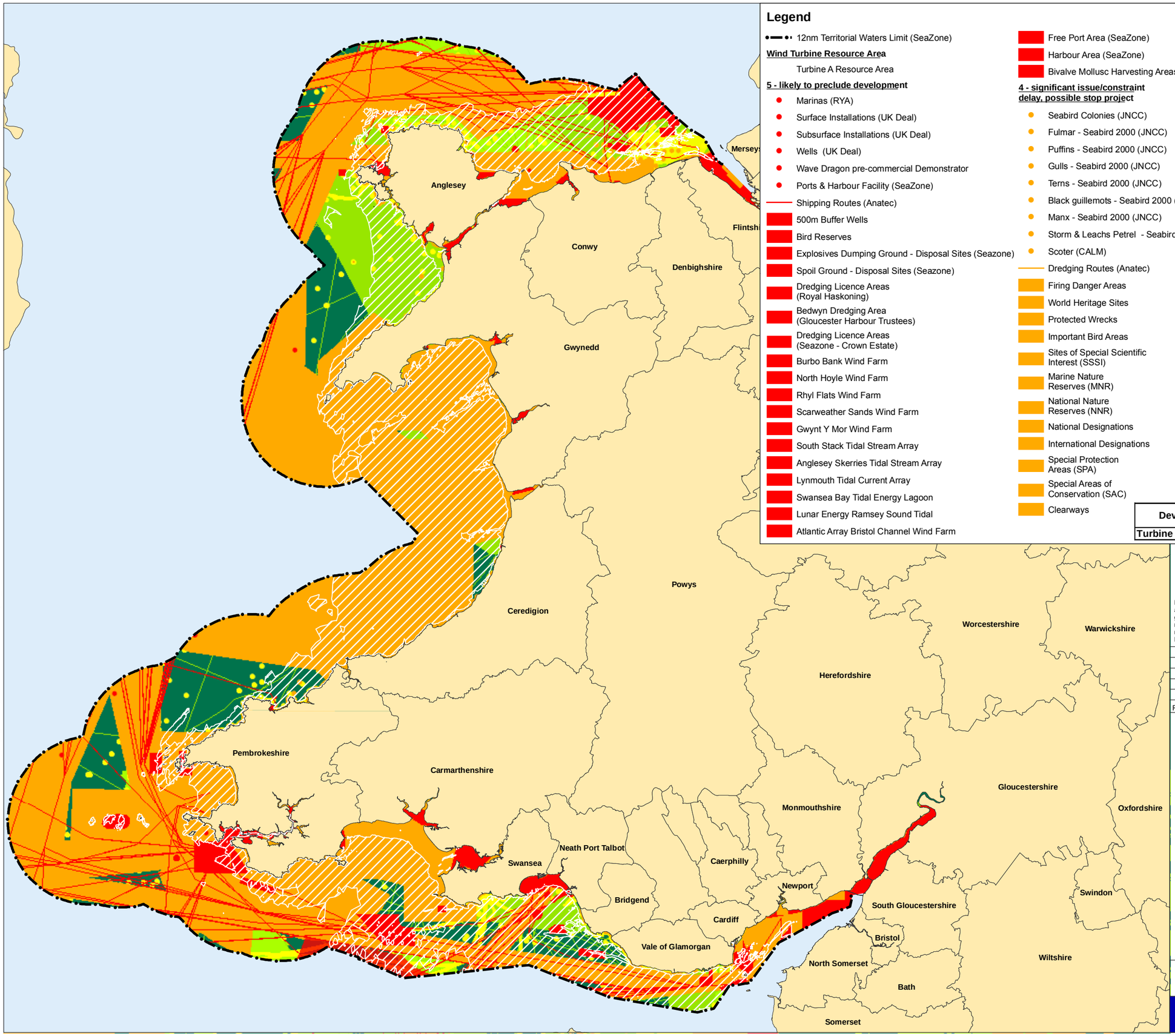
N

Date: 24/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **38iii** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\2_Tidal\B_TidalStreamHHSVE38_TidalStreamHHSVE_ConstraintsJER3688-Figure_38iii_ConstraintsWithinTidalStreamHHSVE_B_PartVisible.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Wind Turbine Resource Area

- Turbine A Resource Area

5 - likely to preclude development

- Marinas (RYA)
- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Wave Dragon pre-commercial Demonstrator
- Ports & Harbour Facility (SeaZone)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Bird Reserves
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter (CALM)
- Dredging Routes (Anatec)
- Firing Danger Areas
- World Heritage Sites
- Protected Wrecks
- Important Bird Areas
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- National Designations
- International Designations
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Clearways

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Wrecks (Exclusion Zones)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length Medium Risk Area
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Angling Sea (EA)
- Power Boating Only (EA)

1 - no likely constraint

Device	Distance from Shore	Depth	Wind Speed	Substrate
Turbine A	0 - 12nm	5 - 35m	>5 - 25m/s	Variable

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wind Turbine A Constraints Map**

Scale: A3 @ 1:1,000,000

0 25 50 km

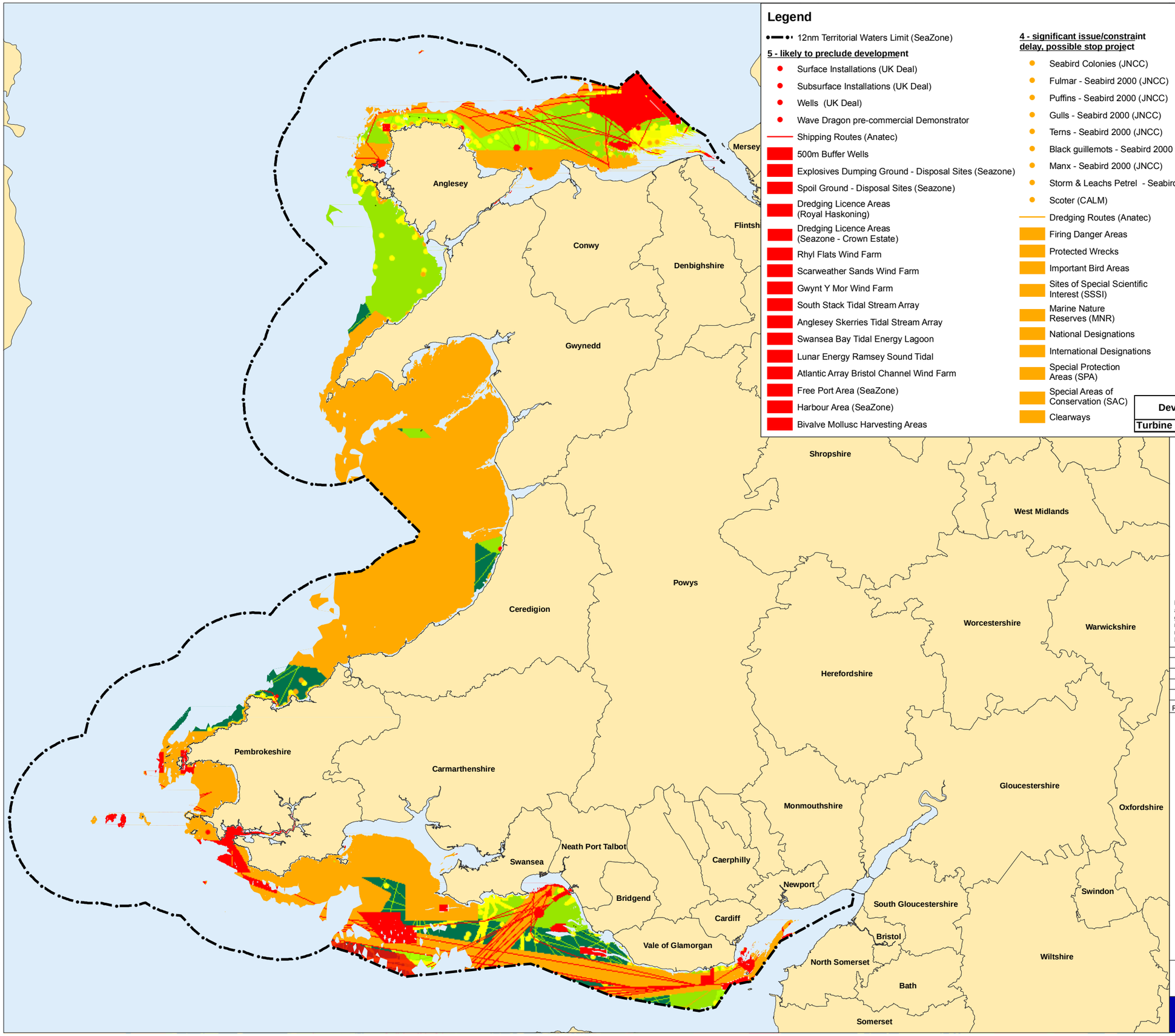
N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **39** Revision: **-**

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\3_Wind\39_WindConstraints\JER3688-Figure_39_ConstraintsWindTurbineA.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Wave Dragon pre-commercial Demonstrator
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Dredging Licence Areas (Seazone - Crown Estate)
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter (CALM)
- Dredging Routes (Anatec)
- Firing Danger Areas
- Protected Wrecks
- Important Bird Areas
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Designations
- International Designations
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Clearways

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- Heritage Coast (HC)

2 - constraint, assessment/ study required, but low likelihood of delay

- Cruising Routes
- Radar 140m Blade Length Medium Risk Area
- Racing Areas (RYA)
- Sailing Areas (RYA)

1 - no likely constraint

Device	Distance from Shore	Depth	Wind Speed	Substrate
Turbine A	0 - 12nm	5 - 35m	>5 - 25m/s	Variable

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Wind Turbine A**

Scale: A3 @ 1:1,000,000

0 25 50 km

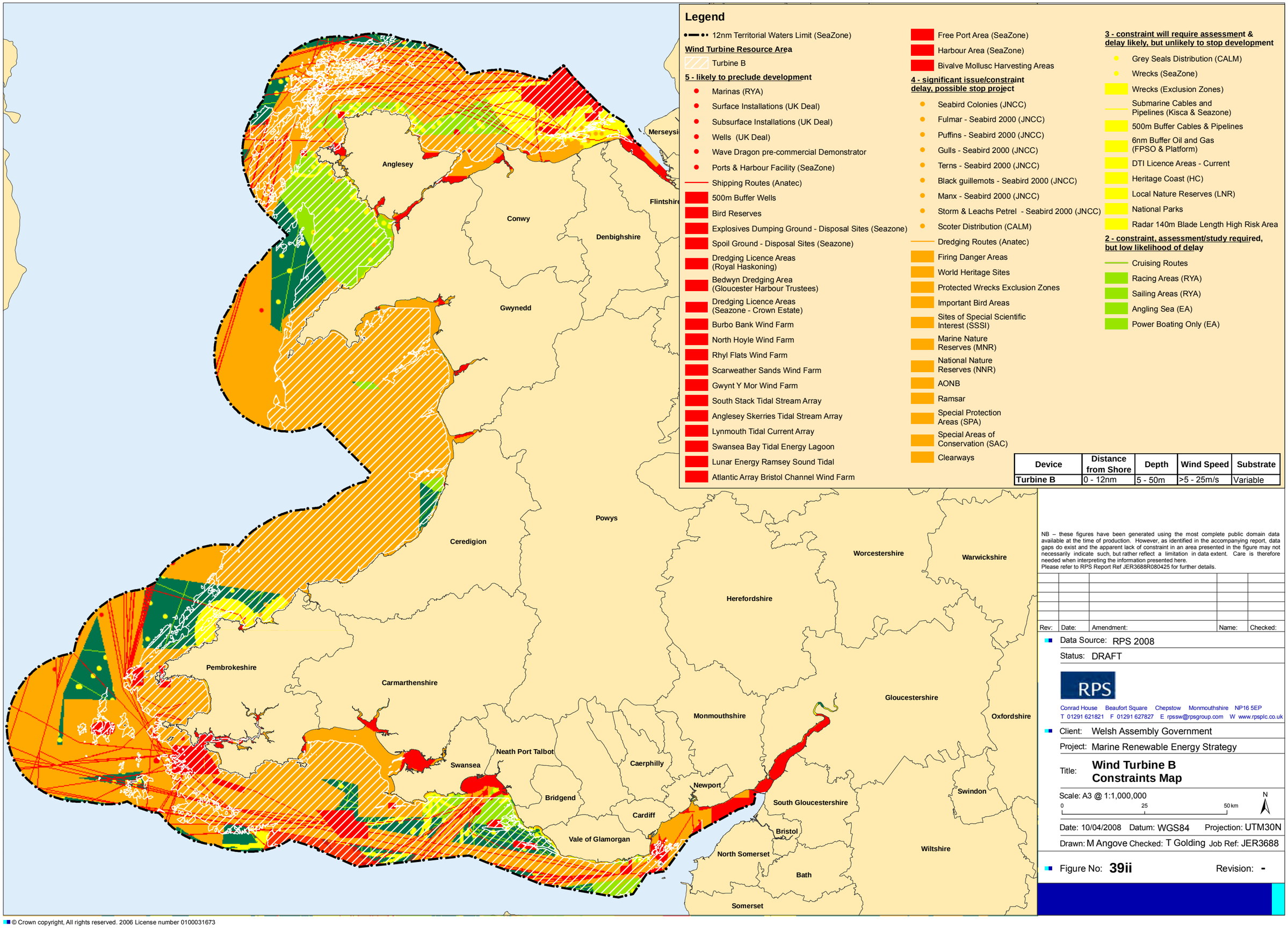
N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **39i** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ContraintsMapping\3_Wind\39_WindConstraints\JER3688-Figure_39i_ConstraintsWithinWindTurbineA.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

Wind Turbine Resource Area

- Turbine B

5 - likely to preclude development

- Marinas (RYA)
- Surface Installations (UK Deal)
- Subsurface Installations (UK Deal)
- Wells (UK Deal)
- Wave Dragon pre-commercial Demonstrator
- Ports & Harbour Facility (SeaZone)
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Bird Reserves
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Bedwyn Dredging Area (Gloucester Harbour Trustees)
- Dredging Licence Areas (Seazone - Crown Estate)
- Burbo Bank Wind Farm
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lynmouth Tidal Current Array
- Swansea Bay Tidal Energy Lagoon
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Dredging Routes (Anatec)
- Firing Danger Areas
- World Heritage Sites
- Protected Wrecks Exclusion Zones
- Important Bird Areas
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- National Nature Reserves (NNR)
- AONB
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Clearways

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Wrecks (Exclusion Zones)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- Heritage Coast (HC)
- Local Nature Reserves (LNR)
- National Parks
- Radar 140m Blade Length High Risk Area

2 - constraint, assessment/study required, but low likelihood of delay

- Cruising Routes
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Angling Sea (EA)
- Power Boating Only (EA)

Device	Distance from Shore	Depth	Wind Speed	Substrate
Turbine B	0 - 12nm	5 - 50m	>5 - 25m/s	Variable

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

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Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Wind Turbine B Constraints Map**

Scale: A3 @ 1:1,000,000

0 25 50 km

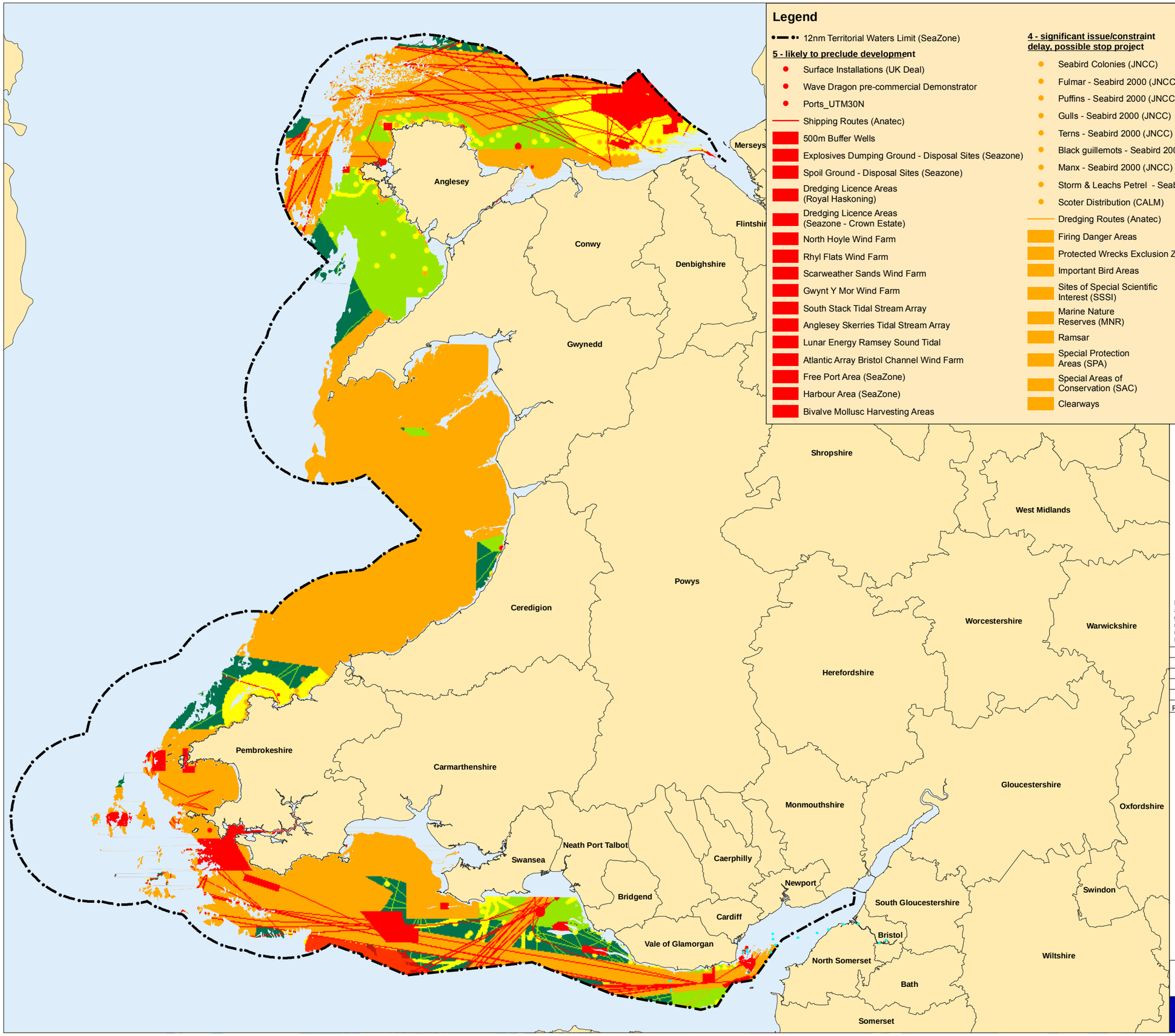
N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **39ii** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\3_Wind\39_Wind\ConstraintsJER3688-Figure_39ii_ConstraintsWindTurbineB.mxd



Legend

- 12nm Territorial Waters Limit (SeaZone)

5 - likely to preclude development

- Surface Installations (UK Deal)
- Wave Dragon pre-commercial Demonstrator
- Ports_UTM30N
- Shipping Routes (Anatec)
- 500m Buffer Wells
- Explosives Dumping Ground - Disposal Sites (Seazone)
- Spoil Ground - Disposal Sites (Seazone)
- Dredging Licence Areas (Royal Haskoning)
- Dredging Licence Areas (Seazone - Crown Estate)
- North Hoyle Wind Farm
- Rhyl Flats Wind Farm
- Scarweather Sands Wind Farm
- Gwynt Y Mor Wind Farm
- South Stack Tidal Stream Array
- Anglesey Skerries Tidal Stream Array
- Lunar Energy Ramsey Sound Tidal
- Atlantic Array Bristol Channel Wind Farm
- Free Port Area (SeaZone)
- Harbour Area (SeaZone)
- Bivalve Mollusc Harvesting Areas

4 - significant issue/constraint delay, possible stop project

- Seabird Colonies (JNCC)
- Fulmar - Seabird 2000 (JNCC)
- Puffins - Seabird 2000 (JNCC)
- Gulls - Seabird 2000 (JNCC)
- Terns - Seabird 2000 (JNCC)
- Black guillemots - Seabird 2000 (JNCC)
- Manx - Seabird 2000 (JNCC)
- Storm & Leachs Petrel - Seabird 2000 (JNCC)
- Scoter Distribution (CALM)
- Dredging Routes (Anatec)
- Firing Danger Areas
- Protected Wrecks Exclusion Zones
- Important Bird Areas
- Sites of Special Scientific Interest (SSSI)
- Marine Nature Reserves (MNR)
- Ramsar
- Special Protection Areas (SPA)
- Special Areas of Conservation (SAC)
- Clearways

3 - constraint will require assessment & delay likely, but unlikely to stop development

- Grey Seals Distribution (CALM)
- Wrecks (SeaZone)
- Wrecks (Exclusion Zones)
- Submarine Cables and Pipelines (Kisca & Seazone)
- 500m Buffer Cables & Pipelines
- 6nm Buffer Oil and Gas (FPSO & Platform)
- DTI Licence Areas - Current
- Heritage Coast (HC)
- Radar 140m Blade Length High Risk Area

2 - constraint, assessment/study required, but low likelihood of delay

- Cruising Routes
- Racing Areas (RYA)
- Sailing Areas (RYA)
- Angling Sea (EA)

1 - No Likely Constraint

Device	Distance from Shore	Depth	Wind Speed	Substrate
Turbine B	0 - 12nm	5 - 50m	>5 - 25m/s	Variable

NB – these figures have been generated using the most complete public domain data available at the time of production. However, as identified in the accompanying report, data gaps do exist and the apparent lack of constraint in an area presented in the figure may not necessarily indicate such, but rather reflect a limitation in data extent. Care is therefore needed when interpreting the information presented here.
Please refer to RPS Report Ref JER3688R080425 for further details.

Rev:	Date:	Amendment:	Name:	Checked:

Data Source: RPS 2008

Status: DRAFT

RPS
Conrad House Beaufort Square Chepstow Monmouthshire NP16 5EP
T 01291 621821 F 01291 627827 E rpssw@rpsgroup.com W www.rpsplc.co.uk

Client: Welsh Assembly Government

Project: Marine Renewable Energy Strategy

Title: **Constraints within Resource Area Wind Turbine B**

Scale: A3 @ 1:1,000,000
0 5 10 km

N

Date: 10/04/2008 Datum: WGS84 Projection: UTM30N

Drawn: M Angove Checked: T Golding Job Ref: JER3688

Figure No: **39iii** Revision: -

Project Ref: J:\Drawings\JER3688A_MarineRenewables\--- DRAWINGS ---\ConstraintsMapping\3_Wind\39_WindConstraintsJER3688-Figure_39iii_ConstraintsWithinWindTurbineB.mxd

Appendices

Appendix A

Consultation

Consultee List

Developers

Name	Organisation	Response Received?
-	AMEC Wind Energy	Yes
Ben Yeats	AWS Ocean Energy Ltd	Yes
Giles Edwards	C-Wave	Yes
Danielle Lane	Centrica Renewables	No
Glen Darou	Clean Current	Yes
Jesper Krarup Holst	Dong Energy	Yes
Peter Sills	Eclipse Energy	No
Chris Williams	Eco2	Yes
-	Elsam A/S	No
Nick Thornley	Embley Energy	Yes
Jenny Norris	EMEC	Yes
Eleri Owen	Eon	Yes
Michael Huntingford	Farm Energy	Yes
Chris Hill	Greater Gabbard Offshore Wind Ltd	Yes
Bill Law	Lunar Energy	No
Peter Fraenkel	Marine Current Turbine	Yes
Prof Jack Hardisty	Neptune Renewable Energy Ltd	Yes
Carla Houghton	npower Renewables	Yes
Paul Jordan	Ocean Power Technology	Yes
-	Open Hydro	No
Max Carcas	Pelmais Wave Power	Yes
Russell Hall	Peterbrotherbood and Tidal Hydraulic Generators	Yes
-	Pulse Generation	No
Robin Burnett	Renewable Technology Ventures	Yes
-	Scira Offshore Energy Ltd	No
-	Scotrenewables Ltd	No
James Orme	Swan Turbines	Yes
George Gibberd	Tidal Generation Ltd	No
-	Triton	No
-	Warwick Energy Ltd	No
Paul Wegener	Waveberg	Yes
David Gibb	Wavegen	Yes

Data Sources and Regulators

Name	Organisation	Response Received?
Dr Beth Scott	University of Aberdeen	Yes
	BERR	Steering Group
Phil Bloor	BERR Offshore Bird Surveys	Yes
John Hartley	BERR RAG	Yes
John Hartley	BERR SEA Team	Yes
Robert Lilly	BERR (OREEF, FLOW and NOREL)	Yes
Martin Hooker	Bridgend County Borough Council	Yes
Brian Clark	British Marine Federation	No
Llewelyn Rhys	BWEA Cymru	Yes
Duncan Ayling	BWEA	Yes
Deb Wozencraft	Campaign for the Protection of Rural Wales	Yes
John Callaghan	Carbon Trust	Yes
Sarah Perry	Cardigan Bay Marine Wildlife Group	No
Andy Younger	Cefas	Yes
Adrian Judd		No
Sylvia Blake		No
	Countryside Council for Wales	Steering Group
Georgia Boston	COWRIE	Yes
Dr Andrew Gill	Cranfield University	Yes
Carolyn Heeps	Crown Estate	Steering Group
Various	Defra	Various
Jim Spooner	Department for Transport	Yes
Malachy McKernan	DETINI	Yes
Dr Henry Jeffrey	University of Edinburgh	Yes
Jennifer Dack	Environment Agency	Yes
Susan Freeman		Yes
Nigel Hollett		Yes
Rhys Morgan		Yes
Jim Poole		Yes
Matt Strickland		Yes
David Tudor		Yes
Roger Wade		Yes
Peter Wilkinson		Yes
Neil Crumpton	Friends of the Earth	No
Chris Hill	Geodata	Yes
Prof Mike Cowling	Glasgow University	No

Name	Organisation	Response Received?
Doug Parr	Greenpeace	Yes
Robin Oakley		No
Darren Shirley		No
Steve Walker	Health and Safety Executive	Yes
Judith Tetlow		No
Prof Jon Side	Heriot-Watt University, MREDS	Yes
	ICES	Yes
Zoe Crutchfield	JNCC	Yes
Dr George Aggidis	Lancaster University	No
Melissa Moore	Marine Conservation Society	Yes
Jean-Luc Solandt		No
Gill Bell		No
Dr David Cotton	Marine Data and Information Partnership	Yes
	Marine and Fisheries Agency	Steering Group
	Marine Institute, Sustainable Energy	No
Paul Townsend	Maritime Coastguard Agency	Yes
Hannah Pitt	National Trust	Yes
Adrian Woodall		Yes
Victoria Copley	Natural England	Yes
Dr Simon Thain	North Highland College	No
Steven Atkins	North Western and North Wales Sea Fisheries Committee	Yes
Sue Burton	Pembrokeshire Coastal Forum	Yes
David Jones		No
Dr Dean Millar	Peninsula Research Institute for Marine Renewable Energy	No
Steph Merry	REA	Yes
Alan Owen	Robert Gordon University	Yes
Annie Smith	RSPB	Yes
Kate Moore	Royal Yachting Association	Yes
Dr Ben Wilson	Scottish Association Marine Science	Yes
	Sea Mammal Research Unit	No
Natasha Barker	Severn Estuary Partnership	Yes
Ali Hood	Shark Trust	Yes
Phil Coates	South Wales Sea Fishery Committee	Yes
Jonny Boston	South West Regional Development Agency	Yes
Emmanuel Idowu	Sports Council for Wales	Yes

Name	Organisation	Response Received?
Prof AbuBakr S Bahaj	University of Southampton	Yes
Andy Cummins	Surfers Against Sewage	Yes
Oliver Knight	Sustainable Development Commission	Yes
Dr Ian Horfall Dr Miles Willis	Swansea University	Yes Yes
Capt Duncan Glass	Trinity House	Yes
-	Wave Energy – Denmark	No
Joanna Crouch	WCLink	Yes
Lia Moutselou	Welsh Coastal Maritime Partnership	Yes
Craig Mitchell	Welsh Local Government Association	Yes
Jerry Percy	Welsh Federation of Fishermens Associations	Yes
Eryl Mason	Welsh Surfing Federation	No
Sonia Eisseld	Whale and Dolphin Conservation Society	Yes
Madeline Harvard	The Wildlife Trust West and South Wales	Yes
Nia Jones	The Wildlife Trust North Wales	Yes
Nicky Starkey	WWF	No

Stakeholders

Name	Organisation	Response Received?
Mr Kennerly	ABP	Pending
Cerys Percival	BHP Billiton	No
Mark Russell	BMAPA	Yes
David Whitehead	BPA	Pending
Edmund Brooks	Chamber of Shipping	No
-	Civil Aviation Authority	Yes
Mike Johnson	Gloucester Harbour Trustees	Yes
	MoD	Steering Group
Mick Borwell	Oil and Gas UK	Yes
Doug Percy Bob Greenfield	UKCPC	Yes Yes
Richard Bird	UKMPG	Yes
Christopher Smith	Swangrove Estate	Yes

Consultee Questionnaire Proformas

Contact made by				
Date				
Company				
Contact Name				
Contact Details				
Device(s) type				
Device name				
TO CHECK BEFORE CALLING	**RPS prior contact**	**Yes (details)**		
		No		
	Do we hold any reports?	**Yes (details)**		
		No		
	Do we know project status?	**Yes (details)**		
		No		
Project Overview	This project is being undertaken for the National Assembly for Wales (NAW), as part of a drive 'Towards a Marine Renewable Energy Strategy for Wales'. Part of the overall aim is the drive to use an evidence based evaluation of clean energy developments, both as part of an economic drive and WAGs commitment to sustainable development and internal competitiveness.			
Why are we contacting them	As part of this project, we are contacting a range of organisations, groups and individuals to ensure that the project includes a comprehensive review of the current status of the industry and the scientific knowledge associated with it. To do this, we need information on marine renewable devices, where they may be located, how they work, and how they interact with the environment.			
Device status				
Consenting/ Development Hurdles (e.g. perception, lack of data, issues not resolved)				
Device Requirements :	Water Depth	min		
		max		

		range			
		economic preference			
	Distance from shore	min			
		max			
		range			
		economic preference			
	Substrate type	Specific requirements?			
		Preferences?			
	Positioning in the water column	Above surface?			
		On surface?			
		Mid-column?			
		Seabed?			
	Fixing to seabed	Flexible?			
		Piled			
		Anchor			
		Gravity base			
		Moorings			
	Energy capture	Efficiency			
		Extent of energy capture			
	Arrays	Numbers			
		Density			
		Layout			
	Energy Requirements (economic viability)	Wind - min			
		Wind - Mean			
		Wind - Max			
		Wave - min			
		Wave - mean			
		Wave - max			
		Tide - min			

		Tide - mean				
		Tide - max				
Data availability?	Studies undertaken	Availability				
		Confidentiality				
		Device performance studies				
		Scoping/EIA/AA				
		Technical reports				
		Regulator feedback				
		Monitoring requirements and any reporting				

Appendix B

Bibliography

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
1	Potential Impacts	Physical environment	Change in coastal processes			y	ETSU	Broad	Generic	ABPmer	2002	Potential effects of offshore wind developments on coastal processes	pdf file held
2	Baseline	Physical environment	Resource	y	y	y	BERR	Broad	UK	ABPmer	2004	Atlas of UK marine renewable energy resources	pdf file held
3	Potential Impacts	Physical environment	Change in sediment transport			y	Report No. R.1109. January 2005	Broad	UK	ABPmer	2005	Assessment of the potential impact of Round 2 offshore wind farm developments on sediment transport	Not held
4	Baseline	Physical environment	Wave and tide resource		y		Npower Juice	Broad	UK	ABPmer	2007	Quantification of exploitable tidal energy resources in UK waters	pdf file held
5	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Sustainable Energy Ireland	Broad	Generic	AEA Energy and Environment	2006	Review and analysis of ocean energy systems development and supporting policies	pdf file held
6	Device specific info	Device specific info	Marine Current Turbines		y		BERR	Broad	Device specific	Ainsworth, D and Thake, J	2006	Final report on preliminary works associated with 1MW tidal turbine	pdf file held
7	Potential Impacts	Tourism and recreation	Provision of tourist attraction			y	North Devon Wind Power	Site specific	North Devon	Aitchison, C	2004	Evidence gathering of the impact of wind farms on visitor numbers and tourist experience	pdf file held
8	Baseline	Archaeology	General	y	y	y	University of Wales Press	Regional	Gwent	Aldhouse-Green, M and Howell, R	2004	The Gwent County History, Volume 1 – Gwent in Prehistory and Early History	Not held
9	Baseline	Archaeology	General	y	y	y	in Lynch, F., Aldhouse-Green, S. and Davies, J.L., 2000, Prehistoric Wales, Sutton Publishing, Stroud	Broad	Wales	Aldhouse-Green, S	2000	Palaeolithic and Mesolithic Wales	Not held
10	Baseline	Archaeology	General	y	y	y	Antiquity 72: 756-772	Site specific	Paviland Cave	Aldhouse-Green, S and Pettitt, P	1998	Paviland Cave: contextualising the 'Red Lady	
11	Potential Impacts	Aviation	Radar			y	BERR	Broad	Generic	Alenia Marconi Systems Ltd	2003	Feasibility of mitigating the effects of windfarms on primary radar	pdf file held
12	Potential Impacts	Benthic ecology	Artificial reef effect	y			Bulletin of Marine Science 55: 694-708	Broad		Ambrose, RF	1994	Mitigating the effects of a coastal power-plant on a kelp forest community - rationale and requirements for an artificial reef	Not held
13	Potential Impacts	Sea birds	General			y	BERR	Site specific	North East England, off Newcastle	AMEC Wind Ltd	2005	Offshore wind turbines and bird activity at Blythe	pdf file held
14	Development specific info	Projects	Lynn OWF			Y	Lynn Offshore Wind Farm	Site specific	Greater Wash	AMEC Wind Ltd		Lynn Offshore Wind Farm	NTS
15	Potential Impacts	Shipping	General			y	Morecambe Bay Windfarms	Regional	Morecambe Bay	Anatec UK Ltd	2005	Impact on navigation report: Morecambe Bay Windfarms - Cumulative Study	pdf file held
16	Baseline	Shipping	Shipping Activity	y	y	y	Gwynt y Mor Offshore Wind Farm	Site specific	North Wales	Anatec UK Ltd	2005	Maritime Traffic Survey: Gwynt y Mor Offshore Wind Farm (Survey Report A)	pdf file held
17	Baseline	Shipping	Shipping Activity	y	y	y	Gwynt y Mor Offshore Wind Farm	Site specific	North Wales	Anatec UK Ltd	2005	Maritime Traffic Survey: Gwynt y Mor Offshore Wind Farm (Survey Report B)	pdf file held
18	Development specific info	Projects	Walney Offshore Windfarm			y	Walney Offshore Wind Farm	Site specific	Walney Island	Anatec UK Ltd	2006	Navigational Risk Assessment Walney Offshore Windfarm	pdf file held
19	Potential Impacts	Shipping	General	y			Wave Hub	Site specific	North Cornwall	Anatec UK Ltd	2006	Navigational Risk Assessment: Wave Hub Development	pdf file held
20	Baseline	Fish Ecology	Cod, sole, plaice and whiting	y	y	y	CEFAS	Regional	South west	Anon	2000	Fisheries information - cod, sole, plaice and whiting in the south west of the Birtish Isles	pdf file held
21	Baseline	Tourism and recreation	Recreational fishing	y	y	y	Welsh Assembly Government	Broad	Wales	Anon	2003	A Strategy for the Recreational Fisheries of Wales	pdf file held
22	Device specific info	Device specific info	General	y	y		Danish Wave Energy Programme	Broad	Generic	Anon	2003	Development of recommended practices for testing and evaluating ocean energy systems	pdf file held
23	Baseline	Baseline	Monitoring	y	y	y	N-power Renewables	Site specific	North Wales	Anon	2003	North Hoyle Offshore Wind Farm Baseline Monitoring Report	pdf file held
24	Potential Impacts	Broad Issues	General impacts	y			Energy, Environment and Sustainable Development Programme	Broad	Europe	Anon	2003	WaveNet: Results from the work of the European Thematic Network on Wave Energy	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
25	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	Regional	Cardigan Bay	Friends of Cardigan Bay	2004	Marine projects : Part 1 : Pembrokeshire offshore survey 2003 : Part 2 : Local bottlenose dolphin survey 2003 : Part 3 : Enlli cetacean survey 2003	CCW library
26	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	CCW Library	Regional	Menai Strait	Anon	2004	Menai Strait tidally exposed seabed and shores	CCW library
27	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	CCW Library	Regional	Milford Haven	Anon	2004	Milford Haven and Daugleddau Estuary tidally exposed seabed and shores	CCW library
28	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	MCA	Broad	UK	Anon	2004	Proposed UK offshore renewable energy installations (OREI) - Guidance on navigational safety issues	pdf file held
29	Potential Impacts	Visual (seascape/landscape character, visual amenity)	General			y	CCW	National	Wales	Anon	2004	Studies to inform advice on offshore renewable energy development: visual perception versus photomontage	Not held
30	Potential Impacts	Sea birds	General			y	Wind energy and bird/bats workshop	Broad	USA	Anon	2004	Understanding and resolving bird and bat impacts	pdf file held
31	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	CCW Library	Regional	Pembrokeshire	Anon	2004	West Pembrokeshire tidally exposed seabed and shores	CCW library
32	Development specific info	Impact monitoring	General			Y	N-power Renewables	Site specific	North Wales	Anon	2005	Annual FEPA Monitoring Report June 2005	pdf file held
33	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	EMEC	Broad	Europe	Anon	2005	Environmental Impact Assessment (EIA): Guidance for developers at the European marine energy centre	pdf file held
34	Potential Impacts	Shipping	Increased/displacement of shipping density	y	y	y	NOREL sub-group meeting March 2005	Broad	UK	Anon	2005	Interference with the use of recognised sea lanes essential to international navigation	pdf file held
35	Device specific info	Device specific info	General	y	y		CA-OE Workshop in Uppsala, November 2005	Broad	Generic	Anon	2005	Summary of the CA-OE Workshop in Uppsala, Nov 2005	pdf file held
36	Potential Impacts	Physical environment	Scour			y	Sheringham Offshore Wind Farm	Site specific	Sheringham Shoal	Anon	2006	Appendix 6.1 Foundation scour assessment	pdf file held
37	Potential Impacts	Physical environment	Scour			y	Sheringham Offshore Wind Farm	Site specific	Sheringham Shoal	Anon	2006	Appendix 6.3 Further work on the effect of large gravity base structures on tidal currents, waves and sediment transport	pdf file held
38	Potential Impacts	Sea birds	Potential collision risk			y	Sheringham Offshore Wind Farm	Site specific	Sheringham Shoal	Anon	2006	Appendix 8.4 Collisision risk modelling	pdf file held
39	Potential Impacts	Fish Ecology	Disturbance/displacement/avoidance of/by fish due to noise (incl migratory routes)		y		RITE	Site specific	Roosevelt Island	Anon	2006	East River Underwater Noise Survey - Roosevelt Island Tidal Energy Project	pdf file held
40	Potential Impacts	Marine mammals and birds	General			y	MINOS	Regional	North and Baltic Sea	Anon	2006	Further Investigations on Sea Birds and Marine Mammals for the Evaluation of Offshore Windfarms	pdf file held
41	Development specific info	Projects	Makah Bay Offshore Wave Project	Y			Finavera Renewables	Site specific	Makah Bay, nr Washington, USA	Anon	2006	Makah Bay Offshore Wave Energy Pilot Project	pdf file held
42	Baseline	Water and sediment quality	Turbidity	y	y	y	CCW Library	Site specific	Menai Strait	Anon	2006	Menai Strait turbidity and other co-variate surveillance	CCW library
43	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Welsh Assembly Government	Broad	Wales	Anon	2006	Possible Working Title: 'Making the Most of Wales' Coast	pdf file held
44	Potential Impacts	Physical environment	Scour			y	Scour conference, Denmark, 2006	Broad	Denmark	Anon	2006	Results from development projects offshore wind turbines situated in areas with strong currents	pdf file held
45	Development specific info	Projects	Sheringham Shoal OWF			Y	Sheringham Offshore Wind Farm	Site specific	Sheringham Shoal	Anon	2006	Sheringham Shoal Offshore Wind Farm - Draft	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
46	Baseline	Grid	General	y	y	y	Unstated	National	Wales	Anon	2007	Distribution Long Term Development Statement For SP Manweb PLC for the years 2007/08 to 2011/12, SP Transmission and Distribution	Not held
47	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	HM Government White Paper	Broad	UK	Anon	2007	Planning for a Sustainable Future White Paper	pdf file held
48	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	Carbon Trust	Broad	Generic	Anon	2007	Setting the Scene: an Overview of Marine Energy in the UK	ppt file held
49	Baseline	Carbon Capture and Storage	General				http://www.edenenergy.com.au	Regional	South Wales	Anon	2007	South Wales Coal Bed Methane Exploration Update	Not held
50	Potential Impacts	Ecology	General	y	y	y	Workshop at Aberdeen Univ, 08/03/07	Broad	Generic	Anon	2007	Summary of workshop: Tidal energy and the marine environment	word file held
51	Baseline	Grid	General	y	y	y	Unstated	Regional	South Wales	Anon	2007	The Long Term Development Statement for Western Power Distribution (South Wales) plc's Electricity Distribution System 2007	Not held
52	Potential Impacts	Broad Issues	General impacts		y		Offshore Energy Environmental Research Association	Broad	USA	Anon	2007	Workshop on Tidal Power and the Environment in the 21st Century: Summary Report	pdf file held
53	Device specific info	Device specific info	Severn Barrage		y		BERR	Regional	Severn Estuary	Anon	Undated	Energy from tidal barrages: technology description	pdf file held
54	Development specific info	Projects	Hawaiian OPT	Y			US Navy	Site specific	Hawaii	Anon	Undated	Findings of Hawaii Environmental Assessment	Summary held
55	Device specific info	Device specific info	Pelamis	y			BERR	Broad	Device specific	Anon	Undated	Near shore oscillating wave column: prototype development and evaluation	pdf file held
56	Potential Impacts	Water and sediment quality	Use of antifoulants		y		Strangford Lough MCT	Site specific	Strangford Lough	Anon	Undated	Proposed antifoulant sheets	CONFIDENTIAL pdf file held
57	Potential Impacts	Benthic ecology	Effect of cable route		y		www.racerocks.com	Site specific	Race Rocks Reserve	Anon	Undated	Various items	Project in progress
58	Baseline	Fish Ecology	Bass	y	y	y	Defra	Broad	UK	Anon		Bass Nursery Areas and Other Conservation Measures	pdf file held
59	Baseline	Designated sites	MEHRA's	y	y	y	Unstated	Broad	UK	Anon		Establishment of Marine Environmental High Risk Areas (MEHRA's)	pdf file and data files held
60	Baseline	Commercial Fisheries	Fishing Activity	y	y	y	SEA 8	Regional	SEA 8	Anon		Fish and fisheries in area SEA 8	pdf file held
61	Baseline	Fish Ecology	Skates and rays	y	y	y	CEFAS	Site specific	Bristol Channel	Anon		Skates and rays in the Bristol Channel	word file held
62	Potential Impacts	Shipping	Radio navigation and Radar			y	BERR	Broad	UK	Appleton, SG	2005	Design and manufacture of radar absorbing wind turbine blades - final report	pdf file held
63	Baseline	Fish Ecology	General	y	y	y	Fisheries Science Partnership	Regional	Irish Sea	Armstrong, M, Cotter, J, Dann, J and Witthames, P	2005	Programme 4: Irish Sea Roundfish	pdf file held
64	Baseline	Fish Ecology	General	y	y	y	Fisheries Science Partnership	Regional	Irish Sea	Armstrong, M, Dann, J, Garrod, C and Pasco, G	2007	Programme 3: Irish Sea Roundfish	pdf file held
65	Baseline	Carbon Capture and Storage	General				EAGE First Break Magazine	Site specific	Norway	Arts, RJ, Chadwick, A, Eiken, O, Thibeau, S and Nooner, S	2008	Ten years' experience of monitoring CO2 injection in the Utsira Sand at Sleipner, offshore Norway	Not held
66	Device specific info	Device specific info	OWC	y			Carbon Trust	Broad	Generic device specific	Arup	2005	Oscillating water column wave energy converter evaluation report	pdf file held
67	Development specific info	Projects	Swansea Tidal Lagoon		y		Tidal Electric	Site specific	Swansea Bay	Atkins Consultants Ltd	2004	Feasibility Study for a Tidal Lagoon in Swansea Bay	Summary held
68	Potential Impacts	Aviation	Radar			y	NATS	Broad	UK	Auld, A	2006	Options for mitigating the impact of wind turbines on NERLs primary radar infrastructure	pdf file held
69	Development specific info	Projects	EMEC		y		EMEC	Site specific	Warness, Orkney	Aurora Environmental	2005	EMEC Tidal Test Facility Fall of Warness, Eday, Orkney: Environmental Statement	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
70	Device specific info	Device specific info	Horizontal axis marine current turbine		y		Renewable energy 29 (2004) issue 12 1931-1945	Site specific	Alderney Race, Channel Islands	Bahaj, AS and Myers, LE	2004	Analytical estimates of the energy yield potential from the Alderney Race (Channel Islands) using marine current energy converters	not held
71	Device specific info	Device specific info	Marine Current Turbines		y		Sustainable Energy Series, Report 3, March 2005	Broad	Device specific	Bahaj, AS, Batten, WMJ, Molland, AF and Chaplin, JR	2005	Experimental Investigation into the Hydrodynamic Performance of Marine Current Turbines	not held
72	Device specific info	Device specific info	Marine Current Turbines		y		Sustainable Energy Series, Report 4, March 2005	Broad	Device specific	Bahaj, AS, Batten, WMJ, Molland, AF and Chaplin, JR	2005	Theoretical Predictions of the Hydrodynamic Performance of Marine Current Turbines	Not held
73	Potential Impacts	Physical environment	Change in tidal energy		y		7th European Wave and Tidal Energy Conference, 2007	Broad	Device specific	Bahaj, AS, Myers, LE, Thomson, MD and Jorge, N	2007	Characterising the wake of horizontal axis marine current turbines	Not held
74	Device specific info	Device specific info	Wave energy converter	y			Phd at Edinburgh University	Broad	Generic	Bailey, H	Project in progress	Nonlinear modelling and optimising o fpower take off systems for wave energy converters	Project in progress
75	Device specific info	Device specific info	Wave energy converter	y			University of Edinburgh Institute for Energy Systems	Broad	Generic	Bailey, H, Bryden, I and Mueller, M	Project in progress	Nonlinear modeling of the Power Take Off of Wave Energy Converters	Project in progress
76	Baseline	Marine mammals	Cetaceans	y	y	y	INTERREG	Regional	Cardigan Bay	Baines, ME, Reichelt, M, Evans, PGH and Shepherd, B	2000	Bottlenose dolphins in Cardigan Bay, West Wales	Not held
77	Baseline	Marine mammals	Cetaceans	y	y	y	INTERREG	Regional	Cardigan Bay	Baines, ME, Reichelt, M, Evans, PGH and Shepherd, B	2002	Bottlenose dolphin studies in Cardigan Bay, west Wales	pdf file held
78	Device specific info	Device specific info	Tidal lagoon		y		BERR	Broad	Device specific	Baker, C and Leach, P	2006	Tidal lagoon power generation scheme in Swansea Bay	pdf file held
79	Potential Impacts	Broad Issues	General impacts	y	y	y	WWF	Broad	Wales	Ball, I	2002	Turning the tide: power from the sea and protection for nature in Welsh waters	pdf file held
80	Potential Impacts	Aviation	Radar			y	BERR	Regional	Wash	Banister, DJ	2007	Radar in-fill for greater Wash Area	pdf file held
81	Potential Impacts	Sea birds	General			Y	Greater Gabbard	Site specific	Greater Thames	Banks, AN, Burton, NHK, Austin, GE, Carter, N, Chamberlain, DE, Holt, C, Wakefield, E and Gill, P	2005	The Potential Effects on Birds of the Greater Gabbard Offshore Wind Farm Report for February 2004 to March 2005	pdf file held
82	Baseline	Seabirds	Seabirds				CCW Library	Regional	Carmarthen Bay and Estuaries	Banks, AN, Maclean, IMD, Collier, MP, Hainsworth, I, Howells, RJ, Hughes, DS	2007	Monitoring bird distribution and behaviour on the Camarthen bay and estuaries SAC at low tide	Not held
83	Potential Impacts	Military Use	Disruption of radar			y	COWRIE	Regional	Greater Wash	Bannister, DJ	2007	Radar In-fill for the Greater Wash Area Feasibility Study	pdf file held
84	Baseline	Physical environment	Wave and tide resource	y			Hydraulics & Maritime Research Centre, Cork, Ireland	Broad	Generic	Barrett, S	Project in progress	Analysis techniques for ocean waves	Project in progress
85	Baseline	Seabirds	Seabirds	y	y	y	SEA 6, 7 and 8	Regional	SEA 6, 7 and 8	Barton, C and Pollock, C	2005	A review of inshore seabird species in SEA areas 6, 7 and 8	pdf file held
86	Baseline	Seabirds	Swans and geese	y	y	y	SEA 6, 7 and 8	Regional	SEA 6, 7 and 8	Barton, C and Pollock, C	2005	Review of overwintering swans and geese in the SEA 6, 7 and 9 areas	pdf file held
87	Baseline	Carbon Capture and Storage	General				Proceedings of the Geologists Association Volume 98 Part 4	Broad	Generic	Bassett, EMG	1987	Geological Association	Not held
88	Device specific info	Device specific info	Marine Current Turbines		y		Proceedings World Renewable Energy Congress (WREC-VIII), Denver, 29 Aug - 3 Sept 2004	Broad	Device specific	Batten M, Bahaj AS, Chaplin JR and Molland AF	2004	Hydrodynamics of marine current turbines	Not held
89	Device specific info	Device specific info	Marine Current Turbines		y		Renewable Energy, In Press, Corrected Proof, Available online 9 August 2007	Broad	Device specific	Batten WMJ, Bahaj AS, Molland AF and Chaplin JR	2007	The prediction of the hydrodynamic performance of marine current turbines	Not held
90	Potential Impacts	Physical environment	Change in tidal energy		y		Proceedings World Renewable Energy Congress (WREC-IX), Florence, 19-25 August 2006	Broad	Generic	Batten, WMJ and Bahaj, AS	2006	CFD simulation of a small farm of horizontal axis marine current turbines	Not held
91	Potential Impacts	Broad Issues	General impacts	Y			Virginia Tech University	Broad	USA	Bedard, R	2004	Offshore wave power in the US: Environmental issues	pdf file held
92	Device specific info	Device specific info	Wave energy converter	y			Electric Power Research Institute (EPRI)	Broad	Generic device specific	Bedard, R	2005	Final summary report: project definition study - Offshore wave power feasibility demonstration project	pdf file held
93	Device specific info	Device specific info	Tidal Stream Energy		y		Electric Power Research Institute (EPRI)	Broad	Device specific	Bedard, R, Previsic, M, Polagye, B and Casavant, A	2006	North America Tidal In-Stream Energy Conversion Technology Feasibility Study	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
94	Baseline	Military Use	Location of munitions	y	y	y	MoD	Broad	UK and NE Atlantic	Beddington, J and Kinloch, AJ	2005	Munitions dumped at sea: a literature review	pdf file held
95	Potential Impacts	Physical environment	Cumulative effects	y			Department of Civil Engineering, Ghent University	Broad	Generic	Beels, C	Project in progress	A farm of interacting wave power devices	Project in progress
96	Potential Impacts	Physical environment	Cumulative effects	y			International Conference Ocean Energy, 2006	Broad	Generic	Beels, C, Troch, P, De Backer, G, De Rouck, J, Moan, T and Falcão, A	2006	A model to investigate interacting wave power devices	Not held
97	Baseline	Archaeology	General	y	y	y	World Archaeology 29(1): 95-113	Regional	Severn Estuary	Bell, M and Neumann, H	1997	Prehistoric Intertidal Archaeology and Environments in the Severn Estuary, Wales	Not held
98	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	BERR	Broad	UK	BERR	2000	Guidance on the Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2000	pdf file held
99	Potential Impacts	Shipping	Increased/displacement of shipping density	y	y	y	BERR	Broad	UK	BERR	2006	Consultation on Safety Zones	pdf file held
100	Development specific info	Projects	Appropriate Assesssment	y	y	y	24th Offshore Oil and Gas Licensing Round Cardigan Bay	Site specific	Cardigan Bay	BERR	2007	Appropriate Assessment	pdf file held
101	Potential Impacts	Shipping	Increased/displacement of shipping density	y	y	y	BERR	Broad	UK	BERR	2007	Consultation on Safety Zones - Government Response	pdf file held
102	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	BERR	Broad	UK	BERR	2007	Strategic Environmental Assessment for Offshore Oil and Gas Licensing and Wind Leasing	pdf file held
103	Potential Impacts	Ecology	Disturbance/displacement/avoidance of/ due to noise			y	Horns Reef	Site specific	Denmark	Betke, K	2006	Measurement of underwater noise emitted by an offshore wind turbine at Horns Rev	pdf file held
104	Baseline	Physical environment	Seabed sediment	y	y	y	ALSF	Regional	Bristol Channel	BGS	2004	Outer Bristol Channel Marine Habitat Study: Geophysical and Video Surveys	Not held
105	Baseline	Physical environment	Seabed sediment	y	y	y	SEA 8	Regional	SEA 8	BGS		DTI SEA 8 Area Superficial Seabed Processes and Hydrocarbon Prospectively	Not held
106	Device specific info	Device specific info	Conwy tidal power		y		ETSU	Site specific	Conwy	Binnie and Partners	1990	Conwy estuary feasibility study of tidal power	CCW library
107	Potential Impacts	Commercial fisheries	General			y	Vindeby	Site specific	Denmark	Bio/consult	2002	Offshore wind farm at Vindeby on the outcome of fishing: The possible effects of electromagnetic fields and noise	pdf file held
108	Potential Impacts	Fish Ecology	Artificial reef effect			y	Horns Reef	Site specific	Horns Reef	Bio/consult A/S	2001	Introducing hard bottom substrate sea bottom and marine biology	pdf file held
109	Development specific info	Projects	Walney Offshore Windfarm			y	Walney Offshore Wind Farm	Site specific	Walney Island	Bio/consult AS	2006	Environmental impact Assessment marine mammals in the NW3 area, Irish Sea	pdf file held
110	Potential Impacts	Marine mammals	General			y	COWRIE	Broad		BioConsult SH	Project in progress	Methodologies for measuring and assessing potential changes in marine mammal behaviour, abundance or distribution arising from the construction, operation and decommissioning of offshore windfarms	Project in progress
111	Potential Impacts	Ecology	Artificial reef effect			y	Nysted offshore windfarm	Site specific	Denmark	Birklund, J	2005	Surveys of hard bottom communities on foundations in Nysted offshore wind farm and Schonheiders Pulle in 2004	pdf file held
112	Potential Impacts	Ecology	Artificial reef effect			y	Nysted offshore windfarm	Site specific	Denmark	Birklund, J and Petersen, AH	2004	Development of the fouling community on turbine foundations and scour protection in Nysted offshore wind farm, 2003	pdf file held
113	Potential Impacts	Visual (seascape/landscape character, visual amenity)	General			y	Renewable energy 32 (2007) 814-831	Broad	Generic	Bishop, ID and Miller, DR	2007	Visual assessment of offshore wind turbines: the influence of distance, contrast, movement and social variables	pdf file held
114	Baseline	Physical environment	Wave and tide resource		y		Carbon Trust	Broad	UK	Black and Veatch	2005	Phase 2: UK Tidal Stream Energy Resource Assessment	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
115	Device specific info	Device specific info	General	y	y		Carbon Trust	Broad	Generic	Black and Veatch	2006	Key Marine Energy Component Technologies for Cost Reduction R&D	pdf file held
116	Device specific info	Device specific info	Severn Barrage		y		Sustainable Development Commission	Regional	Severn Estuary	Black and Veatch	2007	Research Report 3 - Severn Barrage Proposals	pdf file held
117	Potential Impacts	Tourism and recreation	Disturbance to recreational activities	y			Wave Hub	Broad	UK	Black, KP	2007	Review of wave hub technical studies: impacts on inshore surfing beaches	pdf file held
118	Baseline	Physical environment	Wave and tide resource				6th European Wave and Tidal Energy Conference, 2005	Broad	UK	Blunden, LS and Bahaj, AS	2005	A high resolution model of the English Channel for tidal stream resource assessment	Not held
119	Device specific info	Device specific info	Horizontal axis marine current turbine		y		2nd International Conference of Renewable Energy in Maritime Island Climates	Broad	Device specific	Blunden, LS and Bahaj, AS	2006	Comparison of different approaches to site selection for tidal stream energy resource assessment.	Not held
120	Baseline	Physical environment	Wave and tide resource		y		Renewable energy 31 (2006) 2 pg 121-132	Site specific	Portland Bill	Blunden, LS and Bahaj, AS	2006	Initial evaluation of tidal stream energy resources at Portland Bill, UK	Not held
121	Potential Impacts	Physical environment	Change in tidal energy		y		7th European Wave and Tidal Energy Conference, 2007	Site specific	Portland Bill	Blunden, LS and Bahaj, AS	2007	Effects of tidal energy extraction at Portland Bill, southern UK predicted from a numerical model	pdf file held
122	Baseline	Physical environment	Wave and tide resource		y		Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy, 221 (2), pp 137-146	Broad	UK	Blunden, LS and Bahaj, AS	2007	Tidal energy resource assessment for tidal stream generators	Not held
123	Baseline	General site background	Offshore Wind SEA	y	y	y	BERR	Regional	Offshore wind SEA regions	BMT Cordah Ltd	2003	Offshore wind energy generation: Phase 1 proposals and environmental report	pdf file held
124	Baseline	Archaeology	General	y	y	y	The Atiquaries Journal 57: 10-30	Regional	North Wales	Boon, GC	1977	A Graeco-Roman anchor stock from north Wales	Not held
125	Baseline	Archaeology	General	y	y	y	in Moore, D, 1970, The Irish Sea Province in Archaeology and History, Cambrian Archaeological Society	Broad	UK	Bowen, E.G.	1970	Britain and the British Seas	Not held
126	Baseline	Tourism and recreation	General	y	y	y	Pembrokeshire Coastal Forum	Regional	South West Wales	Bowles Green Ltd	2005	South West Wales Coastal Recreation Audit - Consultants Report	pdf file held
127	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Boyle, DP	2002	Grey seal breeding census : Skomer Island 2001	CCW library
128	Baseline	Archaeology	General	y	y	y	Unpublished Report, The Archaeological Diving Company Ltd	Regional	Irish Sea	Brady, N	2002	Archaeological Monitoring and Excavation: Gas 2025 Irish Subsea Interconnector Gormanstown Landfall Co. Louth – Interim Report	Not held
129	Baseline	Benthic Ecology	Intertidal biotopes	y	y	y	CCW	Broad	Welsh intertidal	Brazier, P, Birch, K, Brunstrom, A, Bunker, A, Jones, M, Lough, N, Salmon, L and Wyn, G	2007	When the tide goes out : the biodiversity and conservation of the shores of Wales : results from a 10 year intertidal survey of Wales	CCW library
130	Baseline	Carbon Capture and Storage	General				Geological Society	National	England and Wales	Brechley, E and Rawson	2006	The Geology of England and Wales. 2nd Ed	Not held
131	Baseline	Archaeology	General	y	y	y	Tempus Publishing, Stroud	National	Ireland	Breen, C, and Forsythe, W	2004	Boats and shipwrecks of Ireland	Not held
132	Potential Impacts	Physical environment	Change in direction/reflection of energy	y			Azores trials	Site specific	Pico, Azores	Brito-Melo, A, and Sarmento, AJNA	2005	A 3D boundary element code for the analysis of OWC wave-power plants	pdf file held
133	Potential Impacts	Physical environment	Change in direction/reflection of energy	y			Azores trials	Site specific	Pico, Azores	Brito-Melo, A, Castro, RA and Sarmento, AJNA		The estimation of the diffraction flow from sea trials measurements in OWC plants	pdf file held
134	Baseline	Carbon Capture and Storage	General				J Geol Soc	Regional	Bristol Channel	Brooks, Traynor and Trimble	1988	Mesozoic reactivation of Variscan thrusting in the Bristol Channel Area	Not held
135	Baseline	Commercial Fisheries	Fishing Activity	y	y	y	Walney and West of Duddon	Regional	Walney and West of Duddon	Brown and May Marine Ltd	2005	Commercial fisheries - exsting baseline	pdf file held
136	Potential Impacts	Shipping	Search and rescue			y	MCA	Site specific	North Hoyle	Brown, C	2005	Offshore wind farm helicopter search and rescue trials undertaken at the North Hoyle wind farm	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
137	Baseline	Physical environment	Wave and tide resource	y	y		Proceedings of the Institution of Civil Engineers: Maritime Engineering 159, Issue MA2, pp 55-65.	Broad	UK	Bryden, IG	2006	The Marine Energy Resource, Constraints and Opportunities	Not held
138	Baseline	Physical environment	Wave and tide resource		y		WREC04, Denver	Broad	Generic	Bryden, IG and Couch, SJ	2004	Marine Energy Extraction: Tidal Resource Analysis	Not held
139	Baseline	Physical environment	Wave and tide resource		y		Renewable Energy, RENE2412, paper 10.1016/j.renene.2005.08.012.	Regional	generic	Bryden, IG and Couch, SJ	2005	Marine Energy Extraction: Tidal Resource Analysis	Not held
140	Baseline	Physical environment	Wave and tide resource		y		IMechE Journal of Power and Energy, Vol. 221, No. 2, pp. 125-135(11)	Regional	Generic	Bryden, IG and Couch, SJ, Owen, A and Melville, G	2007	Tidal Current Resource Assessment	Not held
141	Baseline	Archaeology	General	y	y	y	in McCaughan, M. and Appleby, J., 1989, The Irish Sea Aspects of Maritime History, The Institute of Irish Studies, The Queen's University of Belfast and the Ulster Folk and Transport Museum	Regional	Irish Sea	Buchanan, RH	1989	The Irish Sea: The Geographical Framework	Not held
142	Baseline	Plankton	Plankton ecology	y	y	y	CEFAS	Regional	Irish Sea	Bunn, N and Fox, CJ	2004	Spring plankton surveys of the Irish Sea in 2000: hydrography and the distribution of fish eggs and larvae	pdf file held
143	Baseline	Plankton	Plankton ecology	y	y	y	CEFAS	Regional	Eastern Irish Sea	Bunn, N, Fox, CJ and Nash, RDM	2004	Spring plankton surveys of the eastern Irish Sea in 2001, 2002 and 2003: hydrography and the distribution of fish eggs and larvae	pdf file held
144	Baseline	Designated sites	Management Plan	y	y	y		Site specific	Pembrokeshire	Burton, S	2006	Pembrokeshire Marine SAC Draft Management Plan	pdf file held
145	Baseline	Carbon Capture and Storage	General				Journal of the Geological Society v. 154	Regional	South Wales	Butler, AJ, Woodcock, NH and Stewart, DM	1997	The Woolhope and Usk Basins: Silurian rift basins revealed by subsurface mapping of the southern Welsh Borderland	Not held
146	Potential Impacts	Shipping	Radio navigation and Radar				ETSU	Broad	UK	Butler, MM and Johnson, DA	2003	Feasibility of mitigating the effects of windfarms on primary radar	pdf file held
147	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	BWEA	Broad	UK	BWEA	1994	Best practice guidelines for wind energy development	pdf file held
148	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	BWEA	Broad	UK	BWEA	2002	Best practice guidelines: Consultation for offshore wind energy developments	pdf file held
149	Potential Impacts	Tourism and recreation	General			y	All-party parlimentary group on tourism	Broad	UK	BWEA	2006	The Impact of wind farms on the tourist industry in the UK	pdf file held
150	Potential Impacts	Fish Ecology	General	y	y		Fisheries, April 2007, Vol 32, No 4, pg174-181	Broad	Generic	Cada, G, Ahlgrimm, J, Bahleda, M, Stravrakas, SD, Hall, D, Moursund, R, Sale, M	2007	Potential impacts of Hydrokinetic and Wave Energy Conversion Technologies on Aquatic Environments	pdf file held
151	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y		Carbon Trust	Broad	UK	Callaghan, J and Boud, R		Future Marine Energy Results of the Marine Energy Challenge: Cost competitiveness and growth of wave and tidal stream energy	pdf file held
152	Baseline	Designated sites	General	y	y	y	SEA 8	Regional	SEA 8	CALM		Strategic Environmental Assessment SEA 8 Conservation	Not held
153	Potential Impacts	Fish Ecology	Disturbance/displacement/avoidance of/by fish due to noise (incl migratory routes)	y	y	y	San Francisco – Oakland Bay Bridge East Span Seismic Safety Project	Site specific	San Francisco	Caltrans	2001	Pile Installation Demonstration Project: Fisheries Impact Assessment	pdf file held
154	Potential Impacts	Broad Issues	Benefits of large scale deployments	y	y	y	UK's Office of Gas and Electricity Markets	Broad	Generic	Cambridge Economic Policy Associates Ltd and Climate Change Capital	2005	Assessment of the benefits from large-scale deployment of certain renewable technologies	pdf file held
155	Potential Impacts	Archaeology	General	y			Wave Hub	Site specific	North Cornwall	Cambridge, K, Johns, C, Rees, P and Tapper, BP	2006	South West Wave Hub, Hayle, Cornwall: Archaeological Assessment	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
156	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	Campaign for the Protection of Rural Wales	National	Wales	Campaign for the Protection of Rural Wales	2000	Renewable Energy Installations, Annex B: 2000. Policy on Offshore Wind Installations	pdf file held
157	Baseline	Seabirds	Seabird sampling methods			y	COWRIE	Broad	UK	Camphuysen, K, Fox, AD, Leopold, MF, Petersen, IbK	2004	Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore windfarms in the UK	pdf file held
158	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Report to Canadian Government	Broad	Generic	Canadian High Commission, London	2002	The Renewable Energies Market in the United Kingdom	pdf file held
159	Baseline	Physical environment	Wave and tide resource	y	y		Carbon Trust	Broad	UK	Carbon Trust	2005	An Assessment of the variability characteristics of the UKs wave and tidal current power resources and their implications for large scale development scenarios	pdf file held
160	Baseline	Marine mammals	Cetaceans	y	y	y	Cardigan Bay Marine Wildlife Centre	Regional	Cardigan Bay	Cardigan Bay Marine Wildlife Centre	2005	Cardigan Bay Marine Wildlife Centre Bottlenose Dolphin (Tursiops truncatus) Photo-Identification Catalogue	pdf file held
161	Baseline	Marine mammals	Marine mammals	y	y	y	Cardigan Bay Marine Wildlife Centre	Regional	Cardigan Bay	Cardigan Bay Marine Wildlife Centre		What lives here - An interactive map showing marine mammal hotspots here in Cardigan Bay	Zip file held
162	Development specific info	Projects	EMEC	y			EMEC	Site specific	Billia Croo, Orkney	Carl Bro Group Ltd	2002	Billia Croo Environmental Statement	pdf file held
163	Baseline	Archaeology	General	y	y	y	Village Publishing, Torfaen	National	Wales	Carradice, P	1997	The Last Invasion: The story of the French landing in Wales	Not held
164	Potential Impacts	Broad Issues	General impacts			y	Metoc	Broad	UK	Carryer, R and Deeming, K		Environmental risk for offshore wind farm developers: lessons from other industries	pdf file held
165	Potential Impacts	Marine mammals	Potential collision risk	y	y	y	Scottish Association Marine Science MSc project	Broad	Generic	Carter, C	2007	Do marine renewable energy devices give sufficient warning to marine mammals to avoid harmful collisions?	Not held
166	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	CCW	National	Wales	CCW	2000	A Policy Statement. CCW Policy on Wind Turbines	pdf file held
167	Baseline	Visual (seascape/landscape character, visual amenity)	Baseline	y	y	y	LANDMAP	National	Wales	CCW	2001	The LANDMAP Information System	pdf file held
168	Baseline	Designated sites	Regulation 33 documents	y	y	y	CCW	Site specific	Cardigan Bay	CCW	2005	Advice provided by the Countryside Council for Wales in fulfillment of Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994 for Cardigan Bay European Marine Site	pdf file held
169	Baseline	Designated sites	Regulation 33 documents	y	y	y	CCW	Site specific	Carmarthen Bay and Estuaries	CCW	2005	Advice provided by the Countryside Council for Wales in fulfillment of Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994 for Carmarthen Bay and Estuaries European Marine Site	pdf file held
170	Baseline	Designated sites	Regulation 33 documents	y	y	y	CCW	Site specific	Menai Strait and Conwy Bay	CCW	2005	Advice provided by the Countryside Council for Wales in fulfillment of Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994 for Menai Strait and Conwy Bay European Marine Site	pdf file held
171	Baseline	Designated sites	Regulation 33 documents	y	y	y	CCW	Site specific	Pembrokeshire	CCW	2005	Advice provided by the Countryside Council for Wales in fulfillment of Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994 for Pembrokeshire European Marine Site	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
172	Baseline	Designated sites	Regulation 33 documents	y	y	y	CCW	Site specific	Lleyn Peninsula	CCW	2005	Draft advice provided by the Countryside Council for Wales in fulfillment of Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994 for Lleyn Peninsula and the Sarnau European Marine Site	pdf file held
173	Development specific info	Projects	Skerries Tidal Stream Array		y		CCW	Site specific	Anglesey	CCW	2006	Request for a scoping opinion on the proposed Skerries Tidal Stream Array project in waters off the Anglesey Coast	Scoping response letter held
174	Development specific info	Projects	South Stack Tidal Stream Array		y		CCW	Site specific	Anglesey	CCW	2006	Request for a scoping opinion on the proposed South Stack Tidal Stream Array project in waters off the Anglesey Coast	Scoping response letter held
175	Baseline	Designated sites	Sites of special scientific interest	y	y	y	CCW	National	Wales	CCW	2006	Sites of Special Scientific Interest in Wales: Current state of knowledge	pdf file held
176	Baseline	Designated sites	Highly Protected Marine Reserves	y	y	y	CCW	Regional	Wales	CCW	2007	Highly Protected Marine Reserves: defining a process for identification of HPMRs in Wales	pdf file held
177	Device specific info	Device specific info	Severn Barrage		y		CCW, English Nature and Environment Agency	Regional	Severn Estuary	CCW, English Nature and Environment Agency	2006	Severn Estuary Barrage	pdf file held
178	Baseline	Commercial Fisheries	Coastal fisheries	y	y	y	ALSF	Broad	UK	CEFAS	2004	Building GIS and Environmental Data Management Capabilities of the Sea Fisheries Committees	Not held
179	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	CefAS	Broad	UK	CEFAS	2004	Guidance notes for Environmental Impact Assessment in respect of FEPA and CPA requirements	pdf file held
180	Potential Impacts	Physical environment	Change in wave energy			y	CEFAS	Site specific	Scroby Sands	CEFAS	2005	Assessment of the significance of changes to the inshore wave regime as a consequence of an offshore wind array	pdf file held
181	Potential Impacts	Physical environment	Change in coastal processes			y	Scroby Sands monitoring	Site specific	Scroby Sands	CEFAS	2006	Scroby Sands Offshore Wind Farm - Coastal Processes Monitoring	pdf file held
182	Baseline	Water and sediment quality	Contaminants				SEA 8	Broad	SEA 8	CEFAS		A Review of the Contaminant Status of SEA 8 Covering the Western Approaches, Celtic Sea and English Channel	Not held
183	Baseline	Fish Ecology	General	y	y	y	SEA 8	Regional	SEA 8	CEFAS		Fish and Fish Assemblages of the British Isles	Not held
184	Baseline	Fish Ecology	Salmon	y	y	y	CEFAS and Environment Agency	National	England and Wales	CEFAS and Environment Agency	2006	Annual Assessment of Salmon Stocks and Fisheries in England and Wales 2005	pdf file held
185	Baseline	Physical environment	Wave and tide resource	y	y		Centre for Renewable Energy Sources	Broad	Europe	Centre for Renewable Energy Sources	2006	Ocean energy converstion in Europe: recent advancements and prospects	pdf file held
186	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	Renewables Advisory Board and DTI	Broad	Wales	Centre for Sustainable Energy, BDOR Ltd and Capener, P	2007	The protocol for public engagement with proposed wind energy developments in Wales	pdf file held
187	Legislation, policy and guidance	Carbon Capture and Storage	General				SACS and CO2Store Projects	Broad	Generic	Chadwick, A, Arts, R, Bernstone, C, May, F, Thibeau, S and Zweigel, P	Undated	Best Practice for the Storage of CO2 in Saline Aquifers	Not held
188	Baseline	Carbon Capture and Storage	General				NERC Report No: COAL R302 DTI/Pub URN06/755	National	Wales	Chadwick, Evans, Holloway, Williams, Gaus, Van der Meer and Hanstock	2006	CO2 Store: The Valleys Case Study on CO2 Capture, Transport and Storage	Not held
189	Baseline	Archaeology	General	y	y	y	in Moore, D., 1970, The Irish Sea Province in Archaeology and History, Cambrian Archaeological Society	National	Ireland and Wales	Chadwick, NK	1970	Early Literary Contacts between Wales and Ireland	Not held
190	Potential Impacts	Physical environment	Change in wave energy	y			7th European Wave and Tidal Energy Conference, 2007	Broad	Generic	Child, BFM and Venugopal, V	2007	Interaction of waves with an array of floating wave energy device	pdf file held
191	Potential Impacts	Sea birds	General			y	Horns Reef	Site specific	Denmark	Christensen, TK and Hounisen, JP	2004	Investigations of migratory birds during operation of Horns Rev offshore wind farm	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
192	Potential Impacts	Sea birds	General			y	Horns Reef	Site specific	Denmark	Christensen, TK, Clausager, I and Petersen, IK	2003	Base-line investigations of birds in relation to an offshore wind farm at Horns Rev, and results from the year of construction	pdf file held
193	Potential Impacts	Sea birds	Potential collision risk			y	Horns Reef	Site specific	Denmark	Christensen, TK, Hounisen, JP, Clausager, I and Petersen, IK	2004	Visual and radar observations of birds in relation to collision risk at the Horns Rev offshore wind farm	pdf file held
194	Device specific info	Device specific info	General	y			Renewable and Sustainable Energy Reviews, Volume 6, Issue 5, October 2002, Pages 405-431	Broad	Europe	Clément, A, McCullenc, P, Falcãod, A, Fiorentinoe, A, Gardnerf, F, Hammarlundg, K, Lemonis, G, Lewish, T, Nielseni, K, Petroncinij, S, Pontesk, M-T, Schildl, P, Sjöströmm, B-O, Sørensenn, H C and Thorpe, T	2002	Wave energy utilisation in Europe: current status and perspectives	pdf file held
195	Potential Impacts	Fish Ecology	Potential effects of EMF			y	COWRIE	Broad	UK	CMACS	2003	A baseline assessment of electromagnetic fields generated by offshore windfarm cables	pdf file held
196	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	Gwynt y Mor Offshore Wind Farm	Regional	North Wales	CMACS	2005	Gwynt y Mor Offshore Windfarm: Marine Ecology Technical Report	pdf file held
197	Potential Impacts	Water and sediment quality	General	y	y	y	UK Marine SAC series	Broad	UK	Cole, S, Codling, ID, Parr, W and Zabel, T	1999	Guidelines for managing water quality impacts within UK European marine sites	pdf file held
198	Baseline	Tourism and recreation	General	y	y	y	INTERREG	Regional	Irish Sea	Connolly, N, Buchanan, C, O'Connell, M, Cronin, M, O'Mahony, C, Sealy, H, Kay, D and Buckley, S	2001	Assessment of human activity in the coastal zone	pdf file held
199	Baseline	Benthic Ecology	Subtidal biotopes	y	y	y	UKSeaMap	Broad	UK	Connor, DW, Gilliland, PM, Golding, N, Robinson, P, Todd, D and Verling, E	2006	The mapping of seabed and water column features of UK seas	pdf file held
200	Baseline	Archaeology	General	y	y	y	Antiquity 69: 969-980	Broad	Generic	Cooney, G, and Mandal, S	1995	Getting to the core of the problem: petrological results from the Irish Stone Axe Project	Not held
201	Development specific info	Projects	London Array			y	London Array Offshore Wind Farm: Review of Cable Installation Options	Site specific	Greater Thames	Cooper, B and Cooper, N	2005	London Array Offshore Wind Farm: Review of Cable Installation Options	pdf file held
202	Potential Impacts	Ecology	General	y	y		CCW and Crown Estate funded	Broad	Wales	Cooper, B and Kazer, S	2006	The potential nature conservation impacts of wave and tidal energy extraction by marine renewable developments	pdf file held
203	Baseline	Seabirds	Seabirds	y	y	y	SEA 8	Regional	SEA 8	Cork Ecology		Technical Report on Offshore Seabirds and Waders in the SEA 8 Area	Not held
204	Device specific info	Device specific info	Archimedes wave swing	y			6th European Wave and Tidal Energy Conference, 2005	Site specific	Generic	Costa, J, Sarmento, A, Gardner, F, Beirao and Brito-Melo, A	2005	Time domain model of the AWS wave energy converter	pdf file held
205	Baseline	Fish Ecology	General	y	y	y	Fisheries Science Partnership	Regional	Irish Sea	Cotter, J, Armstrong, M, Woods, T, Dann, J, White, P and Keable, J	2004	Programme 8: Gear selectivity in the Irish Sea Part 1: Eastern Irish Sea plaice fishery	pdf file held
206	Baseline	Fish Ecology	General	y	y	y	Fisheries Science Partnership	Regional	Irish Sea	Cotter, J, Dann, J, Boon, T, Righton, D and Heffernan, O	2004	Report on catches of cod and other species in the eastern Celtic Sea and Bristol Channel by FV Our Josie Grace in spring 2004	pdf file held
207	Baseline	Fish Ecology	General	y	y	y	Fisheries Science Partnership	Regional	Western approaches	Cotter, J, Warnes, S, Bannister, C, Boon, T and Mills, C	2004	Catches of monk, hake and other species in western waters by FV Billy Rowney, FV Twilight III and by RV Corystes, Autumn 2003	pdf file held
208	Baseline	Fish Ecology	General	y	y	y	Fisheries Science Partnership	Regional	Irish Sea	Cotter, J, Witthames, P, Goad, D and Boon, T	2004	Report on catches of cod and other species in the north eastern Irish Sea by FV Kiroan in spring 2004	pdf file held
209	Potential Impacts	Physical environment	Change in tidal energy		y		6th European Wave and Tidal Energy Conference, 2005	Broad	Generic	Couch SJ, Sun X and Bryden IG	2005	Modelling of Energy Extraction from Tidal Currents	Not held
210	Potential Impacts	Physical environment	Change in tidal energy		y		3rd International Conference on Marine Renewable Energy	Broad	Generic	Couch, SJ and Bryden, IG	2004	The impact of energy extraction on tidal flow development	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
211	Potential Impacts	Physical environment	Change in tidal energy		y		World Renewable Energy Congress 2005	Broad	Generic	Couch, SJ and Bryden, IG	2005	Numerical Modelling of Energy Extraction from Tidal Flows	Not held
212	Potential Impacts	Physical environment	Change in tidal energy		y		Proceedings of the Institution of Mechanical Engineers, Part M: Engineering for the Maritime Environment, 220, 4, 185-194, 2006, ISSN 1475-0902	Broad	Generic	Couch, SJ and Bryden, IG	2006	Tidal Current Energy Extraction: Hydrodynamic Resource Characteristics	Not held
213	Potential Impacts	Physical environment	Change in tidal energy		y		IEEE/OES Oceans '07 Marine Challenges: Coastline to Deep Sea, 2007/06/18-21	Broad	Generic	Couch, SJ and Bryden, IG	2007	Large-scale physical response of the tidal system to energy extraction and its significance for informing environmental and ecological impact assessment	Not held
214	Baseline	Fish Ecology	Fishery sensitivity	y	y	y	CEFAS	Broad	UK	Coull, KA, Johnstone, R and Rogers, SI	1998	Fisheries sensitivity maps in British waters	pdf file held
215	Baseline	Archaeology	General	y	y	y	Countryside Council for Wales	National	Wales	Countryside Council for Wales	1996	Seas, Shores, Coastal Areas: Maritime Policy	Not held
216	Baseline	Carbon Capture and Storage	General				Petroleum of North West Europe, Proceedings of the 5th Conference Ed Fleet and Boldy	Regional	Eastern Irish Sea	Cowen, Burley, Hoey, Holloway, Bermingham, Beveridge, Hamborg, Sylta	Undated	Oil and Gas migration in the Sherwood Sandstone of the East Irish Sea Basin	Not held
217	Potential Impacts	Fish Ecology	Potential effects of EMF			y	COWRIE	Broad	UK	Cranfield University, CMACS and CEFAS	Undated	Electromagnetic fields (EMF) Phase 2: Stage 1 project plan	pdf file held
218	Baseline	Seabirds	Scoter distribution	y	y	y	Wildfowl and Wetlands Trust	National	UK	Cranswick, P		Status and distribution of common scoter Melanitta nigra and velvet scoter M. fusca in the United Kingdom	pdf file held
219	Baseline	Archaeology	General	y	y	y	Unpublished Report, Malvern Archaeological Diving Unit	Site specific	Cardigan Bay	Cundy, I	2004	Licensee's Report on the Designated Wreck Site of the Diamond for the 2004 Season	Not held
220	Baseline	Archaeology	General	y	y	y	Oxford: University Press	Broad	Atlantic	Cunliffe, B	2001	Facing the Ocean. The Atlantic and its peoples 8000 BC – AD 1500	Not held
221	Baseline	Benthic Ecology	Subtidal biotopes	y	y	y	CCW	Broad	Welsh sandbanks	Darbyshire, T, Mackie, ASY, May, SJ and Rostron, D		A macrofaunal survey of Welsh sandbanks	CCW library
222	Potential Impacts	Broad Issues	Constraints	y	y		SWRDA	Broad	South West England	Daruvala, J, Galbraith, D, Griffiths, J, Grimshaw, I, Harrison, R, Holroyd, S, Pingree, R, Pitt, T, Sharp, J and Sinclair, D	2004	Seapower SW Review - Resources, Constraints and Development Scenarios for Wave and Tidal Stream Power	pdf file held
223	Baseline	Archaeology	General	y	y	y	CBA Research Report 131, Council for British Archaeology, York	National	Wales	Davidson, A	2002	The coastal archaeology of Wales	Not held
224	Device specific info	Device specific info	General		y		British Columbia Ministry of Energy, Mines and Petroleum Resources	Regional	British Columbia	Davidson, B	2007	A Feasibility Study: Tidal Power Generation for a Remote, Off-Grid Community on the British Columbia Coast	pdf file held
225	Baseline	Benthic Ecology	MNCR Review	y	y	y	NCC	Regional	Western Channel and Bristol Channel	Davies, J	1991	Marine Nature Conservation Review. Benthic marine ecosystems in Great Britain:a review of current knowledge. Western Channel and Bristol Channel and approaches (MNCR coastal sectors 8 and 9).	CCW library
226	Potential Impacts	Physical environment	Change in wave energy	y			17th International Offshore and Polar Engineering Conference & Exhibition ISOPE 2007	Broad	Generic	De Backer, G, Vantorre, M, Banasiak, R, Beels, C and De Rouck, J	2007	Numerical modelling of wave energy absorption by a floating point absorber system	Not held
227	Baseline	Marine mammals	Cetaceans	y	y	y	WDCS/Greenpeace	Regional	Wales and southwest England	de Boer, MN and Simmonds, MP	2003	Small cetaceans along the coasts of Wales and Southwest England	pdf file held
228	Potential Impacts	Sea birds	General			y	Donana Biological Station (Spanish Research Council)	Broad	Generic	de Lucas, M, Janss, GFE and Ferrer, M	2007	Birds and Wind Farms: Risk Assessment and Mitigation	Available to purchase
229	Device specific info	Device specific info	Archimedes wave swing	y			EPP-TUDelft, Delft, Netherlands	Broad	Generic	de Sousa Prado, MG	Project in progress	AWS Design Optimisation	Project in progress
230	Device specific info	Device specific info	Archimedes wave swing	y			Proceedings of the Institution of Mechanical Engineers Vol. 220 Part A: J. Power and Energy	Broad	Device specific	de Sousa Prado, MG, Gardner, F, Damen, M and Polinder, H	2006	Modelling and test results of the Archimedes wave swing	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
231	Baseline	Seabirds	Aerial survey seabirds	y	y	y	JNCC	Broad	UK	Dean, BJ, Webb, A, McSorley, CA and Reid, JB	2003	Aerial surveys of UK inshore areas for wintering seaduck, divers and grebes: 2000/01 and 2001/02	pdf file held
232	Baseline	Archaeology	General	y	y	y	in McCaughan, M. and Appleby, J., 1989, The Irish Sea Aspects of Maritime History, The Institute of Irish Studies, The Queen's University of Belfast and the Ulster Folk and Transport Museum	National	Ireland	DeCourcy Ireland, J	1989	A Survey of Early Irish Maritime Trade and Ships	Not held
233	Baseline	General site background	Quality Status Report of the Marine and Coastal Areas of the Irish Sea and Bristol Channel 2000	y	y	y	Defra	Regional	Irish Sea	Defra	2000	Quality Status Report of the Marine and Coastal Areas of the Irish Sea and Bristol Channel 2000	Not held
234	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	Defra	Broad	UK	Defra	2005	Nature conservation guidance on offshore windfarm development	pdf file held
235	Legislation, policy and guidance	Archaeology	General	y	y	y	DCMS	National	UK	Department for Culture, Media and Sport	2004	Protecting our Marine Environment: Making the System Work Better	Not held
236	Potential Impacts	Sea birds	Potential collision risk			y	Nysted offshore windfarm	Site specific	Denmark	Desholm, M	2004	TADS investigations of avian collision risk at Nysted offshore wind farm, autumn 2004	pdf file held
237	Potential Impacts	Sea birds	Potential collision risk			y	Nysted offshore windfarm	Site specific	Denmark	Desholm, M	2005	Preliminary investigations of bird-turbine collisions at Nysted offshore wind farm and final quality control of thermal animal detection system (TADS)	pdf file held
238	Potential Impacts	Sea birds	Potential collision risk			y	Biology Letters	Site specific	Nysted offshore wind farm	Desholm, M and Kahlert, J	2005	Avian collision risk at an offshore wind farm	pdf file held
239	Baseline	Seabirds	Seabird sampling methods			y	COWRIE	Broad	UK	Desholm, M, Fox, AD, Beasley, PDL	2004	Best practice guidance for the use of remote techniques for observing bird behaviour in relation to offshore wind farms	pdf file held
240	Potential Impacts	Sea birds	Potential collision risk			y	Ibis (2006) 148 76-89	Broad	Generic	Desholm, M, Fox, AD, Beasley, PDL and Kahlert, J	2006	Remote techniques for counting and estimating the number of bird-wind turbine collisions at sea: a review	pdf file held
241	Device specific info	Device specific info	Wave energy converter	y			Carbon Trust	Broad	Generic device specific	Det Norske Veritas	2005	Guidelines on design and operation of wave energy converters: A guide to assessment and application of engineering standards and recommended practices for wave energy conversion devices	pdf file held
242	Potential Impacts	Broad Issues	General impacts		Y		Electric Power Research Institute (EPRI)	Broad	USA	Devine Tarbell and Associates Ltd	2006	Instream tidal power in North America: Environmental and permitting issues	pdf file held
243	Potential Impacts	Benthic ecology	Effect of cable route			y	Rodsand Offshore Windfarm	Site specific	Rodsand	DHI Water and Environment	2005	Marine Biological Surveys Along the Cable Trench in the Lagoon of Rodsand	pdf file held
244	Baseline	Archaeology	General	y	y	y	White Row Press, Belfast	National	Ireland	Dickson, D	1997	Arctic Ireland: The Extraordinary Story of the Great Frost and Forgotten Famine of 1740-41	Not held
245	Potential Impacts	Broad Issues	General impacts			y		Broad	Netherlands	Dirksen, S	2000	Consideration on environmental issues in the planning of offshore wind farms in the Netherlands	pdf file held
246	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance		y		University of New Brunswick Law Journal	Regional	Nova Scotia	Doelle, M, Russell, D, Saunders, P, VanderZwaag, D and Wright, D	2006	The regulation of tidal energy development off Nova Scotia: navigating foggy waters	pdf file held
247	Potential Impacts	Marine mammals	Potential collision risk	y	y	y	WDCS	Broad	Generic	Dolman, S, Williams-Grey, V, Asmutis-Silvia, R and Isaac, S		Vessel collisions and cetaceans: what happens when they don't miss the boat	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
248	Potential Impacts	Marine mammals	General	y	y	y	Whale and Dolphin Conservation Society	Broad	Generic	Dolman, SJ, Green, M and Simmonds, MP	Undated	Marine Renewable Energy and Cetaceans	pdf file held
249	Potential Impacts	Marine mammals	General			y	Whale and Dolphin Conservation Society	Broad	Generic	Dolman, SJ, Simmonds, MP and Keith, S	Undated	Marine wind farms and cetaceans	pdf file held
250	Potential Impacts	Broad Issues	General impacts			y	Danish Consortium	Broad	Denmark	DONG Energy, Vattenfall, The Danish Energy Authority and the Danish Forest and Nature Agency	2006	Danish Offshore Wind - Key Environmental Issues	pdf file held
251	Potential Impacts	Sea birds	General			y	Ibis (2006) 148 29-42	Broad	UK	Drewitt, AL and Langston, RHW	2006	Assessing the impact of wind farms on birds	pdf file held
252	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	BERR	Broad	UK	DTI	2002	Future Offshore: A strategic framework for the offshore wind industry	pdf file held
253	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	BERR	National	Generic	DTI	2003	Offshore windfarms Round 2: Designed to provide a framework for rapid and successful expansion	word file held
254	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y		BERR	Broad	UK	DTI	2005	Guidance on consenting arrangements in England and Wales for a pre-commercial demonstration phase for wave and tidal stream energy devices (marine renewables)	pdf file held
255	Baseline	Seabirds	Aerial survey seabirds	y	y	y	BERR RAG	Regional	windfarm SEA areas	DTI	2006	Aerial surveys of birds in strategic wind farm areas 2004-2005	pdf file held
256	Development specific info	Projects	Appropriate Assesssment	y	y	y	SEA 6	Regional	SEA 6	DTI	2007	Appropriate Assessment with regard to 24th Offshore Oil and Gas Licensing Round	pdf file held
257	Baseline	Plankton	Plankton ecology	y	y	y	SEA 8	Regional	SEA 8	DTI	Undated	Metadata report for DTI area 8: Plankton	pdf file held
258	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	BERR	Broad	UK	DTI and MCEU	2004	Guidance notes: offshore wind farm consents process	pdf file held
259	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	ETSU	Broad	Generic	DTI, CAA and MoD	2002	Wind energy and aviation interests - interim guidelines	pdf file held
260	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	BERR	Broad	UK	DTI, MCA and DfT	Undated	Guidance on the assessment of the impact of offshore wind farms: methodology for assessing the marine navigational safety risks of offshore wind farms	pdf file held
261	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	BERR	Broad	UK	DTI, the Countryside Agency, the Countryside Council for Wales and Scottish Natural Heritage	2005	Guidance on the assessment of the impact of offshore wind farms: seascape and visual impact report	pdf file held
262	Baseline	Archaeology	General	y	y	y	Unstated	Regional	South Wales	Eames, A	1991	Shrouded Quays (The Lost Ports of Wales), Gwasg Carreg Gwalch	Not held
263	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	Regional	Pembrokeshire	Earl, S, Benson, C, Lomax, L and Baxter, J	2005	The short-beaked common dolphin Delphinus delphis and other cetaceans recorded during small boat surveys in Pembrokeshire waters, 2004	pdf file held
264	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	Regional	Pembrokeshire and southern Irish Sea	Earl, S, Sheen, E and Benson, C	2004	The short-beaked common dolphin Delphinus delphis and other cetaceans in Pembrokeshire waters and the southern Irish Sea	pdf file held
265	Potential Impacts	Marine mammals	General			y	Nysted offshore windfarm	Site specific	Denmark	Edren, SMC, Teilmann, J, Dietz, R and Cartensen, J	2004	Effect from the construction of Nysted Offshore wind farm on seals in Rodsand seal sanctuary based on remote video monitoring	pdf file held
266	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Deloitte Manufacturing Industry Group	Broad	UK	EEF and Deloitte	2008	Delivering the low-carbon economy – Business opportunities for UK manufacturers	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
267	Device specific info	Device specific info	General	y	y	y	US Department of the Interior Minerals Management Service (MMS)	Broad	USA	Elcock, D	2006	Potential Alternative Energy Technologies on the Outer Continental Shelf	pdf file held
268	Development specific info	Projects	Kentish Flats			Y	Kentish Flats Offshore Wind Farm	Site specific	North Kent coast	Emu	2002	Kentish Flats Offshore Wind Farm	EIA and associated documents
269	Potential Impacts	Fish Ecology	Disturbance/displacement/avoidance of/by fish due to noise (incl migratory routes)			y	Nysted offshore windfarm	Site specific	Denmark	Engell-Sorensen, K and Skyt, PH		Evaluation of the effect of noise from offshore pile-driving on marine fish	pdf file held
270	Potential Impacts	Fish Ecology	Change in sediment deposition			y	Nysted offshore windfarm	Site specific	Denmark	Engell-Sorensen, K and Skyt, PH		Evaluation of the effect of sediment spill from offshore wind farm construction on marine fish	pdf file held
271	Baseline	Designated sites	Regulation 33 documents	y	y	y	English Nature	Site specific	Dee Estuary	English Nature	2004	Dee Estuary European marine site – Consultation Draft Regulation 33 package	pdf file held
272	Baseline	Designated sites	Regulation 33 documents	y	y	y	English Nature and CCW	Site specific	Severn Estuary	English Nature and CCW	2003	English Nature and the Countryside Council for Wales' draft advice for the Severn Estuary Special Protection Area given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994	pdf file held
273	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	English Nature, RSPB, WWF-UK and BWEA	Broad	England	English Nature, RSPB, WWF-UK and BWEA	2001	Windfarm development and nature conservation: a guidance document for nature conservation organisations and developers when consulting over wind farm proposals in England	pdf file held
274	Device specific info	Device specific info	Wave energy converter	y			Swedish Centre for Renewable Electric Energy Conversion	Broad	Generic	Engstrom, J	Project in progress	Hydrodynamic modelling on a direct-driven linear generator	Project in progress
275	Device specific info	Device specific info	Stingray		y		Report for The Engineering Business Ltd by Entec Uk Ltd	Broad	Device specific	Entec	2002	Stingray Tidal Power Environmental Appraisal - Final Report	Not held
276	Device specific info	Device specific info	Tidal power		y		Sustainable Development Commission	Broad	Generic	Entec	2007	Research Report 2 - Tidal Technologies Overview	pdf file held
277	Baseline	Visual (seascape/landscape character, visual amenity)	Baseline	y	y	y	Gwynt y Mor Offshore Wind Farm	Regional	North Wales	Environe Partnership	2005	Gwynt y Mor Offshore Wind Farm Seascape & Visual Impact Assessment	pdf file held
278	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance		y		Environment Agency	Broad	UK	Environment Agency	2004	Position statement: generating electricity from tidal power	pdf file held
279	Baseline	Water and sediment quality	Bathing Waters	y	y	y	Environment Agency	Broad	Wales	Environment Agency	2005	Bathing Waters Report - Wales	pdf file held
280	Baseline	Water and sediment quality	Bathing Waters	y	y	y	Environment Agency	Broad	Wales	Environment Agency	2007	Bathing Waters Report - Wales	pdf file held
281	Device specific info	Device specific info	Cardiff Bay Barrage				Cardiff Bay Barrage	Site specific	Cardiff Bay	Environmental Advisory Unit, Liverpool University	1991	Cardiff Bay Barrage - Environmental Statement Part F. Summary	pdf file held
282	Potential Impacts	Sea birds	Potential collision risk			y	Bonneville Power Administration	Broad	USA	Erikson, W, Johnson, G, Young, D, Strickland, D, Good, R, Bourassa, M, Bay, K, Sernka, K	2002	Synthesis and comparison of baseline avian and bat use, raptor nesting and mortality information from proposed and existing wind developments	pdf file held
283	Baseline	Seabirds	Seabirds	y	y	y	Gwynt y Mor Offshore Wind Farm	Regional	North Wales	ERM	2005	Proposed Gwynt y Mor Offshore Windfarm: Offshore Ornithological Technical Report	pdf file held
284	Potential Impacts	Commercial fisheries	General	y			Wave Hub	Site specific	North Cornwall	Essen, M	2006	Wave Hub Development EIA Commercial Fisheries Study	pdf file held
285	Potential Impacts	Marine mammals	General	y	y	y	ASCOBANS	Broad	Baltic and North Seas	Evans, PGH	2003	Shipping as a possible source of disturbance to cetaceans in the ASCOBANS region	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
286	Baseline	Marine mammals	Cetaceans	y	y	y	Seawatch Foundation	Regional	Liverpool Bay and Northern Irish Sea	Evans, PGH and Anderwald, P		Cetaceans in Liverpool Bay and Northern Irish Sea: an update for the period 2001-05	pdf file held
287	Baseline	Marine mammals	Cetaceans	y	y	y	Seawatch Foundation	Regional	Liverpool Bay and Northern Irish Sea	Evans, PGH and Shepherd, B		Cetaceans in Liverpool Bay and Northern Irish Sea	pdf file held
288	Baseline	Marine mammals	Cetaceans	y	y	y	Seawatch Foundation	Broad	UK	Evans, PGH and Wang, J	2002	Re-examination of distribution data for the harbour porpoise around Wales and the UK with a view to site selection for this species	Not held
289	Baseline	Marine mammals	Cetaceans	y	y	y	Seawatch Foundation	Broad	UK	Evans, PGH, Anderwald, P and Baines, ME	2003	UK Cetacean Status Review	Not held
290	Baseline	Marine mammals	Cetaceans	y	y	y	Seawatch Foundation	Regional	Cardigan Bay	Evans, PGH, Baines, ME and Shepherd, B	2001	Bottlenose Dolphin Prey and Habitat Sampling Trials in Cardigan Bay	Not held
291	Development specific info	Projects	Rhyl tidal lagoon		y		3rd International Conference on Marine Renewable Energy	Site specific	North Wales	Evans, SE, Poole, JEP and Williams, KP	2004	The North Wales offshore tidal impoundment scheme: a preliminary study of requirements, constraints and opportunities	word file held
292	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y		Scottish Executive	Broad	Scotland	Faber Maunsell and Metoc plc	2007	Scottish marine renewables Strategic Environmental Assessment	pdf file held
293	Baseline	Archaeology	General	y	y	y	International Journal of Nautical Archaeology 18: 221-8	Site specific	Lough Lene	Farrell, RT	1989	The Crannog Archaeological Project (CAP), Republic of Ireland II: Lough Lene offshore island survey	Not held
294	Baseline	Archaeology	Prehistoric archaeological remains	y	y	y	SEA 6	Regional	SEA 6	Flemming, NC	2005	The scope of strategic environmental assessment of Irish Sea area SEA 6 in regard to prehistoric archaeological remains	pdf file held
295	Potential Impacts	Sea birds	Potential collision risk			y	California Energy Commission	Broad	USA	Flint, SA and Sterner, D	2007	California guidelines for reducing impacts to birds and bats from wind energy development	pdf file held
296	Potential Impacts	Physical environment	Change in coastal processes	y	y		Foresight Marine Panel	Regional	Bridgwater Bay	Foresight Marine Panel	2003	The potential for wet renewables to aid coast protection	Available to purchase
297	Device specific info	Device specific info	Marine Current Turbines		y		26th International Conference on Offshore Mechanics & Arctic Engineering June 10-15, 2007, San Diego, USA	Broad	Device specific	Fraenkel, P	2007	Marine Current Turbines: moving from experimental test rigs to a commercial technology	not held
298	Device specific info	Device specific info	Wind Turbine			y	Department of Electrical Power Engineering, Norwegian University of Science and Technology	Broad	Generic	Fuglseth, TP	Project in progress	Modelling of and controller design for floating wind turbines	Project in progress
299	Potential Impacts	Visual (seascape/landscape character, visual amenity)	General			y	REFocus	Broad	Generic	Furze, J	2002	Stealth wind turbines: designs and technologies to reduce visual pollution	pdf file held
300	Baseline	Archaeology	General	y	y	y	in Hurley, MF, Scully, OMB, Cleary, RM, Hurley, MF, and McCutcheon, SWJ, 1997, Late Viking Age and medieval Waterford: excavations 1986-1992. Waterford: Waterford Corporation	Broad	Generic	Gahan, A, McCutcheon, C, Hurley, MF, and Hurst, JG	1997	Medieval Pottery	Not held
301	Potential Impacts	Sea birds	General			y	Journal of applied ecology 41 724-734	Broad	Generic	Garthe, S and Huppop, O	2004	Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
302	Potential Impacts	Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)			y	COWRIE	Broad	UK	Georg Nehls, Klaus Betke, Stefan Eckelmann & Martin Ros	2007	Assessment and costs of potential engineering solutions for the mitigation of the impacts of underwater noise arising from the construction of offshore windfarms	pdf file held
303	Potential Impacts	Fish Ecology	Potential effects of EMF	y	y	y	COWRIE	Broad	UK	Gill, AB	2007	COWRIE 2.0 EMF First Quarterly Interim Report	pdf file held
304	Potential Impacts	Fish Ecology	Potential effects of EMF	y	y	y	J. Mar. Biol. Ass. UK (2005), 85, 1075-1081	Broad	UK	Gill, AB and Kimber, JA	2005	The potential for cooperative management of elasmobranchs and offshore renewable energy development in UK waters	pdf file held
305	Potential Impacts	Fish Ecology	Potential effects of EMF			y	CCW	Broad		Gill, AB and Taylor, H	2001	The potential effects of electromagnetic fields generated by cabling between offshore wind turbines upon elasmobranch fishes	Not held
306	Potential Impacts	Fish Ecology	Potential effects of EMF			y	COWRIE	Broad	UK	Gill, AB, Gloyne-Phillips, I, Neal, KJ and Kinmer, JA	2005	The potential effects of electromagnetic fields generated by sub-sea power cables assocaiated with offshore wind farm developments on electrically and magnetically sensitive marine organisms - a review	pdf file held
307	Baseline	Benthic Ecology	Marine landscape classification	y	y	y	The Irish Sea Pilot	Regional	Irish Sea	Golding, N, Vincent, MA and Connor, DW	2004	Report on the development of a marine landscape classification for the Irish Sea	pdf file held
308	Potential Impacts	Broad Issues	General impacts	y	y		BWEA	Broad	UK	Golding, T	2006	The npower Juice Path to Power: Delivering confidence in the development of wave and tidal stream energy around the UK. Stage 2: The Stakeholder/Statutory bodies view on deployment	pdf file held
309	Baseline	Physical environment	Seabed sediment	y	y	y	BGS	National	UK	Graham, C, Stewart, HA, Poulton, CVL and James, JWC	2001	A description of offshore gravel areas around the UK	pdf file held
310	Baseline	Physical environment	Wave and tide resource	y			University of Edinburgh Institute for Energy Systems	Broad	UK	Graham, S, Wallace, R and Macpherson, E	Project in progress	Marine Energy Resource Mapping and Cable Routing Using a GIS	Project in progress
311	Potential Impacts	Ecology	General		y		British ecological society Ecological issues No.3	Broad	Generic	Gray, A	1992	The ecological impact of estuarine barrages	pdf file held
312	Baseline	Commercial Fisheries	Coastal fisheries	y	y	y	CEFAS	Broad	England and Wales	Gray, MJ	1995	The coastal fisheries of England and Wales, Part 3: A review of their status 1992-1994	pdf file held
313	Potential Impacts	Commercial fisheries	General			y	Ethics Place and Envirojment, Vol. 8, No. 2, 127-140, June 2005	Broad	UK	Gray, T, Haggett, C and Bill, D	2005	Offshore wind farms and commercial fisheries in the UK: a study in stakeholder consultation	pdf file held
314	Device specific info	Device specific info	Vertical axis current turbine		y		University of Edinburgh Institute for Energy Systems	Broad	Generic	Gretton, G, Bruce, T and Salter, S	Project in progress	Evaluation of vertical axis tidal current turbines	Project in progress
315	Device specific info	Device specific info	Power production estimates		y		Electric Power Research Institute (EPRI)	Broad	Generic	Hagerman, G, Bedard, R and Polagye, B	2005	Guidelines for preliminary estimation of power production by tidal in stream (current) energy coinversion devices	pdf file held
316	Development specific info	Projects	Wave Hub	Y			SWRDA	Site specific	North Cornwall	Halcrow	2006	Wave Hub	EIA and associated documents
317	Potential Impacts	Physical environment	Change in coastal processes	y			Wave Hub	Site specific	North Cornwall	Halcrow	2006	Wave Hub Development and Design Phase: Coastal Processes Study Report	pdf file held
318	Baseline	Marine mammals	Grey seals	y	y	y	SEA 6	Regional	Wales	Hammond, PS, Aarts, G, Matthiopoulos, J and Duck, CD	2005	Distribution and movements of grey seals around Wales	Not held
319	Baseline	Marine mammals	Cetaceans	y	y	y	SEA 6, 7 and 8	Regional	SEA 6, 7 and 8	Hammond, PS, Northridge, SP, Thompson, D, Gordon, JCD, Hall, AJ, Aarts, G and Matthiopoulos, J	2005	Background information on marine mammals for Strategic Environmental Assessment 6	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
320	Development specific info	Projects	Wave Dragon Wave Energy	Y			Wave Dragon	Site specific	Nissum Bredning	Hansen, LK, Christensen, L and Sørensen, HC	2003	Experiences from the Approval Process of the Wave Dragon Project	pdf file held
321	Baseline	Noise	Ambient noise	y	y	y	SEA 6	Regional	SEA 6	Harland, EJ and Jones, SAS	2005	Underwater Ambient Noise	pdf file held
322	Device specific info	Device specific info	Wave energy converter	y			3rd International Conference on Marine Renewable Energy	Broad	Generic	Harris, RE, Johanning, L and Wolfram, J	2004	Mooring systems for wave energy converters: A review of design issues and choices	pdf file held
323	Baseline	Physical environment	Wave and tide resource	y	y		University of Edinburgh Institute for Energy Systems	Broad	University of Edinburgh	Harrison, G	Project in progress	Climate Change and the Marine Energy Resource	Project in progress
324	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Health and Safety Executive	Broad	UK	Health and Safety Executive	2006	The health and safety risks and regulatory strategy related to energy developments	pdf file held
325	Potential Impacts	Fish Ecology	Potential collision risk		y		ASCE Journal of Hydraulic Engineering Vol 131, No 10	Broad	USA	Hecker, GE and Cook, TC	2005	Development and Evaluation of a new helical fish friendly hydro-turbine	pdf file held
326	Baseline	Fish Ecology	Shad	y	y	y	CCW	Broad	Welsh waters	Henderson, PA	2003	Background information on species of shad and lamprey	pdf file held
327	Device specific info	Device specific info	Wave energy converter	y			BERR	Broad	Device specific	Heriot-Watt University and the University of Edinburgh	2007	Preliminary wave energy device performance protocol	pdf file held
328	Baseline	Archaeology	General	y	y	y	in Moore, D., 1970, The Irish Sea Province in Archaeology and History, Cambrian Archaeological Society	Regional	Irish Sea	Herity, M	1970	The Early Prehistoric Period around the Irish Sea	Not held
329	Potential Impacts	Fish Ecology	Artificial reef effect			y	Ocean and Coastal Management 47 (2004) 95-122	National	Germany	Hieronymus, B, Krause, G and Rosenthal, H	2004	Extensive open ocean aquaculture development within wind farms in Germany: the prospect of offshore co-management and legal constraints	pdf file held
330	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	CCW	Broad	Ireland and Wales	Hill, M, Briggs, J, Minto, P, Bagnall, D, Foley, K and Williams, A	2001	Guide to best practice in seascape assessment	pdf file held
331	Potential Impacts	Environment	General	y	y	y	CCW	Broad	Wales	Hinton, C, Kazer, S and Hawkins, K	2005	Potential Nature conservation and landscape impacts of marine renewable energy developments in Welsh territorial waters	pdf file held
332	Baseline	Benthic Ecology	BAP habitats and species	y	y	y	WWF	Broad	UK	Hiscock, K and Breckels, M		Marine Biodiversity Hotspots in the UK: Identification and Protection	pdf file held
333	Potential Impacts	Broad Issues	General impacts			y	BERR	Broad	UK	Hiscock, K, Tyler-Walters, H and Jones, H	2002	High level environmental screening study for offshore wind farm developments - marine habitats and species project	pdf file held
334	Device specific info	Device specific info	Davis Hydro Turbine		y		Ministry of Employment and Investment, Government of British Columbia	Broad	Device specific	HN Halvorson Consultants Ltd	1994	Evaluation of Nova Energy ltds Hydro Turbine	pdf file held
335	Potential Impacts	Marine mammals	General			y	Horns Reef	Broad	Denmark	Hoffmann, E, Astrup, J, Larsen, F, Munch-Petersen, S and Stottrup, J	2000	Effects of marine windfarms on the distribution of fish, shellfish and marine mammals in the Horns Rev area	pdf file held
336	Device specific info	Device specific info	Severn Barrage		y		CCW library	Regional	Severn Estuary	Holbrook, A	2000	Tidal barrages in the Severn Estuary: a bibliography 1904 - 1999	CCW library
337	Baseline	Physical environment	Seabed sediment	y	y	y	SEA 6	Regional	SEA 6	Holmes, R and Tappin, DR	2005	Dti Strategic Environmental Assessment area 6, Irish Sea, seabed and surficial geology and processes.	pdf file held
338	Baseline	Carbon Capture and Storage	General				EAGE First Break Magazine	National	Netherlands	Hostee, Seeberger, Orlic, Mulders, Bergen and Bisschop	2008	The Feasibility of Effective and Safe Carbon Dioxide storage in the De Lier Gas Field	Not held
339	Potential Impacts	Shipping	Radio navigation and Radar				MCA	Site specific	North Hoyle	Howard, M and Brown, C	2004	Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle wind farm by QinetiQ and the Maritime and Coastguard Agency	pdf file held
340	Baseline	Physical environment	Hydrography	y	y	y	SEA 6	Regional	SEA 6	Howarth, MJ		Hydrography of the Irish Sea	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
341	Potential Impacts	Fish Ecology	Potential collision risk		y		Teamwork Technology BV	Site specific	Afsluitdijk, Netherlands	http://www.reinwater.nl/	2005	A full fish monitoring program was done in 2005, by setting to Fishing nets. One behind the turbine and one as a reverence. The fish was guided through these nets in a small vessel and checked for possible injuries. No injured fish was found from the net behind the turbine or at the reference net. Together with stichting reinwater is being researched how the migration of fish goes together with the aplication of these turbines. As it looks most fish migrates as there is hardly any flow. Although all think that these turbines will not harm any fish. The character of the mogration prohibits fish to go through when the turbine is rotating.	Not in English
342	Potential Impacts	Broad Issues	General impacts	y			Wave Energy Centre, Losboa, Portugal	Broad	Generic	Huertas-Olivares, C	Project in progress	Environmental impacts of wave energy	Project in progress
343	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y			Portuguese wave energy centre	Broad	Portugal	Huertas-Olivares, C, Neumann, F and Sarmento, A	2007	Environmental management recommendations for the wave energy Portuguese Pilot Zone	pdf file held
344	Potential Impacts	Sea birds	Potential collision risk			y	Ibis (2006) 148 90-109	Broad	Germany	Huppop, O, Dierschke, J, Exo, K-M, Friedrich, E and Hill, R	2006	Bird migration studies and potential collision risk with offshore wind turbines	pdf file held
345	Baseline	Archaeology	General	y	y	y	Waterford Corporation	Broad	Generic	Hurley, MF, Scully, OMB, Cleary, RM, Hurley, MF, and McCutcheon, SWJ	1997	Late Viking Age and medieval Waterford: excavations 1986-1992	Not held
346	Potential Impacts	Fish Ecology	General			y	Nysted offshore windfarm	Site specific	Denmark	Hvidt, CB and Jensen, BS	2005	Hydroacoustic monitoring of fish communities at offshore wind turbine foundations	pdf file held
347	Potential Impacts	Fish Ecology	General			y	Horns Reef	Site specific	Horns Reef	Hvidt, CB, Brunner, L and Knudsen, FR	2005	Hydroacoustic registration of fish abundance in offshore wind farms	pdf file held
348	Potential Impacts	Fish Ecology	General			y	Horns Reef	Site specific	Denmark	Hvidt, CB, Leonhard, SB, Klaustrup, M and Pedersen, J	2006	Hydroacoustic monitoring of fish communities at offshore wind farms	pdf file held
349	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	International association of marine aids to navigation and light house authorities	Broad	UK	IALA	2004	IALA recommendation O-117 on the marking of offshore wind farms Edition 2	pdf file held
350	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y		International association of marine aids to navigation and light house authorities	Broad	UK	IALA	2005	IALA recommendation O-131 on the marking of offshore wave and tidal energy devices Edition 1	pdf file held
351	Legislation, policy and guidance	Archaeology	General	y	y	y	ICOMOS.IFA, 2001, Standard and Guidance for Archaeological Desk-based Assessment, Institute of Field Archaeologists	Broad	Generic	ICOMOS	1996	Charter on the Protection and management of Underwater Cultural Heritage	Not held
352	Potential Impacts	Sea birds	Potential collision risk			Y	Thanet Offshore Wind Farm	Site specific	North east Kent coast	IECS	2004	Appendix 8.2 Bird collision risk assessment	pdf file held
353	Legislation, policy and guidance	Archaeology	General	y	y	y	Institute of Field Archaeologists	Broad	Generic	IFA	2001	Standard and Guidance for Archaeological Desk-based Assessment	Not held
354	Baseline	Fish Ecology	Basking shark	y	y	y	Conserving Endangered Basking Sharks	National	UK	In press		Conserving Endangered Basking Sharks	In press
355	Potential Impacts	Physical environment	Scour	y	y	y	RAG list of issues 2007	Broad		In press		Dynamics of scout pits and scour protection	In press
356	Potential Impacts	Shipping	Potential for sediment accretion to affect dredging programmes	y	y	y	RAG list of issues 2007	Broad		In press		Review of channel migration	In press
357	Potential Impacts	Physical environment	Change in sediment transport			y	RAG list of issues 2007	Broad	Generic	In press		Review of Round 1 sediment process monitoring data - lessons learnt	In press

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
358	Device specific info	Device specific info	General	y	y		BERR	Broad	Generic	International Energy Agency	2003	Status and research and development priorities: wave and marine current energy	pdf file held
359	Baseline	Physical environment	Wave and tide resource				Seminar	Regional	Irish Sea	Irish Sea Forum	1999	Irish Sea Forum : joint seminar on Irish Sea renewable energy resources	CCW library
360	Development specific info	Projects	Greater Gabbard OWF			Y	Greater Gabbard	Site specific	Greater Thames	ISVR Consulting	2005	Proposed Greater Gabbard offshore wind farm prediction of noise from offshore piling operations during construction	pdf file held
361	Potential Impacts	Fish Ecology	Potential collision risk		y		Carbon Trust	Broad		IT Power		Fish Friendly Turbines	Not held
362	Baseline	Archaeology	General	y	y	y	Oxford Journal of Archaeology 17(1): 15-41	National	UK	Ixer, RA, and Budd, P	1998	The mineralogy of the Bronze Age copper ores from the British Isles: implications for the composition of early metalwork	Not held
363	Device specific info	Device specific info	Semi-submersible tidal stream prototype		y		BERR	Broad	Device specific	JA Consult	2004	The monitoring, operation and assessment of a semi-submersible tidal stream prototype	pdf file held
364	Development specific info	Projects	Fundy Tidal Energy SEA		y		Offshore Energy Environmental Research Association, Tidal Advisory Group and the New Brunswick Department of Energy	Local	Bay of Fundy	Jacques Whitford	2008	Background Report for the Fundy Tidal Electric Energy Strategic Environmental Assessment	pdf file held
365	Potential Impacts	Aviation	Radar			y	BERR	Broad	Generic	Jago, P and Taylor, N	2002	Wind turbines and aviation interests - European experience and practice	pdf file held
366	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	ALSF	Site specific	Outer Bristol Channel	James, JWC, Philpott, SL, Jenkins, G, Mackie, ASY, Darbyshire, T and Rees, EIS	2003	Outer Bristol Channel Marine Habitat Study - 2003 Investigations and Results	pdf file held
367	Baseline	Archaeology	General	y	y	y	Unstated	National	Wales	Jenkins, J Geraint	2006	Welsh Ships & Sailing Men, Gwasg Carreg Gwalch	Not held
368	Potential Impacts	Fish Ecology	General			y	Horns Reef	Site specific	Denmark	Jensen, H, Kristensen, PS and Hoffmann, E	2004	Sandeels in the wind farm area at Horns Reef	pdf file held
369	Development specific info	Projects	Gwynt y Mor			y	Gwynt y Mor Offshore Wind Farm	Site specific	North Wales	Jiggins, M and Marks, P	2005	Gwynt y Mor Offshore Wind Farm Noise Impact Assessment	pdf file held
370	Device specific info	Device specific info	Wave energy converter	y			Water Environment Technology, Chalmers University of Technology, Sweden	Broad	Generic	John Fitzgerald, Lars Bergdahl	Undated	Considering Mooring Cables for Offshore Wave Energy Converters	pdf file held
371	Baseline	Designated sites	Offshore habitats regs	y	y	y	JNCC	Broad	UK	Johnston, CM, Turnbull, CG and Tasker, ML		Natura 2000 in UK Offshore Waters: Advice to support the implementation of the EX Habitats and Birds Directives in UK offshore waters	pdf file held
372	Legislation, policy and guidance	Archaeology	General	y	y	y	JNAPC	National	UK	Joint Nautical Archaeology Policy Committee	1995	Code of Practice for Seabed Developers	Not held
373	Potential Impacts	Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)			y	COWRIE	Broad	UK	Jonathan Gordon, David Thompson, Douglas Gillespie, Mike Lonergan, Susannah Calderan, Ben Jaffey, Victoria Todd	2007	Assessment of the potential for acoustic deterrents to mitigate the impact on marine mammals of underwater noise arising from the construction of offshore windfarms	pdf file held
374	Baseline	Archaeology	General	y	y	y	International Journal of Nautical Archaeology 7(2): 152-8	Site specific	Menai Strait	Jones, C	1978	The Pwll Fanog wreck – A slate cargo in the Menai Strait	Not held
375	Baseline	Designated sites	Marine Natural Area	y	y	y	English Nature	Regional	Irish Sea	Jones, LA, Coyle, MD, Gilliland, PM, Larwood, JG, Murray, AR		The Irish Sea Marine Natural Area: A contribution to regional planning and management of the seas around England	pdf file held
376	Baseline	Designated sites	Marine Natural Area	y	y	y	English Nature	Regional	South Western Peninsula	Jones, LA, Irving, R, Cork, M, Coyle, MD, Evans, D, Gilliland, PM, Murray, AR		The South West Peninsula Marine Natural Area: A contribution to regional planning and management of the seas around England	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
377	Baseline	Designated sites	Marine Natural Area	y	y	y	English Nature	Regional	The Western Approaches	Jones, LA, Irving, R, Coyle, MD, Evans, D, Gilliland, PM, Murray, AR		The Western Approaches Marine Natural Area: A contribution to regional planning and management of the seas around England	pdf file held
378	Baseline	Benthic Ecology	Sensitivity mapping	y	y	y	CCW	Regional	Ceredigion	Jones, M	2001	SensMap atlas : sensitivity and mapping of inshore marine biotopes in the southern Irish Sea : Ceredigion	CCW library
379	Baseline	Benthic Ecology	Sensitivity mapping	y	y	y	CCW	Regional	Gwynedd	Jones, M	2001	SensMap atlas : sensitivity and mapping of inshore marine biotopes in the southern Irish Sea : Gwynedd	CCW library
380	Baseline	Benthic Ecology	Sensitivity mapping	y	y	y	CCW	Regional	Pembrokeshire	Jones, M	2001	SensMap atlas : sensitivity and mapping of inshore marine biotopes in the southern Irish Sea : Pembrokeshire	CCW library
381	Baseline	Benthic Ecology	Sensitivity mapping	y	y	y	CCW	Regional	Yns Mon	Jones, M	2001	SensMap atlas : sensitivity and mapping of inshore marine biotopes in the southern Irish Sea : Ynys Mon	CCW library
382	Baseline	Archaeology	General	y	y	y	in Davidson, A., 2002, The coastal archaeology of Wales, CBA Research Report 131, Council for British Archaeology, York	National	Wales	Jones, N	2002	Description of the coast	Not held
383	Baseline	Marine mammals	Cetaceans	y	y	y	Marine Awareness North Wales	Regional	Anglesey	Jones, N.H., Shucksmith, R, Dicks, E.F. & Stoyle G.W	2005	Abundance and Distribution of Harbour Porpoise (Phocaena phocaena) in North Anglesey waters determined from 2002, 2003 & 2004 boatbased surveys.	Not held
384	Baseline	Physical environment	Water temperature	y	y	y	CEFAS	Broad	UK	Jouce, AE	2006	The coastal temperature network and ferry route programme: long-term temperature and salinity observations	pdf file held
385	Potential Impacts	Sea birds	General			y	Nysted offshore windfarm	Site specific	Denmark	Kahlert, J, Petersen, IK, Desholm, M and Therkildsen, O	2004	Investigations of birds during operation of Nysted offshore wind farm at Rodsand	pdf file held
386	Potential Impacts	Sea birds	General			y	Nysted offshore windfarm	Site specific	Denmark	Kahlert, J, Petersen, IK, Fox, AD, Desholm, M and Therkildsen, O	2003	Investigations of birds during construction and operation of Nysted offshore wind farm at Rodsand	pdf file held
387	Potential Impacts	Sea birds	Physical presence of new structures affecting use of area			y	COWRIE	Broad	UK	Kaiser, MJ	2002	Predicting the displacement of common scoter Melanitta nigra from benthic feeding areas due to offshore windfarms	pdf file held
388	Baseline	Seabirds	Scoter distribution	y	y	y	Ibis (2006) 148 110-128.	Site specific	Liverpool Bay	Kaiser, MJ, Galanidi, M, Showler, DA, Elliott, AJ, Caldrow, RWG, Rees, EIS, Stillman, RA and Sutherland, WJ		Distribution and behaviour of common scoter relative to prey resources and environmental parameters	word file held
389	Potential Impacts	Marine mammals	General			y	MINOS	Regional	North and Baltic Sea	Kellermann, A et al	2004	Marine warm-blooded animals in the North- and Baltic Seas Evaluation of the effects of offshore wind farms	Summary held
390	Baseline	Plankton	Plankton ecology	y	y	y	SEA 6	Regional	SEA 6	Kennington, K and Rowlands, WLI		SEA area 6 Technical Report - Plankton ecology of the Irish Sea	pdf file held
391	Baseline	Water and sediment quality	Contaminants	y	y	y	SEA 6	Broad	SEA 6	Kenny, A, Reynolds, W, Sheahan, D, McCubbin, D, Kershaw, P, Rycroft, R, Smith, A, Brooks, S, Kelly, C, Allchin, C, Lawton, E	2005	Contaminant status of the Irish Sea	pdf file held
392	Device specific info	Device specific info	Severn Barrage		y		Proceeds of the Institute of Civil Engineers March 2005 Issue ES1 pg 31-39	Regional	Severn Estuary	Kirby, R and Shaw, TL	2005	Severn Barrage, UK- Environmental Reappraisal	pdf file held
393	Baseline	Carbon Capture and Storage	General				Tyndall Centre for Climate Change Research and British Geological Survey	Regional	Eastern Irish Sea	Kirk, K	2006	Potential for Storage of CO2 in the Rocks beneath the East Irish Sea	Not held
394	Device specific info	Device specific info	Wave energy converter	y			Wave Dragon	Broad	Device specific	Knapp, W, Holmen, E and Schilling, R	Undated	Considerations for water turbines to be used in wave energy converters	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
395	Potential Impacts	Ecology	Disturbance/displacement/avoidance of/by fish due to noise (incl migratory routes)			y	ETSU	Broad	UK	Kragh, J, Theofiloyiannakos, D, Klug, H, Osten, T, Andersen, B, van der Borg, N, Ljunggren, S, Fegeant, O, Whitson, RJ, Bass, J, Englich, D, Eichenlaub, C and Weber, R	1999	Noise emmission from wind turbines	pdf file held
396	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Carbon Trust	Broad	UK	L.E.K. Consulting		Policy frameworks for renewables Analysis on policy frameworks to drive future investment in near and long-term renewable power in the UK	pdf file held
397	Potential Impacts	Visual (seascape/landscape character, visual amenity)	General			y	Energy Policy 35 (2007) 4050-4071	Broad	Denmark	Ladenburg, J and Dubgaard, A	2007	Willingness to pay for reduced visual disamenities from offshore wind farms in Denmark	pdf file held
398	Potential Impacts	Visual (seascape/landscape character, visual amenity)	General		y		Natural England	Regional	Severn Estuary	Land Use Consultants	2007	Advice on potential landscape/seascape and visual impacts of a Severn Barrage	pdf file held
399	Potential Impacts	Broad Issues	Cumulative			y	ETSU	Broad	UK	Landscape Design Associates	2000	A Guide to Assessing the Cumulative Effects of Wind Energy Development	Volume 3 only
400	Potential Impacts	Ecology	Artificial reef effect	y			7th European Wave and Tidal Energy Conference, 2007	Broad	Generic	Langhamer, O and Wilhelmsson, D	2007	Wave power devices as artificial reefs	pdf file held
401	Baseline	Fish Ecology	General	y	y	y	Fisheries Science Partnership	Regional	Western approaches	Large, P, Mainprize, B, Cotter, J, Van Der Kooij, J, Warne, S and Mills, C	2004	Catches of blue ling and other deep-water species to the west of Britain by the MFV Farnella, February-March 2004	pdf file held
402	Potential Impacts	Benthic ecology	General			y	Horns Reef	Site specific	Horns Reef	Leonhard, SB		Horns Rev Offshore Windfarm Environmental Impact Assessment of Sea Bottom and Marine Biology	pdf file held
403	Potential Impacts	Benthic ecology	General			y	Horns Reef	Site specific	Horns Reef	Leonhard, SB and Pedersen, J	2005	Benthic Communities at Horns Rev Before, During and After Construction of Horns Rev Offshore Windfarm	pdf file held
404	Potential Impacts	Ecology	Artificial reef effect			y	Horns Reef	Site specific	Denmark	Leonhard, SB and Pedersen, J	2005	Hard bottom substrate monitoring	pdf file held
405	Potential Impacts	Ecology	Disturbance/displacement/avoidance of/ due to noise			y		Site specific	New Zealand	Leventhall, G	2004	Notes on low frequency noise from wind turbines with special reference to the Genesis Power Ltd proposal, near Waiuku New Zealand	pdf file held
406	Development specific info	Projects	Pembrokeshire Tidal Energy		y		Lunar Energy	Site specific	Pembrokeshire	Lewis, J	2007	Pembrokeshire Tidal Energy Project: Environmental Impact Assessment Scoping Report	pdf file held
407	Baseline	Designated sites	Nationally important marine areas	y	y	y	Irish Sea Pilot	Regional	Irish Sea	Lieberknecht, LM, Carwardine, J, Connor, DW, Vincent, MA, Atkins, SM and Lumb, CM	2004	The Irish Sea Pilot - report on the identification of nationally important marine areas in the Irish Sea	pdf file held
408	Baseline	Designated sites	Nationally important marine features	y	y	y	Irish Sea Pilot	Regional	Irish Sea	Lieberknecht, LM, Vincent, MA and Connor, DW	2004	The Irish Sea Pilot - report on the identification of nationally important marine features in the Irish Sea	pdf file held
409	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise			y		Site specific	Sweden	Lindell, H	2003	Measurements of underwater noise	pdf file held
410	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	WWF	Broad	Wales	Linley-Adams	2003	All at sea: Welsh case study on marine renewable energy	pdf file held
411	Baseline	Human environment	Fishing Activity	y	y	y	Gwynt y Mor Offshore Wind Farm	Regional	Liverpool Bay	Lockwood, S	2005	Commercial and Recreational Fisheries of Liverpool Bay	pdf file held
412	Baseline	Fish	Fishing Activity	y	y	y	Eastern Irish Sea Offshore Windfarms	Regional	Eastern Irish Sea	Lockwood, S	2005	Strategic Environmental Assessment of the Fish and Shellfish Resources with respect to Proposed Offshore Wind Farms in the Eastern Irish Sea	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
413	Device specific info	Device specific info	Wind Turbine			y	Department of Civil and Transport Engineering, Norwegian University of Science and Technology	Broad	Generic	Long, H	Project in progress	An option for towers in larger wind turbines	Project in progress
414	Baseline	Human environment	General	y	y	y	SEA 6	Regional	SEA 6	Luddington, L and Moore, JJ	2005	SEA 6 Area Other Users	pdf file held
415	Baseline	Designated sites	Nature conservation objectives	y	y	y	Irish Sea Pilot	Regional	Irish Sea	Lumb, CM, Fowler, SL, Atkins, s, Gilliland, PM and Vincent, MA	2004	The Irish Sea Pilot: Developing marine nature conservation objectives for the Irish Sea	pdf file held
416	Baseline	Archaeology	General	y	y	y	Sutton Publishing, Stroud	National	Wales	Lynch, F, Aldhouse-Green, S and Davies, JL	2000	Prehistoric Wales	Not held
417	Baseline	General site background	Economic and social	y	y	y	SEA 6	Regional	SEA 6	Mackay Consultants	2005	SEA Economic and Social Baseline Study	pdf file held
418	Baseline	Seabirds	Seabirds	y	y	y	SEA 6, 7 and 8	Regional	SEA 6, 7 and 8	Mackey, M and Gimenez, DP		SEA 678 Data Report for Offshore Seabird Populations	pdf file held
419	Baseline	Marine mammals	Cetaceans	y	y	y	SEA 6, 7 and 8	Regional	SEA 6, 7 and 8	Mackey, M, Gimenez, DP and Cadhla, O		SEA 678 data Report for Offshore cetacean Populations	pdf file held
420	Baseline	Benthic Ecology	Subtidal biotopes	y	y	y	ALSF	Regional	Outer Bristol Channel	Mackie, ASY, James, JWC, Rees, EIS, Darbyshire, T, Philpott, SL, Mortimer, K, Jenkins, GO and Morando, A	2007	The outer Bristol Channel marine habitat study	Summary held
421	Potential Impacts	Commercial fisheries	General			y	CEFAS	Broad	UK	Mackinson, S, Curtin, H, Brown, S, McTaggart, K, Taylor, N, Neville, S and Rogers, S	2006	A report on the perceptions of the fishing industry into the potential socio-economic impacts of offshore wind energy development on their work patterns and income	pdf file held
422	Potential Impacts	Ecology	General			y	COWRIE	Broad	Generic	Maclean, IMD, Frederiksen, M and Rehfisch, MM	2007	Potential use of population viability analysis to assess the impact of offshore windfarms on bird populations	pdf file held
423	Potential Impacts	Sea birds	Physical presence of new structures affecting use of area			y	COWRIE	Broad	Generic	Maclean, IMD, Skov, H and Rehfisch, MM	2007	Further use of aerial surveys to detect bird displacement by offshore windfarms	pdf file held
424	Potential Impacts	Sea birds	Physical presence of new structures affecting use of area			y	COWRIE	Broad	UK	Maclean, IMD, Skov, H, Rehfisch, MM and Piper, W	2006	Use of aerial surveys to detect bird displacement by offshore windfarms	pdf file held
425	Baseline	Archaeology	General	y	y	y	Waine Research, Wolverhampton	Broad	Generic	MacRae, JA and Waine, CV	1990	The Steam Collier Fleets	Not held
426	Potential Impacts	Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)			y	Marine Ecology Progress Series 309, 279-295	Broad	Generic	Madsen, PT, Wahlberg, M, Tougaard, J, Lucke, J and Tyack, P	2006	Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs	summary held
427	Potential Impacts	Shipping	Radio navigation and Radar			y	BWEA	Site specific	Kentish Flats	Marico Marine	2007	Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm	pdf file held
428	Development specific info	Projects	Seagen Strangford Lough work		y		Marine Current Turbines	Site specific	Strangford Lough, Northern Ireland	Marine and Risk Consultants Ltd	2005	Navigational Risk Assessment Strangford Narrows Preliminary Report	pdf file held
429	Baseline	Marine mammals	Cetaceans	y	y	y	Marine Awareness North Wales	Regional	Anglesey	Marine Awareness North Wales		On-going project to monitor harbour porpoise	Ongoing project
430	Potential Impacts	Broad Issues	General impacts			y	Report for the Marine Institute	Broad	Generic	Marine Institute	2000	Assessment of impact of offshore wind energy structures on the marine environment	pdf file held
431	Potential Impacts	Broad Issues	Economic Benefits	y	y	y	Marine Institute	Broad	Ireland	Marine Institute	2005	Analysis of the Potential Economic Benefits of Developing Ocean Energy in Ireland	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
432	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Marine Institute	Broad	Ireland	Marine Institute	2006	Sea Change – A Marine Knowledge, Research & Innovation Strategy for Ireland (2007-2013)	pdf file held
433	Potential Impacts	Broad Issues	General impacts	y	y	y	BERR RAG	Broad	UK	Marine Renewable Energy Research Advisory Group	2007	Environmental Research Portfolio - Status Report December 2007	pdf file held
434	Baseline	Archaeology	General	y	y	y	SEA 8	Regional	SEA 8	Maritime Archaeology Ltd		Marine Archaeological Heritage	Not held
435	Baseline	Archaeology	General	y	y	y	English Heritage	Site specific	London	Marsden, P	1994	Ships of the Port of London: First to eleventh centuries AD	Not held
436	Baseline	Archaeology	General			y	Gwynt y Mor Offshore Wind Farm	Site specific	North Wales	Martin, A, Hayes, L and Bowyer, M	2005	Gwynt y Môr Offshore Wind Farm Cultural Heritage Technical Report	pdf file held
437	Potential Impacts	Physical environment	Change in direction/reflection of energy	y			7th European Wave and Tidal Energy Conference, 2007	Site specific	Foz do Douro, Azores?	Martins-Rivas, H and Mei, CC	2007	Diffraction effects near Foz do Douro Breakwater	pdf file held
438	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	MCA	Broad	UK	MCA	2006	Windfarm Shipping Route template	pdf file held
439	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	MCA	Broad	UK	MCA	2007	Draft Marine Guidance Note: Guidance to mariners operating in the vicinity of UK offshore renewable energy installations	Not held
440	Baseline	Archaeology	General	y	y	y	The Institute of Irish Studies, The Queen's University of Belfast and the Ulster Folk and Transport Museum	Regional	Irish Sea	McCaughan, M and Appleby, J	1989	The Irish Sea Aspects of Maritime History	Not held
441	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise			y		Site specific	Sweden	McKenzie Maxon, C and Nielsen, OW	2000	Offshore wind turbine construction: Offshore pile-driving underwater and above-water noise measurements and analysis	pdf file held
442	Potential Impacts	Ecology	General	y			Hatfield Marine Science Centre, Oregon State University	Broad	Generic	McMurray, G	2007	Wave Energy Ecological Effects Workshop: Ecological Assessment Briefing Paper	pdf file held
443	Baseline	Designated sites	Inshore SPA	y	y	y	JNCC	Broad	UK	McSorley, CA, Webb, A, Dean, BJ and Reid, JB	2005	UK Inshore Special Protection Areas: a methodological evaluation of site selection and definition of the extent of an interest feature using transect data	pdf file held
444	Development specific info	Projects	Seagen Strangford Lough work		y		Marine Current Turbines	Site specific	Strangford Lough, Northern Ireland	MCT		Effects of a tidal stream energy system on the water column and local environment	CONFIDENTIAL pdf file held
445	Baseline	Seabirds	Hi Definition Video Survey	y	y	y	COWRIE	Broad	Generic	Mellor, M, Craig, T, Baillie, D and Woolaghan, P	2007	Trial high definition video survey of seabirds	pdf file held
446	Baseline	Archaeology	General	y	y	y	Bournemouth University for English Heritage, Aggregates Levy Sustainability Fund	Broad	Generic	Merritt, O, Parham, D, and McElvogue, DM	2007	Enhancing our Understanding of the Marine Historic Environment: Navigational Hazards Project Final Report	Not held
447	Baseline	General site background	Wave and tide review	y	y	y	SWRDA	Regional	SW England	Metoc	2004	Seapower SW Review - Resources, constraints and development scenarios for wave and tidal stream power	pdf file held
448	Baseline	Physical environment	Wave and tide resource		y		Sustainable Development Commission	Broad	UK	Metoc	2007	Research Report 1 - UK Tidal Resource	pdf file held
449	Baseline	Human environment	General	y	y	y	SEA 8	Regional	SEA 8	Metoc		SEA 8 Area Other Users	Not held
450	Potential Impacts	Broad Issues	General impacts			y	ETSU	Broad	UK	Metoc plc	2000	An Assessment of the Environmental Effects of Offshore Wind Farms	Not held
451	Baseline	Carbon Capture and Storage	General				Cambridge University Press	Broad	UK	Metz, B, Davidson, O, de Coninck, H, Loos, M and Meyer, L	2005	CO2 Capture and Storage. Inter-govermental Panel on Climate Change Special Report	Not held
452	Device specific info	Device specific info	General	y			Danish Wave Energy Programme	Broad	Denmark	Meyer, NI and Nielsen, K		The Danish Wave Energy Programme Second Year Status	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
453	Potential Impacts	Environment	General	y	y	y	US Department of the Interior Minerals Management Service (MMS)	Broad	USA	Michel, J, Dunagan, H, Boring, C, Healy, E, Evans, W, Dean, JM, McGillis, A and Hain, J	2007	Worldwide synthesis and analysis of existing information regarding environmental effects of alternative energy uses on the Outer Continental Shelf	pdf file held
454	Potential Impacts	Physical environment	Change in coastal processes	y			Ocean Engineering 34 Issues 5-6 April 2007 Pages 884-901	Site specific	North Cornwall	Millar, DL, Smith, HCM and Reeve, DE	2007	Modelling analysis of the sensitivity of shoreline change to a wave farm	Not held
455	Potential Impacts	Visual (seascape/landscape character, visual amenity)	General	y	y	y	CCW	National	Wales	Miller, DR and Morrice, JG	2001	A Geographical Analysis of the Intervisibility of the Coastal Areas of Wales	Not held
456	Baseline	Commercial Fisheries	Fishing Activity	y	y	y	SEA 6	Regional	SEA 6	Mills, C and Eastwood, P	2005	Provision of fishing activity data for the DTI Strategic Environmental Assessment No. 6	pdf file held
457	Baseline	Benthic Ecology	MNCR Review	y	y	y	NCC	Regional	Cardigan Bay and North Wales	Mills, DJL	1991	Marine Nature Conservation Review. Benthic marine ecosystems in Great Britain : a review of current knowledge. Cardigan Bay, North Wales, Liverpool Bay and the Solway (MNCR coastal sectors 10 and 11.)	CCW library
458	Legislation, policy and guidance	Archaeology	General	y	y	y	MoD	Broad	Generic	Ministry of Defence	2001	Public Consultation on Military Maritime Graves and the Protection of Military Remains Act 1986	Not held
459	Baseline	Seabirds	Seabirds	y	y	y	Seabird 2000/JNCC	National	UK	Mitchell, PI, Newton, SF, Ratcliffe, N and Dunn, TE	2004	Seabird Populations of Britain and Ireland	pdf file and data files held
460	Potential Impacts	Designated sites	General	y			NCC	Regional	Hebridees	Mitchell, R	1979	Nature conservation implications of siting wave energy converters off the Outer Hebrides	CCW library
461	Potential Impacts	Designated sites	General	y			NCC	Site specific	Moray Firth	Mitchell, R, Probert, PK	1980	Nature conservation implications of siting wave energy converters off the Moray Firth	CCW library
462	Potential Impacts	Military Use	Disruption of radar			y	MoD	Site specific	UK	MoD		Further Evidence of the Effect of Wind Turbine Farms on Air Defence Radar, RAF Air Warfare Centre, August 2005	Not held
463	Potential Impacts	Military Use	Disruption of radar			y	MoD	Site specific	UK	MoD		The Effects of Wind Turbine Farms on Air Defence Radar, RAF Air Warfare Centre, January 2005	Not held
464	Potential Impacts	Military Use	Disruption of radar			y	MoD	Site specific	UK	MoD		The Effects of Wind Turbine Farms on Air Traffic Control Radar, RAF Air Warfare Centre - May 2005.	Pdf file held
465	Baseline	Archaeology	General	y	y	y	Cambrian Archaeological Society	Regional	Irish Sea	Moore, D	1970	The Irish Sea Province in Archaeology and History	Not held
466	Baseline	Benthic Ecology	BAP habitats and species	y	y	y	CCW	Broad	Welsh waters	Moore, J		An atlas of marine biodiversity action plan species and habitats and species of conservation concern in Wales : 2nd edition. CONFIDENTIAL	CCW library
467	Baseline	Designated sites	General conservation	y	y	y	SEA 6	Regional	SEA 6	Moore, JJ	2005	Conservation	pdf file held
468	Baseline	Ecology	General	y	y	y	CCW	Regional	South West Wales	Moore, JJ	2006	State of the Environment in SW Wales, 10 Years after the Sea Empress Oil Spill	pdf file held
469	Baseline	Commercial Fisheries	Shellfish beds and harvesting areas	y	y	y	Welsh Assembly Government	Site specific	Wales	Moran, PJ	2004	The Surface Waters (Shellfish) (Classification) Regulations 1997: Classification of Waters in Wales	pdf file held
470	Potential Impacts	Broad Issues	Constraints	y	y	y	Research Engineer / Centrale Nantes	Broad	Generic	Mouslim, H	Project in progress	Market drivers and offshore renewable energy deployment	Project in progress
471	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Defra	Broad	UK	MSPP Consortium	2006	Marine Spatial Planning Pilot	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
472	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y		UK Energy Research Centre	Broad	UK	Mueller, M and Jeffrey, H		UKERC Marine (Wave and Tidal Current) Renewable Energy Technology Roadmap	pdf file held
473	Device specific info	Device specific info	Pelamis	y			University of Edinburgh Institute for Energy Systems	Broad	Generic	Mundon, T, Wallace, R and Murray, A	Project in progress	Optimising Pelamis Wave Energy Converter Efficiency Using AI Techniques	Project in progress
474	Baseline	Archaeology	General	y	y	y	in Davidson, A., 2002, The coastal archaeology of Wales, CBA Research Report 131, Council for British Archaeology, York	National	Wales	Murphy, K	2002	The archaeological resource: chronological overview to 1500 AD	Not held
475	Baseline	Archaeology	General	y	y	y	Unpublished report, Cambria Archaeology	Regional	South and West Wales	Murphy, K and Allen, B	1997	1997, Coastal Survey 1996-97. Strumble Head (Pembrokeshire) to Ginst Point (Carmarthenshire)	Not held
476	Device specific info	Device specific info	Marine Current Turbines		y		Renewable energy 30 (2005) issue 11 1713-1731	Site specific	Alderney Race, Channel Islands	Myers, L and Bahaj, AS	2005	Simulated electrical power potential harnessed by marine current turbine arrays in the Alderney Race	not held
477	Device specific info	Device specific info	Horizontal axis marine current turbine		y		Renewable energy 31 (2006) issue 2 197-208	Broad	Device specific	Myers, L and Bahaj, AS	2006	Power output performance characteristics of a horizontal axis marine current turbine	not held
478	Potential Impacts	Physical environment	Change in tidal energy		y		Ocean engineering 34 Issues 5-6 April 2007 Pages 758-762	Broad	Device specific	Myers, L and Bahaj, AS	2006	Wake studies of a 1/30th scale horizontal axis marine current turbine	Not held
479	Potential Impacts	Physical environment	Cumulative effects		y		Proceedings World Renewable Energy Congress (WREC-IX), Florence , 19-25 August 2006	Broad	Device specific	Myers, LE and Bahaj, AS	2006	Flow effects in marine current turbine arrays	Not held
480	Baseline	Physical environment	Seabed sediment	y	y	y	MADP	Regional	Bristol Channel	National Assembly for Wales	2001	Summary Consultation Document: Draft Marine Aggregate Dredging Policy South Wales	pdf file held
481	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	National Assembly of Wales	National	Wales	National Assembly of Wales and AEA Technology	2001	Review of Strategic Study of Renewable Energy Resources in Wales	Not held
482	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	National Trust	Broad	UK	National Trust	2006	National Trust Coast and Marine Policy March 2006	word file held
483	Baseline	Archaeology	General	y	y	y	CBA Research Report 115, Council for British Archaeology, York	Regional	Severn Estuary	Nayling, N	1998	The Magor Pill Wreck	Not held
484	Potential Impacts	Designated sites	General		y		NCC	Regional	Severn Estuary	NCC		Severn Barrage development project:nature conservation	CCW library
485	Potential Impacts	Sea birds	General			y	Ibis, 148, 129-144	Broad	Europe	Fox, AD, Desholm, M, Kahlert, J, Kjaer Christensen, T and Krag Petersen, IB	2006	Publishing Ltd Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds	pdf file held
486	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise	y	y	y	Subacoustech Ltd	Site specific	Littlehampton	Nedwell, J, and Edwards, B	2002	Measurements of underwater noise in the Arun River during piling at County Wharf, Littlehampton	pdf file held
487	Potential Impacts	Ecology	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)			y	COWRIE	Broad	UK	Nedwell, J, Langworthy, J and Howell, D	2003	Assessment of sub-acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife: initial measuremnents of underwater noise during construction of offshore windfarms and comparison with background noise	pdf file held
488	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise			y	COWRIE	Broad	UK	Nedwell, J, Langworthy, J and Howell, D	2004	A review of offshore windfarm related underwater noise sources	pdf file held
489	Potential Impacts	Fish Ecology	Disturbance/displacement/avoidance of/by fish due to noise (incl migratory routes)	y	y	y	Subacoustech Ltd	Site specific	Southampton Water	Nedwell, J, Turnpenny, A, Langworthy, J and Edwards, B	2003	Measurements of underwater noise during piling at the Red Funnel Terminal, Southampton, and observations of its effect on caged fish	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
490	Development specific info	Projects	Greater Gabbard OWF			Y	Greater Gabbard	Site specific	Greater Thames	Nedwell, J, Workman, R and Parvin, SJ	2005	The assessment of likely levels of piling noise at Greater Gabbard and its comparison with background noise, including piling noise measurements at Kentish Flats	pdf file held
491	Potential Impacts	Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)	y	y	y	Subacoustech Ltd	Broad	Generic	Nedwell, JR and Edwards, B	2004	A review of measurements of underwater man-made noise carried out by Subacoustech Ltd, 1993 – 2003	pdf file held
492	Baseline	Ecology	Audiograms	y	y	y	Subacoustech Ltd	Broad	Generic	Nedwell, JR, Edwards, B and Turnpenny, AWH	2004	Fish and Marine Mammal Audiograms: A summary of available information	pdf file held
493	Potential Impacts	Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)	y	y	y	Subacoustech Ltd	Broad	Generic	Nedwell, JR, Turnpenny, AWH, Lovell, J, Parvin, SJ, Workman, R, Spinks, JAL and Howell, D	2007	A validation of the dBht as a measure of the behavioural and auditory effects of underwater noise	pdf file held
494	Potential Impacts	Fish Ecology	Potential collision risk		y		US Department of Energy Advanced Hydropower Turbine System Program	Broad	USA	Neitzel, DA		Developing biological specifications for fish friendly turbines	Summary held
495	Device specific info	Device specific info	Pico	y			European wave energy plant	Site specific	Pico, Azores	Neumann, F, Brito-Melo, A, Didier, E and Sarmento, A	2007	Pico OWC recovery project: recent activities and performance data	pdf file held
496	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y			IX WREC – World Renewable Energy Congress, Firenze	Broad	Europe	Neumann, F, Tedd, J, Prado, M, Russell, I, Patricio, S and la Regina, V	2006	Licensing and environmental issues of wave energy projects	pdf file held
497	Potential Impacts	Tourism and recreation	General			y	Visit Scotland	Broad	Scotland	NFO System Three	2002	Investigation into the potential impact of wind farms on tourism in Scotland	pdf file held
498	Device specific info	Device specific info	General	y			Danish Wave Energy Programme	Broad	Denmark	Nielsen, K and Meyer, NI		The Danish Wave Energy Programme	pdf file held
499	Potential Impacts	Sea birds	Cumulative effects on birds			y	COWRIE	Broad	Generic	Norman, T, Buisson, R and Askew, N	2007	COWRIE workshop on the cumulative impact of offshore windfarms on birds	pdf file held
500	Potential Impacts	Broad Issues	General impacts	y	y		EMEC	Broad	Generic	Norris, J and Mueller, M	2005	Environmental impacts and monitoring of marine energy conversion devices	pdf file held
501	Baseline	Physical environment	Water temperature	y	y	y	CEFAS	Broad	UK	Norris, SW	2001	Near surface sea temperatures in coastal waters of the North Sea, English Sea and Irish Sea - Volume II	pdf file held
502	Baseline	Carbon Capture and Storage	General				University of Wales Press	Regional	Bristol Channel	North, FJ	1964	The Evolution of the Bristol Channel	Not held
503	Baseline	Archaeology	General	y	y	y	in McCaughan, M. and Appleby, J., 1989, The Irish Sea Aspects of Maritime History, The Institute of Irish Studies, The Queen's University of Belfast and the Ulster Folk and Transport Museum	Regional	Irish Sea	O'Neill, T	1989	Trade and Shipping on the Irish Sea in the Later Middle Ages	Not held
504	Device specific info	Device specific info	Pelamis	y			Ocean Power Delivery	Site specific	Orkney	Ocean Power Delivery	2003	Pelamis machine summary for EMEC environmental review	Not held
505	Device specific info	Device specific info	Pelamis	y			Ocean Power Delivery	Broad	Generic	Ocean Power Delivery	2003	Pelamis pre-installation noise review	Not held
506	Device specific info	Device specific info	flettner rotors and turbosails		y		BERR	Broad	Device specific	Oreada	2005	Potential applications for flettner rotors and turbosails in tidal stream turbines	pdf file held
507	Device specific info	Device specific info	Tidal Stream Energy		y		MAREC 2004 International Conference on Marine Renewable Energies	Broad	Device specific	Orme, JAC and Masters, I	2004	Design and testing of a direct drive tidal stream generator	not held
508	Device specific info	Device specific info	Tidal Stream Energy		y		Swan Turbines and University of Wales	Broad	Device specific	Orme, JAC and Masters, I		Analysis and comparison of support structure concepts for tidal stream turbines	not held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
509	Potential Impacts	Water and sediment quality	Use of antifoulants		y		MAREC 2001 International Conference on Marine Renewable Energies	Broad	Generic	Orme, JAC, Masters, I and Griffiths, RT	2001	Investigation of the effect of biofouling on the efficiency of marine current turbines	pdf file held
510	Potential Impacts	Designated sites	General			y	OSPAR Commission	Broad	North East Atlantic	OSPAR Commission	2004	Problems and benefits associated with the development of offshore wind farms	pdf file held
511	Potential Impacts	Broad Issues	General impacts	y	y		OSPAR Commission	Broad	Generic	OSPAR Commission	2006	An overview of the environmental impact of non-wind renewable energy systems in the marine environment	pdf file held
512	Potential Impacts	Broad Issues	General impacts			y	OSPAR Commission	Broad	Generic	OSPAR Commission	2008	Draft Assessment of the Environmental Impact of Offshore Wind Farms	pdf file held
513	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Welsh Assembly Government	Broad	Wales	Ove Arup and Partners	2005	Facilitating Planning For Renewable Energy in Wales: Meeting the Target. Review of Final Report - Research Contracts 105/2002 and 269/2003	pdf file held
514	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	COWRIE	Broad	UK	Oxford Archaeology	2007	Guidance for the assessment of cumulative impact on the historic environment from offshore renewable energy	pdf file held
515	Device specific info	Device specific info	Sloped IPS Buoy	y			BERR	Broad	Device specific	Parkin, P, Payne, G, Salter, S and Taylor, J	2002	Design and Construction of a Dynamometer for a Free-Floating Sloped-Buoy Wave Energy Device	pdf file held
516	Potential Impacts	Marine mammals	General	y	y	y	Whale and Dolphin Conservation Society	Broad	UK	Parsons, ECM, Clark, J, Ross, A and Simmonds, MP		The conservation of British cetaceans: A review of the threats and protection afforded to whales, dolphins and porpoises in UK waters	pdf file held
517	Development specific info	Projects	Greater Gabbard OWF			Y	Greater Gabbard	Site specific	Greater Thames	Parvin, SJ and Nedwell, JR	2005	A brief review of mitigation strategies for reducing the impact of piling noise during construction of the Greater Gabbard wind farm	pdf file held
518	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise			y	COWRIE	Broad	UK	Parvin, SJ and Nedwell, JR	2006	Underwater noise and offshore wind farms	pdf file held
519	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise		y		Strangford Lough MCT	Site specific	Strangford Lough	Parvin, SJ, Workman, R, Bourke, P and Nedwell, JR	2005	CONFIDENTIAL: Assessment of tidal current turbine noise at the Lynmouth site and predicted impact of underwater noise at Strangford Lough	pdf file held
520	Baseline	Commercial Fisheries	Coastal fisheries	y	y	y	CEFAS	Broad	England and Wales	Pawson, MG, Pickett, GD and Walker, P	2002	The coastal fisheries of England and Wales, Part 4: A review of their status 1999-2001	pdf file held
521	Baseline	Tourism and recreation	Recreational fishing	y	y	y	CEFAS	Broad	Europe	Pawson, MG, Tingley, D, Padda, G and Glenn, H	2007	EU Contract FISH/2004/011 on 'Sport Fisheries (or Marine Recreational Fisheries) in the EU	pdf file held
522	Device specific info	Device specific info	CETO	y			Renewable Energy Holdings plc	Broad	Device specific	PB Power		Technical appraisal of the CETO wave power generation devices	pdf file held
523	Baseline	Tourism and recreation	General	y	y	y	Pembrokeshire Coastal Forum	Regional	South West Wales	Pembrokeshire Coastal Forum	Ongoing	Coastal Recreation GIS database	Not held
524	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	Regional	Wales	Penrose, R and Pierpoint, C	1999	The use of Welsh coastal habitats as calving and nursery grounds for the Harbour porpoise (Phocoena phocoena)	Not held
525	Baseline	Marine mammals	Cetaceans	y	y	y	Defra, WAG and CCW	Regional	Wales	Penrose, RS	2007	Marine Mammal and Marine Turtle Strandings (Welsh Coast) Annual Report 2006	pdf file held
526	Potential Impacts	Sea birds	General			y	ETSU	Broad	UK	Percival, SM	2001	Assessment of the effects of offshore wind farms on birds	pdf file held
527	Potential Impacts	Sea birds	General			y	Nysted offshore windfarm	Site specific	Denmark	Petersen, IK	2004	Investigation of birds during the operational phase of the Nysted offshore wind farm	pdf file held
528	Baseline	Carbon Capture and Storage	General				PESGB	National	North Sea and Atlantic	Petroleum Exploration Society of Great Britain	2007	Structural Framework of the North Sea and Atlantic Margin	Not held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
529	Potential Impacts	Sea birds	Physical presence of new structures affecting use of area			y	Swedish Energy Agency, GE Energy and Vindkompaniet AB	Site specific	Sweden	Pettersson, J	2003	Waterfowl and offshore wind farms. A study in southern Kalmar Sound, Sweden. Spring and autumn migrations 1999-2003	pdf file held
530	Device specific info	Device specific info	Wave energy converter	y			7th European Wave and Tidal Energy Conference, 2007	Broad	Generic	Pierpaolo Ricci, Jean-Baptiste Saulnier, António F. de O. Falcão	2007	Point-absorber arrays: a configuration study off the Portuguese West-Coast	pdf file held
531	Baseline	Marine mammals	Cetaceans	y	y	y	IFAW	Regional	SW Wales	Pierpoint, C	2001	Harbour porpoise distribution in the coastal waters of SW Wales	Not held
532	Baseline	Marine mammals	Cetaceans	y	y	y	Unpublished manuscript	Regional	South West Wales	Pierpoint, C		Harbour porpoise (Phocoena phocoena) foraging strategy at a high-energy near-shore site in south-west Wales, UK	Not held
533	Baseline	Marine mammals	Cetaceans	y	y	y	Ceredigion County Council and CCW	Regional	Ceredigion	Pierpoint, C and Allan, L	2000	Cetacean site use and boat traffic on the Ceredgion Marine Heritage Coast, West Wales 1994-99	pdf file held
534	Baseline	Marine mammals	Cetaceans	y	y	y	Ceredigion County Council and CCW	Regional	Ceredigion	Pierpoint, C and Allan, L	2001	Cetacean site use and boat traffic at New Quay on the Ceredigion Marine Heritage Coast, West Wales 2000	pdf file held
535	Baseline	Marine mammals	Cetaceans	y	y	y	Ceredigion County Council and CCW	Regional	Ceredigion	Pierpoint, C and Allan, L	2004	Bottlenose dolphins and boat traffic on the Ceredigion Marine Heritage Coast, West Wales, 2002 and 2003	pdf file held
536	Baseline	Marine mammals	Cetaceans	y	y	y	Ceredigion County Council and CCW	Regional	Ceredigion	Pierpoint, C and Allan, L	2006	Bottlenose dolphins and boat traffic on the Ceredigion Coast, West Wales, 2004 and 2005	pdf file held
537	Baseline	Marine mammals	Cetaceans	y	y	y	A report by RPS Energy to Scarweather Sands Limited	Site specific	Scarweather Sands	Pierpoint, CJL	2005	Pre-construction monitoring of harbour porpoises at Scarweather Sands offshore wind farm, SW Wales – first interim report	not held
538	Baseline	Marine mammals	Cetaceans	y	y	y	A report by RPS Energy to Scarweather Sands Limited	Site specific	Scarweather Sands	Pierpoint, CJL	2007	Pre-construction monitoring of harbour porpoise at Scarweather Sands offshore wind farm, SW Wales – Annual Report 2005-06	CONFIDENTIAL pdf file held
539	Baseline	Marine mammals	Cetaceans	y	y	y	Report to CCW/the Windlife Trusts	Site specific	Pembrokeshire	Pierpoint, CJL, Baines, M and Earl, S	1999	Field trials of the POD – an acoustic data logger – to monitor harbour porpoise activity in Newport Bay, Pembrokeshire	Not held
540	Baseline	Physical environment	Hydrography	y	y	y	SEA 8	Regional	SEA 8	PML Applications Ltd		SEA 8 Technical Report - Hydrography	Not held
541	Baseline	Benthic Ecology	Subtidal biotopes	y	y	y	SEA 8	Regional	SEA 8	PML Applications Ltd		Synthesis of Information on the Benthos of Area SEA 8	Not held
542	Development specific info	Projects	Wave Dragon Wave Energy	Y			Wave Dragon	Site specific	Pembrokeshire	PMSS	2007	Wave Dragon Pre-Commercial Wave Energy Device	EIA and associated documents
543	Potential Impacts	Physical environment	Change in tidal energy		y		University of Washington, Seattle	Broad	Generic	Polagye, B	Project in progress	Impacts of large scale kinetic power extraction from time-unsteady tidal estuaries	Project in progress
544	Development specific info	Projects	Tacoma Narrows		y		Electric Power Research Institute (EPRI)	Site specific	Tacoma Narrows Washington	Polagye, B and Previsic, M	2006	System level design, performance, cost and economic assessment - Tacoma Narrows Washington tidal in-stream power plant	pdf file held
545	Baseline	Seabirds	Seabirds	y	y	y	Report to the DTI	Broad	UK	Pollock, C and Barton, C	2006	An analysis of ESAS seabird surveys in UK waters to highlight gaps in coverage	pdf file held
546	Development specific info	Projects	Rhyl tidal lagoon		y		Unstated	Site specific	North Wales	Poole, J	2007	North Wales Tidal Lagoon	ppt file held
547	Baseline	Fish Ecology	Fish fauna	y	y	y	Journal of Experimental Marine Biology and Ecology. 258 2001 15-37	Regional	Severn Estuary	Potter, IC, Bird, DJ, Claridge, PN, Clarke, KR, Hyndes, GA and Newton, LC	2001	Fish fauna of the Severn Estuary. Are there long-term changes in abundance and species composition and are the recruitment patterns of the main marine species correlated?	word file held
548	Baseline	Fish Ecology	Marine and estuarine fish	y	y	y	CCW	Regional	Wales	Potts, GW and Swaby, SE	1993	Marine and Estuarine fish of Wales	CCW library

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
549	Baseline	Fish Ecology	Marine and estuarine fish	y	y	y	CCW	Regional	Wales	Potts, GW and Swaby, SE	1994	Marine and estuarine fishes of Wales : Review of the monitoring programme for Wales with an analysis of the 1993/94 results	CCW library
550	Baseline	Fish Ecology	Marine and estuarine fish	y	y	y	CCW	Regional	Wales	Potts, GW and Swaby, SE	Undated	Marine and estuarine fishes of Wales : review of the monitoring programmes for Wales 1994 to 1998; and update 1998-1999	CCW library
551	Baseline	Fish Ecology	Marine and estuarine fish	y	y	y	CCW	Regional	Wales	Potts, GW and Swaby, SE	Undated	Marine and estuarine fishes of Wales : update of the monitoring programme for Wales (1999-2000)	CCW library
552	Potential Impacts	Aviation	Radar			y	BERR	Broad	Generic	Poupart, GJ	2003	Wind farms impact on radar aviation interests - final report	pdf file held
553	Potential Impacts	Shipping	Radio navigation and Radar			y	Gwynt y Mor Offshore Wind Farm	Site specific	North Wales	Poupart, GJ	2005	An assessment of the impact of the proposed Gwynt y Môr offshore wind farm on marine radio navigation and communication systems	pdf file held
554	Device specific info	Device specific info	Wave energy converter	y			Electric Power Research Institute (EPRI)	Broad	Generic device specific	Previsic, M	2004	Offshore wave energy conversion devices	pdf file held
555	Device specific info	Device specific info	California wave power	y			Electric Power Research Institute (EPRI)	Regional	California	Previsic, M and Bedard, R	2007	California wave power demonstration project: Bridging the gap between the completed Phase 1 project definition study and the next phase - phase 2 detailed design and permitting	pdf file held
556	Device specific info	Device specific info	Wave energy converter	y			Electric Power Research Institute (EPRI)	Broad	USA	Previsic, M, Siddiqui, O and Bedard, R	2004	Economic Assessment Methodology for Offshore Wave Power Plants	pdf file held
557	Potential Impacts	Broad Issues	Noise	y	y		EMEC	Site specific	Orkney	Project in progress	Project in progress	Baseline noise assessments against which noise levels of when devices are operational can be assessed	Project in progress
558	Potential Impacts	Ecology	Habitat exclusion or avoidance	y	y		EMEC	Site specific	Orkney	Project in progress	Project in progress	Baseline wildlife observations underway against which change can be assessed when devices are in the water	Project in progress
559	Potential Impacts	Marine mammals	Potential collision risk	y	y		EMEC	Broad	Orkney	Project in progress	Project in progress	EMEC has a joint project with SMRU to develop sonar devices to monitor potential collisions and possible damage	Project in progress
560	Potential Impacts	Benthic ecology	General	y	y		EMEC	Site specific	Orkney	Project in progress	Project in progress	Funding for an ROV project to characterise the benthos in the site and cable route against which change can be assessed	Project in progress
561	Potential Impacts	Physical environment	Change in coastal processes	y	y	y	RAG list of issues 2007	Broad		Project in progress	Project in progress	Understand that a project investigating models to predict effects on seabed and coastal processes is active	Project in progress
562	Potential Impacts	Benthic ecology	Effect of cable route			y	RAG list of issues 2007	Broad		Project in progress	Project in progress	Understand that a study on cable techniques and effects for offshore wind farms is active	Project in progress
563	Potential Impacts	Marine mammals	Habitat exclusion or avoidance			y	BERR RAG	Broad	UK	Project in progress	Project in progress	Understand that there is a RAG project to tag seals during and post wind farm construction	Project in progress
564	Potential Impacts	Shipping	General	y	y		EMEC	Site specific	Orkney	Project in progress	Project in progress	Undertaking studies to determine shipping in the area to provide advice to developers and to enable them to address device specific safety issues	Project in progress
565	Potential Impacts	Marine mammals	Habitat exclusion or avoidance		y		BERR	Broad		Project in progress	Project in progress	Use of GPS location tags to monitor seal interactions with tidal stream turbine	Project in progress
566	Baseline	Seabirds	Aerial survey seabirds	y	y	y	BERR RAG	Regional	windfarm SEA areas	Project in progress		Aerial surveys of birds in strategic wind farm areas 2005-2006	Project in progress
567	Baseline	Seabirds	Aerial survey seabirds	y	y	y	BERR RAG	Regional	windfarm SEA areas	Project in progress		Aerial surveys of birds in strategic wind farm areas 2006-2007	Project in progress
568	Baseline	Seabirds	Aerial survey seabirds	y	y	y	BERR RAG	Regional	SW Region	Project in progress		Aerial surveys of birds in SW region 2006-2007	Project in progress

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
569	Potential Impacts	Sea birds	Physical presence of new structures affecting use of area				BERR RAG	National	UK	Project in progress		Energetic costs of barrier effects on birds	Project in progress
570	Potential Impacts	Commercial fisheries	General			y	BERR RAG	Broad		Project in progress		Fishing in and around offshore wind farms	Project in progress
571	Potential Impacts	Broad Issues	General impacts			y	BERR RAG	Broad	UK	Project in progress		Review of cabling techniques and effects applicable to the offshore wind farm industry	Project in progress
572	Potential Impacts	Ecology	Artificial reef effect			y	BERR RAG	Broad		Project in progress		Review of reef effects of offshore windfarm structures and potential for enhancement and mitigation	Project in progress
573	Baseline	Seabirds	Radar survey	y	y	y	BERR RAG	National		Proposal	Proposal	Radar studies of bird migration volume, timing, altitude and spatial distribution	Proposal
574	Potential Impacts	Sea birds	Physical presence of new structures affecting use of area			y	BERR RAG	Broad		Proposal		Behavioural responses of red-throated divers and common scoter to windfarm construction and operation	Proposal
575	Potential Impacts	Ecology	General		y		EMEC	Site specific	EMEC sites	Proposal		Seabed communities in areas of strong tidal streams	Proposal
576	Potential Impacts	Marine mammals	Potential collision risk		y		BERR RAG	Broad		Proposal		Use of sonar imaging to monitor seal (and other large animal) interactions with tidal stream turbine	Proposal
577	Development specific info	Projects	Tacoma Narrows		y		Puget Sound Tidal Power	Site specific	Tacoma Narrows Washington	Puget Sound Tidal Power LLC	2007	Tacoma Narrow Tidal Power Feasibility Study	pdf file held
578	Baseline	Archaeology	General	y	y	y	Anglo-Saxon Books, Norfolk	National	England	Pullen-Appleby, J	2005	English Sea Power c. 871 to 1100	Not held
579	Device specific info	Device specific info	Cycloidal tidal power generation		y		BERR	Broad	Device specific	QinetiQ Ltd	2004	Cycloidal tidal power generation - phase 1	pdf file held
580	Potential Impacts	Water and sediment quality	General		y			Regional	Severn Estuary	Radford, PJ, Young, KME	1981	Severn tidal power:predicted effects of proposed tidal power schemes upon the Severn estuary ecosystem, Volume 1, Water quality, Volume, 2, Ecosystem effects.	CCW library
581	Potential Impacts	Aviation	Radar			y	NATS	Broad	Generic	Raytheon Canada Ltd	2006	On advanced mitigating techniques to remove the effects of wind turbines and wind farms on the Raytheon ASR-10/23SS radars	pdf file held
582	Potential Impacts	Broad Issues	Sustainable Use of Marine Energy	y	y	y	Phd at Edinburgh University	Broad	UK	Reade, L	Project in progress	Research route map for the environmental sustainability of marine renewable energy	Project in progress
583	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	CCW	Site specific	Red Wharf and Conwy Bay	Rees, EIS	2004	Subtidal sediment biotopes in Red Wharf and Conwy Bays, North Wales: A review of their composition, distribution and ecology	pdf file held
584	Baseline	Marine mammals	Cetaceans	y	y	y	JNCC	Broad	North-west Europe	Reid, JB, Evans, PGH and Northridge, SP	2003	Atlas of Cetacean Distribution in north-west European waters	pdf file and data files held
585	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Renewables Advisory Board	Broad	UK	Renewables Advisory Board	2006	The Marine Bill: consultation response from the Renewables Advisory Board	pdf file held
586	Development specific info	Projects	Tidal Current Energy		Y		ETSU	Broad	Generic	Robert Gordon University and Centre for Environmental Engineering and Sustainable Energy	2002	Scoping study for an environmental impact field programme in tidal current energy	pdf file held
587	Potential Impacts	Physical environment	Change in coastal processes			y	Gwynt y Mor Offshore Wind Farm	Regional	North Wales	Robinson, D	2005	Gwynt y Môr Offshore Wind Farm Coastal Process Study	pdf file held
588	Baseline	Commercial Fisheries	Closed areas	y	y	y	CEFAS	Broad	UK	Rogers, SI	1997	A review of closed areas in the United Kingdom Exclusive Economic Zone	pdf file held
589	Baseline	Physical environment	Seabed sediment	y	y	y	NAW	Regional	Bristol Channel	Royal Haskoning	1996	Bristol Channel marine Aggregates; Resources and Constraints research Project	Not held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
590	Potential Impacts	Broad Issues	Cumulative			y	Round 2 Wash Wind Farms	Regional	Wash	Royal HAskoning	2004	Greater Wash Round 2 Offshore Wind Farms: Cumulative Effects Scoping Report	pdf file held
591	Development specific info	Projects	Seagen Strangford Lough work		y		Marine Current Turbines	Site specific	Strangford Lough, Northern Ireland	Royal Haskoning	2004	Strangford Lough Marine Current Turbine	pdf file held
592	Development specific info	Projects	Thanet OWF			Y	Thanet Offshore Wind Farm	Site specific	North east Kent coast	Royal Haskoning	2005	Thanet Offshore Wind Farm	EIA and associated documents
593	Development specific info	Projects	Seagen Strangford Lough work		Y		Marine Current Turbines	Site specific	Strangford Lough, Northern Ireland	Royal Haskoning		Potential impact of propsoed Seagen marine current turbine on Strangford Lough European protected features, sub-features and sub-feature attributes	CONFIDENTIAL pdf file held
594	Development specific info	Projects	London Array			y	London Array Offshore Wind Farm: Review of Cable Installation Options	Site specific	Greater Thames	RPS	2005	Environmental Statement Non Technical Summary London Array Ltd	EIA and associated documents
595	Potential Impacts	Sea birds	General			y	Walney Offshore Wind Farm	Site specific	Walney Island	RPS	2006	Walney offshore windfarm ornithological impact assessment	pdf file held
596	Potential Impacts	Physical environment	General		y		Strangford Lough MCT	Site specific	Strangford Lough	RPS Kirk McClure Morton	2005	Tidal energy turbine - Strangford Narrows Hydraulic model studies	CONFIDENTIAL pdf file held
597	Development specific info	Projects	Barrow Offshore Wind Farm			Y	Barrow Offshore Wind Farm	Site specific	Barrow Offshore Wind Farm	RSK Environment	2002	Barrow Offshore Windfarm	EIA and associated documents
598	Development specific info	Projects	Shell Flats			Y	Shell Flat Offshore Wind Farm	Site specific	Liverpool Bay	RSK Environment	2003	Shell Flat Offshore Wind Farm	EIA
599	Baseline	Designated sites	Offshore habitats regs	y	y	y	RSPB	National	National	RSPB	2000	The Development Of Boundary Selection Criteria For The Extension Of Breeding Seabird Special Protection Areas Into The Marine Environment	word file held
600	Device specific info	Device specific info	Severn Barrage		y		RSPB	Regional	Severn Estuary	RSPB	2008	A response by the Royal Society for the Protection of Birds to the Sustainable Development Commissions report 'Turning the Tide - Tidal Power in the UK' supporting construction of a sustainable Severn Barrage	word file held
601	Development specific info	Projects	Gwynt y Mor			y	Gwynt y Mor Offshore Wind Farm	Regional	North Wales	RWE Group	2005	Gwynt y Mor Offshore Windfarm: Environmental Statement	pdf file held
602	Baseline	Tourism and recreation	General	y	y	y	SEA 6	Regional	SEA 6	RYA	2005	Identifying Recreational Cruising Routes, Sailing and Racing Areas within the SEA 6 Area	pdf file held
603	Baseline	Tourism and recreation	General	y	y	y	SEA 8	Regional	SEA 8	RYA		Identifying Recreational Cruising Routes, Sailing and Racing Areas within the SEA 8 Area	Not held
604	Potential Impacts	Tourism and recreation	Impact of exclusion zones			y	BERR	Broad	Windfarm SEA areas	RYA and the Cruising Association	2004	Sharing the wind: Recreational boating in the offshore wind farm strategic areas	pdf file held
605	Potential Impacts	Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)	y	y	y	Subacoustech Ltd	Broad	Generic	S J Parvin, E Harland and J R Nedwell	2007	The Target Strength of marine mammals, and estimated performance of Active Acoustic Monitoring systems	pdf file held
606	Potential Impacts	Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)	y	y	y	Subacoustech Ltd	Broad	Generic	S J Parvin, J R Nedwell and E Harland	2007	Lethal and physical injury of marine mammals, and requirements for Passive Acoustic Monitoring	pdf file held
607	Baseline	Fish Ecology	Cephalopods	y	y	y	SEA 6	Regional	SEA 6	Sacau, M, Pierce, GJ, Stowasser, G, Wang, J and Santos, MB	2005	An overview of cephalopods relevant to the SEA 6 area	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
608	Baseline	Plankton	Plankton ecology	y	y	y	SEA 8	Regional	SEA 8	SAHFOS		The Plankton Ecology of the SEA 8 Area	Not held
609	Potential Impacts	Sea birds	General			y	Department of the Army, Corps of Engineers, Los Angeles District	Site specific	Los Angeles Harbour	San Pedro Bay, Ltd., Vestas Wind Technology A/S and Energy Research Consultants	1992	Los Angeles Harbour Wind Power Plant, San Pedro Breakwater, San Pedro Bay. Research Report - avifaunal impact	not held
610	Device specific info	Device specific info	Pico	y			European wave energy plant	Site specific	Pico, Azores	Sarmento, A, Brito-Melo, A and Neumann, F		Results from sea trials in the OWC European wave energy plant at Pico, Azores	word file held
611	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y			2004 New and Renewable Energy Technologies for Sustainable Development (pp 225-233)	Broad	Generic	Sarmento, AJNA, Neumann, F and Brito-Melo, A	2004	Non-technical barriers to large scale wave energy utilisation	Contents held
612	Baseline	Archaeology	General	y	y	y	Journal of Human Evolution 48: 493-505	Site specific	Eel Point	Schulting, RJ, Trinkaus, E, Higham, T, Hedges, R, Richards, M, and Cardy, B	2005	A Mid-Upper Palaeolithic human humerus from Eel Point, South Wales, UK	Not held
613	Potential Impacts	Broad Issues	General impacts	y	y		National Renewable Energy Laboratory	Broad	USA	Schwartz, SS	2006	Proceedings of the Hydrokinetic and Wave Energy Technologies Technical and Environmental Issues Workshop. Washington, DC. October 26-28, 2005	pdf file held
614	Baseline	Archaeology	General	y	y	y	Archaeology Ireland 21(1): 4	National	Ireland	Schweitzer, H	2007	The 'Drogheda Boat	Not held
615	Baseline	Visual (seascape/landscape character, visual amenity)	Baseline	y	y	y	BERR RAG	National	England	Scope in development	Undated	Seascape baseline	Scope in development
616	Potential Impacts	Visual (seascape/landscape character, visual amenity)	General			y	BERR RAG	Broad	Round two wind farm sites	Scope in development		Effectiveness of visual limits used in R2	Scope in development
617	Baseline	Seabirds	Aerial survey seabirds	y	y	y	BERR RAG	National	UK	Scope in development		Further aerial bird surveys of offshore areas of potential renewable energy interest	Scope in development
618	Potential Impacts	Archaeology	General				SNH	Regional	Scotland	Scott Wilson and Downie, A.J	2003	A review of possible marine renewable energy development projects and their natural heritage impacts from a Scottish perspective	pdf file held
619	Potential Impacts	Ecology	General	y	y	y	Oceans 2007 - Europe	Broad	Generic	Scott, BE	2007	A Renewable Engineers Essential Guide to Marine Ecology	pdf file held
620	Potential Impacts	Broad Issues	Constraints	y	y		Scottish Enterprise	Broad	Scotland	Scottish Enterprise	2005	Marine Renewable (Wave and Tidal) Opportunity Review	pdf file held
621	Baseline	Benthic Ecology	Subtidal biotopes	y	y	y	Seasearch	Local	Milford Haven	Seasearch	Undated	Entrances of Milford Haven	pdf file held
622	Device specific info	Device specific info	General	y	y		University of Edinburgh Institute for Energy Systems	Broad	Generic	Seller, B, Bruce, T and Wallace, R	Project in progress	Modelling Marine Energy Converters: Tank Testing and Numerical Simulation	Project in progress
623	Device specific info	Device specific info	Severn Barrage		y		CCW library	Regional	Severn Estuary	Shaw, TL	1980	An environmental appraisal of tidal power stations:with particular reference to the Severn barrage	CCW library
624	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise			y	RPS Energy Report No. EOR0523	Site specific	Thames	Shepherd, B, Weir, C, Golightley, C, Holy, T and Gricks, N	2006	Underwater noise impact on marine mammals and fish during pile driving of proposed Round 2 offshore wind farms in the Thames Estuary	Not held
625	Baseline	Fish Ecology	Basking shark	y	y	y	Report to Defra	Broad	South west England and west Scotland	Sims, DW, Southall, EJ, Metcalfe, JD and Pawson, MG	2005	Basking shark population assessment	pdf file held
626	Baseline	Fish Ecology	Basking shark	y	y	y	Marine Ecology Progress Series Vol 248 187-196 2003	Broad	South west England and west Scotland	Sims, DW, Southall, EJ, Richardson, AJ, Reid, PC, Metcalfe, JD	2003	Seasonal movements and behaviour of basking sharks from archival tagging: no evidence of winter hibernation	pdf file held
627	Potential Impacts	Marine mammals	General			y	Horns Reef	Site specific	Horns Reef	Teilmann, J, Damsgaard Henriksen, O, Carstensen, J and Skov, H	2002	Monitoring effects of offshore windfarms on harbour porpoises using PODs (porpoise detectors)	pdf file held
628	Potential Impacts	Physical environment	Change in wave energy	y			Wave Hub	Site specific	North Cornwall	Smith, H and Millar, DL	2005	Detailed wave climate modelling off the north Cornwall coast	Summary held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
629	Potential Impacts	Physical environment	Change in wave energy	y			7th European Wave and Tidal Energy Conference, 2007	Broad	Generic	Smith, HCM, Millar, DL and Reeve, DE	2007	Generalisation of wave farm impact assessment on inshore wave climate	pdf file held
630	Baseline	Carbon Capture and Storage	General				Unstated	Regional	Central England	Smith, NJP	1987	The Deep Geology of Central England: the prospectivity of the Palaeozoic Rocks	Not held
631	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	SNH	Broad	Scotland	SNH	2004	Marine Renewable Energy and the Natural Heritage: An overview and policy statement	pdf file held
632	Potential Impacts	Broad Issues	General impacts	y			European Commission's Energy, Environment and Sustainable Development Programme	Broad	Generic	Soerensen, HC, Hansen, LK and Hansen, R	2003	European Thematic Network on Wave Energy: Environmental Impact	pdf file held
633	Development specific info	Projects	Wave Dragon Wave Energy	Y			Wave Dragon	Site specific	Denmark	Soerensen, HC, Hansen, R, Friis-Madsen, E, Panhauser, W, Mackie, G, Hansen, HH, Frigaard, P, Hald, T, Knapp, W, Keller, J, Holmen, E, Holmes, B, Thomas, G, Rasmussen, P and Krogsgaard		The wave dragon - now ready for test in real sea	pdf file held
634	Baseline	Ecology	Ecology	y	y	y	Marine Conservation Society	Broad	Bristol Channel	Solandt, J-L	2007	Outer Bristol Channel Megafaunal Surveys	Pdf file held
635	Potential Impacts	Fish Ecology	Potential collision risk		y		ETSU	Broad	UK	Solomon, DJ	1988	Fish passage through tidal energy barrages	CCW library
636	Potential Impacts	Broad Issues	General impacts	y			WaveNet	Broad	Generic	Sorensen, HC, Hansen, LK, Hansen, R and Hammarlund, K	2003	Thematic Network Wave Energy: Social, planning and environmental impact	pdf file held
637	Baseline	Fish Ecology	Basking shark	y	y	y	J. Mar. Biol. Ass. UK (2005), 85, 1083-1088	Broad	European Shelf	Southall, EJ, Sims, DW, Metcalfe, JD, Doyle, JI, Fanshawe, S, Lacey, C, Shrimpton, J, Solandt, J-L and Speedie, CD	2005	Spatial distribution patterns of basking sharks on the European shelf: preliminary comparison of satellite-tag geolocation, survey and public sightings data	pdf file held
638	Baseline	Marine mammals	Grey seals	y	y	y	SCOS Report	Broad	UK	Special Committee on Seals	2004	Scientific advice on matters related to the management of seal populations: 2004	pdf file held
639	Potential Impacts	Sea birds	General			y	16th British Wind Energy Association Conference, 1994	Site specific	Blythe Harbour	Still, D, Little, B, Lawrence, SG and Carver, H	1994	The Birds of Blythe Harbour	not held
640	Potential Impacts	Marine mammals	Disturbance/damage from noise and vibration (potentially including loss of feeding or breeding areas)	y	y	y	JNCC	Broad	UK	Stone, CJ	2003	The effects of seismic activity on marine mammals in UK waters, 1998-2000	pdf file held
641	Potential Impacts	Fish Ecology	Artificial reef effect			y	Horns Reef	Site specific	Horns Reef	Stottrup, JG	2002	Half-year investigation for the project entitled: Investigations on the artificial reef effect on fish from a marine wind turbine at Horns Reef	pdf file held
642	Potential Impacts	Fish Ecology	General		y		ETSU	Site specific	River Wye	Strange, C	1989	Salmon stock monitoring. Part 1; a review of techniques for salmon stock monitoring in relation to tidal power barrages. Part 2; survey of juvenile salmon population in the R. Wye in relation to monitoring the effects of a tidal energy scheme	CCW library
643	Potential Impacts	Shipping	General			y	Gwynt y Mor Offshore Wind Farm	Site specific	North Wales	Strategic Marine Services Ltd	2005	Technical Report - Navigation and Shipping	pdf file held
644	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Pembrokeshire	Strong, PG, Lerwill, JK, Morris, SR and Stringell, TB	2006	Pembrokeshire marine SAC grey seal monitoring 2005	CCW library
645	Development specific info	Projects	Seagen Strangford Lough work		y		COWRIE	Site specific	Strangford Lough, Northern Ireland	Subacoustech	Project in progress	Measurement and assessment of underwater noise in the Strangford Lough during drilling and casing cutting for the SeaGen device	Project in progress

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
646	Potential Impacts						COWRIE	Broad	UK	Subacoustech Ltd	2003	Assessment of subsea acoustic noise emission and vibration from offshore wind turbines and its impact on marine wildlife	pdf file held
647	Device specific info	Device specific info	General		y		University of Edinburgh Institute for Energy Systems	Broad	Generic	Sun, X and Bryden, I	Project in progress	Establishment and Assessment of Laboratory Testing Procedures of Tidal Current Energy Devices	Project in progress
648	Potential Impacts	Broad Issues	General impacts		y		SWRDA	Broad	Generic	Sustainable Development Commission	2007	Turning the Tide: Tidal power in the UK	pdf file held
649	Baseline	Archaeology	General	y	y	y	Arms and Armour, London	Broad	Generic	Tarrant, VE	2000	The U-boat offensive 1914-1945	Not held
650	Baseline	Physical environment	Wave and tide resource	y			6th European Wave and Tidal Energy Conference, 2005	National	Scotland	Taylor, JRM and Motion, A	2005	Estimating wave energy in Scottish waters from hindcast data	Not held
651	Device specific info	Device specific info	Severn Barrage		Y		ETSU	Regional	Severn Estuary	Taylor, S	2002	The Severn Barrage - Definition study for a new appraisal of the project	pdf file held
652	Potential Impacts	Marine mammals	General			y	Nysted offshore windfarm	Site specific	Denmark	Teilmann, J, Carstensen, J, Dietz, R and Edren, S	2004	Effect on seals at Rodsand seal sanctuary from the construction of Nysted offshore wind farm based on aerial surveys	pdf file held
653	Potential Impacts	Marine mammals	General			y	Nysted offshore windfarm	Site specific	Denmark	Teilmann, J, Carstensen, J, Dietz, R and Edren, S	2005	Aerial monitoring of seals during construciton and operation of Nysted offshore wind farm	pdf file held
654	Potential Impacts	Marine mammals	General			y	Horns Reef	Broad	Denmark	Teilmann, J, Tougaard, J and Carstensen, J	2006	Summary on harbour porpoise monitoring 1999-2006 around Nysted and Horns Rev offshore wind farms	pdf file held
655	Device specific info	Device specific info	large scale tidal current turbine		y		BERR	Broad	Device specific	Thake, J	2005	Development, installation and testing of a large scale tidal current turbine	pdf file held
656	Device specific info	Device specific info	Stingray		y		BERR	Broad	Device specific	The Engineering Business Ltd	2003	Stingray tidal stream energy device - Phase 2	pdf file held
657	Device specific info	Device specific info	Frond type wave power generator	y			BERR	Broad	Device specific	The Engineering Business Ltd	2003	Technical and economic feasibility of a frond type wave power generator	pdf file held
658	Device specific info	Device specific info	Frond type wave power generator	y			BERR	Broad	Device specific	The Engineering Business Ltd	2005	EB Frond Wave Energy Converter	pdf file held
659	Device specific info	Device specific info	Stingray		y		BERR	Broad	Device specific	The Engineering Business Ltd	2005	Stingray Tidal stream energy device - Phase 3	pdf file held
660	Device specific info	Device specific info	Stingray		y		BERR	Broad	Device specific	The Engineering Business Ltd	2001(?)	Research and Development of a 150kW tidal stream generator	Summary held
661	Baseline	Marine mammals	Cetaceans	y	y	y	MSc Project - Sea Trust	Regional	Strumble Head near Fishguard	The Sea Trust	Undated	Proposal for a management plan of harbour porpoise near Strumble Head near Fishguard	pdf file held
662	Baseline	Marine mammals	Cetaceans	y	y	y	SEA 8	Regional	SEA 8	The University of St Andrews		SEA 8 Marine Mammals - draft not yet produced	In press
663	Baseline	Marine mammals	Cetaceans	y	y	y	Sea Trust	Regional	Irish Sea	Thomas, D		The geographic distribution of cetaceans observed from the Fishguard-Rosslare passenger ferry	pdf file held
664	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise			y	COWRIE	Broad	UK	Thomsen, F, Ludermann, K, Kafemann, R and Piper, W	2006	Effects of offshore wind farm noise on marine mammals and fish	pdf file held
665	Potential Impacts	Broad Issues	Constraints	y	y	y	All-Energy Futures Conference, Aberdeen, February 2001	Broad	UK	Thorpe, TW	2001	The UK market for marine renewables	pdf file held
666	Device specific info	Device specific info	Race Rocks		y		Race Rocks Ecological Reserve	Site specific	Race Rocks Reserve	Thuringer, P	2006	Race Rocks Interim Monitoring Report	pdf file held
667	Device specific info	Device specific info	Race Rocks		y		Race Rocks Ecological Reserve	Site specific	Race Rocks Reserve	Thuringer, P and Reidy, R	2006	Summary Report on Environmental Monitoring Related to the Pearson College-Encana-Clean Current Tidal Power Demonstration Project at Race Rocks Ecological Reserve	pdf file held
668	Development specific info	Projects	Race Rocks (www.racerocks.com)		Y		Race Rocks Ecological Reserve	Site specific	Race Rocks Reserve	Thuringer, P and Reidy, R	2006	Tidal Power Demonstration Project at Race Rocks Ecological Reserve	EIA and associated documents
669	Device specific info	Device specific info	Tidal Hydraulic		y		Pembrokeshire Coast National Park funded work	Regional	Device specific	Tidal Hydraulic Turbines Ltd		A brief summary of the pembrokeshire tidal energy project	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
670	Baseline	Fish Ecology	General	y	y	y	Report CS0149/D1/V1, Scarweather Sands Limited	Site specific	Scarweather Sands	Titan Environmental Surveys	2005	Scarweather Sands Offshore Windfarm - Fisheries Monitoring August 05	Not held
671	Baseline	Fish Ecology	General	y	y	y	Report CS0149/D1/V1, Scarweather Sands Limited	Site specific	Scarweather Sands	Titan Environmental Surveys	2005	Scarweather Sands Offshore Windfarm - Fisheries Monitoring Spring 06	Not held
672	Baseline	Fish Ecology	General	y	y	y	Report CS0149/D1/V1, Scarweather Sands Limited	Site specific	Scarweather Sands	Titan Environmental Surveys	2005	Scarweather Sands Offshore Windfarm - Fisheries Monitoring Winter Survey 05	Not held
673	Potential Impacts	Physical environment	Change in tidal energy		y		University of Edinburgh Institute for Energy Systems	Broad	Generic	Topper, M and Bryden, I	Project in progress	Application of a Potential Flow Model to the Hydrodynamic Interaction between a Tidal Turbine, its Wake and the Free-Surface	Project in progress
674	Potential Impacts	Marine mammals	General			y	Horns Reef	Site specific	Denmark	Tougaard, J, Carstensen, J, Teilmann, Hentiksen, OD, Skov, H and Teilmann, J	2003	Short term effects of the construction of wind turbines on harbour porpoises at Horns Reef	pdf file held
675	Potential Impacts	Marine mammals	General			y	Nysted offshore windfarm	Site specific	Denmark	Tougaard, J, Carstensen, J, Teilmann, J and Bech, NI	2005	Effect of the Nysted offshore wind farm on harbour porpoises	pdf file held
676	Potential Impacts	Marine mammals	General			y	Horns Reef	Site specific	Denmark	Tougaard, J, Carstensen, J, Wisz, M, Jespersen, M, Teilmann, J, Bech, NI and Skov, H	2006	Harbour porpoises on Horns Reef: Effects of the Horns Reef wind farm	pdf file held
677	Potential Impacts	Marine mammals	General			y	Horns Reef	Site specific	Denmark	Tougaard, J, Tougaard, S, Jensen, RC, Jensen, T, Teilmann, J, Adelung, D, Liensch, N, Muller, G	2006	Harbour seals at Horns Reef before, during and after construction of Horns Rev offshore wind farm	pdf file held
678	Potential Impacts	Broad Issues	General impacts		y		BC Hydro, Engineering	Regional	British Columbia	Triton Consultants Ltd	2002	Green Energy Study for British Columbia Phase 2: Mainland	pdf file held
679	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise	y	y	y	Fawley Aquatic Research Lab	Broad	UK	Turnpenny, AWH and Nedwell, JR	1994	The effects on marine fish, diving mammals and birds of underwater sound generated by seismic surveys	pdf file held
680	Potential Impacts	Fish Ecology	Potential collision risk		y		ETSU	Broad	UK	Turnpenny, AWH, Clough, S, Hanson, KP, Ramsay, R and McEwan, D		Risk assessment for fish passage through small, low-head turbines	pdf file held
681	Baseline	Physical environment	Seabed sediment	y	y	y	SEA 8	Regional	SEA 8	Tyrell, D and Voisey, C	2004	Geology and sediment processes	pdf file held
682	Baseline	Physical environment	Oceanography and hydrography	y	y	y	SEA 8	Regional	SEA 8	Tyrell, D and Voisey, C	2004	Oceanography and Hydrography	pdf file held
683	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	Regional	Cardigan Bay	Ugarte, F and Evans, PGH	2002	Monitoring of marine mammals in the Cardigan Bay SAC: surveys from May 2003 to April 2005	CCW library
684	Baseline	Tourism and recreation	General	y	y	y	University of Brighton	Regional	Wales	University of Brighton	2007	Strategic Planning of Water Related Sports and Recreation in Wales	pdf file held
685	Baseline	Tourism and recreation	General	y	y	y	University of Brighton	Regional	Wales	University of Brighton	Undated	Strategic Planning of Water Related Sports and Recreation in Wales: Workshop Summary	pdf file held
686	Potential Impacts	Benthic ecology	General			y	BERR RAG	Broad	UK	University of Hull		Statistical basis for seabed benthic monitoring as a tool for environmental management in the offshore windfarm industry	Project in progress
687	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	SNH	Broad	Generic	University of Newcastle	2002	Visual assessment of windfarms: best practice	pdf file held
688	Development specific info	Projects	Outer Continental Shelf	y	y	y	US Department of the Interior Minerals Management Service (MMS)	Broad	US Outer Continental Shelf	US Department of the Interior Minerals Management Service	2007	Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate use of Facilities on the Outer Continental Shelf	pdf file held
689	Baseline	Archaeology	General	y	y	y	World Archaeology 35(3), 404-415	Broad	Generic	Van de Noort, R	2003	An ancient seascape: the social context of seafaring in the early Bronze Age	Not held
690	Potential Impacts	Physical environment	Scour			y	Delft University	Broad	Generic	van der Tempel, J, Zaaijer, MB and Subroto, H		The effects of scour on the design of offshore wind turbines	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
691	Development specific info	Projects	Burbo Offshore wind farm			Y	Burbo Offshore Wind Farm	Site specific	Liverpool Bay	Anon	2002	Burbo Offshore Wind Farm	EIA and associated documents
692	Development specific info	Projects	North Hoyle OWF			Y	North Hoyle Offshore Wind Farm	Site specific	North Wales	Anon	2002	North Hoyle Offshore Wind Farm Environmental Statement	EIA and associated documents
693	Development specific info	Projects	Scarweather OWF			Y	Scarweather Sands Offshore Wind Farm	Site specific	Swansea Bay	Anon	2003	Scarweather Sands Offshore Wind Farm	EIA and associated documents
694	Development specific info	Projects	Greater Gabbard OWF			Y	Greater Gabbard	Site specific	Greater Thames	Anon	2005	Greater Gabbard Offshore Wind Farm	NTS
695	Development specific info	Projects	Gwynt y Mor			Y	Gwynt y Mor Offshore Wind Farm	Site specific	North Wales	Anon	2005	Gwynt y Mor Offshore Wind Farm	NTS
696	Development specific info	Projects	Ormonde OWF			y	Eclipse Energy Company Ltd	Site specific	Barrow Offshore Wind Farm	Anon	2005	Ormonde project Environmental Impact Assessment Non Technical Summary	NTS
697	Development specific info	Projects	Gunfleet Sands OWF			Y	Gunfleet Sands 2 Offshore Wind Farm	Site specific	Greater Thames	Anon	2007	Gunfleet Sands 2 Offshore Wind Farm	NTS
698	Development specific info	Projects	Lincs offshore wind farm			Y	Lincs Offshore Wind Farm	Site specific	Greater Wash	Anon	2007	Lincs Offshore Wind Farm	EIA and associated documents
699	Device specific info	Device specific info	Wind Turbine			y	Department of Civil Engineering, Oxford University	Broad	Generic	Anon	Various	Reports on offshore foundations and structures	Not held
700	Potential Impacts	Ecology	Disturbance/displacement/avoidance of due to noise			y	ETSU	Broad	UK	Vella, G, Rushforth, I, Mason, E, Hough, A, England, R, Styles, P, Holt, T and Thorne, P	2001	Assessment of the effects of noise and vibration from offshore wind farms on marine wildlife	pdf file held
701	Potential Impacts	Physical environment	Cumulative effects	y			7th European Wave and Tidal Energy Conference, 2007	Broad	Generic	Venugopal, V. and Smith, G.H	2007	Wave climate investigation for an array of wave power devices	Pdf file held
702	Development specific info	Projects	RITE		y		Verdant Power	Site specific	Roosevelt Island	Verdant Power	2003	Initial consultation document for the Roosevelt Island tidal energy project	pdf file held
703	Potential Impacts	Fish Ecology	Potential collision risk		y		www.verdantpower.com	Site specific	New York	Verdant Power	2007	As part of Phase II of the RITE Project, Verdant Power has installed a field of six Free Flow™ Turbines: five turbines with 35kW nameplate generators each (a total of 175kW), and one turbine equipped with a dynamometer. A key purpose of this second-phase installation is to evaluate and monitor the turbines and overall Kinetic Hydropower System from a variety of environmental perspectives. These analyses will include an assessment of any potential impact the technology may have on aquatic life. To monitor fish movement in and around the test turbine field, Verdant Power and its environmental consultants have deployed a large-scale array of 24 split-beam hydroacoustic transducers, as well as a high-frequency DIDSON unit that will monitor the area 24/7 for 18 months, beginning in December of 2006. This system is unprecedented in terms of its comprehensive and continuous nature of underwater monitoring. Customized software detects, distinguishes, gauges, counts and tracks any events of fish passing near the turbine array or in close proximity to the rotors. In addition to this fixed monitoring o	not held
704	Baseline	General site background	The Irish Sea Pilot	y	y	y	JNCC	Regional	Irish Sea	Vincent, MA, Atkins, SM, Lumb, CM, Golding, N, Lieberknecht, LM and Webster, M	2004	Marine nature conservation and sustainable development - the Irish Sea Pilot	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
705	Baseline	Water and sediment quality	Contaminants				SEA 8	Broad	SEA 8	Voisey, C and Tyrell, D	2004	Contamination of water and sediments	pdf file held
706	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	SEA 8	Regional	SEA 8	Voisey, C and Tyrrell, D	2004	DTI Strategic Environmental Assessment Area 8: Benthos	pdf file held
707	Baseline	Physical environment	Wave and tide resource	y			Waves and operational Oceanography / GLOBWAVE Project Workshop, 19-21 September 2007, Brest, France	National	Generic	Vuillemin, J. and Harrison, G. P	2007	On wave climate predictability: a mesoscale model to assess future wave energy potential	Not held
708	Baseline	Archaeology	General	y	y	y	Galway University Press	National	Ireland	Waddell, J	2000	The Prehistoric Archaeology of Ireland	Not held
709	Potential Impacts	Fish Ecology	Disturbance/displacement/avoidance of/by fish due to noise (incl migratory routes)			y	Marine Ecology Progress Series Vol 288 295-309	Broad	Generic	Wahlberg, M and Westerberg, H	2005	Hearing in fish and their reactions to sound from offshore wind farms	pdf file held
710	Potential Impacts	Fish Ecology	Potential effects of EMF			y	Marine and Freshwater Resources Institute, No. 20 68pp	Broad	Generic	Walker, TI	2001	Baseline project review of impacts of high voltage direct current sea cables and electrodes on Chrondrichyhan fauna and other marine life	Not held
711	Baseline	Seabirds	Seabirds	y	y	y	Walney Offshore Wind Farm	Regional	Eastern Irish Sea	Walney bird observatory		Wildfowl and seabird migration along the eastern Irish Sea flyway	pdf file held
712	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	Plymouth Marine Laboratory, Pisces Conservation	Site specific	Bristol Channel	Warwick, R, Henderson, PA, Fleming, JM and Somes, JR	2001	The impoverished fauna of the deep water channel and marginal areas between Flatholm Island and King Road, Severn Estuary	pdf file held
713	Baseline	Marine mammals	Cetaceans	y	y	y	Gower Marine Mammals Project	Regional	Carmarthen Bay, Gower Peninsula and Swansea Bay	Watkins, H and Colley, R	2004	Harbour porpoise Phocoena phocoena occurrence	pdf file held
714	Baseline	Physical environment	Wind resource			y	OWEN Workshop	Broad	UK	Watson, G	1999	Offshore wind resource assessment and metocean data	pdf file held
715	Device specific info	Device specific info	OWC (wavegen)	y			BERR	Broad	Device specific	Wavegen Ltd	2006	Near shore oscillating wave column: prototype development of power take off systems	pdf file held
716	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	Site specific	Bardsey Island	WDCS	2006	Bardsey Island Cetacean Surveys 2005	Not held
717	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance			y	House of Commons Session 1993-94	Broad	Generic	Welsh Affairs Committee	1994	Second Report: Wind Energy Volume 1	pdf file held
718	Baseline	Physical environment	Seabed sediment	y	y	y	MADP	Regional	Bristol Channel	Welsh Assembly Government	2004	Interim Marine Aggregate Dredging Policy South Wales	pdf file held
719	Baseline	Tourism and recreation	General	y	y	y	Welsh Assembly Government	Broad	Wales	Welsh Assembly Government	2007	Welsh Coastal Tourism Strategy - draft final strategy document	Summary held
720	Baseline	Tourism and recreation	General	y	y	y	Welsh Assembly Government	National	Wales	Welsh Assembly Government	2007	Welsh Coastal Tourism Strategy - SEA	Appendices A and D
721	Baseline	Commercial Fisheries	Coastal fisheries	y	y	y	WDA	Broad	Wales	Welsh Development Agency	2003	Welsh Fisheries and Aquaculture Sector: Strategic Action Plan	Not held
722	Baseline	Archaeology	Maritime archaeology	y	y	y	SEA 6	Regional	SEA 6	Wessex Archaeology	2005	Strategic Environmental Assessment SEA 6: Irish Sea. Maritime Archaeology	pdf file held
723	Baseline	Archaeology	General	y	y	y	Unpublished report (ref.: 53111.03t)	Site specific	Cardigan Bay	Wessex Archaeology	2005	Tal-y-Bont, Cardigan Bay, Wales. Designated Site Assessment: Full Report	Not held
724	Potential Impacts	Archaeology	General				COWRIE	Broad	UK	Wessex Archaeology	2007	Historic environment guidance for the offshore renewable energy sector	pdf file held
725	Legislation, policy and guidance	Archaeology	General	y	y	y	COWRIE	Broad	Generic	Wessex Archaeology	2007	Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy	Not held
726	Baseline	Archaeology	General	y	y	y	Unpublished report (ref.: 53111.03vv)	Site specific	Menai Strait	Wessex Archaeology	2007	Pwll Fanog Wreck, Menai Strait, Anglesey. Deisgnated Site Assessment: Archaeological Report	Not held
727	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	North Wales	Westcott, SM	2002	The distribution of grey seals (halichoerus grypus) and census of pup population in North Wales 2001	CCW library

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
728	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	North Wales	Westcott, SM	2003	Grey seal pup production for north Wales 2002	CCW library
729	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	North Wales	Westcott, SM and Stringell, TB	2004	Grey seal distribution and abundance in North Wales 2002-2003	word file held
730	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	SEA 6	Regional	SEA 6	Wilding, TA, Nickell, LA, Gontarek, S and Sayer, MDJ	2005	Synthesis of information on the Benthos of area SEA 6	pdf file held
731	Baseline	Archaeology	General	y	y	y	Studia Celtica XXX: 277-282	Site specific	Menai Strait	Williams, JLI	1996	A Neolithic axe from Traeth Lafan in the Menai Straits, Gwynedd	Not held
732	Potential Impacts	Ecology	Potential collision risk	y	y		Scottish SEA Appendix C7.B	Broad	Scotland	Wilson, B, Batty, RS, Daunt, F and Carter, C	2007	Collision risks between marine renewable energy devices and mammals, fish and diving birds	pdf file held
733	Baseline	Archaeology	General	y	y	y	in Woodcock, N. and Strachan, R. 2000, Geological History of Britain and Ireland, Blackwell Science Ltd., Cambridge University Press	National	Britain and Ireland	Woodcock, N	2000	The Quaternary history of an ice age	Not held
734	Baseline	Archaeology	General	y	y	y	Blackwell Science Ltd., Cambridge University Press	National	Britain and Ireland	Woodcock, N and Strachan, R	2000	Geological History of Britain and Ireland	Not held
735	Baseline	Archaeology	General	y	y	y	in McCaughan, M. and Appleby, J., 1989, The Irish Sea Aspects of Maritime History, The Institute of Irish Studies, The Queen's University of Belfast and the Ulster Folk and Transport Museum	Regional	Irish Sea	Woodward, D	1989	Irish Sea Trades and Shipping from the Later Middle Ages to c. 1660	Not held
736	Baseline	Benthic Ecology	Site specific benthic data	y	y	y	University of Swansea	Site specific	Carmarthen Bay	Woolmer, AP	2003	The Benthic Ecology of Carmarthen Bay	pdf file held
737	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	WWF	Broad	UK	WWF	2005	Marine Renewable Energy for the UK: Policy Position	pdf file held
738	Baseline	Archaeology	General	y	y	y	4th Edition, Derbyshire, Landmark Publishing	Regional	North Wales	Wynne Jones, I	2001	Shipwrecks of North Wales	Not held
739	Baseline	Designated sites	Management Plan	y	y	y		Site specific	Lleyn Peninsula		2000	Pen Llyn A'r Sarnau Candidate SAC Draft Management Plan	pdf file held
740	Baseline	Designated sites	Action Plan	y	y	y		Site specific	Lleyn Peninsula		2001	Pen Llyn A'r Sarnau Candidate SAC Action Plan	pdf file held
741													
742	Potential Impacts	Benthic ecology	Effect of cable route	y	y	y	Marine Pollution Bulletin, Vol. 32 (8/9) pp 615-622	Site specific		Kenny, AJ and Rees, HL	1996	The Effects of Marine Gravel Extraction on the Macrobenthos: Results 2 years Post Dredging	Not held
743	Potential Impacts	Benthic ecology	Effect of cable route	y	y	y	Oceanography and Marine Biology: an Annual Review. 36: 127-78	Broad	Generic	Newell, R., Seiderer, LJ, Hitchcock, DR	1998	The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed.	Not held
744	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	BWEA Renewables East	Broad	Generic	BVG Associates and Douglas Westwood	2006	Offshore Wind: At a Crossroads	pdf file held
745	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Fortis Securities LLC. New York. 10 February 2005	Broad	Generic	Barret, D	2005	The Offshore Supply Boat Sector	pdf file held
746	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Department of Trade and Industry and Scottish Enterprise	Broad	Generic	BVG Associates and Douglas Westwood	2006	Doing Business with Wind Turbine Manufacturers: Becoming Part of their Supply Chain	pdf file held
747	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Wavegen, Article 1727	Broad	Generic	Heath, T	2008	Realities of Wave Technology	Not held
748	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Project Reference B0367300	Broad	Generic	Jacobs UK Limited	2006	EnergyNet Wales: The Wind Generation Market	pdf file held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
749	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Report to Pushing Offshore Wind Energy Regions (POWER)	Broad	Generic	Douglas Westwood	2007	Transnational Offshore Wind Supply Chain Study.	pdf file held
750	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	Department of Trade and Industry	Broad	Generic	POWER	2006	Correspondence from Pushing Offshore Wind Energy Regions (POWER) to the Energy Review Team	pdf file held
751	Baseline	Physical environment	Wave and tide resource	y	y		Welsh Development Agency	Broad	Wales	PMSS	2006	Wales Marine Energy Site Selection	pdf file held
752	Legislation, policy and guidance	Archaeology	General	y	y	y	CCW, Cadw and WAG	Broad	Wales	CCW, Cadw and WAG	Undated	Guide to good practice on using the register of landscapes of historic interest in Wales in the planning and development process	not held
753	Development specific info	Projects	Rhyl Flats			y	Rhyl Flats	Site specific	North Wales	West Coast Energy Ltd	2002	Rhyl Flats Offshore Wind Farm Environmental Statement	EIA and associated documents
754	Baseline	Fish Ecology	General	y	y	y	National Assembly of Wales	National	Wales	Nautilus Consultants Ltd	2000	Study into inland and sea fisheries in Wales	pdf file held
755	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y		Supergen Consortium	Broad	Generic	University of Edinburgh	2007	Supergen Marine Energy Research: Full Report	pdf file held
756	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y	y	HM Government White Paper	Broad	UK	DTI	2007	Meeting the Energy Challenge: A White Paper on Energy	pdf file held
757	Legislation, policy and guidance	Legislation, Policy and Guidance	Legislation, Policy and Guidance	y	y		BWEA	Broad	UK	BWEA	2005	Wave and Tidal Stream Energy around the United Kingdom Legal and Regulatory Requirements	pdf file held
758	Baseline	Marine mammals	General	y	y	y	CCW	Regional	North Wales	Pesante, G, Evans, PGH, Anderwald, P, Powell, D and McMath, M	2008	Connectivity of Bottlenose dolphins in Wales: North Wales Photo-Monitoring Interim Report 2008	pdf file held
759	Legislation, policy and guidance	Legislation, Policy and Guidance	General	y	y	y	JNCC	National	UK	JNCC	2008	The deliberate disturbance of marine European Protected Species. Guidance for English and Welsh territorial waters and the UK offshore marine area	pdf file held
760	Legislation, policy and guidance	Legislation, Policy and Guidance	General			y	OSPAR Commission	Broad	North East Atlantic	OSPAR Commission	2008	OSPAR Guidance on Environmental Considerations for Offshore Wind Farm Development	Not held
761	Legislation, policy and guidance	Legislation, Policy and Guidance	General	y	y	y	European Commission	Broad	Europe	European Commission	2000	Ccommunication from the Commissionon the precautionary principle	Not held
762	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	National	Wales	Baines, ME and Earl, S	1999	Analysis of sightings for indications of harbour porpoise breeding off the Welsh coast	CCW library
763	Baseline	Marine mammals	Grey seals	y	y	y	Bangor University, Masters Dissertation	Local	Ceredigion	Lewis, KM	2006	Habitat use, haulout behaviour and site fidelity of grey seals (Halichoerus grypus) along the Ceredigion Marine Heritage Coast, Wales	pdf file held
764	Baseline	Marine mammals	Grey seals	y	y	y	Dyfed Wildlife Trust	Regional	Skomer Island	Baines, ME	1992	The West Wales grey seal census. Interim report on the 1991 survey	Dyfed Wildlife Trust
765	Baseline	Marine mammals	Grey seals	y	y	y	Dyfed Wildlife Trust	Regional	Skomer Island	Baines, ME	1993	The West Wales grey seal census. Interim report on the 1992 season	Dyfed Wildlife Trust
766	Baseline	Marine mammals	Grey seals	y	y	y	Dyfed Wildlife Trust	Regional	Skomer Island	Baines, ME, Earl, SJ and Strong, PG	1994	The West Wales grey seal census. Interim report on the 1993 season	Dyfed Wildlife Trust
767	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Baines, ME, Earl, SJ, Pierpoint, CJL and Poole, J	1995	The West Wales grey seal census	CCW library
768	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Duffield, SE	2003	Grey seal breeding census: Skomer Island 2002	CCW library
769	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Field, R	2000	Grey seal breeding census: Skomer Island 1999	CCW library
770	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Matthews, JH	2004	Grey seal breeding census: Skomer Island 2003	CCW library

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
771	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Matthews, JH	2005	Grey seal breeding census: Skomer Island 2004	CCW library
772	Baseline	Marine mammals	Grey seals	y	y	y	Dyfed Wildlife Trust	Regional	Skomer Island	Orsman, C	1991	Grey seal breeding success - Skomer Island 1990	Dyfed Wildlife Trust
773	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Pilsworth, M	2001	Grey seal breeding census: Skomer Island 2000	CCW library
774	Baseline	Marine mammals	Grey seals	y	y	y	Dyfed Wildlife Trust	Regional	Skomer Island	Poole, J	1992	Grey seal breeding success - Skomer Island 1991	Dyfed Wildlife Trust
775	Baseline	Marine mammals	Grey seals	y	y	y	Dyfed Wildlife Trust	Regional	Skomer Island	Poole, J	1993	Grey seal breeding success - Skomer Island 1992	Dyfed Wildlife Trust
776	Baseline	Marine mammals	Grey seals	y	y	y	Dyfed Wildlife Trust	Regional	Skomer Island	Poole, J	1994	Grey seal breeding success - Skomer Island 1993	Dyfed Wildlife Trust
777	Baseline	Marine mammals	Grey seals	y	y	y	Dyfed Wildlife Trust	Regional	Skomer Island	Poole, J	1995	Grey seal breeding success - Skomer Island 1994	Dyfed Wildlife Trust
778	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Poole, J	1996	Grey seal breeding success - Skomer Island 1995	CCW library
779	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Poole, J	1997	Grey seal breeding success - Skomer Island 1996	CCW library
780	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Poole, J	1998	Grey seal breeding success - Skomer Island 1997	CCW library
781	Baseline	Marine mammals	Grey seals	y	y	y	CCW	Regional	Skomer Island	Poole, J	1999	Grey seal breeding success - Skomer Island 1998	CCW library
782	Baseline	Marine mammals	Cetaceans	y	y	y	Bardsey Observatory Report	Site specific	Bardsey Island	de Boer, Clark, J, Keith, S, Simmonds, M	2004	Bardsey Island Cetacean Surveys 2004	Not held
783	Baseline	Marine mammals	Cetaceans	y	y	y	Bardsey Observatory Report	Site specific	Bardsey Island	de Boer, Keith, S, Simmonds, M	2003	Bardsey Island Cetacean Surveys 2003	Not held
784	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	Site specific	Bardsey Island	McMath, M	2005	Bardsey Island Cetacean Surveys 2004	Not held
785	Baseline	Marine mammals	Cetaceans	y	y	y	CCW	Site specific	Bardsey Island	de Boer, M	2001	Bardsey Island Cetacean Surveys 2001	Not held
786	Baseline	Marine mammals	Cetaceans	y	y	y	Bardsey Observatory Report	Site specific	Bardsey Island	de Boer, M and Simmonds, M	2002	Bardsey Island Cetacean Surveys 2002	Not held
787	Baseline	Marine mammals	Cetaceans	y	y	y	University of Jyväskylä	Regional	Cardigan Bay	Saana, I	2006	Coastal habitat use of harbour porpoise (Phocoena phocoena) in Cardigan Bay Special Area of Conservation (Wales)	pdf file held
788	Impact	Sea birds	General			y	Lynn and Inner Dowsing	Site specific	Lynn and Inner Dowsing	Walls, R, Pendlebury, C and Turner, L	2008	Lynn and Inner Dowsing Offshore Wind Farm Boat-based Ornithological Monitoring Report. July-December 2007	pdf file held
789	Impact	Sea birds	General			y	Scroby Sands monitoring	Site specific	Scroby Sands	ECON	2006	Assessing the potential impact of the proposed wind farm upon Little Tern Sterna albifrons: the post construction phase beginning in 2005	pdf file held
790	Impact	Sea birds	General			y	Barrow Offshore Wind Farm	Site specific	Barrow Offshore Wind Farm	NIRAS Consulting Engineers and Planners A/S	2008	Barrow Offshore Wind Farm. Post Construction Monitoring Report	pdf file held
791	Impact	Sea birds	General			y	Burbo Offshore Wind Farm	Site specific	Burbo Bank Offshore Wind Farm	CMACS	2008	Burbo Bank Offshore Wind Farm Ornithological Report - Construction Period	pdf file held
792	Potential Impacts	Sea birds	Attraction to light	y	y	y	Marine Pollution Bulletin, Vol. 42, pp1285-1290	Regional	North West Atlantic	Wiese, FK, Montevecchi, WA, Davoren, GK, Huettmann, F, Diamond, AW and Linke, J	2001	Seabirds at Risk around Offshore Oil Platforms in the North-west Atlantic	not held
793	Potential Impacts	Sea birds	Diving behaviour	y	y		Journal of the Zoological Society, London, Vol. 216, 73-8	Regional	North West Atlantic	Wanless, S, Morris, J. A. and Harris, M. P	1988	Diving behaviour of guillemot Uria aalge, puffin Fratercula arctica and razorbill Alca torda as shown by radio telemetry	not held
794	Baseline	Sea birds	General	y	y	y	CCW	Regional	Severn Estuary	Goodger, B	2005	Mapping locations of non-breeding birds on the Welsh section of the Severn estuary SSSI, Ramsar site, SPA and cSAC	not held
795	Baseline	Sea birds	General	y	y	y	CCW	Regional	Severn Estuary	Ward, R, Marshall, P and Woodward, R	2003	Baseline bird monitoring of the River Severn	not held
796	Baseline	Sea birds	General	y	y	y	BTO	Regional	Severn Estuary	Burton, NHK, Marchant, JH, Musgrove, AJ, Armitage, MJS, Holloway, SJ and Phillips	2003	Low-tide distributions of waterbirds on the Severn Estuary SPA: results of the 2002/03 WeBS Low Tide Counts and a historical analysis	not held
797	Baseline	Ecology	General	y	y	y	CCW	Regional	Cardigan Bay	Green, M and Elliot, D	1993	Surveys of wintering birds and cetaceans in Northern Cardigan Bay	not held

ID	Purpose	Issue	Specific	Wave	Tide	Wind	Data source	Data scale	Data extent	Author	Date	Title	Data availability
798	Baseline	Sea birds	General	y	y	y	CCW	Regional	Carmarthen Bay	Banks, AN, Maclean, IMD, Collier, MP, Hainsworth, I, Howells, R and Hughes, DS	2007	Monitoring Bird Distribution and Behaviour on the Carmarthen Bay and Estuaries SAC at Low Tide	not held
799	Baseline	Sea birds	General	y	y	y	JNCC	Regional	Skomer and Skokholm	Stone, CJ, Harrison, NM, Webb, A and Best, BJ	1992	Seabird Distribution Around Skomer and Skokholm Islands, June 1990	not held
800	Baseline	Sea birds	General	y	y	y	BTO	National	UK	Banks, AN, Burton, NHK, Calladine, JR and Austin, GE	2007	Winter Gulls in the UK: population estimates from the 2003/04 Winter Gull Roost Survey	not held
801	Baseline	Sea birds	General	y	y	y	Bird Study, 50, 22-32	National	UK	Rehfisch, M, Holloway, SJ and Austin, GE	2003	Population estimates of waders on the United Kingdom's and the Isle of Man's non-estuarine coasts during the winter of 1997-98	not held
802	Legislation, policy and guidance	Legislation, Policy and Guidance	General			y	CCW	National	Wales	Miller, I	2005	Offshore wind farms: the European experience	CCW library
803	Impact	Marine mammals	General			y	ECS Special Publication Series	Broad	Generic	Evans, PGH	2007	Offshore wind famrs and marine mammals: impacts and methodologies for assessing impacts	Not held
804	Baseline	Marine mammals	General	y	y	y	ASCOBANS	National	North Sea and North Atlantic	Hammond, PS and Macleod, K	2006	SCANS II – Report on Progress. Paper prepared for ASCOBANS 5th Meeting of the Parties, Netherlands	Not held
805	Baseline	Marine mammals	general	y	y	y	Report for Friends of Cardigan Bay	Regional	Pembrokeshire	De Messieres, M and Ryan, J	2001	Pembrokeshire offshore survey	Not held
806	Baseline	Marine mammals	Grey seals	y	y	y	SCOS Briefing Paper	National	Wales	McMath, AJ and Stringell, TB	2006	Grey seal pup production in Wales	pdf file held
807	Baseline	Marine mammals	General	y	y	y	The Wildlife Trusts / WWF-UK	Regional	Pembrokeshire	Pierpoint, C, Baines, M and Earl, S	1998	The harbour porpoise (Phocoena phocoena) in west Wales - a briefing report to the Wildlife Trusts and WWF-UK in support of a Special Area of Conservation for harbour porpoise at Strumble Head, Pembrokeshire	Not held
808	Baseline	Archaeology	General	y	y	y		National	Wales	Anon	2003	A research framework for the archaeology of Wales	pdf file held
809	Legislation, policy and guidance	Legislation, Policy and Guidance	General	y	y	y	English Heritage and Aggregates Levy Sustainability Fund	National	England	Tapper, B and Johns, C	2008	Englands historic seascapes consolidating the national method	pdf file held
810	Legislation, policy and guidance	Legislation, Policy and Guidance	General	y	y	y	Scottish Natural Heritage	National	Scotland	Scott, KE, Anderson, C, Dunsford, H, Benson, JF and MacFarlane, R	2005	An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms	pdf file held
811	Potential Impacts	Fish Ecology	Collision		y		River Dart	Site specific	River Dart	FISHTEK consulting	2007	Fish Monitoring and Live Fish Trials. Archimedes Screw Turbine, River Dart Phase 1 Report: Live fish trials, smolts, leading edge assessment, disorientation study, outflow monitoring	pdf file held
812	Potential Impacts	Fish Ecology	Collision		y		River Dart	Site specific	River Dart	FISHTEK consulting	2008	Archimedes Screw Turbine Fisheries Assessment. Phase II: Eels and Kelts	pdf file held

Appendix C

Full List of Wave and Tidal Devices Identified

Technologies	Developers	Website	Known Status
Wave Energy			
Aegir Dynamo	Ocean Navitas	www.oceannavitas.com	Working bench model
Aqua Buoy/IPS OWEC	IPS OWEC	www.finavera.com	Deployed in Makah Bay
Archimedes Wave Swing	Teamwork Technology BV	www.waveswing.com	Tested in Portugal, pending development in Orkney, site selection started in Spain and pending in UK
BioWAVE	BioPower Systems	www.biopowersystems.com/biowave.html	
Brandl Motor	Brandl Motor	http://brandlmotor.de/brandlgenerator_eng.htm	Scale model tested in the North Sea
CETO Wave Power Converter (delivers high pressure sea water and not electricity on shore)	Renewable Energy Holdings plc	www.ceto.com.au/home.php	Initial testing of scale models in tanks. 3d computer modelling. Sea trials of CETO II at Freemantle, Australia
C-Wave	Cwavepower	www.cwavepower.com	Undertaken tank testing
Deniss-Auld Turbine	Ocean Linx Ltd (formerly Energetech)	www.oceanlinx.com	Test site at Port Kembla, Australia
Float Wave Electric Power Station (FWEPS)	Applied Technologies Company Ltd	www.atecom.ru/we/	Prototype has been tested (in a lab?)
Floating Wave Power Vessel	Sea Power International AB	www.seapower.se	Tested in Sweden and the Shetlands
FO3 (Buldra)	Fred Olsen	www.seewec.org	1:3 laboratory rig at Buldra and the single system test station (SSTS) at Løkstadt
Frond Wave Generator	The Engineering Business Ltd	www.engb.com	
Grampus Wave Energy Converter	Offshore Wave Energy Ltd	www.owel.co.uk	Investigating deployment at EMEC
Hydro air	Peter Brotherhood Ltd	-	Design stage
Limpet	Wavegen	www.wavegen.co.uk	Installed at Islay, investigating deployment at Siadar
The Linear Generator	Trident Energy	www.tridentenergy.co.uk	Tested a 1/5 scale model at NaREC in 2005
Mighty Whale	JAMSTEC	www.jamstec.go.jp/jamstec/MTD/Whale/	Prototype tested in 1998 Gokasho Bay off Mie Prefecture, Japan
MRC1000	Orecon	www.orecon.com	Trialled at Plymouth, UK
Neptune Near Shore Wave Energy Converter	Triton	www.neptunerenewableenergy.com	Lab tests of 1/100 and 1/10
OE Buoy	Ocean Energy	www.oceanenergy.ie	1:50 and 1:15 lab testing followed by deployment of model in 2006 at the

Technologies	Developers	Website	Known Status
			Marine Institute test site at Galway
OPT Powerbuoy	Ocean Power Technologies Inc	www.oceanpowertechnologies.com	Deployed at New Jersey, USA, Hawaii and looking to deploy off Spain and at EMEC
Pelamis	Ocean Power Delivery	www.oceanpd.com	Device deployed at EMEC, commercial project in Orkney, possible project in Orkney
PICO	Wave Energy Centre	www.pico-owc.net	Installed at Pico Island, Azores. Constructed in-situ in 1998, with repair works 2003-2005
SDE	SDE	www.sde.co.il	Government grant to produce and sell electricity
Seawave Slot-cone Generator, SSG	WAVEenergy	www.wavessg.com	Model testing on 1/15 scale plus 2D and 3D models. Prototype under construction in Norway in 2006
SeWave	SeWave Ltd	www.sewave.fo	Proposed site in the Faroe Islands. Model tests, site investigations and design issues completed in 2005
Sperboy	Embley Energy	www.sperboy.com	Trialled at Plymouth, UK 1/5 sized pilot, proceeding to development of full scale prototype
SyncWave Power Resonator	SyncWave	www.syncwaveenergy.com	Prototype testing, with plans to move ahead with a three year demonstration wave power project off the West Coast of British Columbia
Waveberg	Waveberg Development Ltd	www.waveberg.com	Scale model tested off Nova Scotia, with a potential project in Hawaii
WaveBob	Wavebob Ltd	www.wavebob.com	Sea trials at Marine Institute/ Sustainable Energy Ireland 's wave energy test site in the Atlantic Ocean off the coast of Spiddal in Co. Galway
Wave Dragon	Wave Dragon ApS	www.wavedragon.net	Deployed in Denmark with proposals for deployment in Pembrokeshire
Wave Energy Conversion Activator (WECA)	DaeDalus	www.daedalus.gr/DAEI/PRODUCTS/RET/General/RETWW1.html	Computer modelling undertaken
WavePlane	Caley (technology developed by Danish inventors WavePlane International A/S)	www.caley.co.uk/Pages/wave.htm	Prototype deployed West coast of Jutland
Wave Rotor	Ecofys	www.ecofys.com	1/10 scale testing undertaken at NaREC
Wave Star	Wave Star Energy	www.wavestarenergy.com	1:10 model installed at Nissum Bredning, Denmark
Tidal Energy			
Active Water Column Generator	The Engineering Business Ltd	www.engb.com	Trialled in Blythe dry dock
Aquanator	Atlantic	www.atlantisresourcesc	

Technologies	Developers	Website	Known Status
	Resources Corporation	orporation.com	
bioSTREAM	BioPower Systems	www.biopowersystems.com/	
Bowsprit Generator	Kinetic Energy Systems	www.kineticenergysystems.com	
Clean Current	Clean Current Power Systems	www.cleancurrent.com	Prototype testing in 2002,2003, proof of concept testing in Newfoundland in 2004, generating device at Race Rocks, Canada
Davis Hydro Turbine	Blue Energy Canada Inc	www.bluenergy.com	Lab testing of prototypes in Canada a lab, with historic testing in the sea. Current proposals for pre-commercial demonstration off British Colombia, Canada and in the Philippines
DeltaStream	Tidal Hydraulic Generators Ltd and Peter Brotherhood Ltd		Possible deployment between the Severn Crossings and/or Ramsey Sound, Pembrokeshire. Trials in Milford Haven completed.
EnCurrent Turbine	New Energy Corporation Inc	www.newenergycorp.ca	Tested in a lab and 2 units tested in riverine conditions
Evopod	Ocean Flow Energy	www.oceanflowenergy.com	1/10 scale device tested at NaREC to
Exim	Sea Power International AB	www.seapower.se	Test sites in the Shetlands and Poland
Free Flow™ Turbines	Verdant Power	www.verdantpower.com	Roosevelt Island Tidal Energy (RITE) initiated in 2002. Subsequent CORE project being planned in Canada
GENTEC venturi	Green Heating Systems Ltd	www.greenheating.com	Subject to funding, construction due to start 2008
Gorlov Helical Turbine	GCK Technology Ltd	www.gcktechnology.com	Tested in the Cape Cod Canal
Hammerfest Strom Turbine	Hammerfest Stromas AS Ltd	www.e-tidevannsenergi.com	Installed in Finland in 2002
Hydro-Gen	Hydro-Gen	www.hydro-gen.fr	Prototype deployed at sea
Hydrokinetic Generator	Kinetic Energy Systems	www.kineticenergysystems.com	
Hydro Venturi	HydroVenturi Ltd	www.hydroventuri.com	Demonstration project on the Humber. Has operated low head systems in the UK since 2002
KESC Tidal Generator	Kinetic Energy Systems	www.kineticenergysystems.com	
Kobold Turbine	Ponte de Archimede International S.P.A	www.pontediarchimede.it	A device has been deployed in the Strait of Messina

Technologies	Developers	Website	Known Status
La Rance Barrage	Electricite de France	www.electricite-de-france.com	In operation
Marine Current Turbine	Marine Current Turbines Ltd	www.marineturbines.com	Device deployed at Lynmouth with a further device consented at Strangford Lough
Neptune Proteus Mark III	Neptune Renewable Energy Ltd	www.neptunerenewableenergy.com	Tank and river testing at Hull, looking to deploy full scale demonstrator in 2008
Open-Centre Turbine	Open Hydro	www.openhydro.com	The twin monopile structure was installed at EMEC in late 2006
Pulse Generators	Pulse Generation	www.pulsegeneration.co.uk	Developing a device to be deployed in the Humber
Rotech Tidal Turbine	Lunar Energy	www.lunarenergy.co.uk	Proposed prototype to be deployed at EMEC. Scoping submitted for a scheme off Pembrokeshire
Scotrenewables Tidal Turbine (SRTT)	Scotrenewables (Marine Power) Ltd	www.scotrenewables.com	Undergone tank testing and sea trials, the latter at Orkney and in the Netherlands. Looking to deploy a full scale device at EMEC
Semi-Submersible Turbine (SST)	Tidal Stream	www.teleos.co.uk	1.5m diameter model tested in the Thames at Chiswick
Swan Turbine	Swan Turbines	www.swanturbines.co.uk	Undertaken development and initial demonstrator testing. Demonstrator to be installed at EMEC
Tidal Sails AS	Tidal Sails	www.tidalsails.com	Undertaken tank testing
Tidal Lagoon	Tidal Electric	www.tidalelectric.com	Plans for Rhyll and Swansea Bay (Swansea Bay has been subject to a scoping study)
Tidal turbines	Tidal Generation Ltd	www.tidalgeneration.co.uk	Working on a prototype to be deployed at EMEC
TidEL	SMD Hydrovision	www.smdhydrovision.com	1/10 scale testing undertaken at Blythe
Torcado	Teamwork Technology BV	http://teamwork.wwxs.net and http://tocardo.com	Successful test in the Netherlands
Turbine- Generator Unit (TGU)	Ocean Renewable Power Company	www.oceanrenewablepower.com	Prototype phase in progress, with preliminary permits for deployment granted
Underwater Electric Kite (UEK)	UEK Systems	www.uekus.com	Prototype tested at Chesapeake Bay

Appendix D

Wind, Wave and Tidal Power Projects Identified

Development Name	Development Type	Location	Status (at October 2007)	Associated Information	Held?
Annapolis Plant	Tide	Nova Scotia, Canada	Online 1984		Not held
Arklow Bank	Wind	Ireland	Online 2003		Not held
Baltic 1	Wind	Germany	Online 2004-5		Not held
Barrow	Wind (R1)	North West (UK)	Generating since March 2006	Full EIA and Associated reports	NTS and EIA
Billia Croo	EMEC wave	Orkney	Wave power development site	Full EIA	EIA held
Breitling	Wind	Germany	Online 2003-4		Not held
Burbo Bank	Wind (R1)	North West (UK)	Under construction	Full EIA and Associated reports	NTS and EIA
Cromer	Wind (R1)	East coast (UK)	Withdrawn	Full EIA and Associated reports	Limited number
Docking shoal	Wind (R2)	Greater Wash (UK)	Pre-application studies		Not held
Dronton	Wind	Netherlands	Online 1996		Not held
Dudgeon	Wind (R2)	Greater Wash (UK)	Pre-application studies		Not held
Enermar Project	Tide	Strait of Messina, Italy	Prototype deployed at sea		Not held
Finavera Renewables	Wave	Makah Bay, Washington (USA)	Consent application submitted	EIA equivalent	Held
Frederikshavn	Wind	Denmark	Online 2003		Not held
Gotland-Bockstigen	Wind	Sweden	Online 1997		Not held
Greater Gabbard	Wind (R2)	Thames (UK)	Consented February 2007	Full EIA and Associated reports	NTS, EIA, some technical reports
Gunfleet Sands	Wind (R1)	Thames (UK)	Consented	Full EIA and Associated reports	NTS
Gunfleet Sands	Wind (R2)	Thames (UK)	Consent application submitted	Full EIA and Associated reports	Not held
Gwynt Y Môr	Wind (R2)	North West (UK)	Additional work post application	Full EIA and Associated reports	NTS, EIA and some technical reports
Horns Rev/Reef	Wind	Denmark	Developed 2002	Pre, during and post construction reports	Limited number
Humber Gateway	Wind (R2)	Greater Wash (UK)	Pre-application studies	Full EIA and Associated reports	Not held
Inner Dowsing	Wind (R1)	Greater Wash (UK)	Under Construction	Full EIA and Associated reports	Limited number

Development Name	Development Type	Location	Status (at October 2007)	Associated Information	Held?
Kentish Flats	Wind (R1)	North Kent (UK)	Generating since 2005	Full EIA and Associated reports	NTS
Klasarden	Wind	Sweden	Online 2004		Not held
Lely	Wind	Netherlands	Online 1994		Not held
Lincs	Wind (R2)	Greater Wash (UK)	Consent application submitted	Full EIA and Associated reports	NTS and EIA
London Array	Wind (R2)	Thames (UK)	Consent application submitted	Full EIA and Associated reports	NTS and AA
Lunar Energy	Tide	Aberdeen	Pre-application studies	EIA conducted	Not held
Lunar Energy	Tide	Pembrokeshire	Scoping for array	Scoping completed	Scoping Report
Lynn	Wind (R1)	Greater Wash (UK)	Under construction	Full EIA and Associated reports	NTS
Middlegrunden	Wind	Denmark	Online 2000		Not held
Nordzee Wind	Wind	Netherlands	Online 2004		Not held
North Hoyle	Wind (R1)	North Wales (UK)	Generating since November 2003	Full EIA and Associated reports	NTS, EIA, FEPA monitoring, some technical reports
Nysted/Rodsand	Wind	Denmark	Developed 2003	Pre, during and post construction reports	Limited number
OPT	Wave	Hawaii (USA)	Single buoy installed	EIA	Summary held
Ormonde	Wind (R1)	North West (UK)	Consented	Full EIA and Associated reports	NTS
Race Bank	Wind (R2)	Greater Wash (UK)	Pre-application studies		Not held
Race Rocks	Tide	Vancouver Island (USA)	Demonstration project	Full EIA and Associated reports	EIA
Rhyl Flats	Wind (R1)	Wales (UK)	Consented	Full EIA and Associated reports	Limited number
RITE	Tide	New York	Demonstration project in operation	EIA equivalent	Background information
Robin Rigg	Wind (R1)	North West (UK)	Consented	Full EIA and Associated reports	Limited number
Samso	Wind	Denmark	Online 2003		Not held
Scarweather Sands	Wind (R1)	Swansea Bay (UK)	Consented	Full EIA and Associated reports	NTS, EIA, Decision letters, some technical reports
Scroby Sands	Wind (R1)	East coast (UK)	Generating since July 2004	Full EIA and Associated reports	Limited number

Development Name	Development Type	Location	Status (at October 2007)	Associated Information	Held?
Seaflow	Tide	Lynmouth, Devon (UK)	Installation and testing of commercial scale device	None in public domain	Not held
SeaGen	Tide	Strangford Lough (NI)	Consented	Full EIA and Associated reports (CONFIDENTIAL)	In Confidence
SeaGen Array	Tide	South Stack Tidal Stream Array	Scoping for array	Scoping study	Scoping study
SeaGen Array	Tide	Skerries Tidal Stream Array	Scoping for array	Scoping study	Scoping study
Severn Barrage	Tide	Severn Estuary (UK)	No formal application	Numerous studies undertaken in 1980's, recent renewed interest	Limited number
Shell Flats	Wind (R1)	North West (UK)	Consent application made for relocated site	Full EIA and Associated reports	EIA
Sheringham Shoal	Wind (R2)	Greater Wash (UK)	Consent application submitted	Full EIA and Associated reports	EIA
Slupsk	Wind	Poland	Online 2004		Not held
Tacoma Narrows	Tide	Puget Sound	Tidal Stream project	Feasibility and some environmental work	Initial reports held
Teeside	Wind (R1)	North East (UK)	Not consented	Full EIA and Associated reports	Limited number
Thanet	Wind (R2)	Thames (UK)	Consented	Full EIA and Associated reports	NTS, EIA and AA
The Rance	Tide	France	Operational since 1967		Not held
Tidal Lagoon	Tide	Swansea Bay (UK)	Pre-application studies, including scoping	None in public domain	Part of the Feasibility Report
Tidal Lagoon	Tide	Rhyl (UK)	Expressions of interest	None in public domain	Not held
Triton Knoll	Wind (R2)	Greater Wash (UK)	Pre-application studies	Full EIA and Associated reports	Not held
Tuno Knob	Wind	Denmark	Online 1995		Not held
Utgrunden	Wind	Sweden	Online 2000		Not held
Utgrunden II	Wind	Sweden	Online 2004		Not held
Vindeby	Wind	Denmark	Online 1991		Not held
Walney	Wind (R2)	North West (UK)	Consent application submitted	Full EIA and Associated reports	EIA and navigation risk assessment
Warness	EMEC tide	Orkney	Tidal power development site	Full EIA	EIA held
Wave Hub	Wave	North Cornwall	Consented	Full EIA and	NTS, EIA

Development Name	Development Type	Location	Status (at October 2007)	Associated Information	Held?
		(UK)		Associated reports	and technical reports
Wave Dragon	Wave	Pembrokeshire (UK)	Consent application submitted	Full EIA and Associated reports	EIA, NTS, Scoping, CCW response to scoping
West Duddon	Wind (R2)	North West (UK)	Consent application submitted	Full EIA and Associated reports	Not held
Westermost Rough	Wind (R2)	Greater Wash (UK)	Pre-application studies	Full EIA and Associated reports	Not held
Yttre Stengrund	Wind	Sweden	Online 2001		Not held

Appendix E

Summary of Literature Sourced Related to Potential Impact

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
Physical Environment	Sediment Deposition	Wave	✓	✓								41, 162, 316, 542, 688
		Wind	✓									14, 45, 109, 268, 587, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688,
	Change in wave energy	Wave	✓	✓		✓		✓	✓		PRIMaRE is looking at Wave Hub and the response to energy extraction and mixing	41, 162, 190, 226, 316, 542, 628, 629, 688
		Wind	✓	✓		✓						14, 45, 180, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓			✓		✓	✓			69, 364, 406, 591, 688
	Change in tidal energy	Wave										
		Wind	✓			✓						14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓	✓	✓	✓	✓	✓	✓		Welsh Energy Research Centre project investigating potential impacts on hydrodynamics and wake effects	69, 73, 90, 121, 209, 210, 211, 212, 213, 364, 406, 478, 543, 591, 673, 688
	Change in vertical	Wave										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	mixing	Wind										
		Tide										
	Change in direction/ reflection of energy	Wave				✓			✓			132, 133, 437
		Wind										
		Tide										
	Change in seabed morphology	Wave	✓	✓								41, 162, 316, 542, 688
		Wind	✓	✓								14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide									Welsh Energy Research Centre project investigating potential impacts on morphology	
	Scour	Wave	✓	✓								41, 162, 316, 542, 688
		Wind	✓	✓	✓	✓	✓		✓		BERR RAG research project investigating scour pits and scour protection	14, 36, 37, 44, 45, 268, 355, 592, 594, 597, 598, 601, 690, 691, 692, 693, 694, 696, 697, 698
		Tide	✓	✓								69, 364, 406, 591, 688
	Change in tidal range	Wave										
		Wind										
		Tide										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	Change in sediment transport	Wave	✓	✓							PRIMaRE is looking at Wave Hub and seabed processes	41, 162, 316, 542, 688
		Wind	✓	✓		✓					BERR RAG project: Review of Round 1 sediment process monitoring data	3, 14, 45, 268, 357, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓	✓							Welsh Energy Research Centre project investigating potential impacts on sediment transport	69, 364, 406, 591, 688
	Change in coastal processes	Wave	✓	✓		✓	✓				Potential for wave devices to provide coastal defence is a research topic at the University of Edinburgh PRIMaRE is looking at Wave Hub and shoreline interactions Work at MREDS on coastal processes.	454, 561, 41, 162, 296, 316, 317, 542, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Wind	✓	✓	✓	✓					BERR RAG project to investigate models to predict effects on the seabed and coastal processes COWRIE project to provide a best practice guide to coastal process impact assessments	1, 14, 45, 181,268, 561, 587, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓			✓					Work at MREDS on coastal processes.	69, 296, 364, 406, 561, 591, 688
	Cumulative Effects	Wave	✓				✓		✓			41, 95, 96, 162, 316, 542, 688, 701
		Wind	✓	✓								14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓						✓			69, 364, 406, 479, 591, 688
Water and sediment quality	Disturbance of silt	Wave	✓									41, 162, 316, 542, 688
		Wind	✓	✓	✓							32
		Tide	✓									69, 364, 406, 591, 688
	Mobilisation of	Wave	✓									41, 162, 316, 542, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	contaminants	Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Spillage/leakage of fuel, oils, hydraulic fluids, drilling muds, pile grouting etc	Wave	✓									41, 162, 316, 542, 688
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓								Welsh Energy Research Centre modelling to predict water quality impacts	69, 364, 406, 591, 688
	Use of antifoulants	Wave	✓								Research topic at Glasgow and Newcastle Universities	41, 162, 316, 542, 688
		Wind										
		Tide	✓	✓					✓		Research topic at Glasgow and Newcastle Universities Research by the Welsh Energy Research Centre	56, 69, 364, 406, 509, 591, 688
	Cumulative Effects	Wave										
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
Visual (seascape/ landscape)	Visual disturbance from onshore aspects	Wave	✓			✓						41, 162, 316, 542, 688
		Wind	✓	✓		✓	✓				BERR RAG project investigating the effectiveness of visual limits used in Round 2	616, 14, 29, 45, 113, 268, 277, 331, 397, 398, 453, 455, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓			✓						69, 364, 406, 591, 688
	Visual disturbance from offshore aspects	Wave	✓			✓						41, 162, 316, 542, 688
		Wind	✓	✓		✓	✓				BERR RAG project investigating the effectiveness of visual limits used in Round 2	14, 45, 268, 331, 397, 398, 455, 592, 594, 597, 598, 601, 616, 691, 692, 693, 694, 696, 697, 698
		Tide	✓			✓						69, 364, 406, 591, 688
	Cumulative Effects	Wave	✓									41, 162, 316, 542, 688
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
Marine mammals	Noise	Wave	✓								Baseline study underway at EMEC against which operational devices can be assessed	41, 162, 316, 542, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Wind	✓	✓	✓	✓	✓					14, 45, 103, 268, 302, 373, 395, 405, 426, 441, 487, 488, 518, 592, 594, 597, 598, 601, 624, 664, 691, 692, 693, 694, 696, 697, 698, 700
		Tide	✓	✓	✓						Baseline study underway at EMEC against which operational devices can be assessed Noise monitoring at the RITE project	69, 364, 406, 519, 591, 688
	Disruption of migratory route	Wave	✓									41, 162, 316, 542, 688
		Wind	✓	✓	✓							14, 40, 45, 110, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Habitat exclusion or avoidance	Wave									Baseline studies at EMEC against which change will be assessed	41, 162, 316, 542, 688
		Wind	✓	✓	✓						BERR RAG project to tag seals during and post wind farm construction	14, 45, 265, 268, 335, 389, 592, 594, 597, 598, 601, 652, 653, 654, 674, 675, 676, 677, 691, 692, 693, 694, 696, 697, 698

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Tide	✓								Baseline studies at EMEC against which change will be assessed. BERR RAG project to tag and monitor seal interactions with tidal stream turbine	69, 364, 406, 591, 688
	Use of devices as a haulout	Wave										
		Wind										
		Tide										
	Potential collision risk	Wave	✓			✓	✓				Joint project between EMEC and SMRU to develop sonar devices to monitor potential collisions and damage (presumption that this includes wave)	41, 162, 165,316, 542, 688, 732
		Wind										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Tide	✓			✓	✓				BERR RAG project currently being commissioned to use sonar imaging to monitor seal (and other large animal) interactions with tidal stream turbine. Joint project between EMEC and SMRU to develop sonar devices to monitor potential collisions and damage.	69, 165, 364, 406, 591, 688, 732
	Water quality	Wave	✓									41, 162, 316, 542, 688
		Wind										
		Tide										
	Monitoring techniques	Wave										
		Wind				✓						110
		Tide										
	Cumulative Effects	Wave										
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
Seabirds, wildfowl and waders	Noise	Wave	✓								Baseline study underway at EMEC against which operational devices can be assessed	41, 162, 316, 542, 688
		Wind	✓		✓	✓						14, 45, 103, 268, 395, 405, 409, 441, 488, 518, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698, 700
		Tide	✓	✓	✓						Baseline study underway at EMEC against which operational devices can be assessed	69, 364, 406, 519, 591, 688
	Physical presence and disturbance	Wave	✓								Baseline study underway at EMEC against which operational devices can be assessed	41, 162, 316, 542, 688
		Wind	✓	✓	✓	✓					BERR RAG projects on assessing the energetic costs of barrier effects to birds and on the behavioural response of red throated diver and common scoter	14, 45, 268, 387, 423, 424, 529, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Tide	✓								Baseline study underway at EMEC against which operational devices can be assessed	69, 364, 406, 591, 688
	New roosting site	Wave										
		Wind										
		Tide										
	Potential collision risk	Wave				✓				✓	Understood that initial investigations an project definitions are being formed to look at diving bird patterns	442, 732
		Wind	✓	✓	✓	✓	✓					14, 38, 45, 193, 236, 237, 238, 240, 268, 282, 295, 344, 352, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓			✓				✓	Understood that initial investigations an project definitions are being formed to look at diving bird patterns	50, 69, 364, 406, 591, 688, 732
	Aggregations due to lighting	Wave	✓									316, 542
		Wind										
		Tide										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	Monitoring and mitigation	Wave										
		Wind	✓	✓	✓	✓	✓					14, 45, 193, 236, 237, 240, 268, 295, 301, 423, 424, 442, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Cumulative Effects	Wave										
		Wind	✓	✓						✓	COWRIE research to provide guidance on undertaking cumulative impact assessments on birds for offshore wind farms	14, 45, 268, 499, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
Fish ecology	Noise	Wave	✓								Baseline study underway at EMEC against which operational devices can be assessed	41, 162, 316, 542, 688
		Wind	✓	✓	✓	✓						14, 45, 103, 153, 268, 269, 395, 405, 441, 485, 488, 518, 592, 594, 597, 598, 601, 624, 664, 691, 692, 693, 694, 696, 697, 698, 700, 709

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Tide	✓	✓	✓						Baseline study underway at EMEC against which operational devices can be assessed Noise monitoring at the RITE project	39, 69, 364, 406, 519, 591, 688
	Direct habitat or prey loss	Wave	✓									41, 162, 316, 542, 688
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Change in sediment deposition	Wave										
		Wind	✓			✓						14, 45, 268, 270, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Water quality	Wave										
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Artificial reef effect	Wave							✓			400

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Wind	✓	✓	✓	✓					BERR RAG project reviewing the reef effects of wind farms and potential for enhancement and mitigation	14, 45, 108, 111, 112, 268, 329, 404, 592, 594, 597, 598, 601, 641, 691, 692, 693, 694, 696, 697, 698
		Tide									Ongoing work at Race Rocks in Canada	
	Potential collision risk	Wave	✓			✓					Work on non-physical fish deterrents	41, 162, 316, 542, 688, 732
		Wind										
		Tide	✓		✓	✓					Research on the RITE project in New York (Verdant Power to determine in-situ risk for fish strike currently in prep Work on non-physical fish deterrents	69, 364, 406, 591, 635, 680, 688, 732
	EMF	Wave										
		Wind	✓	✓		✓	✓				Current COWRIE research project in progress, proposal by US Minerals and Management Service	14, 45, 195, 217, 268, 303, 304, 305, 306, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698, 710
		Tide	✓									69, 364, 406, 591, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	Monitoring and mitigation	Wave								✓	Work at PRIMaRE to monitor change and exclusion zone benefits	442
		Wind										
		Tide			✓							642
Plankton	General	Wave									Work on water column processes and pelagic dynamics being undertaken at MREDS	
		Wind	✓									601, 698
		Tide									Work on water column processes and pelagic dynamics being undertaken at MREDS	
	Cumulative Effects	Wave										
		Wind										
		Tide										
Benthic Ecology	Artificial reef effect	Wave							✓			12, 400
		Wind	✓	✓	✓						BERR RAG project reviewing the reef effects of wind farms and potential for enhancement and mitigation	14, 45, 111, 112, 268, 404, 572, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Tide										
	Direct habitat loss	Wave	✓									41, 162, 316, 542, 688
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Change in physical conditions	Wave	✓			✓					Some discussions in academia regarding potential research. Proposal at EMEC to undertake a baseline survey of seabed communities in areas of string tidal stream to provide a baseline	41, 162, 202, 316, 331, 542, 688
		Wind	✓			✓						14, 45, 202, 268, 331, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓			✓						69, 202, 331, 364, 406, 591, 688
	Water quality	Wave										
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Jack up rigs, anchors and	Wave	✓								Work at MREDS on device mooring requirements	41, 162, 316, 542, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	moorings	Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide									Work at MREDS on device mooring requirements	
	Cable route	Wave	✓								Funding is in place for a ROV project to characterise the benthos at the EMEC site and cable route	41, 162, 316, 542, 688
		Wind	✓	✓	✓						BERR RAG project investigating cable techniques and effects	14, 45, 243, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓								Funding is in place for a ROV project to characterise the benthos at the EMEC site and cable route. Some work in progress at Race Rocks in Canada	69, 364, 406, 591, 688
	Monitoring and	Wave										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	Mitigation	Wind				✓					BERR RAG project to provide statistical basis for seabed monitoring Proposed monitoring at Wave Hub to detect change and benefits	686
		Tide										
	Cumulative Effects	Wave										
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
Designated sites	Potential for adverse effect	Wave	✓			✓				✓		41, 162, 202, 316, 331, 542, 688
		Wind	✓			✓				✓		14, 45, 202, 268, 331, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓			✓				✓		69, 202, 331, 364, 406, 591, 688
	Impact on protected habitats, species	Wave	✓			✓				✓		41, 162, 202, 316, 331, 542, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	and geological features	Wind	✓			✓				✓		14, 45, 202, 268, 331, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓			✓				✓		69, 202, 331, 364, 406, 591, 688
	Cumulative Effects	Wave										
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
Shipping	Potential collision risk (fixed structure)	Wave	✓	✓							MREDS project looking at surface collision risk	19, 41, 162, 316, 542, 688
		Wind	✓	✓								14, 15, 45, 268, 592, 594, 597, 598, 601, 643, 691, 692, 693, 694, 696, 697, 698
		Tide	✓								MREDS project looking at surface collision risk	69, 364, 406, 591, 688
	Potential collision risk (devices that become loose)	Wave	✓									542
		Wind										
		Tide										
	Risk and	Wave	✓									41, 162, 316, 542, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	interference from increased shipping	Wind										
		Tide	✓									69, 364, 406, 591, 688
	Potential to hinder Search and Rescue	Wave										
		Wind				✓						136
		Tide										
	Interference with shipping channels and lanes	Wave	✓							✓	BERR RAG project investigation potential for migration of navigation channels, studies at EMEC to provide a baseline against which to assess change	34, 41, 162, 316, 542, 688
		Wind	✓							✓	BERR RAG project investigation potential for migration of navigation channels	14, 34, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓							✓	BERR RAG project investigation potential for migration of navigation channels, studies at EMEC to provide a baseline against which to assess change	34, 69, 364, 406, 591, 688
	Interference with	Wave										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	radio navigation and radar	Wind	✓		✓	✓						14, 45, 62, 146, 268, 339, 427, 553, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Cumulative Effects	Wave	✓									41, 162, 316, 542, 688
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
Tourism and recreation	Increase in traffic (land and marine)	Wave	✓									41, 162, 316, 542, 688
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Disturbance to recreational activities	Wave	✓	✓		✓						41, 117, 162, 316, 542, 688
		Wind	✓	✓		✓						14, 45, 268, 592, 594, 597, 598, 601, 604, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Collision risk for	Wave	✓									41, 162, 316, 542, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	recreational vessels	Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Noise	Wave										
		Wind										
		Tide										
	Provision of tourist attraction	Wave										
		Wind				✓						7, 149, 497
		Tide										
	Impact of exclusion zones	Wave										
		Wind	✓			✓						14, 45, 268, 592, 594, 597, 598, 601, 604, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Cumulative Effects	Wave										
		Wind										14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
Archaeology	Disturbance/damage	Wave										41, 162, 316

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	to archaeological interests	Wind	✓	✓								14, 45, 268, 436, 592, 594, 597, 598, 601, 691, 692, 694, 697, 698
		Tide										69, 591
	Impacts on Landscapes of Historic Interest	Wave										41, 162, 316
		Wind	✓	✓								14, 45, 268, 436, 592, 594, 597, 598, 601, 691, 692, 694, 697, 698
		Tide										69, 591
Commercial fisheries	Direct disturbance of fishing grounds	Wave										
		Wind	✓	✓	✓	✓					BERR RAG study investigating fishing in and around wind farms	14, 32, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Displacement from fishing grounds	Wave	✓	✓								41, 162, 284, 316, 542, 688
		Wind	✓	✓	✓					✓		14, 45, 268, 313, 411, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Impact of exclusion zones	Wave	✓	✓								41, 162, 284, 316, 542, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Wind	✓							✓		14, 45, 268, 313, 411, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 591, 688
	Power cables and fishing activity	Wave	✓	✓								41, 162, 284, 316, 542, 688
		Wind	✓							✓		14, 45, 107, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										69
	Cumulative Effects	Wave										
		Wind	✓	✓		✓						14, 45, 268, 313, 411, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
Military Use	Designated areas e.g. danger areas, exercise areas etc	Wave	✓									41, 162, 316, 542, 688
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									69, 364, 406, 591, 688
	Munitions	Wave										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Disruption or sonar and radar	Wave										
		Wind	✓			✓					Research programme to evaluate radar infill, radar processing software and stealth turbine technologies	14, 45, 83, 268, 462, 463, 464, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Cumulative Effects	Wave										
		Wind										
		Tide										
Cables and pipelines	Direct damage	Wave										
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Reduced access to existing infrastructure	Wave										
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Tide										
	Cumulative Effects	Wave										
		Wind										
		Tide										
Aggregate dredging	General Effects	Wave	✓									316, 542
		Wind	✓									14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide	✓									406
	Sterilisation of potential resource	Wave										
		Wind										
		Tide										
	Cumulative Effects	Wave										
		Wind										
		Tide										
Oil and Gas	General Effects	Wave										316, 542, 688
		Wind										14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										406, 591, 688

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
	Sterilisation of potential resource	Wave										
		Wind										
		Tide										
	Cumulative Effects	Wave										
		Wind										
		Tide										
Licensed disposal site	General effects	Wave										542
		Wind										14, 45, 268, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										406
	Disruption of vessel access	Wave										
		Wind										
		Tide										
	Direct disturbance to disposal site	Wave										
		Wind										
		Tide										
	Cumulative Effects	Wave										
		Wind										

Issue	Specific Issue	Energy Type	Information Source								Work in Progress	References
			SEA, EIA or AA	Associated Technical Report	Monitoring	Technical Research Report	Academic Literature	Research Group	Conference Proceeding	Workshop and Consultation		
		Tide										
Aviation and Radar	Radar	Wave										
		Wind	✓			✓						14, 11,45, 68, 80, 268, 365, 552, 581, 592, 594, 597, 598, 601, 691, 692, 693, 694, 696, 697, 698
		Tide										
	Cumulative Effects	Wave										
		Wind										
		Tide										