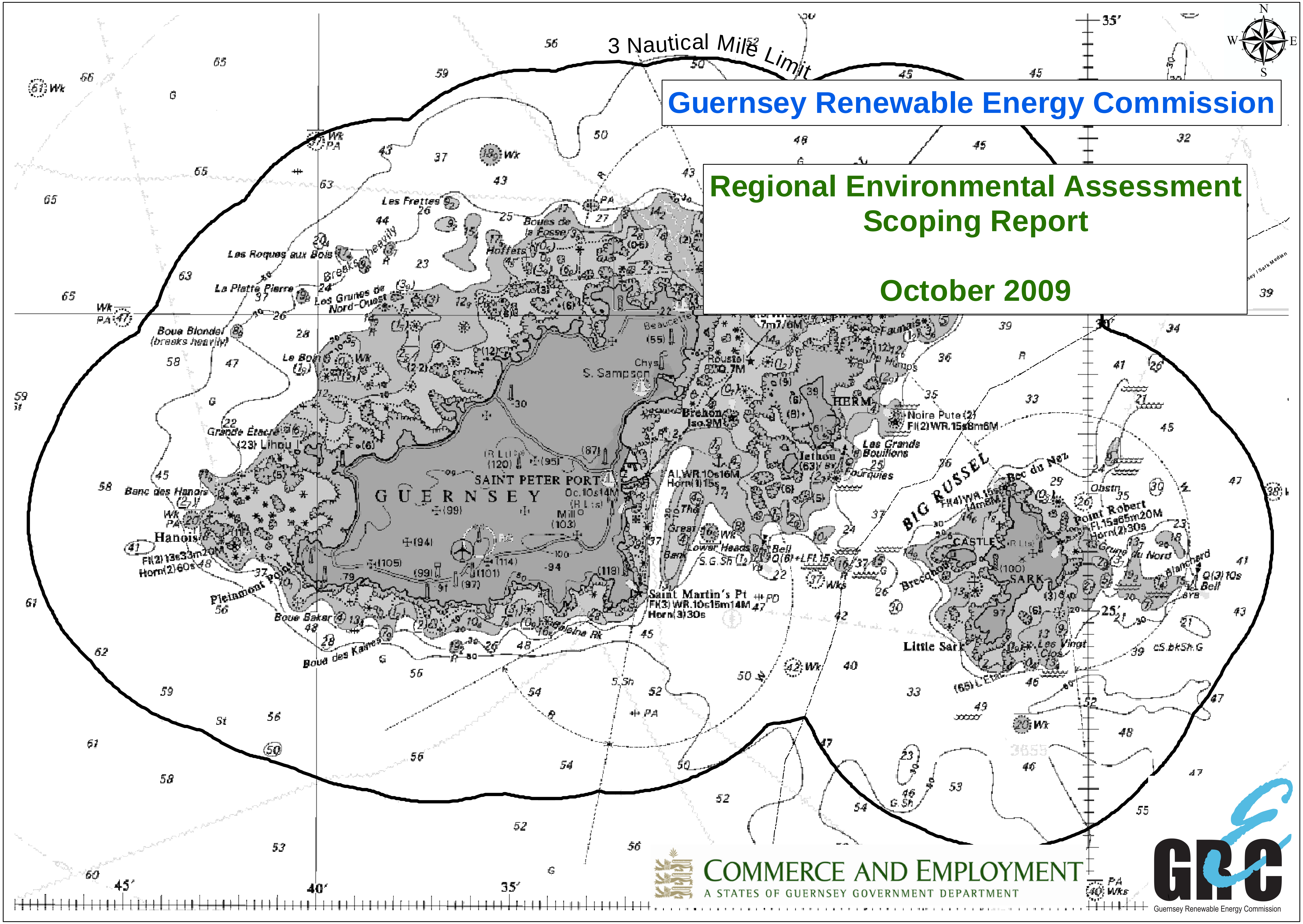

Guernsey Renewable Energy Commission

Regional Environmental Assessment Scoping Report

October 2009

COMMERCE AND EMPLOYMENT
A STATES OF GUERNSEY GOVERNMENT DEPARTMENT

Guernsey Renewable Energy Commission

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Regional Environmental Assessment of Marine Renewable Energy – Scoping Report

October 2009

Contents Amendment Record

This report has been issued and amended as follows:

Rev	Description	Date	Signed	Signed
1	Draft for initial GREF review	08/09/09	*C A Green* C A Green GREC Project Manager	
2	Draft for full internal review	05/10/09	*C A Green* C A Green GREC Project Manager	
3	Draft for public consultation	23/10/09	N Day GREF Chairman	R Babbé GREC Chairman

Foreword

Tackling climate change is a key challenge facing our generation. Here in the Channel Islands, maintaining security of energy supply is also a very important consideration. Furthermore, there are opportunities for the development of a marine renewable energy industry to bring employment and other economic and social benefits.

With some of the strongest tidal currents in the world and facing the Atlantic Ocean, the Bailiwick of Guernsey, is well positioned to be a major contributor to the global response to the threat of climate change. Situated off the coast of Normandy, France, in the English Channel, the islands have very close proximity to Continental Europe with both Guernsey and Jersey having a direct submarine cable link via France to the European Electricity Grid.

There has been a lot of information available recently on developments in the marine renewable energy field, but it should be borne in mind that most technologies are still at the stage of prototype testing. It is not anticipated that the Island will see any energy from tidal or wave power until at least 2014, and marine renewable energy may require financial support for many years to come. However, it is important that Guernsey is ready and able to benefit from these new technologies when they become commercially available. It is likely that the cost of oil (and therefore all energy) is likely to increase considerably in future decades and Guernsey will benefit from having its own source of dependable, secure energy generation both for our own domestic use and for export. Therefore, the States of Guernsey have established the Guernsey Renewable Energy Commission (GREC) to promote and control the development of renewable energy projects in the seas around Guernsey.

In collaboration with the government of the neighbouring island of Sark, and the Guernsey Renewable Energy Forum (GREF), GREC is working to prepare a Regional Environmental Assessment. This strategic study will establish the likely environmental impacts associated with the deployment of Marine Renewable Energy devices in the seas around Guernsey and Sark. With this knowledge, we will be able to ensure that the deployment of renewable energy devices and the associated cable connections will not have an adverse effect on wildlife, or on the coastline and seas around our shores. Furthermore, the study will form the basis of a Consenting Regime to allow the assessment and permitting of operators in Guernsey waters as an essential precursor to commercial development.

In accordance with good environmental practice, and to enable early consultation with stakeholders and the public, GREC has prepared a Scoping Report for the Regional Environmental Assessment, as presented in this document. This defines the terms of reference for the Regional Environmental Assessment to be undertaken. By presenting and receiving feedback on this scoping document, we will ensure that the Regional Environmental Assessment will cover all of the relevant fields of interest and sensitivities.

We need to provide the right environmental and planning framework in order to fully benefit from the opportunities that are presented to us. By reading and responding to this scoping report you will be helping us to put in place policies for the next decade and beyond.

Carla S. MCNULTY BAUER
Minister, Commerce and Employment Department

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1. Introduction

1.1 Introduction

Commissioned and undertaken by the Guernsey Renewable Energy Commission (GREC) and the Guernsey Renewable Energy Forum (GREF), this scoping report has been produced as part of the Regional Environmental Assessment (REA) for the development and deployment of marine renewable energy devices around the coasts of Guernsey, Herm and Sark. It has been prepared for the purpose of consultation and the setting of the scope for the marine renewable REA. It outlines the context of the REA, the details of the baseline data that has been collated to date, and provides details of the methods to be used to strategically assess the potential effects of the development of marine renewable systems on the environment.

The information within this scoping report and the main REA (to follow) should be used to guide further environmental assessments that will be specific to individual sites and projects. While every effort is made to ensure the information is as accurate and robust as possible, there are areas where the data is only preliminary and this is identified and discussed throughout the document.

1.2 The Project

The REA is being carried out to strategically assess the potential effects that the development of marine renewable energy devices (wave and tidal) off the coasts of Guernsey, Herm and Sark will have on the environment. The results from the REA will then be used by GREC, and the States of Guernsey to inform the development and implementation of its strategy for marine energy.

In addition to informing Guernsey's strategy for marine renewable energy, the results of the REA will be used to inform the development of planning policy and guidance for wave and tidal energy developers, together with a legislative framework and a procedure for the consenting of development. The information collected during the preparation of the REA will also be organised into a framework that will be used to provide baseline environmental information to support the decision-making at project-level on potential future marine renewable energy developments. The REA may be used as a basis for the scoping of project specific Environmental Impact Assessments to be provided by prospective developers as part of the planned environmental consent application process.

By the word 'Environment' most people think of plant and animal life, together with their habitats, that may be affected by a proposed project. However, in keeping with globally accepted best practice, our assessment will also cover impacts on the sea and sea-bed, human beings and their existing health, transportation, resources, industry, culture and landscapes.

The REA will consider the cumulative effects of the development scenarios and impacts identified within the study. However it will not assess these cumulative effects in combination with with existing ongoing or long-term impacts such as (for example) sewage discharge and shipping movements around the island. Instead these existing impacts will be treated as the baseline environment into which renewable energy systems are to be placed. The cumulative impacts will be measured primarily within the jurisdiction of the Bailiwick waters. However, in the interests of ensuring a robust monitoring program, which would account for secondary impacts, a wider area may need to be monitored in order to ensure impacts are not missed. This will ensure a robust approach to the detection of impacts.

The study area that will be covered by the REA includes:

- All of the territorial waters of Guernsey, Herm and Sark, to within 3 Nautical Miles of the coast;
- Intertidal and coastal areas within 200m of the shore (at MHWS) where landfall and connection infrastructure are considered to impact.

The study area is illustrated in Figure 2.1 in Chapter 2. An explanation as to how the study area was identified is also provided in Chapter 2: Project Description.

In the context of the REA 'marine renewables' refers to wave and tidal devices only. Off-shore wind has been excluded in this REA. Reasoning behind the exclusion of offshore wind from this REA is discussed in Chapter 2: Project Description.

The main Objectives of the REA are:

- To assess, at a strategic level, the potential effects on the environment of meeting the States of Guernsey's stated objective to actively promote the sustainable use of Guernsey's marine resources. With reference to the maximum Development Scenario shown in Chapter 2, it is intended that this includes for all technically feasible generation activities that do not result in unacceptable environmental impacts
- To assess, at a strategic level, the potential effects on the environments of meeting a minimum requirement of 100MW installed capacity by 2020.
- Advising and supporting the States of Guernsey in the development and implementation of its strategy for marine renewable energy and informing future development of planning guidance for marine developers;
- To inform the project-level decision-making process for all stakeholders (to include regulators and developers);

- To provide information for use in the development of a separate Marine Spatial plan for Guernsey;
- To facilitate focused investment into the marine renewable energy sector in Guernsey.
- To develop a consenting process for the deployment of devices.
- To identify synergies and conflicts within the existing consenting and planning policies
- To form a vehicle for public and stakeholder engagement

Note: this REA is not being carried out for the licensing of specific potential sites. That would be the subject of separate future assessments. However, any future assessments may be expected to draw heavily on the information and analysis presented in the REA.

Based on the above objectives the main deliverables of the REA process will be:

- Establishment of the baseline situation based on available information;
- Identification of gaps and inconsistencies in the baseline data and the need for further survey work or study;
- Start of ongoing consultation (to be undertaken continuously, at varying levels, throughout the project);
- Generic assessment of the effects of the marine renewable devices on the marine environment;
- Recommendation of generic mitigation measures to avoid, reduce or offset any significant adverse effects on the environment;
- Documentation of the findings from the REA (scoping and environmental reports; public consultation documents; and internal discussion papers);
- Advice and support to the States of Guernsey in the preparation and implementation of its strategy for marine energy and planning guidance for marine development
- Provide information that may be used in the development of a separate Marine Spatial Plan for Guernsey
- Advise on the scope of further surveys and analysis
- Comment on likely future monitoring requirements
- Provide an outline plan for future stakeholder engagement

This scoping report will be sent out to a wide range of consultees for comment prior to commencement of the REA. A list of proposed authors and contributors is given in Appendix B.

1.3 Structure of the scoping report

The scoping report contains 9 Chapters, with chapters 1 to 4 setting the context of the REA. They provide the background to the project and set the framework within which the REA will be delivered.

Chapter 5 and 6 discuss the marine renewable energy resource and devices (wave and tidal) that will be assessed as part of the REA. These chapters contain information on the characteristics of the different types of marine devices and identify areas of potential interest for the deployment o f these devices (the areas of wave and tidal resource that are technologically feasible to develop, now and in the foreseeable future).

Chapters 7 to 9 of the scoping report provide details of the baseline data that has been collated as part of this REA. These chapters identify the different environmental topics that will be assessed as part of the REA and present the baseline data that has been collated for each topic. For each of the baseline topic areas, a description of the potential effects of the marine devices has been provided. Chapter 9 provides a summary of the baseline data gaps identified from the review of the baseline data and includes recommendations for further survey work or study.

1.4 An introduction to Renewable Energy

1.4.1 The Drivers for Renewable Energy

There are 6 key drivers for Guernsey in adopting a renewable energy strategy:

- Reducing the amount of CO_2 the island produces
- Reducing chemical and particulate pollution
- Meeting targets and legislation – Kyoto Protocol
- To increase security of supply of electricity to the island
- To become a centre of excellence in marine renewables
- Economic benefits of becoming an exporter of electricity

1.4.2 Guernsey and Renewable Energy

The Kyoto Protocol is the landmark treaty adopted by many nations around the world and is designed to reduce the emissions of greenhouse gasses (GHGs). The UK adopted the Kyoto Protocol in 1997 and in 2000 Guernsey was added to the UK ratification of the Protocol. The UK has been set targets to reduce GHG emissions by 12.5% on 1990 levels by 2012 and as Guernsey is included in the ratification it's emissions are counted as part of the UK total.

Whilst Guernsey is only included in the UK ratification of the Kyoto agreement and so is only required to be a part of the UK's total 12.5% reduction (on 1990) the States of Guernsey are committed to reducing their own emissions by this amount.

The Energy Policy Group produced the Energy Policy Report – June 2008. Although Guernsey does not have any of its own formal targets, the Energy Policy Report set out aims to reduce CO_2 emissions by 30% on 1990 levels by 2020 and to achieve a reduction of 80% on 1990 levels by 2050. In addition to this the report highlighted a commitment to generate 20% of Guernsey's electricity from local renewable sources by 2020. The targets were 'noted', but not formally adopted. However, these are seen as realistic and practical targets for Guernsey. This 30% reduction in CO_2 emissions would put Guernsey in a comparable position to the UK's current reduction targets (the UK Low Carbon Transition Plan, July 2009) for 2020 emissions (34%). However, in order to meet the UKs emissions targets purely from renewable energy at least 30% of electricity would need to come from renewable sources by 2020.

There is a United Nations Framework Convention on Climate Change taking place in December 2009 in Copenhagen to attempt to formulate a successor agreement to the Kyoto Protocol. This is taking place as the Kyoto Protocol only due to last up to 2012 and it is hoped that a Copenhagen Agreement can be reached to set targets for 2020. It is also hoped that through this agreement, some of the main contentious issues of the Kyoto Protocol (eg. It is limited to developed countries, it does not include aviation in the emissions totals and the USA's refusal to adopt it) will be addressed.

Guernsey does not follow any other European or UK Directives or targets on climate change, renewable energy or Environmental Assessment. This is because Guernsey is not a normal member of the European Union and has its own government independent of the UK Government.

It is widely considered that the introduction of the electricity supply cable from France (via Jersey) to Guernsey acted to reduced the amount of CO_2 emissions from Guernsey. Guernsey is moving towards increasing the import of electricity in order to meet 2012 commitments. However, due to market prices, and Guernsey Electricity Ltd's (GEL)'s current obligation to provide electricity at the cheapest rate, Guernsey is generating part of its electricity from fossil fuels rather than relying entirely on imported continental electricity. This led to 2006 emissions being higher than those in 1990. This has led to the need for actions to be taken to reduce GHG emissions from electricity. The introduction of renewable energy to Guernsey should improve the security of supply of electricity and, in the long term, the price of electricity. In addition to this it has the potential to make Guernsey an exporter of electricity due to the anticipated high demand for of renewable energy offshore, and the relatively small consumption on the island.

It is considered that by 2014 it will be possible for 5% of Guernsey's electricity to be sourced from renewables, with this rising to 30% by 2020, with marine renewables making up the bulk of this. Guernsey's energy consumption in 2008 was around 360GWh and it is estimated that by 2020 this will have risen to 600GWh. This means that in order to meet the 30% target the electricity required from renewable sources will be in the region of 200GWh by 2020, which approximately equates to 100MW installed capacity.

1.5 Regional Environmental Review

1.5.1 The EU SEA Directive

In the UK it is a legal requirement to produce a SEA for all spatial plans and programmes due to the application of European Directive 2001/42/EC "the assessment of the effects of certain plans and programmes on the environment" (the Strategic Environmental Assessment (SEA) Directive). However, in Guernsey there is not the legislative requirement to perform a SEA as it falls outside the scope of both UK and EU laws. Although the document will be referred to as a Regional Environmental Assessment (see below), GREC has decided to adopt the general principles of the SEA framework in order to demonstrate transparency and to facilitate ease of understanding for potential developers.

The objectives of the EU SEA directive are "to provide a high level of protection to the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development".

The SEA directive prescribes that the plans and programmes that are subject to an Environmental Assessment are those which:

- Are likely to have significant environmental effects;
- Are prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use, and which set the framework for future development consent of projects requiring and EIA or an 'appropriate assessment' in accordance to the Habitats Directive;
- Are subject to preparation and/or adoption by an authority at national, regional or local level or which are prepared by an authority for adoption through a legislative procedure by parliament or government, and which are required by legislative, regulatory or administrative provisions.

If it were subject to EU or UK Law in this respect, Guernsey's programme for developing marine renewable energy would fall under the above definition as requiring an environmental assessment. The SEA itself is purely a desk based study, which reflects upon policy impacts and defined procedure under EU policy as well as the environmental assessment.

1.5.2 Regional Environmental Assessment

As an alternative to the SEA, a Regional Environmental Assessment (REA) is defined, by The World Bank, as "An instrument that examines environmental issues and impacts associated with a particular strategy, policy, plan, or program, or with a series of projects for a particular region (e.g., an urban area, a watershed, or a coastal zone); evaluates and compares the impacts against those of alternative options; assesses legal and institutional aspects relevant to the issues and impacts; and recommends broad measures to strengthen environmental management in the region. Regional EA pays particular attention to potential cumulative impacts of multiple activities." This shows that a REA has a similar remit to the SEA however it does not carry all the European legal connotations and it is not an assessment against policy. This is the reason that the assessment has been presented as a REA rather than a SEA.

There is a logical order that the parts of the REA process should follow:

1. Provide an objective characterisation of the region based on a desk based assessment using all the relevant existing information, which is to be determined by a detailed scoping exercise (this document), with gaps filled by cross-discipline data mining and fieldwork as necessary. This will serve the purpose of providing a clear objective baseline of information relevant to the REA.
2. Perform analyses on the data collected during stage 1 to determine levels of environmental impact, which can be assessed on a regional basis, but also to identify site-specific issues which individual EIA's may need to focus on more specifically. Consideration to future regional monitoring programmes may be pertinent.

The REA for Marine Renewables on Guernsey has additional outputs in that it can form the basis of a regional coordinated monitoring scheme which would provide extensive offsite monitoring to ensure that no effects are missed. Also, it can form the basis of a marine spatial plan of the study area, with early indications of areas of resource use being covered in the REA main document.

2. Project Description

2.1 Project Overview

The main purpose of this Marine Renewables REA is to strategically assess the potential environmental effects of developing wave and tidal devices off the coasts of Guernsey, Herm and Sark. The basis for this REA is GREC's aim of generating electricity from renewable sources utilising Guernsey's natural resources.

Initial studies into the waters surrounding the Channel Islands, such as the Tidal Stream Resource Assessment for The Channel Islands Area prepared by Robert Gordon University (Appendix E), illustrate that there is a potentially valuable resource in the waters around Guernsey, Herm and Sark.

If Guernsey wishes to adopt UK renewable energy targets, it should aim to have at least 30% of its electricity generated from renewables by 2020. GREC is pursuing ways to accelerate the development of marine renewables off the coast of the island with a view to providing inputs to the existing domestic supply mix, and with a view to exporting power together with the other Channel Islands to UK and Europe.

GREC plans to provide an all encompassing REA of the area and then, after a competitive selection process, allow developers exclusive use of a site (or sites) to place their renewable devices in the water. This will allow the developers to confirm the attributes of a specific area before investing. However, this will not remove the need for them to perform a more detailed EIA prior to submitting an environmental consent application.

This assessment will help to ensure that, at the earliest opportunity, potential conflicts between a strategy for supporting marine renewables and other government strategies are identified and addressed.

2.2 The Marine Renewable Energy Devices

The REA will take account of the following categories of wave and tidal technologies:

- Shoreline wave;
- Nearshore and offshore wave (to include all potential device types);
- Tidal Stream (to include tidal turbines and tidal fences);
- Potential combinations of the above devices.

2.2.1 *Offshore Wind*

The assessment of Wind Energy Devices has been specifically excluded from the scope of the REA for a number of reasons relating to their perceived environmental impact. Additionally, were offshore wind to be considered, there would be a dominance of the analysis of this technology in the REA and this would divert resources away from the preferred technologies (tide and wave). Wind energy can be evaluated at a future date should it become desirable to do so.

2.2.2 *Tidal range*

The assessment of Tidal Range solutions (eg. Barrage, lagoon) has been specifically excluded from the scope of the REA for a number of reasons, again relating to perceived impact. Tidal barrages and lagoons are considered at this stage to be damaging and unsightly. Furthermore, there are also no economically feasible locations in Guernsey for them to be considered. However should they become more feasible and desirable in the future then they can be evaluated at that time.

2.3 The Study Area and Limitations

The broad scope of the REA has been defined through meetings between the Guernsey Renewable Energy Commission (GREC) and the Guernsey Renewable Energy Forum (GREF), together with the recommendations from the States debates in June 2008 (Energy Policy Report) and June 2009 (Establishment of GREC).

The areas identified by GREC as potentially being of interest to wave and tidal developers within this study are:

- All of the territorial waters of Guernsey, Herm and Sark, to within 3 Nautical Miles of the coast;
- Intertidal and coastal areas within 200m of the shore (at MHWS) where landfall and connection infrastructure are considered to impact.

These areas are illustrated in Figure 2.1 Study Area.

Sark is included as a member of the Guernsey Renewable Energy Forum (GREF), and its waters are within the scope of the REA for a number of reasons. With a population in the region of 600, Sark has limited professional and financial resources and so for this reason it makes economic sense to combine its efforts with Guernsey. In addition to this Sark is in the Bailiwick of Guernsey (sharing some of its legislation and administration). Although close neighbours with Guernsey, Sark may wish to maintain independent management of its energy resources. It is with the consent of the Government of Sark that this REA includes its territorial waters within the study.

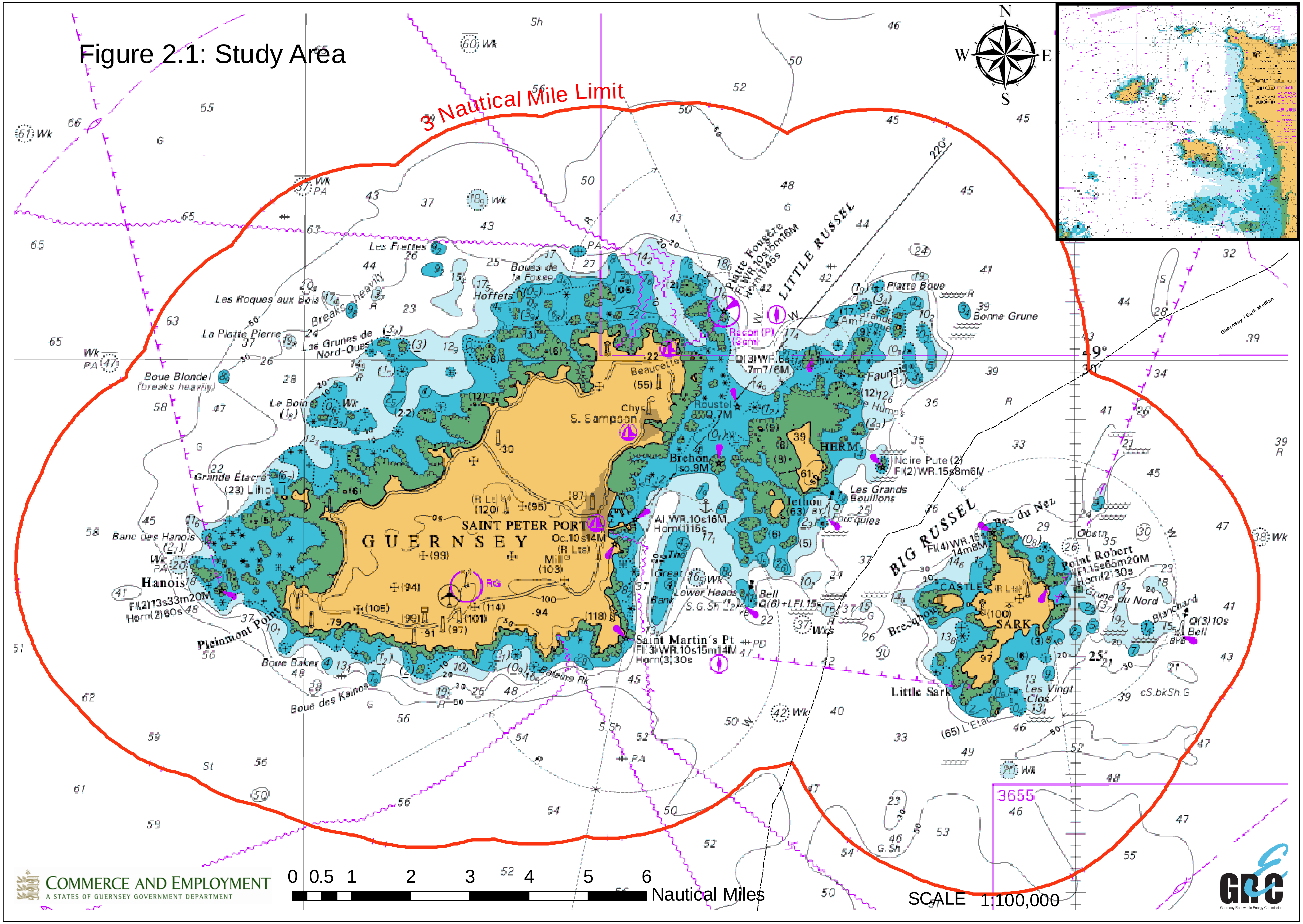


Figure 2.1: Study Area

2.3.1 *Seaward Extent of the Study Area*

The seaward extent of the study area is the 3 nm territorial zone off the coasts of Guernsey, Herm and Sark. This is not suggesting that there is no interest in the development of wave and tidal devices outside of this area, but the current territorial limit restricts the jurisdiction of both Guernsey and Sark to control of development to within this area. However, an additional benefit of this restriction is that it also allows for resources to be concentrated and focussed, so producing a more useful and accurate REA within the time constraints placed upon the project. As such the area of study may be extended in the future if Guernsey's or Sark's jurisdiction is extended beyond 3nm.

Economic issues also drive the 3nm limit as the cost of cabling increases as distance offshore increases. This is because the distance of a development from land affects the costs associated with connecting a device into the electricity grid system onshore and the feasibility and efficiency of the maintenance of the devices.

2.3.2 *Limitations*

There are a number of items of general interest or concern that relate to the development of Renewable Energy Policy that, although beyond the scope of the REA, are being addressed through inter-departmental discussions within the States. It is fully acknowledged that the development of renewable energy cannot be carried out in isolation from the many other areas of States policy that are influenced. Examples are given below.

- General Energy Policy
- Energy security
- Instructions to the Office of the Utility Regulator on incorporation of renewable energy into the supply mix
- Feed-in Tariffs
- Electricity demand management, grid usage
- Ports and Docks, economic development
- Environmental Policy
- Marine Spatial Planning and changes to the Planning and Development Laws/Building Control Regulations
- Consenting of Deposits at Sea by Health & Social Security Department (FEPA Licence)
- Carbon Taxation
- Domestic supply versus export
- Social Policy (vulnerable users, fuel poverty)
- Creation of Jobs
- Education
- Health and Safety Policy and Legislation

The production of the REA will not relieve developers of their responsibility to provide project specific EIAs in support of environmental consent applications. It is likely that these will require the preparation of Environmental Statements to be supported by more detailed investigations, including surveys.

The REA is predominantly a desk study, and very little new survey work will be undertaken within its scope. Therefore, it is likely that there will remain a number of gaps in the baseline data after production of the report. It is intended that these gaps will be addressed by developers during their investigative work that will be necessary to complete their own project specific EIAs.

The REA will not give consideration to the economic viability of the development and use of Marine Renewable Energy on Guernsey. However, this matter is being developed through separate workstreams by the States and in support of the discussions on Policy as listed above.

2.4 Commercial Sites versus Test Sites

As mentioned previously there are a large number of wave and tidal devices that are still in the stages of development. The implication of this is that a large portion of developers that may be looking to place devices in the area in the near future may be looking for test or demonstration sites rather than commercial developments.

The aim of the REA is to assess the effect on the environment from marine renewables contribution towards Guernsey's renewable energy targets and power supply. Test and demonstration developments do not generate significant amounts of electricity as a rule. There has already been significant public sector investment in the UK in creating a test demonstration site in Orkney for wave and tidal technologies. In order to help meet Guernsey's renewables target the focus will be on the development of commercial sites. As a result the REA will only focus on the possibility of sites contributing electricity to Guernsey and for export. GREC is not looking for companies to test or develop designs for wave or tidal devices in its waters and will only accept proposals from developers with a pre tested working device, with arrays contributing electricity to the Guernsey grid.

It should be noted that the REA is not being carried out for the licensing of potential sites. The results of the REA will be used to inform the developments of Guernsey's strategy for marine energy and are totally unrelated to the licensing of commercial wave and tidal sites. The identification of potential sites does not imply the ready consent of applications to deploy devices; any such applications would be considered on their merits.

2.5 The Guernsey Electricity Distribution Network

The REA will collect information relating to the existing electricity generation and distribution network on Guernsey and report on the likely impact of new generation equipment being connected. Preliminary information indicates that the capacity of the Guernsey grid is not a significant constraint on the future developments. There is the capacity to support local supply as well as the capacity to export electricity to Jersey and France through the existing import cables.

However, it should be noted that the existing network is arranged to support the generation and import of electricity to the eastern side of the Island, and this is also the location of greatest usage. There is a general flow of electricity from the urbanised eastern side out towards the more rural areas of the west. Whereas this presents advantages for the connection of arrays in resource areas to the east of Guernsey, it may present constraints to the development of the wave energy resource off the northwest coast. If large scale wave energy production is identified as technically and economically feasible, then this could lead to a requirement to reinforce the existing network in the west of Guernsey to allow a satisfactory connection to the centre of population in the east.

The REA will collect information relating to the existing electricity generation and distribution networks on Herm and Sark, and identify any opportunities to connect potential renewable energy devices to them.

2.6 Development Scenarios

In order to gain an understanding of the cumulative effects of marine renewable devices on the environment, certain Development Scenarios have been drawn up. These will be developed and described in more detail in the REA itself. In addition, a feasibility study will be produced in support of the REA to act as a technical reference for environmental specialists in the delivery of their analysis and reporting for the REA. The development scenarios reflect the potential size of the marine energy resources that exist within the waters around Guernsey as well as Guernsey's targets for renewable energy.

There is a good opportunity for renewable energy to be developed in the waters around Guernsey in terms of its geographical location, available device types and likely future technologies and improvements. The path that the industry is likely to take consists of three key stages:

- Installation of prototypes;
- Developments of small arrays;
- Commercial farms.

Currently the majority of the tidal power industry is at the design stage, with some companies being at the prototype stage of development, a few companies having created working small scale devices and only one full scale model providing power. Wave technology is at a similar stage, although slightly more advanced, with more companies having full scale models and one company, Pelamis, having had a full array of three 750kW devices providing power to the grid. However, the focus of this REA is on commercial developments exclusively and as such it is not looking at providing a test facility.

To ensure the conclusions of this REA are focussed, a small number of scenarios have been devised. The scenarios will be evaluated within each of the resource development areas that are discussed in Chapter 6 and in the REA assessment method in Appendix D.

Taking the resource assessment information in Chapter 6, and making reference to the existing Tidal Resource Assessment by Alan Owen of Robert Gordon University (Appendix E) into account, there are two potential development possibilities to consider. Firstly a maximum development which utilises the resource to its maximum conceivable potential, secondly the minimum development required to meet the proposed targets for 2020 (approximately 100MW installed capacity). For the maximum development 7 potential array development sites and sizes have been identified:

Maximum Development

1. A 50MW Tidal Array in the Big Russel;
2. A 30MW Tidal Array in the Little Russel;
3. A 20MW Tidal Array at St Martin's Point;
4. A 50MW Tidal Array east of Sark;
5. A 50MW Tidal Array north of Guernsey;
6. Two 20MW Offshore Wave Arrays off the northwest Coast;
7. Two 10MW Nearshore Wave Arrays on the west coast.

For the minimum development of 100MW installed capacity there are 6 potential array development sites that have been identified:

Minimum Development

1. A 50MW Tidal Array in the Big Russel;
2. A 10MW Tidal Array in the Little Russel;
3. A 10MW Tidal Array at St Martin's Point;
4. A 10MW Tidal Array east of Sark;
5. A 10MW Offshore Wave Arrays off the northwest Coast;
6. A 10MW Nearshore Wave Arrays on the west coast.

The definition of the development scenarios will be assessed in terms of the significance of effect on each of the environmental topics defined in Chapter 7. It is acknowledged that the industry may not have sufficient production capacity to provide all of the above, even if found to be economic and desirable, within the 2020 timeframe. Also, the REA may, in its findings, determine that the environmental impacts of some or all scenarios are unacceptable. However, it is recommended that these scenarios be taken forward together into the REA for assessment in order to provide a robust and far-sighted REA.

It is again highlighted that these potential development sites are based on the preliminary data that is not focussed specifically on the waters of Guernsey and taken from a number of sources. A process is currently underway to provide more accurate tidal modelling of the study area. This will be included in the REA.

It is possible to look at each of the developments on individual merit, however it is proposed that the impacts of certain groupings of the arrays be assessed together where they have cumulative effects. Using these criteria the following development scenarios will be analysed:

1. Unconstrained development: development of all tidal and wave resources in all reasonable[1] sites – development of all arrays as outlined above;
2. Development of only tidal stream arrays;
3. Development of only wave arrays;
4. Development in areas of greatest resource (provisionally the northwest coast of Guernsey, East of Sark and the Big and Little Russel);
5. Development of a single array;
6. No development ('Do Nothing' Scenario).

To facilitate with the estimation of the device numbers and the total energy generation within a development area a generic energy output and size will have to be assumed for each device type. Total energy generation will then be compared to the development targets and assessed against their environmental impacts.

A key aspect of the assessment of the development scenarios is the Guernsey, Herm and Sark grid capacities. These need to be considered carefully as accessibility to the grid is fundamentally important to where the devices can be situated. As such there are two scenarios to be considered with the development scenarios:

1. Unrestricted grid capacity – the devices can be connected at any point on the grid;
2. Restricted grid capacity – the devices can only be connected at certain points on the grid, primarily at current power stations, or major transmission nodes (bulk supply points).

[1] Based on the resource potential of any given site

Different device technologies require different amounts of space to be allowed between devices for deployment and safe effective operation. However, to allow visualisation of the likely footprint of the arrays that could be deployed, the following may be used:

Tidal Array:

A 50MW array, comprising up to 50 individual devices, would be expected to occupy approximately $0.5km^2$ of the seabed. This is likely to be arranged as 2 to 4 lines of devices aligned at 90 degrees to the primary flow direction.

Offshore Wave Array:

A 20MW array deployment area, comprising up to 50 individual point absorber (buoy) devices, or a smaller number of larger devices, would be expected to occupy approximately $8.0km^2$ of the surface of the sea, including the space between the devices. This is likely to be arranged as 2 x 4 km rectangle aligned such that the longest edge of the deployment area would face the primary wave direction.

2.7 Port Facilities

There is much speculation in the renewable energy industry with regards to the port facilities that will be required for berthing of vessels that may be used in the deployment, operation and servicing of devices. These discussions often extend to the need for such facilities to provide industrial or lay-down areas for storage and maintenance of devices. Initial research into the various types of device that are under development indicates that common practices and their associated port requirements have yet to be established. However, it is likely that many of the devices will require some sort of deep-water port facility at a base of operations close to deployment sites. It is not clear, at this time, if suitable facilities will be available on Guernsey, or if operators will be required to seek facilities elsewhere. Initial feasibility studies have indicated that the overall commercial viability of marine renewable energy on Guernsey will not be sensitive to this aspect. Therefore, for the purposes of the Environmental Assessment, the impacts of increased marine traffic on existing ports, and the requirement for any associated port expansion, will not be included.

3. Stages of the REA

3.1 The REA Framework

The following framework provides an outline to the approach to the REA.

The REA framework is divided into three parts:

A. Establishing the scope of the REA;

B. Assessing the effects of the marine renewable devices;

C. Production of the Environmental Report

D. Consulting on the results of the REA.

3.2 Establishing the Scope of the REA (Stage A)

The scoping process has been used to outline the context, study area and environmental baseline of the REA. The tasks that were performed during the production of the scope are summarised in Table 3.1.

Table 3.1: Framework for Establishing Scope of Guernsey Marine Renewable REA

Task	Description	Scoping Report Chapter
Scoping (REA Stage A: Setting the Context, Establishing the Baseline, Developing Objectives and Defining the Scope)		
Task A1: Setting the Context	▪ Identify and review relevant plans, programmes and policies, e.g. States of Guernsey Policy Council Energy Policy Report	Chapter 4
Task A2: Review Marine Technologies	▪ Identify key marine technologies and device types ▪ Identify power capacity of currently installed devices ▪ Identify the potential of future technologies ▪ Review the marine technologies and describe what the development may be compromised of (e.g. number of devices, size of development, connection to Guernsey)	Chapter 5
Task A3: Identify Marine Resource Areas	▪ Identify the key areas of the tidal and wave resources within the study area	Chapter 6
Task A4: Identify Environmental Topics	▪ Identify the key environmental topics to be assessed	Chapter 7
Task A5: Collate Baseline Information	▪ Carry out a desk-based study to identify and obtain existing sources of baseline information ▪ Evaluate the baseline data ▪ Confirm that data can be illustrated on GIS maps	Chapter 7

Task	Description	Scoping Report Chapter
Scoping (REA Stage A: Setting the Context, Establishing the Baseline, Developing Objectives and Defining the Scope)		
Task A6: Identify Potential Environmental Effects	▪ Identify the general potential environmental effects of the different types of wave and tidal devices ▪ Identify the potential effects of connection to the Guernsey grid	Chapter 8
Task A7: Identification of Addition Baseline Data to be Collected	▪ Identify any gaps and inconsistencies in the collected baseline data ▪ Consult with experts from industry, academics and GREF on the type of information and detail levels needed to fill any gaps in the baseline information ▪ Identify the methods for the collection of further baseline data	Chapters 9
Task A8: Develop the REA 'Assessment Method'	▪ Develop a methodology that will be used in Stage B to assess any effects that the installation of devices will have on the baseline environment. ▪ Define and agree a common set of impact significance criteria with topic specialists	Appendix D
Task A9: Prepare *Draft* Scoping report	▪ Combine all the tasks from A1 to A8 into a draft 'Scoping Report' ▪ Include in this GIS maps of the study area and potential resource areas	N/A
Task A10: Consult on *Draft* Scoping Report	▪ Present the draft scoping report to GREF for comment ▪ Peer Review	N/A
Task A11: Issue the Final Report	▪ Incorporate the comments into the Report ▪ Issue Final REA scoping report for public consultation	N/A
Task A12: Respond to the Scoping Consultation Exercise	▪ Evaluate responses from the scoping consultation ▪ Identify any further gaps and errors that need to be addressed prior to commencing the full REA ▪ Consult with GREC and GREF on responses to determine the level of detail of any additional surveying/sampling and determine the most practicable approach to this ▪ Consult on any additional baseline data that is collected	N/A
Task A13: Collect Additional Baseline Information	▪ Prepare specification for collection of further baseline data ▪ Commission data collection ▪ Collect additional data when appropriate	N/A
Task A14: Client and GREF Feedback	▪ Provide feedback to GREC and GREF to develop and enhance the REA process ▪ Produce a 'Post Adoption Statement' documenting how the consultation responses have been used to inform the REA process	N/A

3.3 Assessing the Environmental Effect of Marine Renewable Devices (Stage B)

The focal point of this area of the REA is assessing how installation, operation, maintenance and decommissioning of the marine devices will potentially affect the baseline environment. The information obtained in this stage can be used to develop the strategy for marine renewable energy and to inform planning guidance for marine energy developments.

The tasks to be carried out to deliver Stage B are summarised in Table 3.2 with details outlining the methodology for assessing the effects of marine energy devices on the environment are presented in Appendix D of this scoping report.

Table 3.2: Framework for Assessing the Environmental Effects of Marine Devices

Task	Description	Scoping Report Chapter
Assessment of the Environmental Effects of Marine Devices (Stage B)		
Task B1: Finalise Assessment Methodology	▪ Consult with GREF on the Assessment Methodology proposed in the Scoping Report ▪ Finalise the Assessment Methodology following a review of the information obtained from the scoping and responses to consultation	N/A
Task B2: Develop Assessment Criteria	▪ Establish the criteria that is to be used to describe and evaluate the predicted effects of the marine devices on the environment	N/A
Task B3: Identify Alternatives	▪ Finalise the development scenarios presented in the scoping report	Chapter 2
Task B4: Assessment Stage 1: Assess effects of installing the Marine Devices	▪ Details of the assessment process in Appendix D	Appendix D
Task B5: Assessment Stage 2: Assess Cumulative effects of the Development Scenarios	▪ Details of the assessment process in Appendix D	Appendix D
Task B6: Develop Mitigation Measures	▪ Recommend measures to minimise the adverse effects of marine energy development ▪ Recommend how they can be incorporated into a Strategy for Renewable Marine Energy and Planning Guidance ▪ Recommend opportunities for improving the potential for future marine energy developments	Appendix D
Task B7: Develop Draft Monitoring Framework	▪ Identify measures for updating the information 'Databank' to monitor the effects of installation and operation of marine energy devices ▪ Make recommendations for addressing any effects identified during monitoring ▪ Make recommendation for incorporating the results into future renewable/marine development strategies and to inform other initiatives	N/A

3.4 Production of the Environmental Report (Stage C)

The results from the environmental assessment of the marine devices are to be published in an Environmental Report. The tasks are illustrated in Table 3.3.

Table 3.3: Framework for the Production of the Environmental Report

Task	Description	Scoping Report Chapter
Production of the Environmental Report (Stage C)		
Task C1: Produce a *Draft* Environmental Report	▪ Produce a *draft* Environmental Report to document the findings of the effects of the marine devices and development scenarios on the environment ▪ Issue Draft to GREC and GREF for comment	N/A
Task C2: Consult the REA Steering Group	▪ Issue to States of Guernsey (Project Board) for comment	N/A
Task C3: Issue Final Environmental Report	▪ Incorporate comments from States, GREC and GREF into the Environmental Report ▪ Issue the final report for consultation	N/A

3.5 Consulting on the Environmental Report (Stage D)

The tasks to be undertaken to consult on the Environmental report are described in table 3.4.

Table 3.4: Framework for Consulting on the Environmental Report

Task	Description	Scoping Report Chapter
Consulting on the Environmental Report (Stage D)		
Task D1: Consult on the Draft Environmental Report	▪ Consult the regulatory bodies, stakeholders, academics, commercial organisations, community groups and members of the public	N/A
Task D2: Respond to Consultation Exercises	▪ Provide Advice to the States of Guernsey, GREC and GREF on the consultation processes and how they affect development of the renewable strategy for marine energy. ▪ Identify how the consultation responses can enhance the REA process	N/A
Task D3: Informing the Development of Policies	▪ Provide advice and support to assist with the renewable strategy and planning guidance for marine energy developers ▪ Provide advice and support to inform development and implementation of other initiatives	N/A
Task D4: Client and REA Steering Group Feedback	▪ Produce a Post Adoption Statement documenting how the findings from the REA process have been used to inform and support the development of the renewable strategy for marine energy and planning guidance for marine energy developers	N/A

4. Policy Review

4.1 Background to Renewable Energy Policy in Guernsey

Guernsey's Billet d'Etat VIII 2008 containing the Policy Council's Policy Report is the key describing how Guernsey plans to deliver its commitments on climate change and CO_2 reduction targets for the Kyoto Protocol. As has already been noted above, this document also outlines Guernsey's commitment for future reductions and long term commitment to renewable energy sources and was noted by the States of Guernsey. Although no specific targets were set, if Guernsey are to keep in line with UK targets then it will need to pursue the generation of 30% of electricity by 2020 from renewable sources, with a strong focus on the potential tidal resource around Guernsey. In addition, the Policy Report identifies a clear aspiration to develop renewable energy for an export market.

4.2 Marine Spatial Planning

DEFRA has suggested the definition of Marine Spatial Planning as "*a strategic plan for regulating, managing and protecting the marine environment that addresses the multiple, cumulative and potentially conflicting uses of the sea.*"

The Scottish Coastal Forum (SCF) gives marine spatial planning the definition as "*two fold: (a) to secure sustainable and integrated development which balances and, where appropriate advances, economic, social and environmental objectives, and considers the implications of the ecosystem approach; and (b) to allocate space in inshore waters in a rational manner which minimises conflicts of interest and maximises synergistic relations.*"

The Marine Spatial Planning process has been piloted in the Irish Sea with the aim to test a proposed framework for nature conservation and examine how far the conservation management needed to implement this framework could be delivered through the existing legal, administrative and enforcement systems (Tyldesley, D. Et al, (2004), Irish Sea Pilot Project: Coastal and Marine Spatial Planning Framework).

The Marine Spatial Planning process is a useful tool for the production of a formal spatial plan of the marine environment within the study. The Irish Sea Pilot study recommends that the plan sets out sustainable uses and developments of the sea, covering all form of physical and spatial development, changes of use and all ongoing or proposed activities.

The REA will collate available data and store it on a Geographical Information System (GIS). This will allow presentation of spatial data quickly and effectively by allowing layers containing specific data to be selectively displayed and printed. These tools will allow the most powerful marine energy resource areas to be overlaid with environmental data to determine the best deployment areas.

It is proposed that the data that will be prepared by the REA be used as the basis of a separate formal Marine Spatial Planning project to be taken forward separately from the work of GREC. It is anticipated that this will be progressed in Guernsey by the Environment Department of the States of Guernsey and will require extensive consultation between departments within the States of Guernsey and with the public. The Marine Spatial Planning project should have, as an objective, the establishment of priorities for the use of various areas of the sea around Guernsey. The delivery of the REA is in no way dependant on the completion of a Marine Spatial Plan.

4.3 Licensing and Consents Process for Marine Renewables

4.3.1 Territorial Waters

The deployment of marine renewable devices within Guernsey's territorial waters currently requires a licence or consent for:

- The placement of a structure in the sea
- Site leases

Under the FEPA Guernsey Act 1987 Deposits in the Sea, a licence is required for placement of any marine structure (or any 'deposit) within Bailiwick waters. The issuing of the licence regards the need to protect the marine environment, effects on human health and prevent interference with the legitimate use of the sea. As well as this, licences may be revoked should there be any perceived breaches to the terms of the licence.

The seabed and waters around Guernsey and Sark area belong to the Crown, represented by The Queen, as Duke of Normandy. Leasing of the seabed is arranged through Her Majesty's Receiver General (HMRG) in the States of Guernsey for the Bailiwick.

There is a Coastal Protection Act in Guernsey, but this does not reflect the content of the UK Coastal Protection Act and there is no directly equivalent legislation in place. Currently in Guernsey an equivalent CPA development licence is not required.

Draft legislation has been prepared to allow GREC to control and provide environmental consent for Marine Renewable Energy Developments. This is expected to be enacted in June 2010.

4.3.2 Beyond Territorial Limits

There is currently no legislation in Guernsey relating to the production of energy by wind and water driven generators outside of the 3 nautical mile territorial limits. Guernsey is looking to extend the territorial limits to 12nm, however at this time the area outside of 3nm of Guernsey, Herm and Sark is not being considered.

4.4 Policy Context for the Marine Environment

This REA aims to ensure that the potential for the development of marine renewables to conflict with any of the following national or international regulations and obligations is identified. The regulations and how they are applicable to Guernsey are outlined in Table 4.1 below.

Table 4.1: Table outlining UK, EU and Guernsey environmental policies

Subject Matter	UK/EU Legislation	Position in Guernsey
Deposits at Sea	FEPA	Extended to Guernsey and the Bailiwick – Require a licence for any deposits at Sea
Environmental Impact Assessment	EIA Directive	Not extended to Guernsey - Does not apply
Maritime Pollution	OSPAR (Oslo/Paris Convention for the Protection of the Marine Environment of the North East Atlantic)	Not extended to Guernsey – Environmental Pollution (Guernsey) Law, 2004
	The London Convention (Convention on the Prevention of Marine Pollution by Dumping of Wastes and other matters)	Extended to Guernsey – 1996 Protocol
	The Oslo Convention (Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft)	Extended to Guernsey
	MARPOL (Convention for the prevention of pollution from ships)	Not Extended to Guernsey - Merchant Shipping (BoG) Law, 2002
Integrated Coastal Zone Management	Draft Marine Bill	Not extended to Guernsey
	EU recommendation on Integrated Coastal Zone Management	Not Extended to Guernsey - European Communities (Implementation) (BoG) Law, 1994
	UNCLOS (United Nations Convention on the Law of the Sea)	Extended to Guernsey
Protection of Waters	Water Framework Directive	Not Extended to Guernsey - Prevention of Pollution (Guernsey) Law, 1989, Environmental Pollution (Guernsey) Law, 2004

Subject Matter	UK/EU Legislation	Position in Guernsey
Nature Conservation	Ramsar Convention (Convention on Wetlands)	Extended to Guernsey – 1999 signed up, 1 site of international importance around Lihou Guernsey and 1 site in Sark – Gouliot Caves
	Wildlife and Countryside Act	Not Extended to Guernsey
	The Habitats Directive	Not Extended to Guernsey
Nature Conservation (continued)	Marine National Parks	None in Guernsey
	Marine Protected Areas (MPAs)	None in the Bailiwick
	No-Take Zones (NTZs)	None in the Bailiwick
	Marine Conservation Zones (MCZs)	None in the Bailiwick
	Marine Special Areas of Conservation (SACs)	None in the Bailiwick
	Sites of Special Scientific Interest (SSSIs)	None in the Bailiwick
Archaeology	The Merchant Shipping Act 1995,	Not extended to Guernsey – Merchant Shipping (BoG) Law, 2002
	The Protection of Wrecks Act 1973, The Protection of Military Remains Act 1986.	Not Extended to Guernsey - The Wreck and Salvage (Vessels and Aircraft)(Bailiwick of Guernsey) Law, 1986
Maritime Safety	SOLAS (International Convention for the Safety of Life at Sea)	Extended to Guernsey – Guernsey is a signed up Member State

5. Description of Marine Devices

5.1 Introduction

The area of study for this REA covers the territorial waters (to 3 nautical miles) around Guernsey, Herm and Sark. The other boundaries to the study are the oceanographic parameters under which current tidal and wave technologies are intended and able to operate in. The technologies include:

- Wave energy devices such as overtopping, hydraulic and air driven devices – sited on the shoreline, nearshore or offshore;
- Tidal Stream energy such as turbine technology and oscillating devices – sited at locations of strong tidal flows;

GREC has been meeting with developers of marine renewable devices with a view to finding information about the operating characteristics of the devices and their potential environmental effects. Developers are also invited to join GREF in order to continue to offer their advice throughout. In addition to this, a pre-feasibility study will be prepared to provide technical inputs to the REA.

It appears that in addition to large arrays, there is still a lot of interest in single test installations. However, as the REA is driven by the desire to provide energy to Guernsey and for export, the focus of the REA will remain solely on large scale development of arrays.

5.2 Device Types and Operating Requirements

5.2.1 Tidal Energy

The REA is not evaluating the construction of tidal barrages and lagoons within the study area.

Tidal flow energy has developed in a number of ways, but the predominant technology is in horizontal axis tidal turbines. There are also vertical axis tidal turbines, but these are less common and lack the development of large scale prototype examples. Tidal flows can also be utilised to create an oscillatory motion of hydroplanes, hydrofoils attached to an oscillating arm. Venturi effect devices can also be used to funnel the tidal stream, concentrating the power output of a turbine.

Horizontal axis marine current turbines work in the same way as wind turbines but are driven by the flow of water rather than air. As the density of water is much higher than air (over 800 times) the turbines experience larger forces which allows smaller rotor diameters.

Oscillating Hydrofoils work by the tidal current flowing either side of the wing which results in lift. The lift affect can be allowed to apply in the opposite direction as the hydrofoil changes its angle through its oscillating cycle. The motion can then be used to drive fluid in a hydraulic system to be converted into electricity by a small hydraulic turbine. The motion can either be an up-and-down motion, or side-to-side.

Venturi Effect devices work by housing a device within a duct with a funnel-like collecting device. This sits in the tidal stream and concentrates the flow through or past a turbine or other generator system.

Technologies for tidal stream energy devices generally require current speeds to reach approximately 2.5m/s at peak spring tide. Lower speeds can become uneconomical, while speeds that are too high may pose risks to the devices. There are some limitations on the depth of water in which these devices can be sited, although this technology is allowing exploitation of shallower waters.

Tidal turbines can be broadly divided into shallow or deep water devices. There is no clear differentiating criteria as some devices can be altered in size to allow greater extraction of power from deeper waters. Additionally the system for fixing the devices to the seabed can be altered to allow for varying environmental conditions. The methods of attachment are:

- Seabed Mounted – the device is attached to the seabed around its base;
- Gravity Base – the device is fixed by a massive weight. May have additional fixing;
- Pile Mounted – the device is attached to a pile penetrating the sea floor;
- Floating –
    - Flexible Mooring – the device is tethered to the seabed allowing freedom of movement ;
    - Rigid Mooring – the device is secured using a fixed system;
    - Floating Structure – the devices are mounted to a platform that can move in relation to changes in sea level;
- Hydrofoil Inducing Downward Force – the device has a number of hydrofoils mounted on a frame to induce downward force from the tidal flow.

A number of prototype and pre-commercial devices have been installed around the UK coast, and Marine Current Turbines have a site generating electricity.

Appendix C provides a summary of the tidal devices currently in development globally. It is important to note that the REA will not assess the environmental effects of any individual device but instead focus on device-types. Below is a selection of tidal energy devices which have been deployed:

- Clean Current Power Systems - Clean Current Tidal Turbine
- Hydro Green Energy - Hydrokinetic Turbine
- Marine Current Turbines - Seagen, Seaflow
- Ponte di Archimede - Kobold Turbine
- Pulse Generation - Pulse Generators
- Open-Hydro – Deep-gen

5.2.2 Wave Energy

There are a variety of devices utilising different methods to harness wave energy offshore, converting their movement in response to wave action into electrical energy. For example the hinged sections of surface floating devices such as Pelamis demonstrate the movement, or the movement of submerged floats such as Ocean Wave Energy Company's OWEC device and Ocean Power Technologies Power Buoy.

Devices such as Wave Dragon use the power of the water itself to drive the device, with the water overtopping the device to drive a turbine, while others such as ORECon's MRC 1000 use an Oscillating Water Column to drive a turbine.

Shoreline technologies for wave energy generation typically use Oscillating Water Column technology attached to the shore. An example of this is Wavegen's LIMPET (Land Installed Marine Powered Energy Transformer) device.

An Outline of the key device concept technologies is given as follows:

Attenuator (Hinged Floating Surface Device) – Energy is produced by the motion of the jointed sections of an extended structure. This is generally a floating device which is aligned parallel to the wave direction.

Point Absorber – Energy is absorbed in all directions by the device with power generated in one of a number of forms. This is generally a floating structure with its motion restricted by a mooring system.

Oscillating Wave Surge Converter – Energy is produced by wave surges and the movement of water particles oscillating an arm on a mounted pivot joint. These are generally bottom mounted devices.

Oscillating Water Column (OWC) – Water pressure is used to drive air through turbines. The device is partially submerged with an open "collector" below the water surface allowing water moved by waves to enter and exit the device. This wave action moves the air through a turbine in both directions through changing pressure. The turbine generally rotates with air flowing both ways and the rotation of the turbine is used to generate power.

Overtopping Devices – Water is directed from waves into a reservoir, sometimes with collectors to concentrate the wave energy, above sea level. The water is then returned to the sea through turbines beneath the reservoir, driving the turbine to generate power.

Submerged Pressure Differential – The motion of the waves causes the sea level to rise and fall above the device therefore causing pressure changes. The device responds to the alternating pressure to pump fluid through a system to generate electricity. They are typically located nearshore attached to the seabed.

Wave Rotors – This is a form of turbine that is driven by the waves. They are generally bottom mounted devices located nearshore.

Table 5.1 in Appendix D provides a summary of the wave devices currently in development globally. It is important to note that the REA will not assess the environmental effects of any individual device but instead focus on device-types. Below is a selection of wave energy devices which have been deployed:

- Aqua Energy / Finevara Renewables – Aqua Buoy
- Aquamarine Power – Oyster
- AW Energy – Waveroller
- AWS Ocean Energy - Archimedes Wave Swing
- Energias de Portugal - Foz do Douro breakwater
- Instituto Superior Tecnico - Pico OWC
- Interproject Service (IPS) AB - IPS OWEC Buoy
- JAMSTEC - Mighty Whale
- Motor Wave - Motor Wave
- Muroran Institute of Technology – Pendulor
- Ocean Energy Ltd - Ocean Energy Buoy
- Ocean Power Technologies - Power Buoy
- Pelamis Wave Power – Pelamis
- SDE - S.D.E
- Straumekraft AS - Winch operated buoy
- Wave Energy Centre (WaVEC) – Pico Plant
- WaveBob Limited - Wave Bob
- Wavegen (Siemens) - Limpet

Wave energy devices generally require significant wave heights (at least 1.5 meters) with the amount of power produced increasing with wave height until the device reaches its maximum capacity. Above this, no additional wave energy can be captured by the device, but the stresses on the device and mooring systems increases.

5.3 Environmental Effects of Devices

For any given device the impacts and risks associated with it are dependent upon the design. For example bed-mounted devices may be able to function at sufficient depth in shipping lanes without any impact upon shipping whereas floating devices could not. Similarly, while floating devices would have minimal impact on the benthic ecology, pile driven or seabed mounted devices would have higher impacts. In order that the devices can be accurately assessed certain information about them will be needed.

The amount of information accessible for specific devices varies depending on the stage of development. Some devices have had detailed assessments performed on them giving information that can be extended to other similar devices. This is especially the case in tidal stream devices where many of the design parameters are similar. However, little is known about the impacts of a number of devices forming part of a commercial array as devices have so far been singular, and further research is needed to accurately determine the impacts of full scale projects.

Information that is useful for assessing the devices is as follows:

- Water Depth Requirement;
- Water Column Location;
- Sea Bed Topography Requirement;
- Sea Bed Foundation Requirement;
- Durability;
- Unit Size / Array Size;
- Energy generation (per unit / array);
- Mooring Requirements;
- Potential Pollution Sources (e.g. Antifoulants, Hydraulic Fluids);
- Sacrificial Anode Requirement;
- Underwater Noise;
- Lighting;
- Moving Parts;
- Installation Requirements;
- Maintenance Requirements;
- Decommissioning Requirements.

It is not the role of the REA to judge specific devices and therefore any information relating to specific devices is strictly confidential and will not be published.

6. Marine Resource Areas

6.1 Tidal Stream Energy

Potential tidal stream sites are confined to specific locations. The most abundant resource in the study area appears to be the Big Russel as this area has been highlighted, by a general study of the Channel Islands by Alan Owen for Black & Veatch Consulting Limited (Appendix E) and by the BERR Atlas of UK Marine Renewable Energy Resources, as a potentially utilisable resource. This area, together with the Little Russel, are examples of tidal constriction by land masses, a constriction of the flow causing higher tidal speeds thereby providing a large amount of energy potential. The Little Russel is not identified in either study but is not being discounted at this stage from the REA because neither study was especially focused on the waters around Guernsey or based on modelling at a high resolution.

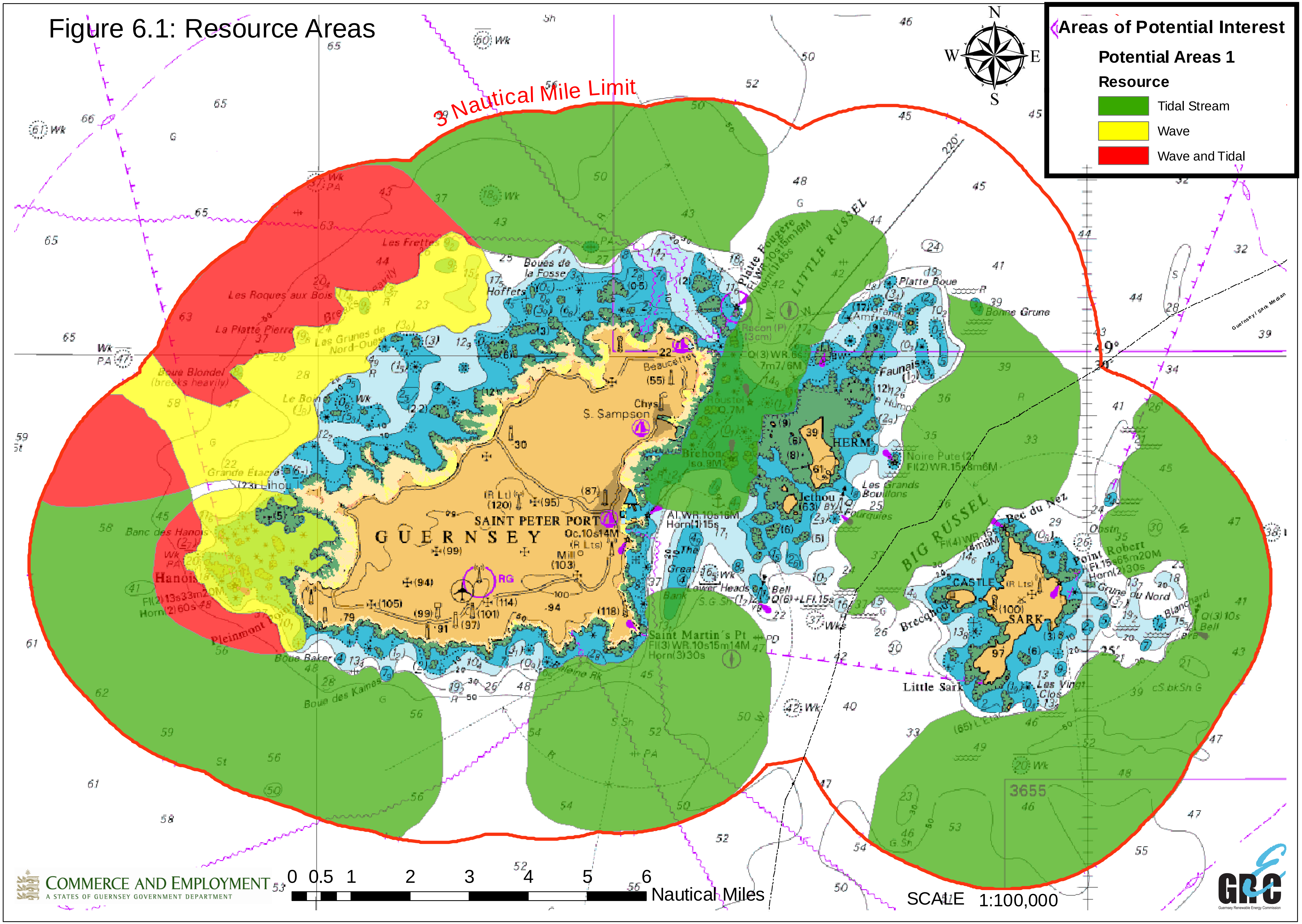
Other potential sites are located around the 'corners' of the islands, for example off St Martin's Point and around the south and east coasts of Sark. Both of these locations are believed to have high tidal flow, which is supported by admiralty chart data. However, the Black & Veatch study did not highlight these areas and the BERR information only highlighted around Sark, but their potential as resource areas will be examined in a more detailed examination of the tidal resource.

According to BERR and the Black & Veatch report there is a potential resource to the north of Guernsey, and a further more detailed study will identify how useful the resource is. This large resource area falls within, and outside, the 3nm limit. There may be further sites, such as the south west of Guernsey which are highlighted as a potential resource areas and these will be identified, after further study, in the REA. The currently predicted areas of interest and resources are illustrated in figure 6.1.

The amount of energy available for extraction by tidal stream devices in Guernsey is to be estimated in a detailed study by Alan Owen of Robert Gordon University (RGU). This study will be supported with available tidal stream information and will help to define the areas of potential resource more accurately. The BERR Atlas of Marine Renewable Energy Resources (2008) indicates an Annual Average Tidal Power of up to 1.5 kW/m2 of the water column, and Mean Peak Spring Tidal Velocities of 2.5m/s. It is anticipated that there is a potential extractable resource of up to 1GWh/yr within the study area.

Generally, potential tidal stream sites do not overlap with the sites of high potential wave development due to their geographical locations. However exceptions to this can be seen on the west coast of Guernsey. After further study these areas will become more accurate and defined.

Figure 6.1: Resource Areas



It is important to reaffirm that the data presented thus far is taken from the BERR Atlas of UK Marine Renewable Energy Resources and Tidal Stream Assessment for The Channel Island area by Black and Veatch, and as these are general models for the entirety of UK waters and the Channel Islands respectively, there may be some localised areas that are not detected or are portrayed inaccurately. Further work is being undertaken to ensure an accurate portrayal of the resource available in the waters around Guernsey, Herm and Sark and this will be available to the REA.

6.2 Wave Energy

The west of Guernsey is open to the Atlantic Ocean and not shielded by islands or the European mainland, and as such provides several potentially attractive sites for wave devices. Attractiveness of a site depends on its energy resource which is affected by two key factors:

- Coastal Orientation relative to the prevailing wave direction;
- Seafloor Depth Characteristics.

The prevailing wind direction and area of greatest fetch for Guernsey is westerly and as such west facing sites will generally have the greatest energy resource.

Friction from the seabed removes energy from waves when they encounter seafloor depths of approximately 100 meters or shallower. The resource decreases steadily shoreward with decreasing depth and so the most attractive sites are those that have deep waters close to the shore. Depths of 50m are often considered to be ideal for offshore devices, and these exist within the 3 nm study area.

Again using data taken from the BERR Atlas of UK Marine Renewable Energy Resources, there is evidence of a 10-15kW/m total power resource around Guernsey. A commercial wave device developer, Pelamis, states that for its devices any area of a yearly average resource with a 15kW/m resource there is a commercial possibility to generate wave energy at competitive prices (http://www.pelamiswave.com/content.php?id=155). The significant wave height that the BERR Atlas suggests is of the order of 1.51-1.75m (excluding the region east of Sark). Suitability of Wave Energy Resource also depends on the wave frequency, which is not covered by the BERR Atlas. Furthermore, it should be noted that this is just an average, power will not be constant and is also subject to the same potential inaccuracies as the current tidal power model data.

Taking data from the nearest wave buoy, the Channel Light Vessel, it is possible to give examples of when power would be extractable from a Pelamis device (the Pelamis devices are considered because they are the only company to publish sufficient information to make calculations. There is a power matrix available from http://www.pelamiswave.com/content.php?id=153). The Channel Light Vessel records data on average wave height and average wave frequency which makes it possible to identify when the resource is extractable, as at different wave heights the wave frequency affects how much power is extractable.

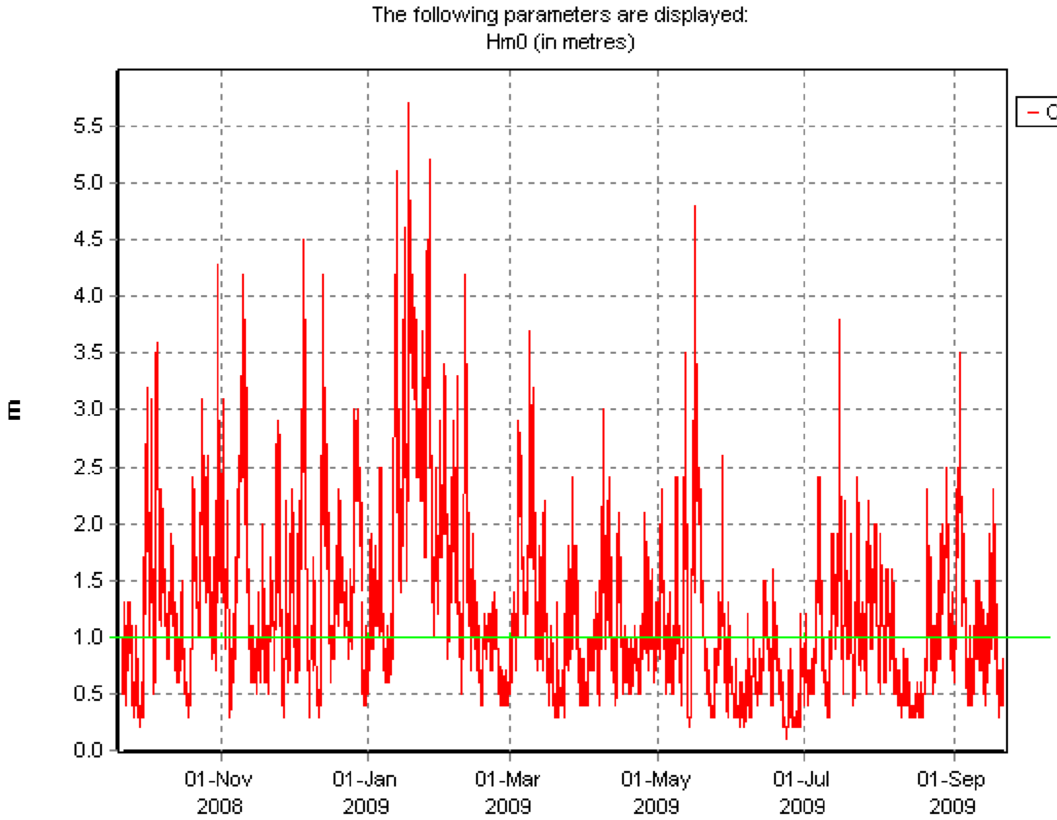
The resource is not extractable below 1m wave height, so all wave amplitudes below this can be discounted. As such, all of the area below the green line (see Figure 6.2 below) represents an unusable part of the resource. Where the red line indicating average wave height is above the green line this indicates potentially usable resource, depending on wave frequency. The highest wave height was just over 5.5m, which would need a wave frequency of every 6.5 seconds or longer, in order for power to be extractable. As can be seen from the graphs below, there is also a peak in frequency at this time of a wave every 13 seconds. This pattern appears to correspond to all the peaks, with increasing wave height occurring at the same time as increasing frequency, which means that so long as the height is available the frequency should be too.

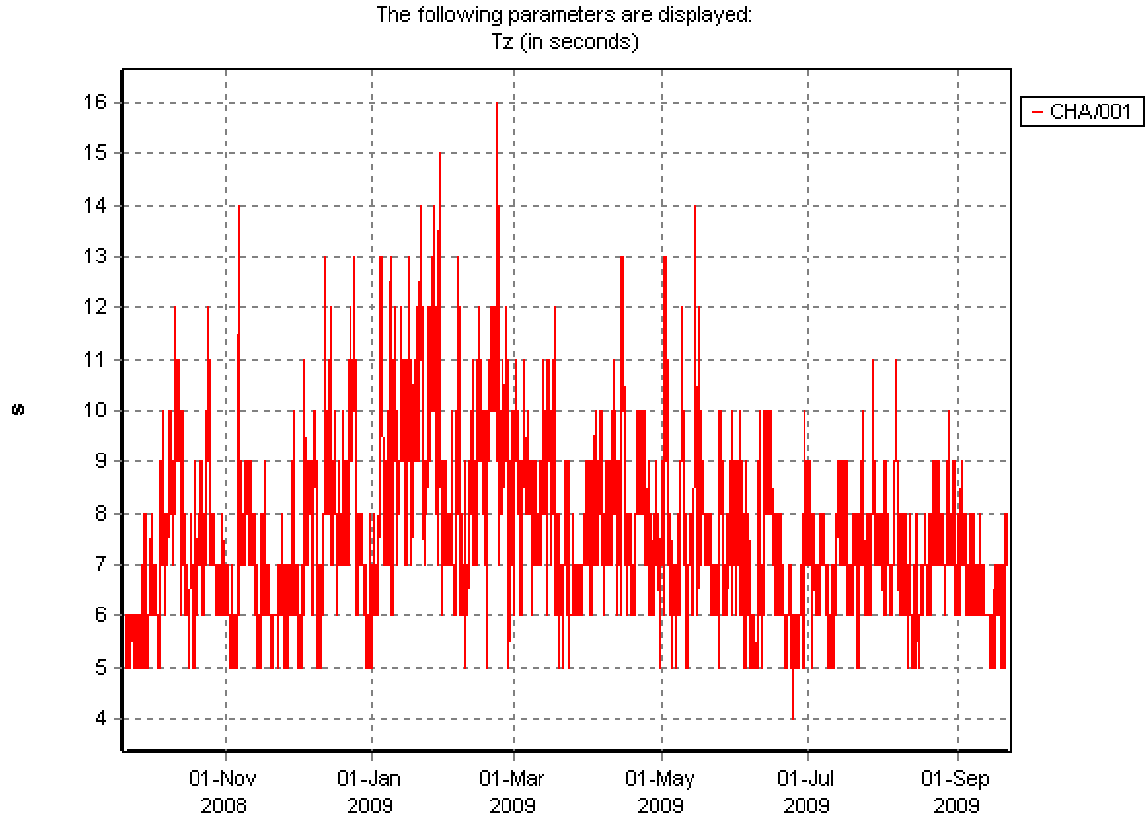
The graph also shows the sporadic and unpredictable nature of wave power, with periods of time where the wave heights are not great enough for electricity generation. This is evident from the graph for the second half of May and June having few peaks above the 1m required energy. But this does outline that there is a potentially exploitable resource in the waters surrounding Guernsey, although it does have to be taken into consideration that the Channel Light Vessel buoy is more in the middle of the channel than Guernsey, Herm and Sark and so the wave profile may differ around the coast of Guernsey.

With further information it may be possible to identify a number of specific areas of interest off the west coast of Guernsey. However due to the significant visual and environmental impact that would result from deploying throughout the length of the west coast, the total generating capacity would be a small fraction of the overall resource. A typical 20MW array would take the form of a 4km long deployment area.

It is also important to point out that once again the data taken is from the BERR Atlas of UK Marine Renewable Energy Resources and from the Channel Light Vessel Buoy in the middle of the English Channel. While this is the closest wave buoy to Guernsey the resource would be better assessed by deploying a wave-measurement buoy, or multiple buoys, in the waters around Guernsey. This would then allow a detailed assessment of the wave resource within the area of study. As well as this, different wave devices will have different efficiencies, both in extraction of resource and in the ability to extract waves of different frequency. Pelamis was used as an example as the information was readily available.

Figure 6.2 – Wave Energy Resource Assessment





6.3 Zoning

Areas of potential resource are indicated in the Figure 6.1 . This shows the main marine resource areas for each of the three renewable energy types. As discussed above, enhanced tidal resource modelling will allow better identification and quantification of those resource areas. The environmental data that will be analyses and assessed in the REA will be overlaid onto the resource areas to allow selection, or 'zoning' of the best deployment areas. This will be a key output of the REA.

It is acknowledged that selection of deployment areas based on resource data that is not supported by site-specific tidal flow monitoring data carries some risk. Furthermore, other detailed environmental classification surveys may be required to fill any data gaps that are identified by the REA. Therefore, the proposed environmental monitoring plan (another key output of the REA) will identify the future survey work that will be required to mitigate this risk prior to the undertaking of detailed project-specific Environmental Impact Assessment work by prospective developers.

6.4 Site Selection

As well as the resource requirement, there are a range of other criteria and factors that affect site selection. These are as follows:

Biological Factors

- Avoidance and minimised disturbance of sensitive environmental areas;
  - Ramsar sites;
  - Presence of important feeding areas;
  - Important migration routes;
  - Presence of protected species and species and habitats of international importance;

Physical Factors

- Avoidance of areas with technical difficulties for device installation and maintenance;
  - Seabed characteristics;
  - Sediment mobility;
  - Bathymetry;
- Avoidance of areas where there is high risk of damage to physical environmental features;
  - Alterations to current flows affecting soft sediment coasts and sea bottoms;
  - Alterations to current flows affecting silting

Human Factors

- Development of most economically attractive sites;
  - Location of grid connections;
  - Accessibility for installation and maintenance;
  - Distance from shore;
- Avoidance of areas where there is high risk of damage to devices/cable;
  - Anchorage areas;
  - Dredging areas;
  - Fishing activity;
  - Disposal areas;
- Avoidance of existing and proposed sea use areas;
  - Military exercise areas;
  - Major shipping channels;
  - Aquiculture;
- Avoidance of siting devices over or around existing cables and pipelines. If any are crossed by export cables the crossing should be as close to 90^{o} as possible;
  - Locations of existing pipelines and cables;
- Avoidance of wrecks;
  - Known Wreck sites;
- Identification of potential third party issues which could affect the project or obtaining consent;
  - Recreation;
  - Commercial fisheries;
  - Shipping intensity;
  - Military practice areas;
  - Fish spawning and nursery areas;
  - Marine ecology;
  - Marine archaeology.

Economic factors are fundamental to a site's attractiveness. Seabed cable costs are a function of distance from the shore and seabed characteristics. This must be balanced with and the need for a deployment area to be large enough to support the number of devices required to generate sufficient power to justify installation costs. The further from the grid connection, and therefore the shore, the larger the development needs to be to achieve economic viability. Further analysis of economic factors is beyond the scope of the REA. Furthermore, the attractiveness of a given site may vary in response to the changing economic circumstances.

7. REA Topics, Baseline Data and Predicted Effects

7.1 Introduction

This chapter contains descriptions of the baseline data that is available to the study for each of the REA topics covered. The topics have been drawn from those required by the EU SEA Directive, but modified to reflect a specific application to Marine Renewable Energy and the fact that the SEA Directive does not apply in the Bailiwick of Guernsey. For each topic, information has been provided to describe:

- Data Sources(shown at the end of this section)
- Baseline Data
- Potential impacts

The identification of potential effects has been based on the study area and the development scenarios described in Chapter 2. Potential sources of impact relate to the whole life cycle of renewable energy projects.

- Installation / Deployment
- Operation
- Maintenance
- Decommissioning

The following table shows the topics covered.

Table 7.1 REA Topics

Section Ref.	Title
7.2	**Physical Marine Environment**
7.2.1	*Geology Bathymetry and Sediment Transition*
7.2.2	*Marine Processes*
7.2.3	*Sediment Contamination and Water Quality*
7.3	**Marine Biological Environment**
7.3.1	*Protected Sites and Species*
7.3.2	*Benthic Ecology*
7.3.3	*Pelagic Ecology*
7.3.4	*Birds*
7.3.5	*Marine Mammals*
7.4	**Marine Human Environment**
7.4.1	*Commercial Fisheries*
7.4.2	*Marine and Coastal Historic Environment*
7.4.3	*Cables Pipelines and Onshore Grid Connections*
7.4.4	*Shipping and Navigation*
7.4.5	*Tourism and Recreation*
7.4.6	*Recreational Fishing*
7.5	**Other Topics**
7.5.1	*Noise*
7.5.2	*Air Quality*
7.5.3	*Electro-magnetic Fields*
7.5.4	*Landscape and Seascape Character*
7.5.5	*Social Aspects*

7.2 Physical Marine Environment

7.2.1 Geology, Bathymetry and Sediment Transition

7.2.1.1 Baseline Description

Digital Hydrospatial data from SeaZone has been procured for use with the GIS system. This includes a basic classification of seabed geology.

There is a limited amount of geophysical data available, with only four geophysical traverses having been identified within the 3 mile REA limit. There is some additional data on the margins of the 3 mile limit that can be used to assess the area.

A brief review of the BGS maps indicates that within the 3 mile territorial waters the seabed has a (probably thin) coarse-grained sediment cover that overlies mainly Pre-Cambrian bedrock on the margins of which lie Cretaceous and Tertiary sediments. From the Admiralty Charts, the seabed adjacent to the islands is obviously extremely rugged.

Baseline bathymetric information is shown on the digital SeaZone Chart data. This will be used to assess the likely locations for deployment of renewable energy devices, which operate at designated water depth ranges. Seabed depths range from 0 to 70m throughout the study area.

7.2.1.2 Potential Impacts

- Impacts on tidal current regimes and attenuation of wave energy, leading to-
  - Impact on sediment scour
  - Impact on sediment dynamics
- Impacts on the seabed from installation of export cables
- Impacts on sub surface geology from devices and foundations
- Impacts on seabed morphology
- Impacts on sediment composition
- Localised effect on Bathymetry
- Secondary impact on sediment movement

7.2.2 Marine Processes

7.2.2.1 <u>Baseline Description</u>

The Atlas of UK Marine Energy Resources indicates that an energy resource is likely to exist that would allow extraction at a commercial scale. Local knowledge and a review of basic data provided on Admiralty charts indicate suitable tidal resources in the following key area.

- Little Russel
- Big Russel
- South of St Martin's Point
- East of Sark
- North of Herm

Suitable wave energy deployment areas exist off the north-west coast of Guernsey.

The REA will assess all of these areas within a wider analysis of the tidal streams throughout the whole study area. For tidal energy, this will be achieved through the use of energy resource mapping tools that have been developed by the Robert Gordon University to identify flow strength and direction in relation to depth. The arrangement of the islands and rocks within the study area makes the accurate prediction of tidal flows difficult. The tidal resource may be prone to eddies and turbulence, and this could present difficulties to the deployment of certain types of device. The risk of these effects occurring will be identified as part of the selection of potential deployment areas.

For wave energy, additional data relating to the wave climate of the west coast of Guernsey will be obtained from the UK Met Office Channel Light-Vessel wave-buoy.

7.2.2.2 <u>Potential Impacts</u>

- Impacts on wave height
- Impacts on wave energy
- Impacts on flow strength
- Impacts on flow direction

Secondary impacts:

  - Sediment scour, movement and deposition patterns
  - Tourism - Impact on surfing/water recreation areas

7.2.3 Sediment Contamination and Water Quality

7.2.3.1 Baseline Description

Current and historical data will be used to determine that location and nature of potential sediment and water quality contamination sources in the study area. These will include sewage discharges, constructions works, discharges from vessels, munitions contaminations and toxic waste dumping.

Historically, there have been water quality concerns relating to bathing beaches along the north coast of Guernsey. It is understood that the occasional fall in the bathing water quality at some of the Island's beaches was probably attributable to pollutants reaching the beach either from streams, birds or animals or from general beach users, as opposed to coming from the Island's wastewater outfalls. The Environment Department is investigating this further before determining the design criteria for any future sewage treatment measures.

7.2.3.2 Potential Impacts

- Re-suspension of contaminated sediments
- Release of pollutants from vessels during construction
- Use of anti-fouling paint
- Damage to or failure of components containing hydraulic fluid
- Biological impacts of contamination

Secondary impacts

  - Impacts on plankton
  - Impacts on shore stability

7.3 Marine Biological Environment

7.3.1 Protected Sites and Species

7.3.1.1 Data Sources

Significant contributions to the reporting of this section will be made by the Guernsey Biological Records Centre. The Centre holds a database of biological records information that will be used to make their assessment of potential impacts from renewable energy devices and associated infrastructure. The Centre will be make an assessment of the proposed development scenarios and likely deployment sites to identify if these will impact on known protected species.

7.3.1.2 Baseline Description

A number of local nature reserves have been designated across the island, administered by La Société Guernesiaise. The area of land covers some 65 hectares, encompassing a number of locally threatened habitats. Many of the headlands and cliffs are designated as Sites of Nature Conservation Importance (SNCIs) and managed in an environmentally sympathetic manner.

One Ramsar site was designated on Guernsey in 2006 - Lihou Island and L'Erée Headland - covering 390ha across Lihou Island, La Claire Mare Nature Reserve and the Colin Best Nature Reserve, including intertidal reefs and rocks and the Gouliot Caves in Sark is also a designated Ramsar site. Another two sites have been proposed: North Herm and Les Amfroques (the Humps), and the Orchid Fields at Rocquaine Bay. These cover a total of 690ha.

7.3.1.3 Potential Impacts

- Impacts on the boundaries, structure and function of the site
- Impacts on site integrity
- Impacts on Quality
- Impacts on ecological coherence within a site or between inter-related sites
- Impact on protected species

7.3.2 *Benthic Ecology*

7.3.2.1 Baseline Description

The assessment of impacts on the benthic ecology will take account of whether sites are designated under national or international legislation or areas where European Protected Species (EPS) and species listed as priority species under the UK BAP are known to be present. The existing available data will be reviewed and used as the basis of the Impact Assessment for the REA. The waters within the study area include potentially rare habitats caused by the complex bathymetry and strong tidal currents.

Formal recording of benthic species in the Bailiwick may be patchy and infrequent. As such for understanding of the likelihood of the occurrence of protected species in the Bailiwick reference needs to be made to wider regional analysis. The REA may, on completion, identify that existing baseline information could be too sparse over possible deployment areas. However, this will be determined by the REA.

7.3.2.2 Potential impacts

- Benthic habitat alterations (loss/disturbance/Increase)
- Benthic population changes
- Displacement of benthic species
- Changes in sediment suspension
- Alterations to habitats and species

Secondary impacts

- Population changes to surrounding species (algae, invertebrates, fish)
- Impact on reproduction
- Impact on competition
- Impact on predation
- Impact on feeding regimes

7.3.3 *Pelagic Ecology*

7.3.3.1 Baseline Description

The report will include a baseline review of key areas for fish (including elasmobranchs) in the study area. This will include identification of sensitivities relating to spawning, nursery areas, seasonality, migration and location in the water column.

The report will include analysis of data gathered, focussing on spatial characteristics and trends in development and anticipated changes in fishing, shellfishing, aquaculture, mariculture and recreational fishing activity.

7.3.3.2 Potential Impacts

The following potential impacts are envisaged:

- Habitat exclusion
- Risk of direct collision or entanglement with devices or arrays of devices
- Chemical pollution
- Sediment pollution or smothering contamination from seabed disturbance during construction of arrays or trenching for cables
- Noise during installation, device operation and ongoing maintenance
- Electromagnetic fields

7.3.4 Birds

7.3.4.1 Data Sources

Much of the information on seabirds inhabiting the Bailiwick of Guernsey's inshore waters will be sourced from the Bailiwick of Guernsey Seabird Ringing Team, the Ornithology Section of La Société Guernesiaise and the Guernsey Biological Records Centre. Other sources of data, such as the European Seabirds at Sea database (ESAS), which covered the region from 1979 to 2003, will also be researched.

Detailed data on breeding seabirds is readily available in three comprehensive censuses as follows –

- Seafarer 1970
- Seabird Colony Register 1986 –1992
- Seabird 2000

Information on birds at sea is currently limited. Where possible, information on seabirds (and to a much lesser extent, landbirds) feeding and migrating through the study area will be gathered initially through contact with local fishermen and ornithologists. A preliminary study of seabird activities will be required initially by observation from land, with potentially important areas studied from boats if necessary.

7.3.4.2 Baseline Description

Where information is available, the REA will include a description of key areas for birds and sensitivities associated with abundance, migration, important feeding areas, breeding locations and seasons.

The information on the location and size of seabird colonies is well known. Data on at-sea distributions and activities is extremely poor. Following further investigations, observations and research, it is anticipated that a better understanding of marine birds will be obtained.

Several of the seabird species which breed in the Bailiwick of Guernsey are nationally or internationally important, such as Northern Gannet (Morus bassanus) and Lesser Black-backed Gull (Larus fuscus). Some species such as Atlantic Puffin (Fratercula arctica) are on or near the southern limit of their breeding distribution.

As is often the case with island populations, many species of local seabirds survive in small colonies, and as such, many are vulnerable to factors such as over-fishing, oil spills, predation by alien species and climate change.

7.3.4.3 Potential Impacts

- Disturbance to feeding
- Disturbance to breeding
- Disturbance of migration

7.3.5 Marine Mammals

7.3.5.1 Data Sources

The assessment of impacts on marine mammals will take account of whether sites are designated under national or international legislation, European Protected Species (EPS) and species listed as priority species under the UK BAP are known to be present.

7.3.5.2 Baseline Description

The REA will include a review of marine mammals known to inhabit the survey area, including any key haul-out and breeding areas for seals. Important areas for cetaceans are harder to identify because of the diverse needs and mobile nature of these species i.e. most species do not restrict their foraging, resting or breeding behaviour to confined areas. There is also substantial inter-annual variation in the distribution of marine mammals, particularly cetaceans, which is difficult to assess. However, information on known migration routes and areas of high abundance for cetaceans will be reviewed to identify key areas for cetaceans.

This information will be used to identify key areas of potential importance for marine mammals and highlight sensitive/valuable areas where further research would be required, should specific projects be planned there. However, additional survey work is not considered to be realistic for the entire area within the scope of the REA.

Channel Island waters are among the richest in the British Isles in terms of their marine biodiversity. These continental islands are approximately 300-400 miles away from the edge of the continental shelf and are situated in the English Channel. The water depth is relatively shallow at a depth typically less than 100m. The upwelling of nutrients at the continental shelf, especially in the Bay of Biscay area, attracts large numbers of whales and dolphins. In the summer months and the water temperature increases, phytoplankton (the "green grass" of the marine ecosystem) flourishes and free-floating marine plants increase dramatically, providing sustenance for all marine creatures from microscopic zooplankton to fish and mammals higher up the food-chain.

The high tidal range (over 10 metres on the highest spring tides) in the Channel Islands archipelago means that there are strong tidal currents around the Bailiwick which increase the flow of nutrients around its waters, causing marine life and key prey species to flourish (e.g. mackerel and sea bass). This in turn attracts animals higher up the food-chain, including large numbers of particular cetacean species, especially short-beaked common dolphins (Delphinus delphis) which have been recorded in schools of over 100 individuals.

Cetacean species recorded in the Bailiwick of Guernsey recording zone include Baleen whales: Fin Whale(Balaenoptera physalus) and Minke Whale(Balaenoptera acutorostrata); Sperm Whale (Physter macrocephalus); Ocean Dolphins, most notably Killer Whale (Orcinus Orca); Risso's Dolphin (Grampus griseus); Short-beaked Common Dolphin (Delphinus delphis); Common Bottlenose Dolphin (Tursiops Truncatus); and Long-finned Pilot Whale (Globicephala melas). In addition, Harbour Porpoise (Phocoena phocoena) are recorded.

There are also recordings of pinniped species, the most commonly sighted being Atlantic Grey Seal (Halichoerus grypus). This species is on the southernmost limit of its range, with other recordings around Jersey and Brittany. As a result the colonies are small (typically between 3-8 individuals recorded), with a known resident colony off Grand Amfroque, north of Herm. Common or Harbour seals (Phoca vitulina) have occasionally been recorded in Bailiwick waters. As in the case of dolphins and whales, seals are a highly mobile species and are known to travel to the Channel Islands from the west coast of Scotland, having been tracked using satellite telemetry by the Sea Mammal Research Unit in St. Andrews.

Whilst, apart from Ramsar and Sites of Nature Conservation Importance (SNCI) listings, the Bailiwick of Guernsey has yet to legislate for or designate areas of Marine Protected Areas (MPAs), Sites of Special Scientific Interest (SSSIs), Marine Special Areas of Conservation (SACs), etc. the precautionary principle of "wise use" should be applied in the context of the development of renewable energy projects (see 'Potential Impacts').

7.3.5.3 Potential Impacts

- Interruption of migration routes
- Collision risk
- Impacts on navigation
- Disturbance to feeding
- Disturbance to breeding
- Effects of noise/vibrations
- Changes to haul out sites (seals)
- Disturbance to communication
- Bioaccumulation of substances (e.g. Anti-foulants)

7.4 Marine Human Environment

7.4.1 Commercial Fisheries

7.4.1.1 Baseline Description

The REA will include a background to the commercial fishing industry in Guernsey, the fleet structure, the methods employed and the landings and value of the principle commercial species caught by GU based vessels.

Historical landings data as well as geographical locations of fishery resource and fishing effort, presence of protected species and habitats, location of spawning and nursery areas, migration routes all need to be identified. Where there are trans boundary differences in fisheries management (e.g. European legislation for Protected species) there needs to be an adequate understanding of how this might affect activities in Guernsey territorial waters.

Mapping of key commercial fish assemblages and areas where commercial fishermen work within Bailiwick waters may be gathered by setting up an interview programme with all commercially registered GU fishing vessel operators/owners. Commercial fishermen can then transfer their own information on fishing areas, gear types and amounts and knowledge of known key fishing grounds.

There are seven designated fishery areas around Guernsey and Herm where shellfish farming takes place. These areas are generally located around the low water mark.

7.4.1.2 Potential Impacts

- Habitat exclusion
  - Spawning area
  - Nursing areas
  - Culturing areas
- Displacement of fishing activity
- Collision of fish with devices
- Electromagnetic disturbance on fish
- Noise/vibration disturbance on fish
- Smothering from increased sedimentation

7.4.2 Marine and Coastal Historic Environment

7.4.2.1 Data Sources

The position and details of the more reliably located wrecks are recorded on the Sites and Monuments Record (SMR) maintained at Guernsey Museum. The data on the SMR has been collated from various sources, including published accounts, the records of the UK Hydrographic Office and information received from local sailors and divers.

7.4.2.2 Baseline Description

The waters around the Bailiwick of Guernsey are known to contain several hundred historic wrecks, dating from Gallo-Roman period to the twentieth century. The locations of at least one hundred of these can be pinpointed with a reasonable degree of accuracy – to within 100m – while others can be associated with particular rocks or reefs. There are many more that remain unlocated or without accurate locations. The position and details of the more reliably located wrecks are recorded on the Sites and Monuments Record (SMR) maintained at Guernsey Museum. The data on the SMR has been collated from various sources, including published accounts, the records of the UK Hydrographic Office, and information received from local sailors and divers.

Historic wreck is protected by The Wreck and Salvage (Vessels and Aircraft) (Bailiwick of Guernsey) Law, 1986. It includes any 'vessel, aircraft or its cargo that has lain wrecked for 50 years or more'. A licence is required to disturb historic wreck and there is also a requirement to report new discoveries. In addition to this, war graves will require a significant exclusion zone at all times.

There is the potential for ancient land surfaces to be preserved in the seabed. At times during the Palaeolithic and Mesolithic periods the Channel Islands were connected to continental Europe; people and animals lived upon and moved across a now inundated landscape. Survey work in the North Sea has shown that traces of these ancient land surfaces can survive. Little is known of this sea area, but evidence from the eroding coastline and beaches indicate that there could also be land surfaces preserved below the water.

There are a very large number of archaeologically important sites situated around the coasts of Guernsey and its dependant islands. As with the historic wrecks, these are fully recorded and, in almost every case, very precisely located on the SMR. These sites range across more than ten thousand years of human occupation, which include flint scatters of the late Palaeolithic period (exposed at low spring tides on the southern shore of Crevichon), the submerged peat landscape occasionally visible at Vazon Bay and comparatively recent post-medieval fortifications. Some coastal sites have the protection of Ancient Monument status.

7.4.2.3 Potential Impacts

- Increased sedimentation of archaeological sites
- Increased scour of archaeological sites
- Damage to archaeological sites

7.4.3 Cables, Pipelines and Onshore Grid Connections

7.4.3.1 Baseline Description

The REA will consider the effect of new generating capacity provided by connection to offshore devices. It will also consider the impact of new cables (both onshore and offshore) and other infrastructure upon both existing import/export cables and other utilities such as telecommunications, sewerage and water supply infrastructure.

The Island of Guernsey benefits from a connection to Jersey and France at Havelet Bay on the east coast south of St Peter Port. At a maximum capacity of 60MW, this has the potential to meet Guernsey's Peak Demand. However, there is also sufficient on-Island generating capacity at Guernsey Electricity's own power facilities at St Sampson, north of St Peter Port. These on-island facilities have sufficient redundancy to allow the two largest generators to suspend operation without threatening Guernsey Electricity's ability to meet Peak Demands.

The existing network is arranged to support the generation and import of electricity to the eastern side of the Island, and this is also the location of greatest usage. There is a general flow of electricity from the urbanised eastern side out towards the more rural areas of the west. However, there is an existing bulk supply station at Kings Mills, Vazon, on the west coast that may accommodate a connection of an array of wave energy devices.

Connection to grid receiving points in other jurisdictions are not covered within the REA. However, it is understood that the existing import cables from Jersey and France may be used for export of up to 60MW, if a market can be established for such quantities.

Existing utility records will be considered in relation to potential deployment areas and likely cabling routes.

7.4.3.2 Potential Impacts

- Visual impact onshore
- Reinforcing existing network

Secondary impacts

  - Impact on existing utilities (telecoms, water, sewerage)
  - Flora and fauna
  - Noise
  - Transport

7.4.4 Shipping and Navigation

7.4.4.1 Data Sources

The following key data sources have been identified, which may be used as part of the assessment.

(a) ShipRoutes data and
(b) that obtained from AIS.

ShipRoutes data gives details of shipping routes and numbers of vessels. ShipRoutes data is based on Lloyds maritime data (which provides information on the majority of ship types for vessels over 100 gross tonnes passing within UK waters), consultation with industry, and surveys. AIS data is taken from live real time shipping transits from all those vessels required to be so fitted (generally and broadly speaking all passenger vessels and all others greater than 300 Gross Tons, except naval ships) and others which do so voluntarily.

The UK DfT has drafted a paper "Guiding Principles for Assessing the Value of Shipping Activities Disrupted or Displaced by OREI Developments". This is under development, but may soon be available and of use.

7.4.4.2 Baseline Description

The assessment will include a review of shipping and navigation within the study area, highlighting routes and areas of particular importance, such as International Maritime Organisation (IMO) adopted routing lanes and areas referred to in the Lord Donaldson report (Safer Ships, Cleaner Seas).

Consideration needs to be given to the proximity of the main traffic flow up and down the English Channel and the probability and consequence of failure to stay within these shipping lanes. A number of very large laden tankers pass close by the study area on their way to and from major European Ports. Smaller vessels, including tanker, cargo and passenger, routinely pass through the area under consideration. The subject area includes key shipping routes for smaller vessels which facilitate the movement of coastal shipping traffic around the near continental shelf. Occasionally, naval ships use these waters for Navigational Training exercises. Shipping traffic in the study area includes Ro-Ro vessels, high speed ferries, container vessels, ferries, fishing vessels and cruise ships. In this respect, the responsibility for Safe Navigation on the Southern side of the English Channel in the area under consideration rests primarily with CROSSMA at Jobourg. Casualty and major incident response is managed under the MANCHEPLAN, which includes provision for a sub-region of responsibility surrounding the Channel Islands. The area in question lies within that sub-region of responsibility.

7.4.4.3 Potential Impacts

- Disturbance to regular shipping routes
- Diversion of shipping routes
- Constriction of shipping routes
- Impact on emergency response vessels
- Collision risk
    - With devices
    - With the environment

Secondary impacts
- Oil spill
- Release of other pollutants

As covered in section 2.7, impacts on port facilities will not be covered in this assessment

7.4.5 Tourism and Recreation

7.4.5.1 Baseline Description

Coastal and marine recreation activities include swimming, sailing, scuba diving, sea angling, rowing, canoeing, surfing, kayaking and board sailing.

Much of the coastline of Guernsey is designated as of High Landscape Value and the coastal and cliff path network offer exception scenic views which are of high recreational value to walkers all year round.

The Ramsar site at Lihou Island and L'Eree headland is also of high recreational value.

Tourism contributes substantially to the Bailiwick's economy, with 185,000 visitors a year contributing approximately £80 million pounds annually.

The scenic environment and the rich variety of wildlife (both above and below water) are key attractions to visitors with marine mammal, wildlife and bird watching popular activities. Several operators offer boat excursions to watch wildlife around the coasts of Guernsey, Herm, Jethou and Sark.

Sea and inshore angling are of high importance and it should be noted that there is a strong tradition of recreational shore gathering.

Several outdoor activities operators offer opportunities for kayaking, coasteering and rock climbing.

Diving attractions within the study area include both wrecks and marine wildlife.

All beaches within the study area are considered to be of recreational and tourism importance with wide ranging appeal, from quiet coves to open stretches of sand offering opportunities for sand and water sports. Thirteen beaches in Guernsey are monitored against the standard of the EU Bathing Waters Directive and these, together with all beaches in Herm, Jethou and Sark, should be considered of high importance for the purposes of this study.

Charter angling operations are centred on Alderney although a number do make visits to the Island (Guernsey) the extent and value derived from this is not known and if required separate research on the sector would need to be carried out.

There is extensive recreational fishing, angling and, to a lesser extent, diving activity within the Bailiwick three mile limit and beyond. There is no published material on the extent and value of this activity. Additional consultation and research would be required to obtain this information.

7.4.5.2 Potential Impacts

- Displacement of recreational activities
- Visual impacts
- Reduction in wave height and quality for surfing
- Positive impact on eco-tourism

7.4.6 *Recreational Fishing*

7.4.6.1 Data Sources

There are no formally recorded comprehensive data sources relating to recreational fishing. However, there is a lot of local anecdotal information available through discussion with local clubs, enthusiasts and on websites. Some clubs may hold their own records, for example, from competitions. In addition, there are Bailiwick maximum-size records.

7.4.6.2 Baseline Description

The coasts and waters around Guernsey, Herm and Sark are renowned for their varied and exciting fishing opportunities. The strong tidal currents, rocky outcrops and varied coastline in close proximity to deep water form a special angling environment. There is a vibrant industry in the provision of small craft for private charter, and guided fishing trips for tourists. In addition, many residents of Guernsey pursue angling as a hobby, either from the shore or by using their own small boats. A number of residents also engage in non-commercial potting activities, for crab and lobster.

Species that are commonly fished are Conger, Plaice, Pollack, Bass, Wrasse, Mackerel, Mullet and Bream. Locally caught/dug baits are sand-eel, ragworm and razorfish.

Although subject to very tight controls, Ormer are collected at certain tides in January and April.

7.4.6.3 Potential Impacts

As the majority of renewable energy projects would be located offshore, it is likely that shore-based angling will remain largely unaffected except for any disturbance around cable landfall sites. However, the following impacts may occur to boat-based angling

- Risk of discharge of pollutants or sediment
- Changes to ambient noise that may affect fish behaviour
- Electromagnetic fields around cables may affect fish behaviour
- Risk that fishing gear could be lost if entangled with renewable energy devices
- If deployment sites were to be located at well-established fishing sites, there would be a risk that anglers would be excluded

- Navigation exclusion zones may affect fishing areas or navigation routes to them
- Exclusion zones could act positively to protect fish, allowing populations to become better established thus providing larger specimen fish

Secondary impacts

  - If important sites were to be made unavailable to anglers, then this could increase pressure on other nearby or similar sites

7.5 **Other Topics**

7.5.1 Ambient Noise

This section refers to noise both in air and underwater.

7.5.1.1 Baseline Description

There is no baseline information available that is specific to the offshore components of the study area.

Existing noise survey records for on-shore areas that may be affected by the construction of land-fall arrangements and any necessary grid upgrades will be sought from the Environment Department.

The report will review and evaluate existing research material to identify the likely generic impacts of marine renewable energy devices in relation to ambient noise levels.

The effects that changes in the baseline have on specific sections, such as marine birds, are covered in detail in the respective section.

7.5.1.2 Potential Impacts

- Impacts on marine organisms
- Impacts on the human environment

7.5.2 Air Quality

7.5.2.1 Baseline Description

There is no baseline information available that is specific to the study area. The effects that changes in the baseline have on specific sections, such as marine birds, are covered in detail in the respective section.

7.5.2.2 Potential Impacts

- Changes in ambient emissions

Secondary Impacts

- Impacts on health
- Impacts on marine and terrestrial organisms

7.5.3 Electro-magnetic Fields

7.5.3.1 Baseline Description

There is no baseline information available that is specific to the study area.

The effects that changes in the baseline have on specific sections, such as marine birds, are covered in detail in the respective section.

7.5.3.2 Potential Impacts

- Impacts on electro sensitive species
- Impacts on migratory species

Opinion is divided over whether EMFs have any impact on the behaviour of fish or marine mammals. Whilst not committing to undertake any of its own specific surveys or studies, the REA will monitor the existing published data and analysis available. Any desk study research material must be relevant, evidence-based and not theoretical or making use of circumstantial evidence.

7.5.4 Landscape and Seascape Character

7.5.4.1 Data Sources

Discussions will be held with the Conservation and Design Section within the Environment Department of the States of Guernsey. Their remit is to maintain a balance between competing demands for economic growth and social development whilst taking full account of environmental integrity. This includes the protection and enhancement of the natural beauty and amenity of Guernsey's coasts, cliffs, countryside and other open spaces.

7.5.4.2 Baseline Description

The coastline of Guernsey is well known for its visual amenity value, and this is a significant benefit to the Tourist industry and the overall quality of life for the general population. Of particular value are the rugged cliffs of the south coast, the wide beaches and rocky headlands of the north-west coast and the historic waterside buildings, harbours, fortifications and coastal structures of St Peter Port. The coastal landscape is characterised by the frequent fortifications originating from medieval times through to the Second World War. The northern end of the east coast is the only significantly industrial landscape.

The assessment will include a review of these landscapes as well as identification of designated protected areas. It will consider the sensitivity of these areas to both wave and tidal devices, and any associated infrastructure.

7.5.4.3 Potential Impacts

- Permanent/temporary visual impacts on the seascape
- Permanent/temporary visual impacts on the landscape

7.5.5 Social aspects

7.5.5.1 Baseline Description

The States are aware of a number of potential difficulties that are presented by the existing arrangements for the supply of electricity. Guernsey could be seen to be vulnerable due to

- reliance on fossil fuels
- requirement to import fuels by sea
- although connected to the European electricity grid, Guernsey is at the end of a spur from France through Jersey
- as with most European markets, any increase in fuel or energy prices affects the poorest people the most

However, with existing generation and distribution networks that are robust, the adoption of renewable energy into the domestic supply mix has the potential for job creation. Although generally considered as positive, this has implications in terms of housing licences for professionals that may have to be sourced off-Island, which in turn has an impact on education/health and other infrastructure aspects and in terms of demographic change.

7.5.5.2 Potential impacts

- Impacts on jobs
- Education
- Health
- Fuel poverty
- Housing

7.6 Data Sources

Table 7.2 Sources of Data References	Section using source
<u>Protected sites</u>	
Ramsar Sites - Lihou Island and L'Erée Headland, Gouliot Caves, Guernsey, North Herm and Les Amfrocques (Proposed). *01/03/06*; Bailiwick of Guernsey; 427 ha; 49°28'N 002°40'W. Site of Nature Conservation Importance (SNCI). Ramsar site no. 1608. RIS 2006. http://www.gov.gg/ccm/navigation/environment/ramsar/	*7.2.2, 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.4.1, 7.4.2, 7.4.4, 7.4.5, 7.5.4*
Courtil Sous L'Eglise, St Saviours	*7.5.4*
Fort Hommet, Vazon	*7.5.4*
Greenbelt	*7.5.4*
Nature Reserves	
Pleinmont	*7.3.1*
Silbe	*7.3.1*
Les Vicheries orchid fields	*7.3.1*
Rue Rocheuse	*7.3.1*
Colin Best	*7.3.1*
La Claire Mare	*7.3.1*
Gélé Road	*7.3.1*
Rue des Bergers	*7.3.1*
La Garenne d'Anneville	*7.3.1*
Le Jardin de Lorette	*7.3.1*
Vale Pond	*7.3.1*
Ozanne	*7.3.1*
Le Grande Pré	*7.3.1*
<u>Websites</u>	
British Geological Survey (BGS) - http://www.bgs.ac.uk/	*7.2.2*
CBBIA - *http://www3.webng.com/jerbarker/home/eia-toolkit/sids/north_atlantic/guernsey_pas.html*	*7.3.1*
Biological Records Centre - http://www.biologicalrecordscentre.gov.gg/	*7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.4.1*
BERR – Severn Tidal Power, Feasibility Study - http://www.berr.gov.uk/energy/sources/renewables/explained/severntidalpower/thefeasibilitystudy/page46182.html	*7.3.2*
CEFAS – www.cefas.co.uk	*7.3.2, 7.3.3, 7.4.1*
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Table 7.2 Sources of Data References	Section using source
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Joint Nature Conservation Committee (JNCC) - www.jncc.gov.uk/	*7.3.2, 7.3.4, 7.3.5*
Institute of Zoology, London - http://www.zoo.cam.ac.uk/ioz/people/jepson.htm	*7.3.2, 7.3.5*
Marine Connection - http://www.marineconnection.org/	*7.3.2, 7.3.5*
Marine Conservation Society – www.mcsuk.org	*7.3.2, 7.3.5*
Marinet - http://www.marinet.org.uk	*7.3.2*
Marlin - www.marlin.ac.uk	*7.3.2*
IFREMER (Institut français de recherche pour l'exploitation de la mer) - http://www.ifremer.fr/anglais/	*7.3.3, 7.4.1*
ICES (International Council for the Exploration of the Sea) - http://www.ices.dk/indexfla.asp	*7.3.3, 7.4.1*
Guernsey Bird News http://www.geocities.com/mplawlorgue/Guernseybirdnews.html	*7.3.4*
ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas) - www.ascobans.org/	*7.3.5*
Organisation Cetacea - http://www.orcaweb.org.uk/	*7.3.5*
Sea Mammal Research Unit - http://www.smru.st-andrews.ac.uk/	*7.3.5*
Sea watch Foundation – Recent Sightings http://www.seawatchfoundation.org.uk/region.php?output_region=9	*7.3.5*
Whale and Dolphin Conservation Society (WDCS) - www.wdcs.org.uk/	*7.3.5*
UK Hydrographic Office - http://www.ukho.gov.uk/Pages/Home.aspx	*7.4.2*
Location of existing submarine cables - Kingfisher Charts, www.kisca.org.uk, English Channel	*7.4.3*

Table 7.2 Sources of Data References	Section using source
Guernsey grid connection data - Guernsey Electricity Ltd, www.electricity.gg	*7.4.3*
DTI Shipping Database - www.maritimedata.co.uk	*7.4.4*
Guernsey Yacht Club - http://www.gyc.org.uk/	*7.4.4*
Royal Channel Islands Yacht Club (Guernsey) - http://www.rciyc.com/	*7.4.4*
States of Guernsey Environment Department – coastline http://www.gov.gg/ccm/navigation/environment/beaches---coastline/	*7.4.5*
'A Cultural Strategy for Guernsey 2008-2012' States of Guernsey Culture and Leisure Department http://www.gov.gg/ccm/navigation/culture---leisure/	*7.4.5, 7.5.5*
Guernsey Sports Commission http://www.guernseysports.com/	*7.4.5*
Guernsey Swimming Club http://swimming.guernsey.net/	*7.4.5*
Guernsey Surf School http://www.guernseysurfschool.co.uk	*7.4.5*
Guernsey Offshore Rowing Club www.guernseyrowingclub.org.gg/	*7.4.5*
Dive Guernsey http://www.diveguernsey.co.uk/	*7.4.5*
Sea Anglers' Conservation Network http://www.sacn.org.uk/	*7.4.5*
Guernsey Board Sailing Association http://www.gbsa.org.gg/	*7.4.5*
Visit Guernsey http://www.visitguernsey.com/guernsey.aspx	*7.4.5*
http://www.gov.gg/ccm/navigation/environment/planning/planning-policy/detailed-development-plans/	*7.5.4*
Reference Books/Maps	
BGS Sea Bed Sediment Distribution map (1:250000)	*7.2.2*
BGS Solid Geology map (1:250000)	*7.2.2*

Table 7.2 Sources of Data References	Section using source
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Table 7.2 Sources of Data References	Section using source
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Table 7.2 Sources of Data References	Section using source
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Consultation with stakeholders - fisheries managers, fishermen, shellfish farmers and recreational organisations	*7.3.3*
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Environment Department List of Ancient Monuments	*7.4.2*
Guernsey Electricity Network Records, stored on a bespoke GIS system at Guernsey Electricy Offices	*7.4.3*
The Marine and Coastguard Agency AIS (Automatic Identification System) Network. (Available from Trinity House or MCA)	*7.4.4*
The Jersey Harbours AIS system.	*7.4.4*
The Guernsey Harbours AIS system.	*7.4.4*
The Alderney AIS system.	*7.4.4*
The French CROSS organisation radar, traffic monitoring and control station at Jobourg	*7.4.4*
Environment Department	*7.5.1, 7.5.2*
Location of landscape conservation areas available from the planning department	*7.5.4*
Rural Area Plan (Review no.1) Written Statement (Dec.2005)	*7.5.4*
Urban Area Plan (Review no.1) Written Statement (July.2002)	*7.5.4*
The National Trust	*7.5.4*
BWEA benefit of communities model	*7.5.5*

8. Summary of Potential Impacts

8.1 Introduction

This chapter provides a summary of the potential impacts associated with the installation, operation, maintenance and decommissioning of marine renewable devices. Table 8.1 outlines which of the devices have potential impacts and at what stage of the devices' life cycle. This is a general table covering all devices and so while the initial impact may not be obvious for a specific device, other devices of the same type may have the impact (e.g. tidal devices and visual impact – many are fully submerged, however some have pylons while others are floating).

Table 8.1: Table Outlining the **Potential** Impacts Associated with Marine Devices[2]

Impact	Onshore Wave Device				Offshore Wave Device				Tidal Stream Device			
	I	O	M	D	I	O	M	D	I	O	M	D
Attenuation of waves and tidal currents impacting on sediment transport regimes and suspended sediment concentrations	-	√	-	-	-	√	-	-	-	√	-	-
Attenuation of waves and tidal currents impacting on hydrodynamics	-	√	-	-	-	√	-	-	-	√	-	-
Attenuation of waves and tidal currents causing change to community structure and function due to effects on seabed sediment	√	√	-	-	√	√	-	-	√	√	-	-
Pollution caused by erosion of sacrificial anodes, leaching, use of antifoulants, leakage of hydraulic fluids	-	-	-	-	-	√	-	-	-	√	-	-
Leakage of pollutants	-	-	-	-	√	-	√	√	√	-	√	√
Increased suspended sediment	√	-	-	√	√	-	-	√	√	-	-	√
Disturbance of contaminated sediments	√	-	-	√	√	-	-	√	√	-	-	√
Direct loss of habitat (and species)	√	-	-	√	√	-	-	√	√	-	-	√
Disturbance of spawning and Nursery grounds	-	-	-	-	√	-	-	√	√	-	-	√
Smothering	√	-	-	√	√	-	-	√	√	-	-	√
Changes to site characteristics and quality	√	√	-	√	√	√	-	√	√	√	-	√
Underwater Noise	√	√	√	√	√	√	√	√	√	√	√	√
Collision risk to fish, mammals and birds	-	-	-	-	-	√	-	-	-	√	-	-

[2] [2] **Table Definitions:**

I = Installation

O = Operation

M = Maintenance

D = Decommissioning

Impact	Onshore Wave Device				Offshore Wave Device				Tidal Stream Device			
	I	O	M	D	I	O	M	D	I	O	M	D
Collision risk to ships	-	-	-	-	√	√	√	√	√	√	√	√
Disturbance to birds breeding and feeding activities	√	-	√	√	√	√	√	√	√	√	√	√
Displacement of breeding seabirds	√	√	-	-	√	√	-	-	√	√	-	-
Interruption of migration routes	-	-	-	-	√	√	√	√	√	√	√	√
Displacement of fishermen from traditional grounds	-	-	-	-	√	√	-	√	√	√	-	√
Disturbance of previously unknown wrecks and other archaeological sites	-	-	-	-	√	-	-	-	√	-	-	-
Disturbance of regular shipping traffic	-	-	-	-	√	√	√	√	√	√	√	√
Requiring safety zones	-	-	-	-	√	√	√	√	√	√	√	√
Exclusion of recreation activities	√	√	√	√	√	√	√	√	√	√	√	√
Visual disturbance	√	√	√	√	√	√	√	√	√	√	√	√
Impact on seascape	√	√	√	√	√	√	√	√	√	√	√	√
Disturbance of Plankton	-	-	-	-	√	√	√	√	√	√	√	√
Disturbance / displacement of recreational fishers	√	√	√	√	√	√	√	√	√	√	√	√

[3]

This table only highlights the **POTENTIAL** for a device to impact and does not assess the intensity of any impact that may occur.

[3] **Table Definitions:**

I = Installation

O = Operation

M = Maintenance

D = Decommissioning

9. Data Gaps and Further Work

9.1 Introduction

A review of the existing data in the area of study has been undertaken as part of the scoping and has identified that there is a large volume of existing data. However, there are still some gaps in the data that has been identified, and these are outlined in table 9.1 below. In addition, possible further work to be undertaken by developers in future EIAs is outlined.

Table 9.1: Table of Data Gaps and Further Work

Topic	Gaps in Data	Further Work for Completion of REA	Notes	Potential Further Work Required in Developer EIA
Bathymetry	Patchy, with areas classed as one depth	Use of Sonar to get accurate depth profile	Not needed for completion of REA	Full Bathymetric Survey
Geology	Limited geophysical data	None	Sufficient data for the REA is available	Boreholes, Geophysical survey, Sub-bottom profiling
Marine Processes	None	None	Sufficient data for the REA is available	Tidal (ADCP) and Wave Climate Monitoring
Sediment Contamination and Water Quality	None	None	Sufficient data for the REA is available	Sampling, water quality monitoring
Protected Sites and Species	None	None	Sufficient data for the REA is available	Classification surveys, identification of endangered or protected species

Table 9.1: Table of Data Gaps and Further Work				
Topic	**Gaps in Data**	**Further Work for Completion of REA**	**Notes**	**Potential Further Work Required in Developer EIA**
Benthic Ecology	Information available is not centred on the Bailiwick and so there is inadequate data to give detailed account of the benthic biotopes in the study area	of the potential deployment location and cable routes prior and post deployment Specific species monitoring programmes for important benthic species prior and post deployment	It is not feasible for this level of survey to be undertaken for the entire REA region. Such work should be carried out for any site specific development within the area.	Bathymetry surveys at potential deployment location and sub-sea cable routes Habitat/biotope surveys of the intertidal, sub-tidal and terrestrial regions
Pelagic Fisheries	To be confirmed	To be confirmed	To be confirmed	
Birds	Potential for collision impacts, Potential for displacement from key areas.	A desk based study to look at abundance of potentially affected species, likelihood of collisions and implications for feeding, breeding and migration	This desk based study can be carried out as part of the REA taking into account all available knowledge on the issue. However there is little, if any, empirical data on this subject – most is related to boat and wind turbine collisions.	The need for any device specific surveys or analysis will be covered by the scoping of any developer EIA

Table 9.1: Table of Data Gaps and Further Work				
Topic	**Gaps in Data**	**Further Work for Completion of REA**	**Notes**	**Potential Further Work Required in Developer EIA**
Marine Mammals	Potential for collision impacts. Migration routes and use of Guernsey waters	A desk based study to look at abundance of potentially affected species, likelihood of collisions and implications for feeding, breeding and migration	This desk based study can be carried out as part of the REA taking into account all available knowledge on the issue. While little is known about migration routes and feeding activity, there are multiple recordings of marine mammals in the Bailiwick, sightings are well documented and no further research into cetaceans is feasible for the REA.	The need for any device specific surveys or analysis will be covered by the scoping of any developer EIA
Commercial Fisheries	Location of key fishing areas	None	Existing knowledge and experience of States Fisheries Officers will be sufficient for delivery of the REA	A Fisheries Evaluation Study, including interview study is likely to be required to support Developer EIA
Marine and Coastal Historic Environment	Accurate locations of all wrecks (known and unknown)	Localised detailed mapping prior to device deployment.	Sufficient data for the REA is available. It is not feasible to map all wrecks within the bailiwick for the REA.	Magnetometer and Side-scan Sonar surveys, together with an archaeological assessment

Table 9.1: Table of Data Gaps and Further Work				
Topic	**Gaps in Data**	**Further Work for Completion of REA**	**Notes**	**Potential Further Work Required in Developer EIA**
Cables Pipelines and Onshore Grid Connections	None	None	Locations of all cables, pipelines and grid connections are known. Analysis of potential cable distribution is to be considered in the REA.	
Shipping and Navigation	None	None	There is comprehensive AIS coverage of the Bailiwick, with key shipping lanes known.	A full Navigation Risk Assessment
Tourism and Recreation	None	None	Many different activities have been identified – sufficient data for the REA is available.	
Noise	Installation noise of the devices and their impacts. Operational noise of the devices and their impacts.	A desk based study of all available information on noise from renewable energy sources and the marine environment.	The desk based study can be carried out as part of the REA.	Device specific noise assessment. Commitment to ongoing monitoring post-installation
Air Quality	Information specific to the study area	None	Information on increased impact should suffice.	
Electro-magnetic Fields	Information specific to the study area	None	Review of existing research is sufficient.	
Landscape and Seascape Character	None	None	Sufficient data for the REA is available.	Visual Impact Assessment