Nature Conservation Guidance on Offshore Windfarm Development

A guidance note on the implications of the EC Wild Birds and Habitats Directives for developers undertaking offshore windfarm developments

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Prepared by the Department for Environment, Food and Rural Affairs*

[*In cooperation with the Scottish Executive, the National Assembly for Wales, DOE (NI), the Countryside Council for Wales, English Nature, Scottish Natural Heritage and the Joint Nature Conservation Committee]

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EXECUTIVE SUMMARY

This document has been produced by the Department for Environment, Food and Rural Affairs (Defra) in order to provide developers with a greater understanding of the potential nature conservation impacts of offshore windfarms and specifically the steps they are legally obliged to follow to ensure these do not harm the Natura 2000 network.

Thus the primary focus is on impacts that may affect Special Areas of Conservation (SACs) or Special Protection Areas (SPAs), which jointly comprise the Nature 2000 site network. It specifically addresses issues that may arise where the area identified for a windfarm development is within a site designated as a SPA or SAC under the EU Habitats and Birds Directives (Directives 92/43/CEE on the conservation of natural habitats and 79/409/EEC on the conservation of wild birds) or is likely to affect such a site.

The guidance does not cover impacts on navigation or fishing activities, to landscape or seascape, or recreation and access interests.

The guidance note builds on knowledge learnt from Round I developments and the Strategic Environmental Assessment (SEA) process.

The aim is to provide developers with an overview of the types of nature conservation impacts that may be caused by construction, operation and decommissioning of an offshore windfarm and steps that can be taken to overcome these. The guidance covers nature conservation impacts on:

- birds;
- marine mammals;
- fish and shellfish;
- subtidal benthos;
- intertidal habitats;
- terrestrial and coastal habitats; and
- coastal and sedimentary processes.

The guidance has been structured around a series of flowcharts that are designed to aid navigation around the document, particularly in electronic format. Section numbers are included in the flowcharts, so they can also be consulted when the document is in paper format. Each of the impact sections (Sections 2 to 8) are structured in the same way to allow a series of key questions relating to likely impacts on the environment:

- is there likely to be an impact?
- is the impact significant?
- will the impact cause adverse effect?
- and, if so, what approaches may be available to minimise the impact, covering best practice, mitigation measures and monitoring.

- A note on compensation is provided separately at Annex 1, should mitigation be unable to reduce the impacts to acceptable levels.

As much as possible of the key information is included in tables and/or brief sections of text with key points highlighted by the use of bullets. The objective has been to make the guidance as accessible as possible, with the use of jargon kept to a minimum.

Glossary

AA	Appropriate Assessment
BACI	Before-After-Control-Impact
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BTO	British Trust for Ornithology
BWEA	British Wind Energy Association
CCW	Countryside Council for Wales
CE	Crown Estate
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
COWRIE	Collaborative Offshore Wind Research into the Environment
CPA	Coast Protection Act
Defra	Department for the Environment, Food and Rural Affairs
DfT	Department for Transport
DTI	Department of Trade and Industry
EA	Electricity Act
EHS	Environment & Heritage Service
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EN	English Nature
ES	Environmental Statement
FEPA	Food and Environment Protection Act
JNCC	Joint Nature Conservation Committee
MCEU	Marine Consents and Environment Unit
ORCU	Offshore Renewables Consents Unit
OWEN	Offshore Wind Energy Network
OWF	Offshore Windfarm
REZ	Renewable Energy Zone
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SCI	Sites of Community Importance
SE	Scottish Executive
SMRU	Sea Mammal Research Unit
SNCA	Statutory Nature Conservation Agency
SNH	Scottish Natural Heritage
SEA	Strategic Environmental Assessment
SPA	Special Protection Area
TWA	Transport and Works Act
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
WAG	Welsh Assembly Government
WWT	Wildfowl and Wetlands Trust
ZVI	Zone of Visual Influence

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1. INTRODUCTION

1.1 Purpose of the Guidance

1.1.1 Aim of the Guidance

The aim of this guidance is to provide developers with an overview of the types of nature conservation impacts that may be caused by construction, operation and decommissioning of an offshore windfarm. The primary focus is on impacts that may affect Special Areas of Conservation (SACs) or Special Protection Areas (SPAs) should the development be likely to significantly affect such a site. . These SACs and SPAs (designated under the EU Habitats and Birds Directives (Directives 92/43/CEE on the conservation of natural habitats and 79/409/EEC on the conservation of wild birds) are known collectively as the Natura 2000 network, a European-wide network of sites designed to promote the conservation of habitats, wild animals and plants, both on land and at sea.

These sites are subject to statutory protection measures contained in the Conservation (Natural Habitats etc.) Regulations 1994, as amended from time to time and from place to place. The protection contained therein includes requirements for steps to be taken to avoid sites being adversely affected by plans or projects taking place either on a Natura 2000 site or outside of its boundaries, where it is likely to affect such a site. Any plan or project which, either alone or in combination with others, would be likely to have a significant effect on a site must be subject to an appropriate assessment of its implications on the site's conservation objectives.

This document has been produced by the Department for Environment, Food and Rural Affairs (Defra) in order to provide developers with a greater understanding of the potential nature conservation impacts of offshore windfarms and the steps they are legally obliged to follow to comply with the requirements of the EC Habitats and Wild Birds Directives, including steps to avoid harming the Natura 2000 network. The guidance note builds on knowledge learnt from Round I developments and the Strategic Environmental Assessment (SEA) process. In this context, nature conservation includes impacts on marine mammals, birds, fish and the benthos, as well as intertidal, terrestrial and coastal habitats. This guidance document does not cover issues such as impacts on navigation or on commercial fishing activities, to landscape or seascape, or recreation and access interests.

1.1.2 Structure of the Guidance

This guidance is based around a number of flowcharts designed to allow the reader to move easily around the document to the most relevant sections. This is done by the use of hyperlinks, which can be selected to

take the reader to the appropriate section of the guidance[1]. Section numbers are also given within the flowcharts such that the guidance can be used in both electronic and hard copy format.

References are given in many of the sections to provide further information (some with short summaries to assist the reader). The references are given as guidance only and are not intended to be definitive. The development of offshore windfarms is relatively new and experience and information is constantly being added to.

Figure 1, overleaf, provides an overview of the organisation of the guidance, as well as providing the hyperlinks to other relevant sections.

[1] To follow a hyperlink, it is necessary to hold down the 'Ctrl' key and left-click the mouse button.

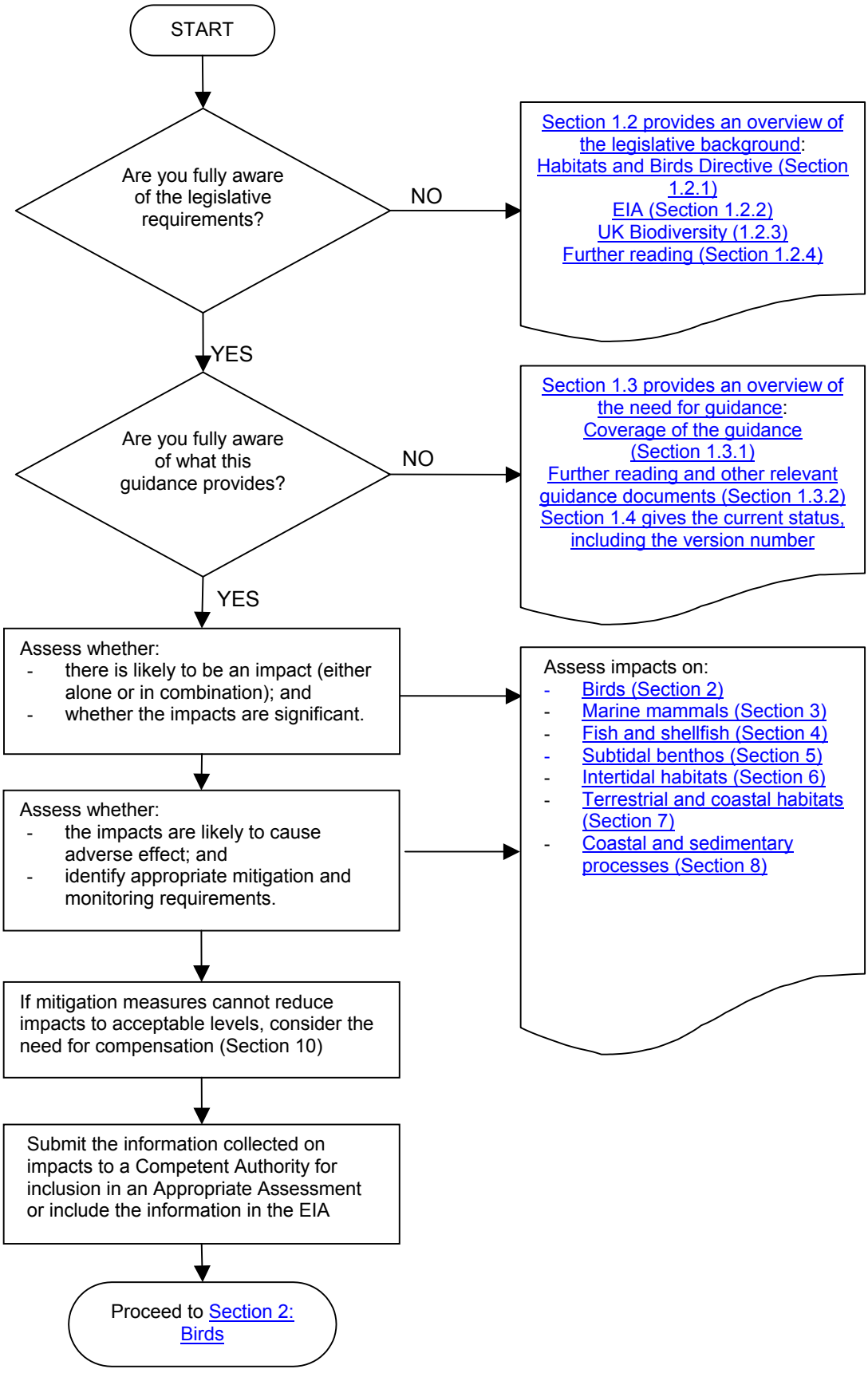

Figure 1: Organisation and Structure of the Guidance

1.2 The Legislative Background

(return to Flowchart 1)

1.2.1 Habitats and Birds Directives

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The Conservation (Natural Habitats etc.) Regulations 1994, as amended, transpose the EU Habitats Directive into domestic legislation. These generally apply to the UK but a series of amendments have been made to them that are specific to England, Wales and Scotland, and their territorial seas (only 12 nautical miles from baseline). Northern Ireland has its own Regulations with the same territorial coverage.

In 1999, a High Court judgment (R -v- Secretary of State for Trade and Industry ex parte Greenpeace Limited) determined that the Habitats Directive should apply to the seas around the UK up to 200 nautical miles from baseline and to the Continental Shelf where the UK has claimed sovereign rights. Regulations to extend the Habitats Directive beyond 12 nautical miles in accordance with the Court ruling are in preparation. The Regulations will apply both the Habitats and Birds Directives to the offshore marine area.

It should also be noted that the Habitats Directive provides protection to European protected fauna (listed in Annex IVa of the Directive) and their breeding sites and resting places whether or not they are within a Natura 2000 site. The 1994 Regulations makes it an offence to deliberately kill, injure or disturb such a species or to damage or destroy such breeding sites or resting places.

In addition, bird species are protected not just on SPAs but wherever they occur. Likely species of birds that occur offshore for example include Red throated Divers, Whooper Swans, Barnacle Geese and Common Scoter.

The list of protected species that may be affected will be particular to the potential site and these will have to be identified by carrying out an initial desk study and further studies if necessary.

The Government has asked its statutory nature conservation agencies (SNCAs) English Nature (EN), Environment and Heritage Services (EHS) in Northern Ireland, Countryside Council for Wales (CCW), Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee (JNCC) to extend the process of selecting marine sites both inshore for SPAs and beyond territorial waters for SACs and SPAs to identify potential sites which are considered to meet the criteria for designation/classification as SPAs or SACs. This process is currently ongoing and it is therefore likely that a number of new sites will be identified in the coming years.

In territorial waters surrounding Wales, when it comes to assessing impacts from proposed activities, in policy terms the Government treats candidate Special Areas of Conservation (cSACs) and potential SPAs as if they are already formally designated and this policy is being applied in relation to inshore and offshore renewables projects. In English, Northern Irish and Scottish waters, amendments to the 1994 Regulations have given statutory effect to that policy. A candidate SAC is one that has been formally proposed to the European Commission by the United Kingdom.

The Habitats and Wild Birds Directives require Member States to take a number of measures to conserve threatened European biodiversity. These include the selection and protection of SPAs and SACs. Protection of those sites is outlined at Article 6 of the Habitats Directive. Articles 6.3 and 6.4 are transposed by regulation 48-54 of the 1994 Regulations.

Article 6(3) states '*any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public*'.

Article 6(4) states '*if, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.*

Where a site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest'.

Although Articles 6(3) and 6(4) are contained in the Habitats Directive they are applicable, by virtue of Article 7 of that Directive, to sites classified as SPAs.

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1.2.2 Environmental Impact Assessment

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Whilst not the primary purpose of this guidance, it is worth mentioning that the EIA Directive (85/337/EEC as amended by 97/11/EC) requires that, in considering whether to grant consents for developments that are likely to have a significant effect on the environment, the consenting authorities have all the necessary environmental information on which to base such decisions.

The EIA Directive has been transposed into UK law through a number of regulations: these require developers of offshore windfarms likely to have a significant effect on the environment to undertake an Environmental Impact Assessment to consider both the positive and negative environmental impact of a development from the construction stage through to decommissioning. The results of these assessments are brought together in an Environmental Statement (ES) and submitted with the various licence/consent applications.

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1.2.3 UK Biodiversity

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The Natura 2000 network, the protection of which is the subject of this Guidance, contains just a small part of the nation's biodiversity. In addition to the designated sites and indeed those features that may qualify for designation, it is important to note that there are wider biodiversity interests outside of such site networks. There are a variety of habitats and species which are of interest and importance at a national and regional level but which receive separate statutory protection.

The Convention of Biological Diversity was signed in 1992 by 159 governments at the Earth Summit, and was the first treaty to provide a framework for such biodiversity conservation. It called for the creation and implementation of national strategies and action plans to conserve, protect and enhance biological diversity. The UK's answer to this call in 1994 was the production of the UK Biodiversity Action Plan (Biodiversity: the UK Action Plan). This sets out action plans for habitats and species of conservation interest. The Action Plans in Table 1.1 are those initially identified as relevant to offshore windfarm proposals. Others may become relevant as Round 2 progresses.

In addition to sites identified and protected as Natura 2000 sites, the UK's national site network of Sites of Special Scientific Interest (SSSI) (or Areas of Special Scientfic Interest (ASSI) in Northern Ireland) also benefit from considerable protection. That protection is provided by the Wildlife and Countryside Act 1981, most recently amended in England by the Countryside and Rights of Way Act 2000 (specifically Schedule 9), in Scotland by the ** and in Northern Ireland by the **. Virtually all terrestrial

Natura 2000 sites are underpinned by SSSI or ASSI so both statutory regimes are applicable to them. There are, however, a number inshore areas designated as SAC or SPA that are not SSSI/ASSI. Nevertheless these remain subject to the protection afforded by the 1994 Regulations as amended. Equally there will be many areas that are notified as SSSI/ASSI both terrestrially or in inshore waters that are not Natura 2000 sites. These remain subject to the protection afforded by the 1981 Act and its equivalents.

Table 1.1: Action Plans Relevant to Offshore Windfarms

Location	Species Action Plans	Habitat Action Plans
Development site and sub sea cable route	Harbour Porpoise Baleen Whales (grouped) Small Dolphins (grouped) Toothed Whales (grouped) Basking Shark Common Skate Commercial Marine Fish (grouped) Native Oyster Common Scoter	Littoral and sublittoral chalk Sabellaria spinulosa reefs Seagrass beds Maerl beds Sublittoral sands and gravels
Intertidal/Landfall issues	Native Oyster	Maritime cliff and slopes Coastal sand dunes Coastal vegetated shingle Littoral and sublittoral chalk Sabellaria alveolata reefs Coastal saltmarsh Mudflats Seagrass beds Saline Lagoons

(go to link for list of Species and Habitats Action plans)

Under the UK's Biodiversity Action Plan process a series of "lead partners" have been identified for the species and habitats action plans. Lead partners are not limited to the UK Government and its statutory bodies. Voluntary conservation groups, academic institutions and industry are also lead partners. It is, therefore, recommended that consideration of which UK BAP habitats and species may be relevant to individual offshore windfarm proposals, the likely effects and how these can be reduced and/or mitigated, is demonstrated in the EIA process and that where possible Action Plan lead partners are contacted in that process.

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1.2.4Key References, Further Reading and Links

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A downloadable copy of the Conservation (Natural Habitats &c) Regulations 1994, and amendments to it are available via the following HMSO links:

http://www.hmso.gov.uk/si/si1994/Uksi_19942716_en_1.htm

http://www.hmso.gov.uk/si/si2000/20000192.htm

[references to legislation in the devolved administrations to be added]

The full text of the Habitats and Birds Directive and associated annexes can be found at the following Internet addresses:

- Habitats Directive: http://europa.eu.int/comm/environment/nature/nature_conservation/eu_nature_legislation/habitats_directive/index_en.htm
- Birds Directive: http://europa.eu.int/comm/environment/nature/nature_conservation/eu_nature_legislation/birds_directive/index_en.htm

The European Commission has produced guidance documents that provide more information on the Habitats and Birds Directives. These can be downloaded from the European Commission's Internet site (www.europa.eu.int/comm/environment/nature/home/htm):

- European Commission (2000): **Managing Natura 2000 Sites: The Provisions of Article 6 of the 'Habitats' Directive 92/43/EEC**; and
- European Commission (2001): **Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites**.

Whilst these documents do not have legal status they are useful in offering guidance. The first of these documents provides definitions of all the key terms (including favourable conservation status, significant effect and appropriate assessment). The second document discusses how an assessment of potential impacts may be undertaken, including checklists of the type of information that can helpfully be provided at each stage.

In August 2003, Defra consulted on the Offshore Marine Conservation (Natural Habitats & c.) Regulations 2003, in terms of extending the Habitats and Birds Directive beyond 12 nautical miles. Further information is available from:

- www.defra.gov.uk/corporate/consult/offshore-marine/letter.htm

Whilst not directly applicable outside of England and the marine zone, English Nature has also produced a number of Habitats Regulation Guidance Notes (HRGNs) which provide an interpretation of the

requirements of different aspects of the Habitats Regulations Defra is looking to revise and update the content on the HRGNs and to place them on the defra website. The notes of key importance here are:

- English Nature (1997): **Habitats Regulations Guidance Note 1: The Appropriate Assessment (Regulation 48)**;
- English Nature (1999): **Habitats Regulation Guidance Note 3: The Determination of Likely Significant Effect under The Conservation (Natural Habitats &c) Regulations 1994** ;
- English Nature (2001): **Habitats Regulation Guidance Note 4: Alone or in Combination** ; and
- English Nature (2001): **Habitats Regulation Guidance Note 6: The Condition Imposed on Permitted Development by The Conservation (Natural Habitats &c) Regulation 1994 (Regulations 60-63)** . [links to be added]

All of the HRGNs are brief and cover the key aspects of the various Regulations. HRGN1 explains when an appropriate assessment needs to be undertaken and what it is. It also includes the key steps and an outline of good practice. HRGN3 introduces the significance test, explains its purpose and the principles used in judging significant effect. It also describes the implications, how to make judgements about the test and a suggested process for documenting the judgement of 'likely significant effect'. HRGN4 provides definitions of 'alone or in combination' and how it is applied and implemented. HRGN6 discusses the role of a developer in identifying if a permitted development is likely to have a significant effect and the information that is required to make such a decision.

More information on the requirements of Environmental Impact Assessment for Offshore Windfarm developments can be found in guidance prepared by CEFAS:

- CEFAS (2004): **Offshore Windfarms**, Guidance note for Environmental Impact Assessment (EIA) in Respect of FEPA and CPA Requirements, Version 2, June 2004: (www.cefas.co.uk/renewables/Default.htm).

CEFAS (2004) is intended to assist the offshore windfarm industry by providing scientific guidance to those involved with the gathering, interpretation and presentation of data within an EIA. It covers the statutory requirements for Environmental Impact Assessment, with a description of the type of information that should be included within an EIA.

An OSPAR workshop held in September 2003 discussed some of the issues related to the potential impacts of offshore windfarms and shared experiences and discussed best practice for offshore renewable technologies. Appendix 4 of the workshop report provides background papers that set out a summary of potential impacts from windfarms (particularly Annex 2):

- OSPAR Workshop on the Environmental Assessment of Renewable Energy in the Marine Environment (www.cefas.co.uk/renewables/r2eiaworkshop/OSPARWorkshopFinalReport3-12-03.pdf).

A study by Hiscock *et al* (2002) considers information on high-level screening for impacts from offshore windfarms:

- Hiscock K, Tyler-Walters H & Jones H (2002): **High Level Environmental Screening Study for Offshore Windfarm Developments – Marine Habitats and Species Project**, Report from the Marine Biological Association to the Department of Trade and Industry New & Renewable Energy Programme. (http://www.og.dti.gov.uk/offshore-wind-sea/reports/index.htm).

The report provides an awareness of the environmental issues related to marine habitats and species for developers and regulators of offshore windfarms. The marine habitats and species considered are those associated with the seabed, sea birds, and sea mammals.

The assessment of cumulative impacts will probably need discussion with other organisations involved in windfarm development, monitoring and research. The Offshore Wind Energy Network (OWEN) aims to promote research on all issues connected with development of the UK's offshore wind resource and encourages co-operation and partnership between commercial organisations and researchers. More information can be found at: www.owen.org.uk.

For information on windfarm legislation such as the Electricity Act (EA) or Transport and Works Act (TWA) please see the guidance provided on the following website: www.dti.gov.uk/energy/renewables/index.shtml.

For information on the procedures and fees for the Food and Environment Protection Act and Coast Protection Act see the guidance provided by MCEU at www.mceu.gov.uk

In terms of biodiversity, the following Internet links provide additional information on the requirements of the Convention and/or Action Plans, as well as more information on the species and habitats that are covered:

- Convention on Biological Diversity: www.biodiv.org/default.aspx;
- Biodiversity: the UK Action Plan (www.ukbap.org.uk): www.ukbap.org.uk/librarysearchresults.aspx? id=526; and
- Government response to the UK Biodiversity Report 'Sustaining the variety of life: five years of the UK Biodiversity Action Plan': www.defra.gov.uk/wildlife-countryside/ewd/rrrpac/biodiv.

A full list and detailed plans for maritime species and habitats are contained within 'Tranche 2 Action Plans, Volume V', which can be downloaded from:

- www.ukbap.org.uk/Library/Tranche2_vol5.pdf.

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1.3 The Need for Guidance

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1.3.1 Coverage of the Guidance

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Guidance is required to allow developers to identify those areas where the nature conservation impacts may be significant and, if the development is likely to affect and area identified as important for nature conservation, and potentially designated as a SAC or SPA, to identify if the development of a windfarm would result in adverse effect on the integrity of the site.

The guidance will help a developer to:

- **assess the likelihood of impacts;**
- **assess whether the impacts are likely to be significant, and**
- **determine if the impacts would result in adverse effects.**

In so doing, the developer will collect the information that may be required for an Appropriate Assessment.

An Appropriate Assessment is a tool used by the competent authority (the body responsible for giving any necessary consents) to assess whether a plan or project is likely to have an adverse effect on the integrity of an SAC or SPA. Advice on whether an Appropriate Assessment may be required for a development (and on the scope of such an assessment) should be sought by the developer and consenting authority from the Statutory Nature Conservation Agency (SNCA) during the scoping stage for the EIA. The SNCAs will provide information as early as possible on the location of features that may qualify as Natura 2000 sites. Where a plan or project is likely to have a significant effect on areas which are in the process of being considered for designation but which have not yet formally been so designated, it would be advisable to undertake a 'shadow appropriate assessment' to prepare for the eventuality of the site being designated.

The Appropriate Assessment process requires likely effects on the conservation interests of a site to be identified and allows for mitigation measures to be considered to reduce the likely effects to an acceptable level to achieve a consent. If no mitigation is possible that will remove the adverse effects, the project or plan may only proceed where the competent authority has assessed that there are no reasonable alternatives and if it is justified for imperative reasons of overriding public interest. This guidance

provides an indication of mitigation measures that can be proposed to minimise likely impacts that may occur. The type of information that needs to be collected while following this guidance should also be applicable at the EIA stage.

One key aspect of this guidance is the focus on cumulative effects. This is required by the Habitats Directive at Article 6(3), which states 'any plan or project … likely to have a significant effect … either individually or in combination … shall be subject to appropriate assessment of its implications'. Developers, therefore, need to be aware of other plans or projects approved or likely to be approved at the same time as considering the impacts of their own development together in the context of the ongoing situation on the site and natural trends and processes. It will be important, therefore, to undertake early discussions with all relevant competent authorities and other developers to ensure that the 'in combination' effects are taken fully into account and can be addressed.

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1.3.2Key References, Further Reading and Links

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There are also numerous other guidance documents available, some of which cover the nature conservation impacts. Key documents include:

- CEFAS (2004): **Offshore Windfarms**, Guidance note for Environmental Impact Assessment (EIA) in Respect of FEPA and CPA Requirements, Version 2, June 2004: www.cefas.co.uk/renewables/Default.htm;
- DTI (2004): **Guidance Notes: Offshore Windfarm Consents Process**, March 2004: www.dti.gov.uk/energy/leg_and_reg/consents/guidance.pdf.
- BirdLife International (2003): **Windfarms and Birds: An Analysis of the Effects of Windfarms on Birds, and Guidance on Environmental Assessment Criteria and Site Selection Issues**: www.abcbirds.org/policy/offshoreBirdLifeStudy.pdf; and
- English Nature *et al* (2001): **Windfarm Development and Nature Conservation**, A Guidance Document for Nature Conservation Organisation and Developers when Consulting over Windfarm Proposals in England: www.bwea.com/pdf/wfd.pdf.

CEFAS (2004) provides scientific guidance to those involved with the gathering, interpretation and presentation of data within an EIA. Much of the data obtained for an EIA and the conclusions drawn from those, will be of use in an "Appropriate Assessment" should one be required under the Habitats Directive. The EIA will cover approaches to baseline assessment, impact assessment, survey design, brief summary of

mitigating actions and monitoring as well as key references for biodiversity, benthos, fish resources, and commercial fisheries. CEFAS (2004) does not, however, consider in detail the potential impacts on birds, designated sites and other nature conservation interests, where the SNCAs are the Government's statutory scientific advisors.

DTI (2004) clarifies the roles and responsibilities of consenting authorities involved in the consents process in England and Wales. The guidance is intended for developers and has been updated to reflect recent developments in respect of the Round 2 lease awards.

BirdLife (2003) was commissioned to analyse the impact of windfarms on birds, establishing criteria for their environmental impact assessment and developing guidelines on precautions to be taken when selecting sites for windfarms.

English Nature *et al* (2001) has the aim of providing information to guide the responses of nature conservation organisations in England to windfarm proposals. The guidance is described as an informal checklist to help in formulating detailed responses to approaches in respect of individual applications.

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1.4 Current Status of the Guidance

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This is a working document and will be revised as Defra and the nature conservation agencies' understanding of issues develops and new information becomes available. To avoid confusion, readers should pay attention to the version number given alongside the page numbers. The current version number is Version 1.9.

It is recommended that this guidance is read in conjunction with the legislation and the other guidance or advice, where available. The information provided in this guidance document is neither definitive nor exhaustive.

2. CONSIDERATION OF IMPACTS ON BIRDS

2.1 Introduction

Birds use a site because it provides opportunities for enhancing survival, feeding and reproduction. This means that sites tend to be used with regular frequency, often attracting large numbers of birds at regular intervals and times each year. Protection of the features that attract and provide for the bird populations in question is important not just when the birds are present but also when they are not. Damage to the relevant interest features will remove their facility whether the birds are present or not. Loss of any important areas is likely to result in birds being forced to use less suitable sites and result in impacts such as increased competition or impoverished food supply. Any such impacts are likely to lead to greater mortality and a loss of numbers.

Under the EC Directive on the Conservation of Wild Birds (79/409/EEC), the UK is committed to taking 'the requisite measures to preserve, maintain or re-establish a sufficient diversity and area of habitat' for 'all species of naturally occurring birds in the wild state'. Furthermore, the UK is committed to taking special conservation measures for 'threatened and vulnerable species' ('Annex I' species) and 'all regularly occurring migrating species'. Measures to protect these species include the designation of Special Protection Areas (SPAs). The Directive places emphasis on the need to conserve bird habitats.

A range of birds could potentially be affected by offshore windfarms. This includes sea birds which feed and roost in offshore areas, such as divers, grebes, gannets, seaducks, auks, gulls and terns. It also includes a wider range of species that may move through the area of a windfarm, either as part of local movements on a daily basis, or during national or international migration. Such species include the sea birds listed above, as well as other wildfowl, waders and migrant songbirds.

Windfarms have the potential to affect birds throughout the year. Large numbers of sea birds congregate in offshore areas during the winter period, often in high concentrations. The spring and early summer periods are also important, especially in those areas adjacent to breeding sea bird colonies. Finally, post-breeding season flocks, moulting seaducks and migrating birds are also vulnerable at all times, up to and including spring migration.

Figure 2 presents a flowchart that will help you to move through this section, identifying the information that you need when making a decision as to the likely impacts on birds.

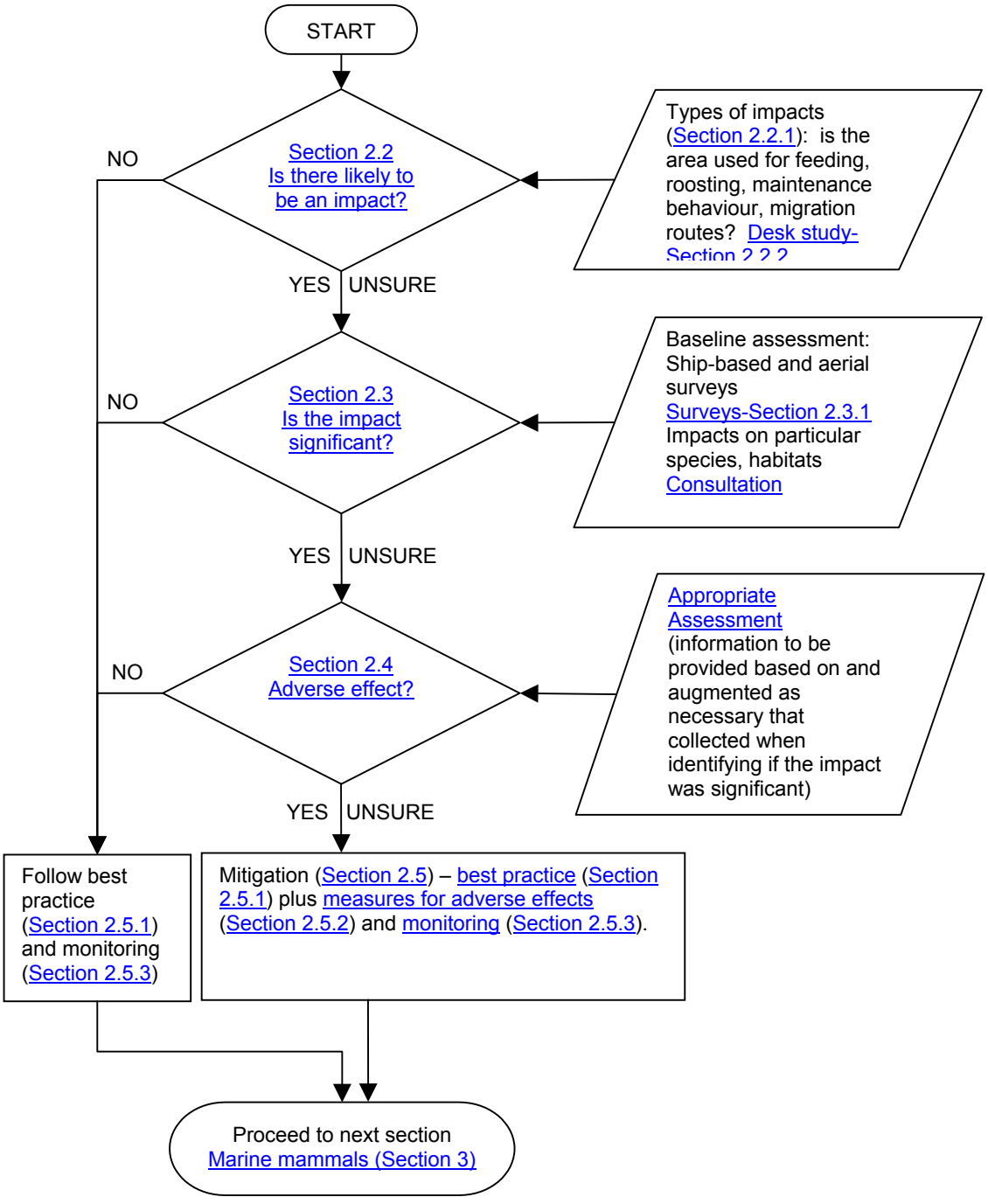

Figure 2: Flowchart for Determining Impacts on BIRDS

2.2 Is There Likely to be an Impact?

2.2.1 The Types of Impacts

The potential impacts of offshore windfarms on birds can be divided into five categories: habitat loss, loss of food resources, displacement, barrier effects and collision mortality.

- Habitat loss refers to the direct loss of seabed resulting from the placement of the turbine foundations and any scour protection, along with any associated losses or changes to benthos due to scour or smothering.

- Loss of food resources, (i.e. fish stocks or invertebrates) can result from damage, disturbance, or scouring of the sites during the development's construction or maintenance phases.

- Displacement is used here to describe the potential for birds to avoid turbines, or the entire area of a windfarm, due to their reluctance to feed adjacent to large structures because of a perception of threat. This is likely to vary greatly depending on species, and perhaps also on issues such as the size and spacing of turbines and noise caused by the rotors and lighting. Displacement is likely to be increased by maintenance activities requiring the use of boats and helicopters.

- Barrier effects result from birds changing their flight lines in response to the perceived barrier presented by a row of turbines. This relates to regular local movements, for example between feeding and roosting areas, as well as to migratory flight paths. The barrier effect could result in birds undertaking longer flights to avoid windfarms, thus resulting in increased energy expenditure and reduced time for other essential activities. If birds are prevented from reaching feeding grounds because of the barrier caused by the turbines, sterilisation of the feeding grounds could result.

- Collision mortality as a result of birds striking turbine towers, nacelles or rotors may be a significant issue where large numbers of birds make regular flights through the windfarm area, especially during conditions of poor visibility or when birds panic in response to disturbance.

All of these potential impacts are likely to be more significant and have a greater effect on populations where several windfarms are proposed in the same area. It is therefore important to undertake assessments of the potential cumulative effects of all proposed windfarms where they are likely to affect the same species or populations of birds.

(return to Flowchart 2)

2.2.2 Desk Study

Overview

The aim of the baseline study is to collect the following basic information:

- distribution of birds across the area, including movements through the area to other sites;
- number of birds;
- types of birds, including species present and age/sex distribution;
- links between number and types of birds to environmental factors including season, time of day, tidal influence and prey availability; and
- behaviour including roosting, feeding, migrating, etc.

The above baseline information is likely to be available through a combination of desk studies and surveys.

A key aim for the desk study should be to identify as much information on the five key factors given above (distribution, number, type, environment and behaviour). The SNCA should also be able to provide assistance with the desk study if they are in the process of identifying SPA and other areas' importance to the SPA. They will be keen to work with developers and to share data from boat and aerial-based surveys.

Aerial surveys have been undertaken in the Irish Sea, Greater Thames and Greater Wash areas of the UK to improve the level of information.

Potential additional sources of existing information which can assist include JNCC Seabirds at Sea data, European Sea birds At Sea (ESAS), Wetland Bird Survey shore-based counts, County Bird Reports and county bird recorders. There is also information of foraging distances around the UK by breeding seabirds that may assist in determining potentially sensitive areas further offshore (BirdLife International, 2000).

Identifying if an Impact is Likely to Occur

The information collected through the desk study should provide the basis for determining if the area is used by birds and if so in what numbers and why, and thus provide the necessary starting point for an assessment of whether there is likely to be an impact on birds during construction, operation and/or decommissioning. In accordance with Article 6(3) of the Habitats Directive, where a SPA is involved either directly or indirectly, if it cannot be concluded that there will not be an impact (i.e. where it is uncertain whether an impact will occur or not), it should be assumed that there will be an impact (precautionary principle). If there are insufficient data to identify whether an impact is likely or not, it will be necessary to move onto collecting additional data through the use of surveys, thus a lack of data is not sufficient justification for concluding that there will not be an impact.

Table 2.1 presents the criteria to consider when determining if there is likely to be an impact. The criteria are linked to the key factors described above, plus a consideration of the likely cumulative effects.

Table 2.1: Criteria to Determine if an Impact is Likely

Factor	**Criteria**[1]
Distribution	Birds are likely to occur in the area or move through the area
Number	Area is identified as potentially being used by birds
Type of birds	Unlikely to be known in detail at this stage
Links to environmental factors	Area provides habitat for prey
Behaviour	Birds feed, carry out maintenance behaviour, roost or fly through the area
Cumulative	Site is located near to other windfarm site(s) (proposed, under construction or operational) and/or other projects are taking place in the area/between the area and important bird sites

(return to Flowchart 2)

2.2.3Key References and Further Reading

Sources of Information for the Desk Study	
Reference	BirdLife International (2000): *The Development of Boundary Selection Criteria for the Extension of Breeding Sea bird Special Protection Areas into the Marine Environment*, paper to the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, OSPAR Commission.
Internet Address	Not available
Summary	Not available

Sources of Information for the Desk Study	
Reference	Cranswick *et al* (2003): *Aerial Surveys for Birds in Proposed Strategic Areas for Offshore Windfarm Development*, Round 2: Preliminary Report, Winter 2002/2003.
Internet Address	www.wwt.org.uk/images/upload/pub/50.pdf
Summary	Aerial surveys of the Round 2 proposed strategic areas were undertaken to collect data on bird numbers and distribution. Surveys of the Greater Wash Strategic area were undertaken in February and March 2003.
Reference	Skov H *et al* (1995): *Important Bird Areas for Sea birds in the North Sea, including the Channel and the Kattegatt*, BirdLife International.
Internet Address	Not available
Summary	Data on the broad distributions of sea birds in coastal waters in all months of the year.

(return to Flowchart 2)

2.3 Is the Impact Significant?

Consideration of the significance of any potential impacts is likely to require the collection of additional information through surveys and/or consultation with the relevant organisations.

(return to Flowchart 2)

2.3.1 Surveys

The initial survey will generally be in the form of a desk study to obtain readily available information to determine if there is likely to be an impact. If sufficient information is not available then more detailed surveys may be required tailored to the specific area and use the birds make of the area (roosting, migrating, etc.). The surveys should be tailored such that they provide the information required to answer the question 'is the impact likely to be significant?'. Further information may be required should it be considered that the impact is likely to be significant. Where this is the case, there will be benefits (in terms of costs and time) of planning a phased approach to surveying.

Desk study information should help tailor the approach to more detailed surveys to make them as effective as possible. Table 2.2 summarises the type and quality of information provided by ship-based and aerial surveys. This can be used to identify where each method is likely to be most applicable and to identify key areas of uncertainty that are likely to arise from the surveys. In most cases, it is likely that a combination of both ship-based and aerial surveys will be required and an understanding of the likely uncertainties will be important when assessing the risks to birds from the offshore windfarm.

Windfarm developers are urged to share data and information from their boat and aerial-based surveys with the relevant SNCA as soon as possible. The SNCA will want to work with windfarm developers to be as flexible and helpful on survey design as possible whilst ensuring that the appropriate data are available from surveys to provide the necessary baseline information within a development's ES.

Table 2.2: Comparison of Ship-based and Aerial Surveys with Regard to Survey Objectives

Key Factors	Ship-based	Aerial
Distribution	Poor in terms of obtaining a snapshot of distribution at any one time. Poor in terms of defining limits of distribution.	Good in terms of obtaining a snapshot of distribution at any one time. Good - birds encountered within a few seconds (at most, 300 metres) from their original position and thus allows good estimate of relative densities.
Number	Moderate in terms of identifying unobtrusive species (auks, gulls, terns and shearwaters). Good accuracy of counts - though less suitable for Common Scoter and Red-throated Diver which take flight at great distances. Poor in terms of estimating total numbers - birds can move position significantly if survey period for a site takes several days, thus reducing reliability of count.	Poor in terms of identifying unobtrusive species. Moderate – accuracy of counts of birds in individual flocks (Common Scoter, Eider) is reduced due to speed of the aircraft. Moderate in terms of estimating total numbers.
Type of birds	Moderate in terms of identifying unobtrusive species (auks, gulls, terns and shearwaters). Good in terms of identifying to species level a relatively high proportion of birds encountered (particularly important for auks, terns and gulls). Moderate in terms of recording of age/sex of birds.	Poor in terms of identifying unobtrusive species. Poor to moderate in terms of identifying to species level (depending on species). Poor in terms of recording of age/sex of birds.
Links to environmental factors	Moderate with simultaneous collection of oceanographic data.	Good – accurate relative density information can be correlated with environmental variables.
Behaviour	Moderate – possible under certain circumstances (feeding, movements between roosts, flight heights) although influence of presence of boat needs to be established.	Poor – not suitable for behaviour, flight height or direction.

Table 2.3 sets out the key issues relating to the recommended approaches to surveying. These issues include the study area, the species to be surveyed, the time period and sampling regime for observations, and the different environmental parameters to be measured. It provides an overview of the survey characteristics that need to be considered when

designing the surveys for use at the windfarm site and surrounding area. Again, the detail required from the survey should be proportionate to the information needed to determine if impacts are likely to be significant. More detailed information may only be needed when assessing if impacts are likely to cause adverse effect.

Table 2.3: Key Requirements of Surveys

Factor	Details
Area to be surveyed	Aerial surveys of the proposed windfarm area and surrounding sea areas are recommended to provide information on bird numbers, distribution and density. Whole windfarm area plus surrounding buffer of 1 to 2 km should be surveyed. The SNCA may advise that ship-based surveys are carried out in combination with aerial surveys. These surveys will provide additional information on behaviour, movements and flight heights, as well as recording any species that are not suitable for detection by aerial surveys. The scale of coverage of ship-based surveys depends on the distribution of the birds. Greater coverage would be required for aggregated distributions whereas smaller sample areas could be surveyed where birds are more evenly distributed. At least one control area no closer than 1500m to nearest proposed turbine. Should be similar in terms of key environmental factors. Due to the difficulty of finding comparable reference sites, it is possible that more than one such site will be needed, each one being selected to control for effects on particular species.
Survey method	Use of a set of line transects running perpendicular to major environmental axes such as water depth. If depth gradient runs in several directions, north-south transects are preferred for aerial surveys to avoid problems of sun glare. Ship-based studies of bird movements should be carried out along transects perpendicular to the known flight direction.
Timing	Needs to be sufficient to give a confident assessment of numbers of birds present throughout the year. Surveys should, wherever possible, relate changes in bird abundance to environmental factors including season, time of day, tidal influence and prey availability. Furthermore, as far as possible, some effort should be made to collect data under different weather conditions, though it is recognised that there is limited scope for this when undertaking aerial and ship-based surveys. It is suggested that at least four flights of the whole area are undertaken during the winter, with counts carried out across the whole period if possible. Where breeding birds are present, the SNCAs suggest that at least three flights should be undertaken between May and July/August, with counts ideally undertaken in late May, late June and mid-July to early August. It is advisable that developers consider additional surveys for any other periods considered likely to be important (post-breeding, moulting or spring/autumn passage). Winter surveys are considered to be mid-October to mid-March, summer breeding from late May to early August, late summer from late August to September and Autumn from mid-September to October. It is recommended that 1 to 2 ship-based surveys be undertaken each month during key periods.
Variability in bird numbers	Survey data from at least two years are necessary to give some indication of natural variation in bird numbers and distribution from year to year. Clearly, more survey data (preferably three years) will be required in circumstances where important concentrations of birds occur which are subject to significant annual variation in numbers and distribution.

Table 2.3: Key Requirements of Surveys

Factor	Details
Movement through the windfarm	Where possible, the feasibility of undertaking studies of bird movements using radar should be carefully considered. In areas where there is potential for large numbers of birds to regularly move through a proposed windfarm, it will be especially important to use radar to supplement information on bird movements recorded during ship-based surveys. If radar is used at the same time as ship-based surveys it may be possible to allocate species to the radar registrations. Radar should also be used at night, both during clear moonlit and cloudy conditions, and at dawn and dusk, in an attempt to identify any significant changes in bird movements at these times. Any data collected during foggy conditions would also be helpful in assessing the risk of bird collision, though radar efficiency may be reduced under these conditions. The use of radar to monitor bird movements is a rapidly developing technology and no specific recommendations can be provided. It is also accepted that it may not be practically feasible to use radar in all conditions or at all sites.
Data analysis	The analysis of the survey data is as important as the data collection and, as such, great care should be taken to ensure that the analysis is completed in an appropriate and consistent manner.

Table 2.3 recommends the use of both aerial and ship-based surveys, supported by radar registrations. However, there are some occasions when one or other of the approaches will be more useful, hence the need for a combined approach. When undertaking the surveys, it is important to consider the potential cumulative effects of a number of windfarms. This will require discussions with developers on adjacent sites, as well as consideration of the location of important bird areas around the sites where movement of birds through the area could be affected.

Table 2.4 sets out a recommended methodology for seabird surveys from ships. It is recommended that detailed surveys undertaken at and around the windfarm site follow this methodology. Any differences in the actual method used and the recommended methodology set out in Table 2.4 should be recorded, with appropriate justification given as to why the changes were made. Such justifications could relate to the level of detail required when determining if an impact is likely to be significant (or not) and where information collected as part of the desk study has been used to tailor the surveys so that they provide specific data on a species or habitat of particular concern.

Table 2.4: Recommended Methodology for Seabird Surveys from ships (from Camphuysen *et al*, 2004)	
General	Bird detection by naked eye (except by boat in areas with wintering divers and seaduck where early forward detection is required).
	Observers should be trained by ornithologists with experience of surveys from the appropriate platform. Observers should be able to survey under contrasting situations and in different seasons and should have adequate training in identification skills, estimating numbers in flocks and recording routines.

Table 2.4: Recommended Methodology for Seabird Surveys from ships (from Camphuysen *et al*, 2004)	
Ship-based survey	Line transect with a strip width of 300m maximum and snap-shots for flying birds.
	Subdivision of survey bands to allow correction for missed birds at following intervals: 0-50m, 50-100m, 100-200m, 200-300m, 300+m perpendicular to ship.
	Record detailed information where feasible on species, sex and age, foraging behaviour, flight height and hydrographical data: sea surface temperature, salinity, water depth.
	No observations in sea state 5 or more to be used (moderate waves, chance of some spray).
	Survey time intervals of 1-5 minutes (range 1-10 minutes).
	Preferred ship speed 10 knots/20 kph (range 5-15 knots/10-28 kph).
	Ship with forward viewing observation positions at a height of 10 metres (range 5-25 m) above sea level, not being a commercial or frequently active fishing vessel.
	Two skilled observers are required for each transect (four observers needed if transects used on both sides of the ship).
	Transects should be between 0.5 and 2 nm (1-4 km) apart with the wider separations used for rapid surveys of large areas to give broad, contextual information, 2 km separations are preferred for more detailed surveys of development footprint areas, and 1 km separations may be necessary for breeding terns. Transects should be closer where birds are more aggregated. Transects should be counted so that time of day is equally distributed over the entire area (changing start and end time over the area to take account of diurnal rhythms).
Aerial survey	Twin-engine, high wing aircraft (e.g. Partenavia PN68 Observer).
	Flying speeds of 185 km/hour (100 knots) preferred.
	Flight altitude of 80m (250 feet) above surface of sea.
	See under ship-based surveys for transect separations. Transect separations no less than 2 km (to avoid risk of double-counting birds flushed into adjacent transects). 1 km separations more suitable for species less prone to disturbance (e.g. terns).
	Transects separated into three transect bands 44-163 m, 164-432 m, 433-1000m (or four bands where practical) to allow correction for missed birds.
	Two observers used, each covering one side of aircraft.
	All observations (species, number, behaviour, transect band, time, presence of human activities) continuously recorded on Dictaphone flight trajectory monitored by GPS. GPS positions recorded at least every 5 seconds.
	No observations above sea state 3 (small waves with a few whitecaps), preferably winds less than 15 knots.

Once the surveys are complete, the information can be used to assess whether the impacts are likely to be significant or not.

Identifying if the Impact is Likely to be Significant

The information collected through the surveys should provide the basis for determining if there is likely to be a significant impact on birds. Here, the definition of significance is based upon the following factors:

- magnitude of the impact;
- type of impact;
- extent of impact;
- duration of impact;
- intensity of impact;
- timing of impact; and
- probability of impact.

These factors mean that the definition of significant is not fixed and can vary between different projects. Information on each of these seven factors will, therefore, be required when determining if the impact of the windfarm, either alone or in combination, is likely to be significant on birds.

No thresholds are given in this guidance in terms of defining *significant* as the approach to considering whether impacts are significant needs to be considered objectively (rather than against somewhat arbitrary thresholds). Thus, it is necessary to consult with the appropriate organisations in order to determine the likely significance of impacts. The provision of information on magnitude, type, extent, duration, intensity, timing and probability should help with the identification of significant impacts. This information will be required if it is concluded that a significant effect is likely and an Appropriate Assessment has to be undertaken (see also Section 2.4). Organisations with whom it may be necessary to consult to discuss the potential significance of effects on birds are given in Table 2.5. In all cases, significance should be considered cumulatively with other projects as well as the overall impact of a combination of the four impact types (habitat loss, displacement, barrier effects and collision mortality).

Table 2.5: Potential Consultees for Determining the Significance of Impacts on Birds

England	Scotland	Wales
JNCC	JNCC	JNCC
English Nature	SNH	CCW
Potential non government organisations:		
RSPB/BirdLife International	RSPB/BirdLife International	RSPB/BirdLife International
BTO	BTO	BTO
WWT	WWT	WWT

Notes: For more information and contact details see Annex 2, or click on the organisation name in the Table while holding down the 'Ctrl' key.

As an indication of the potential significance of the impacts, examples of types of effects that are likely to be significant are (English Nature, HRGN3):

- changes to the coherence of the site (e.g. introducing a barrier between isolated fragments or indirect change to the physical quality of the environment or habitat within the site);
- a reduction in the area of habitat or of the site;
- direct or indirect change to the physical quality of the environment or habitat within the site;
- on-going disturbance to species or habitats;
- alterations to community structure (species composition);
- direct or indirect damage to the size, characteristics or reproductive ability of populations on the site;
- alteration to the vulnerability of populations, etc. to other impacts; or
- reduction in the resilience of the feature against external damage.

The European Commission (2001) identifies potential significant impacts from disturbance as:

- any event that contributes to the long-term decline of the population of the species;
- any event contributing to the reduction or the risk of reduction of the range of the species; or
- any event that contributes to the reduction of the size of the habitat of the species.

(return to Flowchart 2)

2.3.2Key References and Further Reading

Seabird Survey Methods	
Reference	Anderson R *et al.* (1999): *Studying Wind Energy/Bird Interactions: A Guidance Document* (*Metrics and Methods for Determining or Monitoring Potential Impacts on Birds at Existing and Proposed Wind Energy Sites*), National Wind Co-ordinating Committee.
Internet Address	http://www.nationaleind.org/pubs/avian99/Avian_booklet.pdf
Summary	Outlines guidelines for studying the risk of death to birds in wind energy developments. Includes methods to assess avian risk, reviews hazards to birds in wind energy environments and describes methods of study design for evaluating bird risk and assessing the effectiveness of treatments in reducing that risk.
Reference	Buckland *et al.* (1993): *Distance Sampling*, *Estimating Abundance of Biological Populations*, Chapman and Hall, London.
Internet Address	Not available
Summary	Explains the methods of distance sampling which is a statistical procedure for estimating the abundance and density of biological

Seabird Survey Methods	
	populations. It also gives advice on survey protocol and design.
Reference	Camphuysen CJ *et al.* (2004): *Towards standardised sea birds at sea census techniques in connection with environmental impacts assessments for offshore windfarms in the UK: A comparison of ship and aerial sampling methods for marine birds, and their applicability to offshore windfarm assessments*. Report commissioned by COWRIE (Collaborative Offshore Wind Research into the Environment), Royal Netherlands Institute for Sea Research, Texel.
Internet Address	http://www.crownestate.co.uk/estates/marine/windfarsm/cowrie.html.
Summary	Standardised guidance document/manual for bird counts in relatively small areas of sea, using either ships or aircraft as observation platforms, for all involved in the offshore wind energy industry. Includes a review and comparison of existing methodologies for sampling sea birds.
Reference	Cranswick (2002): *Surveillance of seaducks in the United Kingdom: a review of methods and proposals for future activity*, WWT, Slimbridge.
Internet Address	Not available
Summary	Not available
Reference	Cranswick *et al* (1998): *Common Scoter* Melanitta nigra *monitoring in Carmarthen Bay following the Sea Empress oil spill: April 1997 to March 1998*, WWT Wetlands Advisory Service report to CCW, Contract no. FC 73-02-53A, Slimbridge, 25pp.
Internet Address	www.ccw.gov.uk/Images_client/Reports/ACF9A.pdf
Summary	Land-based counts of Common Scoters undertaken following the *Sea Empress* oil spill. Counts were taken at two week intervals between 22 February 1996 and 23 March 1997.
Reference	Gilbert *et al* (1998): *Bird monitoring methods: a manual of techniques for key UK species*, RSPB/BTO/WWT/JNCC/ITE/The Sea bird Group. RSPB Sandy, Beds.
Internet Address	Not available
Summary	Not available
Reference	Komdeur *et al* (1992): *Manual for aeroplane and ship surveys of waterfowl and sea birds*, IWRB Special Publication No. 19, Ministry of the Environment, National Environmental Research Institute, Denmark.
Internet Address	Not available
Summary	Not available
Reference	Langston R (2002): *Wind energy and birds: results and requirements*, RSPB report no. 2. RSPB Sandy, Beds.
Reference	WWT (2003): *All-Wales Common Scoter survey: report on 2001/02 work programme*, WWT Wetlands Advisory Service April 2003. CCW Contract Science Report No.568.
Internet Address	www.wwt.org.uk/images/upload/pub/53.pdf
Summary	The survey was established to assess the numbers and distribution of Common Scoter in Carmarthen Bay, Cardigan Bay and Liverpool Bay (Anglesey to Morecambe Bay) and to assess possible qualification of sites as Special Protection Areas (SPAs). The primary source of data was aerial survey, but complemented by land- and ship-based survey where practicable.

Thermal detection	
Reference	Desholm M (2003): *Thermal Animal Detection System (TADS)*, NERI Technical Report No. 440, Ministry of the Environment, National Environmental Research Institute, Denmark.
Internet Address	http://www.dmu.dk/1_viden/2_publikationer/3_fagrappoerter/rapporter/FR440.pdf.
Summary	Not available

(return to Flowchart 2)

2.4 Will the Impacts Cause Adverse Effect?

2.4.1 Identifying if there is Likely to be an Adverse Effect

The concept of adverse effect is linked to the potential that the integrity of a site and its contribution to the site network, designated under the Habitats and Birds Directives, would be affected. The conclusion as to whether an adverse effect is likely, is undertaken by a competent authority in the Appropriate Assessment. The collection of data as part of the approach to determining if the impact is likely to be significant should provide the competent authority with the basic level of information necessary to begin to undertake the Appropriate Assessment. To carry out an Appropriate Assessment, at a minimum, the information necessary should cover:

- a description of the project;
- a description of the aspects of the environment likely to be affected; and
- a description of the project's likely significant effects.

(return to Flowchart 2)

2.5 Minimising the Impacts

Where a potential adverse effect is identified, mitigation measures should be considered to remove that effect before any consent can be given. Mitigation measures fall into two broad categories: best practice measures which should be adopted by any offshore windfarm and should be an industry standard; and additional mitigation which is aimed at reducing an impact specific to a particular development.

(return to Flowchart 2)

2.5.1 Best Practice

Examples of possible best practice measures are summarised as follows:

- adequate briefing of construction and maintenance personnel and, in particularly sensitive locations, the presence of an on-site construction ecologist;
- design turbine spacing and grouping to avoid alignment perpendicular to main flight paths and provide corridors to allow passage;
- timing of phases of construction and maintenance works to avoid sensitive periods and sensitive areas;
- painting rotors - experiments to increase detection of blades by birds in conditions of poor visibility have included painting blades with luminous paint. However, this requires further investigation to determine effectiveness;
- sensitive routing of maintenance trips to reduce potential disturbance from boats and personnel; and
- monitoring of effects using a Before-After-Control-Impact (BACI) study (see also Section 2.5.3 on monitoring).

(return to Flowchart 2)

2.5.2 Possible Mitigation Measures for Adverse Effects

By sensitive design and adoption of best practice it may be possible to avoid adverse impacts. However, if such steps do not initially remove a threat of adverse effects, suitable mitigation measures will need to be considered and proposed to remove those effects. For each mitigation measure proposed, it is necessary to identify (European Commission, 2001):

- evidence of how it will be secured and implemented and by whom;
- evidence of the degree of confidence in its likely success;
- a timescale of when it will be implemented; and
- evidence of how the measure will be monitored and, should mitigation failure be identified, how that failure will be rectified.

Where mitigation is proposed to alleviate damaging impacts, the effectiveness should be assessed. Any mitigation measure will require monitoring to determine its effectiveness against prescribed targets and a contingency plan in the event of it not meeting those targets.

The mitigation measures described in Table 2.6 are linked to the four main types of impact given in Section 2.2.1. They are organised in a hierarchy of preferred options (European Commission, 2001):

- highest preference: avoid impacts at source (implemented at planning level);

- second highest: reduce impacts at source (implemented at design level);
- third highest: abate impacts on site (implemented during construction, operation and decommissioning); and
- lowest: abate impacts on receptor (implemented for particular species).

It is suggested that consideration be given to the proposed mitigation measures in this hierarchy as this is most likely to result in the reduction of impacts to an acceptable level.

Table 2.6: Potential Mitigation Measures and Impacts they are Intended to Minimise

Avoid Impacts at Source				
Mitigation Measure	Avoidance of areas with concentrations of species of conservation importance (precautionary principle in terms of appropriate site selection) or important migratory paths.			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
	✓	✓	✓	✓
Summary of Likely Effectiveness	Weight of evidence indicates that locations with high bird use, especially protected species, are not suitable for windfarm development. Location is considered of critical importance to avoid deleterious impacts on birds. Moving turbines further offshore needs to be considered.			
Reduce Impacts at Source				
Mitigation Measure	Appropriate siting and design in terms of orientation, spacing and location. Allowing wide corridors between clusters of turbines (potentially a few km wide), with a line formation parallel to the main flight direction, is thought to be the best arrangement and deep placement of turbines to avoid shellfish beds. Lines of turbines should be broken up.			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
	✓		✓	✓
Summary of Likely Effectiveness	Effectiveness on collision mortality in particular is not well known, but there is some evidence that bird collision risk could be high if turbines intercept flight paths between feeding and roosting areas. Clusters of turbines are thought to be less damaging as they dissuade birds from flying amongst the turbines. Birds approaching windfarms parallel to the alignment of the turbines are more likely to cross the site than if the approach is perpendicular to the alignment. For large windfarms, it may be appropriate to organise the site in several smaller clusters to mitigate the potential barrier effect of one large cluster. One long line of turbines could result in birds concentrating along the line rather than avoiding them. This can be avoided by breaking lines apart.			
Mitigation Measure	Construction of larger turbines may provide greater visibility			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
				✓
Summary of Likely Effectiveness	May enable birds to judge their passage through the windfarm more easily <u>but</u> larger turbines may also pose a problem because of the greater height range through which the rotor blades travel (although the height of the rotors could be raised above flying			

Table 2.6: Potential Mitigation Measures and Impacts they are Intended to Minimise

	heights for some species). Research is needed.			
Abate Impacts on Site				
Mitigation Measure	Appropriate timing of construction works and construction methods used.			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
		✓		
Summary of Likely Effectiveness	Will reduce disturbance at critical times such as moulting.			
Mitigation Measure	Intermittent rather than continuous navigation lighting, particularly strobing lights. Clusters of turbines will reduce the single point source and provide a more diffuse light distribution. Floodlighting of turbines should be avoided, particularly in times of bad weather. White lights are preferable to red although some lights will attract birds.			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
				✓
Summary of Likely Effectiveness	Effectiveness not well known – research required but continuous lighting has the potential to attract birds, especially in bad weather. Strobing lights are considered to have the fewest flashes per minute (but are expensive). Massive mortality events have occurred under poor visibility conditions, particularly for nocturnal migrants. Evidence over difference in light colours is mainly anecdotal.			
Mitigation Measure	High contrast patterns on turbine blades to reduce motion smear (the inability to distinguish quickly moving objects).			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
				✓
Summary of Likely Effectiveness	Effectiveness not known and may be unacceptable on landscape grounds. Painting rotor blades with UV paint resulted in no significant effect on bird collisions. Initial trials into antimotion smear patterns have been reported as being successful, although more research and testing is needed.			
Mitigation Measure	Postponement of maintenance of turbine(s).			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
		✓		

Table 2.6: Potential Mitigation Measures and Impacts they are Intended to Minimise

Summary of Likely Effectiveness	Will reduce disturbance at critical times such as moulting.			
Mitigation Measure	Increasing down-time of turbine(s) in conditions when high levels of collision mortality are likely (e.g. adverse weather conditions during periods of peak migration.			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
				✓
Summary of Likely Effectiveness	The temporary shutdown as a mitigation measure is questionable, as the turbines may pose a hazard in poor flying condition even when not operational, owing to the removal of auditory clues. Down-time would also only remove the collision risk with rotors and does not remove the need to avoid siting the windfarm in important migration areas.			
Mitigation Measure	Modifications to aspects of associated infrastructure.			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
	✓			
Summary of Likely Effectiveness	Requires a good understanding of alternative options and effects they will have.			
Mitigation Measure	Set thresholds of number of maintenance visits to be made to each turbine according to sensitivity of birds present on the site at certain times (e.g. January to April or September to December for over-wintering species).			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
		✓		
Summary of Likely Effectiveness	Requires good records to be kept of the average frequency of maintenance visits. Contingency is required if the thresholds are to be exceeded – this may include reviewing maintenance schedules or limiting trips until the number of trips drops below the threshold.			
Mitigation Measure	Employing methods of chemical use that minimise release of polluting materials into the water column and only using chemicals selected from the List of Notified Chemicals.			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
	✓			
Summary of Likely Effectiveness	Voluntary code used by oil and gas industry.			
Abate Impacts on Receptor				
Mitigation Measure	Cable-laying outside of the moult period for Common Scoters (July to September).			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
		✓		
Summary of Likely Effectiveness	Minimises disturbance to species that are particularly sensitive.			

Table 2.6: Potential Mitigation Measures and Impacts they are Intended to Minimise

Mitigation Measure	Construction works must not be undertaken between 16 December and March (inclusive) to minimise impacts on over-wintering Common Scoter.			
Impacts Mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
		✓		
Summary of Likely Effectiveness	Minimises disturbance to species that is particularly sensitive.			
Mitigation Measure	Cable laying along the beach from October to April should avoid the sensitive period 2 hours either side of high water for overwintering wader species.			
Impacts mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
		✓		
Summary of Likely Effectiveness	Minimises disturbance to species that is particularly sensitive.			
Mitigation measure	Piling work fur turbine foundations should only be carried out between high tide – 3hours and high water +3 hours to minimise disturbance to Little Terns. No work should be carried out between 1 May and 1 August near to nesting/breeding areas.			
Impacts mitigated	**Habitat loss**	**Displacement**	**Barrier effects**	**Collision mortality**
		✓		
Summary of Likely Effectiveness	Minimises disturbance to species that is particularly sensitive.			
Notes and sources: RSPB & BirdLife International (2003); English Nature (Pers. Comm.), Sinclair (2001)				

(return to Flowchart 2)

2.5.3 Monitoring

Monitoring of sea bird activity during the construction and operational phase of the windfarm is essential for two reasons:

- to assess the impacts of a particular development with regard to the need for further mitigation of those impacts; and
- to provide general information on effects on birds to help future developers minimise potential impacts.

Table 2.7 summarises the approaches to monitoring that could be used with an offshore windfarm project. The Table also proposes recommended approaches and gives an overview of the advantages and drawbacks of methods of monitoring for collision mortality.

Cooperative studies are likely to be of considerable value, particularly in areas with multiple proposals for offshore windfarms.

Table 2.7: Summary of Approaches to Monitoring

Aim	Monitoring should aim to measure changes in bird density, abundance, movements and other behaviour resulting from the development.		
Timing	It is recommended that aerial and ship-based surveys be carried out for at least three years following construction and some monitoring may be required for the full lifetime of the development. Radar studies may also be required in order to measure any changes in bird movements resulting from any barrier effects. Further work may be required subject to the results of the initial monitoring period. Longer term monitoring will be needed to evaluate gradual or incremental changes, for example the potential cumulative effect of increased mortality, or where birds gradually habituate to the presence of turbines.		
Analysis of results	It is essential that monitoring protocols and data analyses be subject to statistical expertise, especially with regard to power analysis and sample size.		
Recommended approach	The preferred approach is to design a BACI (Before-After-Control-Impact) study. The BACI design enables a comparison to be made before, during and after the construction of the windfarm.		
Timing/duration	Data should be collected before the construction, up to several years after construction and, ideally, during construction. It is important that studies explore the impacts of both construction and operational phases, as the potential effects can differ at each stage of the development.		
Inclusion of reference areas	Reference or control areas are important to enable a distinction to be made between results that can be attributed to the windfarm and those that can be attributed to other causative factors, such as natural change. Ideally more than one reference area should be used, although, as it may be difficult to find even one suitably matched area, a single reference for each windfarm may have to be sufficient.		
Uncertainties/ difficulties	Assessing the level of bird mortality due to collisions with the turbine tower and rotors is difficult as corpses will sink or be washed away by currents. The chance of observing a collision is remote as bird strike is likely to occur at a very low frequency or sporadically, and is perhaps most likely to occur at night or during periods of poor visibility.		
Approaches to Assessing Collision Mortality			
Approach	**Description**	**Advantages**	**Drawbacks**
Thermal detection technique	Depends on the use of a thermal camera aimed at the turbine structure, linked to a computer set to record any images above a predetermined threshold of activity.	Capable of recording birds approaching the turbine structure even under conditions of poor visibility.	Limited field of view of the thermal cameras (restricted to half of the rotor-sweep area) and prohibitive costs of the specialised equipment.

Table 2.7: Summary of Approaches to Monitoring

Vibration detection technique	Depends on a sensor placed either in the rotor blades or in the nacelle.	Sensor can be calibrated to distinguish between small, medium and large size classes of birds striking the blades or nacelle.	Technique is currently under development by National Environmental Research Institute, Denmark and is unlikely to be available before the end of 2005.
Strand-line searches for corpses	Frequent searches with data correction for scavenger removal, search effort and cause of death.	Most useful where there are particular concerns about high collision risk of large species (but only if the results are calibrated).	For windfarms closer to the shore only. Correction factors required to calculate true levels of mortality based on search efficiency. Of limited value for small birds.

(return to Flowchart 2)

2.5.4Key References and Further Reading

Mitigation Measures	
Reference	RSPB & BirdLife International (2003): *Windfarms and Birds: An Analysis of the Effects of Windfarms on Birds, and Guidance on Environmental Assessment Criteria and Site Selection Issues.*
Internet Address	www.abcbirds.org/offshoreBirdLifeStudy.pdf
Summary	An analysis of the impact of windfarms on birds, establishing criteria for their environmental impact assessment and developing guidelines on precautions to be taken when selecting sites for windfarms.
Reference	Offshore Chemicals Regulations 2002: *List of Notified Chemicals.*
Internet Address	www.cefas.co.uk/ocns
Summary	The Offshore Chemical Notification Scheme (OCNS) is administered by the Department of Trade and Industry using scientific and environmental advice from CEFAS and the Fisheries Research Services. The OCNS applies to all chemicals, which are used in the actual exploration, exploitation and associated offshore processing of petroleum and natural gas on the UK Continental Shelf. The OCNS therefore applies to those 'operational' chemicals/products, which through their mode of use are expected in some proportion to be discharged.

Mitigation Measures	
Reference	Sinclair K (2001): *Status of avian research at the National Renewable Energy Laboratory*, Presented at AWEA's WINDPOWER 2001 Conference, Washington D.C. NREL/CP-500-30546. Golden, CO: National Renewable Energy Laboratory.
Internet Address	Not available
Summary	Not available

Useful Internet Sites	
Reference	Proceedings of National Avian-Wind Power Planning Meetings.
Internet Address	www.nationalwind.org
Summary	Include technical information on different monitoring techniques, in particular: - Gauthreaux SA (1994): *Suggested practices for monitoring bird populations, movements and mortality in wind resource areas*; - Cooper BA (1995): *Use of radar for wind power-related avian research*; and - Pollock KH (1994): *Assessing avian – wind power interactions: sampling, study design and statistical issues*.
Reference	Danmarks Miljøundersølgeser (DMU) – National Environmental Research Institute (NERI).
Internet Address	www.dmu.dk
Summary	Aerial and boat-based survey methods and the outcome of monitoring work undertaken in Denmark.
Reference	Central Science Laboratory.
Internet Address	http://www.csl.gov.uk
Summary	Central Science Laboratory Bird Management Unit and its mobile bird detecting radar.

3. CONSIDERATION OF IMPACTS ON MARINE MAMMALS

3.1 Introduction

Marine mammals, whales and dolphins (cetaceans) and seals (pinnepeds) are distributed throughout the waters of the United Kingdom Continental Shelf (UKCS). There are approximately 27 species of whales and dolphins observed in UK waters and two species of seal. All species of whale and dolphin are protected under UK legislation and are listed as BAP priority species. Harbour Porpoise, Bottlenose Dolphin, Common Seal and Grey Seal are listed on Annex II of the Habitats Dir3ctive as species that may benefit from the selection of SAC. In addition, priority species such as otters and Common and Grey Seals listed on Annex IVa and are protected against deliberate killing, taking or disturbance under the Habitats Directive and the 1994 Regulations.

In the areas where windfarm developments are likely, which tend to be restricted to the relatively shallower coastal waters, potential impacts are likely to be restricted to seals and smaller dolphins and porpoises, although disturbance to other species cannot be ruled out.

In order to assess any potential impacts that a windfarm development may have it is important to understand both the nature and significance of any impact and if an impact does occur what effect this may have at a local, national or international species level. Windfarms have the potential to affect marine mammals throughout the year although they will be particularly sensitive in breeding and nursery areas. Protection of the features that attract and provide for the marine mammal populations in question is important not just when the mammals are present but also when they are not. Damage to the relevant interest features will remove their facility whether the mammals are present or not. Loss of any important areas is likely to result in seals and cetaceans being forced to use less suitable sites and result in impacts such as increased competition or impoverished food supply. Any such impacts are likely to lead to greater mortality and a loss of numbers.

Figure 3 presents a flowchart that will help you to move through this section, identifying the information that you need when making a decision as to the likely impacts on marine mammals.

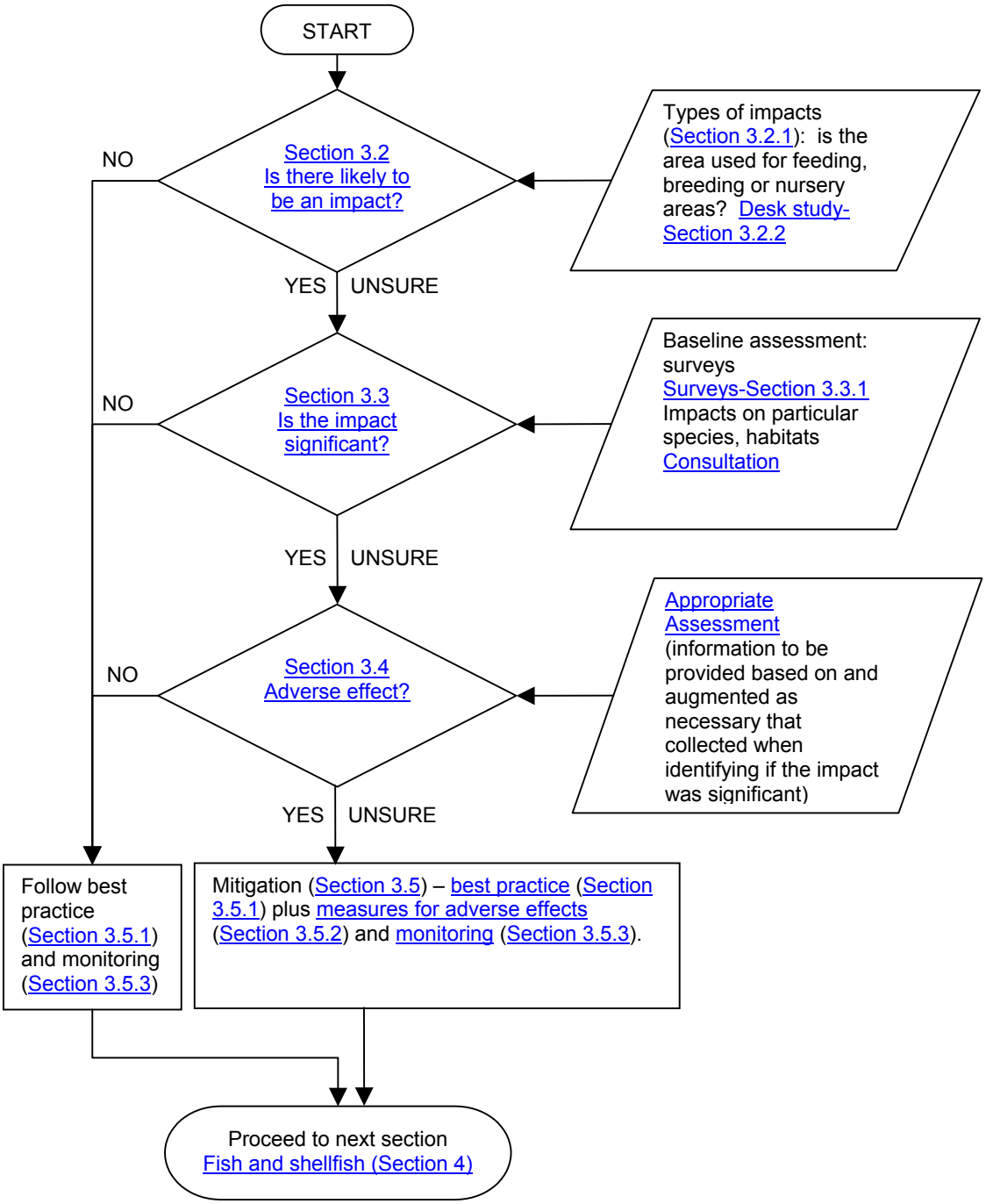

Figure 3: Flowchart for Determining Impacts on MARINE MAMMALS

3.2 Is There Likely to be an Impact?

3.2.1 The Types of Impacts

Potential impacts from windfarm developments on marine mammals fall into three categories:

- physiological impacts such as hearing damage as a direct result of noise produced;
- Loss of foodstock, (i.e. fish stocks or invertebrates) can result from damage, disturbance, or scouring of the sites during the development's construction or maintenance phases.
- behavioural impacts as a result of noise produced such as avoidance of a breeding, nursery or feeding area; and
- indirect effects such as noise impacts to a food source.

Table 3.1: Summary of Impacts on Marine Mammals from Windfarms

Period	Description of Potential Impacts
Construction	Attachment of turbines to seabed by gravity-based structures or piling the turbine base. Hammer piling noise may be at a frequency and level that may impact upon marine mammals. Ongoing activity, e.g. from vessels present in an area along with heavy lift vessels or jack up to install the turbines and associated infrastructure. All these vessels will produce noise whether through engines, propeller movements or use of positioning thrusts.
Operation	Noise and vibration produced as a result of maintenance activities including the number and frequency of vessel movements in the windfarm development area.
Decommissioning	It may be necessary to use explosives to remove structures from the seabed.
Other impacts	Increased vessel traffic, especially of fast moving vessels may also lead to increased risk of marine mammal vessel collisions. Construction and operation of the windfarm may lead to a 'barrier effect' for cetaceans.

Thus, the impacts can be divided into four types:

- habitat and prey species loss;
- impacts from noise;
- impacts from collisions; and
- impacts as a result of a barrier effect.

Marine mammals use sound to communicate, sense food and to understand their local environment. Waterborne noise and vibration transmitted from the moving blades, through the tower and into the water

column may disturb marine mammals (Metoc, 2000). Research is being undertaken into the effects of windfarms on marine mammals. A project in Germany (MINOS) is investigating reactions of marine mammals to noise pollution.

(return to Flowchart 3)

3.2.2Desk Study

Overview

The aim of the baseline study is to collect the following basic information:

- distribution of mammals across the area, including movements through the area to other sites;
- number of mammals;
- species presence and age/sex distribution;
- links between number and types of mammals to environmental factors including season, time of day, tidal influence and prey availability; and
- behaviour including breeding, feeding, migrating, etc.

The above baseline information is likely to be available through a combination of desk studies and surveys

A key aim for the desk study should be to identify as much information on the five key factors given above (distribution, number, type, environment and behaviour). The SNCA should also be able to provide assistance with the desk study. They will be keen to work with developers and to share data from boat and aerial-based surveys.

Noise Disturbance

By calculating the possible increase in sound levels at a proposed windfarm site it may be possible to predict impacts to marine mammals by assessing the frequency and strength of any noise produced.

In order to determine whether there are likely to be impacts on marine mammals, it is necessary to understand the distribution of marine mammals in the development area and appreciate why any marine mammals are there. It is suggested that developers start the review of the baseline using existing information on marine mammals from the JNCC (such as the Atlas of cetacean distribution in north-west European waters) or from the Sea Mammal Research Unit (SMRU) for seals. Local knowledge and records of sightings and strandings can be obtained, for example, from the SeaWatch Foundation and the Whale and Dolphin Conservation Society.

The SMRU regularly monitor Grey and Common Seals, although surveying is mostly restricted to Scotland. In particular, they have completed surveys

on population size, diet, movements and foraging behaviour. Research data are also available for specific areas, particularly the Moray Firth area and Cardigan Bay. The SMRU and Aberdeen University have also studied dolphin populations in the Moray Firth since 1989.

(return to Flowchart 3)

Identifying if an Impact is Likely to Occur

In determining whether an impact is likely to occur, it is necessary to consider if the area is used by marine mammals and if so in what numbers and why and thus provide the necessary starting point for an assessment of whether there is likely to be an impact on mammals during construction, operation and/or decommissioning. In accordance with Article 6(3) of the Habitats Directive, where an SPA is involved either directly or indirectly, if it cannot be concluded that there will not be an impact (i.e. where it is uncertain whether an impact will occur or not), it should be assumed that there will be an impact (precautionary principle). If there are insufficient data to identify whether an impact is likely or not, it will be necessary to move onto collecting additional data through the use of surveys, thus a lack of data is not sufficient justification for concluding that there will not be an impact where there is an SAC designated at or near the location or whether there are any marine mammals in the area. If the desk study highlights that certain species may be present in an area in significant numbers there can be a presumption that it is likely that an impact **will** occur (precautionary approach). It is then necessary to consider whether the impact is significant.

Table 2.1 presents the criteria to consider when determining if there is likely to be an impact. The criteria are linked to the key factors described above, plus a consideration of the likely cumulative effects.

Table 2.1: Criteria to Determine if an Impact is Likely

Factor	**Criteria**[1]
Distribution	Marine mammals are likely to occur in the area or move through the area
Number	Area is identified as potentially being used by marine mammals
Type of birds	Unlikely to be known in detail at this stage
Links to environmental factors	Area provides habitat for prey
Behaviour	Marine mammals feed, breed or migrate through the area
Cumulative	Site is located near to other windfarm site(s) (proposed, under construction or operational) and/or other projects are taking place in the area/between the area and important marine mammals sites

3.2.3Key References and Further Reading

Sources of Information for the Desk Study	
Reference	Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its potential impact on marine wildlife For COWRIE website see:
Internet Address	http://www.thecrownestate.co.uk/35_cowrie_04_02_07/
Summary	Summary of research reports being undertaken and opportunities to download publications and project summaries.
Reference	Reid JB, Evans PGH & Northridge SP (2003). Atlas of cetacean distribution in north-west European waters. Joint Nature Conservation Committee, Peterborough.
Internet Address	http://www.jncc.gov.uk/Publications/cetaceansatlas_web.pdf/
Summary	Provides an account and snapshot of the distribution of all 28 cetacean species that are known certainly to have occurred in the waters off north-west Europe in the last 50 years. A methods chapter describes data collection methods.
Reference	**Seals:** Thompson PA *et al* (1996): *Comparative Distribution, Movements and Diet of Harbour and Grey Seals in the Moray Firth, NE Scotland*, Journal of Applied Ecology, Vol 33, pp1572-1584. Thompson PA & Miller D (1990): *Summer Foraging Activity and Movements of Radio-Tagged Common Seals in the Moray Firth, Scotland*, Journal of Applied Ecology, Vol 27, pp492-501. Tollit DJ & Thompson PM (1996): *Seasonal and Between-year Variations in the Diet of Harbour Seals in the Moray Firth, NE Scotland*, Canadian Journal of Zoology, Vol 74, pp 1110-1121. **Dolphins:** Wilson B *et al* (1997): *Habitat Use by Bottlenose Dolphins: Seasonal Distribution and Stratified Movement Patterns in the Moray Firth, Scotland*, Journal of Applied Ecology, Vol 34, pp1365-1374.
Internet Address	www.adn.ac.uk/~nhi104/seals/marmamm.htm
Summary	Aberdeen University and SMRU research on Moray Firth area, covers both seals and dolphins.
Reference	MINOS project (Germany):
Internet Address	www.minos-info-de
Summary	The most clearly formulated objection to offshore wind parks is the effects they might have on birdlife and marine mammals. The Harbour Porpoise (Phocoena phocoena), Common Seal (Phoca vitulina), Grey Seal (Halichoerus grypus) and the birds roosting in the offshore area are thus at the centre of the investigations in the interdisciplinary "MINOS" project. The project will supply information on the populations of birds and marine mammals in the offshore area including their population size, their temporal-spatial pattern of utilisation, and their reactions to the effects of noise pollution.

(return to Flowchart 3)

3.3 Is the Impact Significant?

Consideration of whether an impact is likely to be significant requires the collection of additional information through surveys and/or consultation with the relevant organisations.

3.3.1 Surveys

Issues for consideration during the survey include:

- the study area;
- the species to be surveyed;
- the time period;
- sampling regime for observations; and
- the different environmental parameters to be measured.

A summary of suggested approaches is given in Table 3.2. The surveys should be tailored such that they provide the information required to answer the question 'is the impact likely to be significant?'. Further information may be required should it be considered that the impact is likely to be significant. Where this is the case, there will be benefits (in terms of costs and time) of planning a phased approach to surveying.

Table 3.2: Approaches to Stratified Benthic Sampling Design

Factor	Description of Appropriate Approaches
Approach	Advice on techniques such as ship-based, aerial or hydrophone surveys should be sought from the relevant nature conservation agency. Use of two fly-overs per month at low water for six months (April to September) to establish use of the area by marine mammals.
Timing	Where possible surveys should relate changes in mammal numbers to environmental factors including season, time of day, tidal influence and prey availability.
Duration	The SNCA recommend that these surveys will cover at least two full seasons.

Once the surveys are complete, the information can be used to assess whether the impacts are likely to be significant or not. The detail required from the surveys should be proportionate to the information needed to determine if impacts are likely to be significant. More detailed information may only be needed when assessing if impacts are likely to cause adverse effect.

Identifying if the Impact is Likely to be Significant

The information collected through the surveys should provide the basis for determining if there is likely to be a significant impact on marine mammals. Here, the definition of significance is based upon the following factors:

- magnitude of the impact;
- type of impact;
- extent of impact;
- duration of impact;
- intensity of impact;
- timing of impact; and
- probability of impact.

These factors mean that the definition of significant is not fixed and can vary between different projects. Information on each of these seven factors will, therefore, be required when determining if the impact of the windfarm, either alone or in combination, is likely to be significant on marine mammals.

No thresholds are given in this guidance in terms of defining *significant* as the approach to considering whether impacts are significant needs to be considered objectively (rather than against somewhat arbitrary thresholds). Thus, it is necessary to consult with the appropriate organisations in order to determine the likely significance of impacts. The provision of information on magnitude, type, extent, duration, intensity, timing and probability should help with the identification of significant impacts. This information will be required if it is concluded that a significant effect is likely and an Appropriate Assessment has to be undertaken (see also Section 3.4). Organisations with whom it may be necessary to consult to discuss the potential significance of effects on marine mammals are given in Table 3.3. In all cases, significance should be considered cumulatively with other projects as well as the overall impact of a combination of the four impact types (habitat loss, smothering, scour and vibration).

Table 3.3: Potential Consultees for Determining the Significance of Impacts on Marine Mammals

England	Scotland	Wales
JNCC	JNCC	JNCC
English Nature	SNH	CCW
Sea Mammal Research Unit	Sea Mammal Research Unit	Sea Mammal Research Unit
Potential non government organisations		
Sea Mammal Research Unit	Sea Mammal Research Unit	Sea Mammal Research Unit
Whale and Dolphin Conservation Society	Whale and Dolphin Conservation Society	Whale and Dolphin Conservation Society

In determining the likely significance of any impacts, the following issues need to be considered:

- presence of marine mammals in the area of concern;
- sensitivity of the marine mammals;
- information on the level, type and frequency of noise emitted;
- information on the likely attenuation of noise along the propagation path; and
- ambient noise levels reaching/near to the marine mammals.

Most assessments of potential impacts to cetaceans concentrate on the use of the sonar equation to work out the noise level received by the cetacean. This model assumes the received level (RL) equals the source level (SL) minus the transmission loss (TL), which is the attenuation of the sound as it travels through water; RL = SL – TL. The received level can then be assessed to decide whether any of the following impacts are likely to occur to the receiving marine mammal:

- permanent hearing damage;
- temporary hearing damage;
- behavioural alteration; and
- sound masking i.e. where background noise interferes with or masks the ability of an animal to detect a sound signal which would normally be heard.

(return to Flowchart 3)

3.3.2Key References and Further Reading

Noise	
Reference	Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its potential impact on marine wildlife For COWRIE website see:
Internet Address	http://www.thecrownestate.co.uk/35_cowrie_04_02_07/
Summary	Summary of research reports being undertaken and opportunities to download publications and project summaries.
Reference	Hiscock K, Tyler-Walters H & Jones (2002): *High Level Environmental Screening Study for Offshore Windfarm Developments – Marine Habitats and Species Project*, Report from the Marine Biological Association to The Department of Trade and Industry New & Renewable Energy Programme.
Internet Address	http://www.og.dti.gov.uk/offshore-wind-sea/reports/index.htm
Summary	Provides an awareness of the environmental issues related to marine habitats and species for developers and regulators of offshore windfarms. The marine habitats and species considered are those associated with the seabed, sea birds, and sea mammals.

Noise	
Reference	Horns Rev Windfarm – studies into seal and harbour porpoise disturbance:
Internet Address	http://www.hornsrev.dk/Engelsk/default_ie.htm
Summary	Project to determine whether the Danish Government's Energy Plan involving offshore wind turbines is feasible and the effects on the environment.
Reference	Culik BM, Koschinski S, Tregenza N & Ellis GM (2001): *Reactions of harbour porpoises* Phocoena phocoena *and herring* Clupea harengus *to acoustic alarms*. Mar Ecol Prog Ser, 211: 255-260.
Internet Address	Abstract only from www.int-res.com/abstracts/meps/v211/p255-260.html
Summary	Presents the results of 2 field experiments: (1) Harbour Porpoises exposed to a single PICE-pinger and (2) Herring capture rates in surface gillnets equipped with and without acoustic alarms. Results show that Harbour Porpoises do not seem to react to an experimental net in their foraging area. A net equipped with an acoustic alarm, however, was avoided within audible range. Herring, one of the main prey species of Harbour Porpoises, were not affected by the acoustic alarms tested.
Reference	Richardson W (1997): Marine mammals and man-made noise: current issues, Proceedings of the Institute of Acoustics 19(9), 39-50.
Internet Address	www.underwaternoise.org.uk
Summary	The main web site is a report summarising the information currently available on man-made noise underwater.

(return to Flowchart 3)

3.4 Will the Impacts Cause Adverse Effect?

3.4.1 Identifying if there is Likely to be an Adverse Effect

The concept of adverse effect is linked to the potential that the integrity of a site and its contribution to the site network, designated under the Habitats and Birds Directives, would be affected. The conclusion as to whether an adverse effect is likely is undertaken by a competent authority in an Appropriate Assessment. The collection of data as part of the approach to determining if the impact is likely to be significant should provide the competent authority with the information required to undertake the Appropriate Assessment. At a minimum, this information should cover:

- a description of the project;
- a description of the aspects of the environment likely to be affected; and
- a description of the project's likely significant effects.

(return to Flowchart 3)

3.4.2 Key References and Further Reading

Reference	UK Biodiversity Group (1999): *Tranche 2 Action Plans – Maritime Species and Habitats Vol 5*.
Internet Address	www.ukbap.org.uk
Summary	Provides background information on marine and coastal habitats and species action plans.

(return to Flowchart 3)

3.5 Minimising the Impacts

Where a potential adverse effect is identified mitigation measures should be considered to remove that effect before any consent can be given. Mitigation measures fall into two broad categories: best practice measures which should be adopted by any offshore windfarm and should be an industry standard; and mitigation measures for adverse effects which is aimed at reducing an impact specific to a particular development.

(return to Flowchart 3)

3.5.1 Best Practice

Examples of possible best practice measures include:

- adequate briefing of construction and maintenance personnel and, in particularly sensitive locations, the presence of an on-site construction ecologist;
- 'soft' start procedure to construction; and
- sensitive timing and routing of maintenance trips to reduce potential disturbance from boats.

(return to Flowchart 3)

3.5.2 Possible Mitigation Measures for Adverse Effects

By sensitive design and adoption of best practice it may be possible to avoid adverse impacts. However, if such steps do not initially remove a threat of adverse effects, suitable mitigation measures will need to be considered and proposed to remove those effects. For each mitigation measure proposed, it is necessary to identify (European Commission, 2001):

- evidence of how it will be secured and implemented and by whom;
- evidence of the degree of confidence in its likely success;
- a timescale of when it will be implemented; and
- evidence of how the measure will be monitored and, should mitigation failure be identified, how that failure will be rectified.

Where mitigation is proposed to alleviate damaging impacts, the effectiveness should be assessed. Any mitigation measure will require monitoring to determine its effectiveness against prescribed targets and a contingency plan in the event of it not meeting those targets.

The mitigation measures described in Table 3.4 are linked to the four main types of impact given in Section 3.2.1. They are organised in a hierarchy of preferred options (European Commission, 2001):

- highest preference: avoid impacts at source (implemented at planning level);
- second highest: reduce impacts at source (implemented at design level);
- third highest: abate impacts on site (implemented during construction, operation and decommissioning); and
- lowest: abate impacts on receptor (implemented for particular species).

It is suggested that consideration be given to the proposed mitigation measures in this hierarchy as this is most likely to result in the reduction of impacts to an acceptable level.

There are three basic methods for reducing impacts of noise to marine mammals – minimise the power of the noise source, reduce the transmission of the noise so that the received level is reduced or make sure that no marine mammals are present when making a noise.

(return to Flowchart 3)

Table 3.4: Potential Mitigation Measures and Impacts they are Intended to Minimise

Avoid Impacts at Source				
Mitigation Measure	Avoiding locating the windfarm on important feeding, spawning and nursery areas.			
Impacts Mitigated	**Habitat Loss**	**Noise**	**Collision**	**Barrier Effects**
	✓	✓	✓	✓
Summary of Likely Effectiveness	Location is of critical importance. Moving further offshore may need to be considered.			
Reduce Impacts at Source				
Mitigation Measure	Alternatives to hammer piling such as vibropiling or gravity based structures are assessed especially in areas which are considered to be sensitive for marine mammals.			
Impacts Mitigated	**Habitat Loss**	**Noise**	**Collision**	**Barrier Effects**
		✓		
Summary of Likely Effectiveness	Gravity based structures may need a larger footprint. Effects of vibropiling versus hammer piling may need assessing.			

Table 3.4: Potential Mitigation Measures and Impacts they are Intended to Minimise

Abate Impacts on Site				
Mitigation Measure	Use of bubble curtains.			
Impacts Mitigated	**Habitat Loss**	**Noise**	**Collision**	**Barrier Effects**
		✓		✓
Summary of Likely Effectiveness	It may be possible to use bubble curtains to minimise the noise transmission from operations such as piling or the use of explosives, which prevent the propagation of underwater noise.			
Mitigation Measure	Plan the timing of operations.			
Impacts Mitigated	**Habitat Loss**	**Noise**	**Collision**	**Barrier Effects**
		✓	✓	
Summary of Likely Effectiveness	Operations can be planned so that they do not coincide with sensitive times of the year for marine mammals for example the seal pupping season.			
Mitigation Measure	Acoustic deterrents – acoustic harassment devices or 'porpoise pingers' in order to deter porpoise from piling areas.			
Impacts Mitigated	**Habitat Loss**	**Noise**	**Collision**	**Barrier Effects**
		✓	✓	✓
Summary of Likely Effectiveness	Note this is construed to be a 'deliberate disturbance' and some form of a consent to carry out this activity may be required.			
Mitigation Measure	Employing methods of chemical use that minimise release of polluting materials into the water column and only using chemicals selected from the List of Notified Chemicals.			
Impacts Mitigated	**Habitat Loss**	**Noise**	**Collision**	**Barrier Effects**
	✓			✓
Summary of Likely Effectiveness	Voluntary code used by oil and gas industry.			
Abate Impacts at Receptor				
Mitigation Measure	Visual and acoustic watch/listen for marine mammals with temporary suspension of piling operations if cetaceans are sighted in the area.			
Impacts Mitigated	**Habitat Loss**	**Noise**	**Collision**	**Barrier Effects**
		✓	✓	
Summary of Likely Effectiveness	Area under watch/listen may need to be relatively large.			
Mitigation Measure	Operation of a soft start procedure for all drilling and/or piling operations			
Impacts Mitigated	**Habitat Loss**	**Noise**	**Collision**	**Barrier Effects**
		✓	✓	
Summary of Likely Effectiveness	Can be incorporated into the construction plan.			
Notes and sources: Metoc (2000)				

(return to Flowchart 3)

3.5.3 Monitoring

Monitoring of marine mammal activity during the construction and operational phase of the windfarm is essential for two reasons:

- to assess the impacts of a particular development with regard to the need for further mitigation of those impacts, including whether a sterile area is created while the turbines are in operation; and
- to provide general information on effects on marine mammals to help future developers minimise potential impacts.

Table 3.5 summarises the approaches to monitoring that could be used with an offshore windfarm project. It is suggested that approaches to monitoring be discussed with CEFAS/FRS, JNCC, EN/CCW/SNH.

Table 3.5: Summary of Approaches to Monitoring

Timing	Data should be collected before the construction, up to several years after construction and, ideally, during construction.
Recommended approach	The BACI design enables a comparison to be made before, during and after the construction of the windfarm. Monitoring should be based on the use of sightings and hydrophones to record the presence of marine mammals on or close to the site.
Inclusion of controls	Downtime can be used as a control.
Links	There is scope for this monitoring to the noise and vibration, and bird studies.

(return to Flowchart 3)

3.5.4 Key References and Further Reading

Mitigation Measures	
Reference	For COWRIE website see:
Internet Address	http://www.thecrownestate.co.uk/35_cowrie_04_02_07/
Summary	Summary of research reports being undertaken and opportunities to download publications and project summaries.
Reference	Metoc (2000): *An Assessment of the Environmental Effects of Offshore Windfarms*, ETSU W/35/00543/REP.
Internet Address	www.dti.gov.uk/energy/renewables/publications/pdfs/35-00543.pdf
Summary	Provides an agreed approach to formal environmental assessment of large-scale offshore windfarms around the UK coast.

Mitigation Measures	
Reference	Offshore Chemicals Regulations 2002: *List of Notified Chemicals*.
Internet Address	www.cefas.co.uk/ocns
Summary	The Offshore Chemical Notification Scheme (OCNS) is administered by the Department of Trade and Industry using scientific and environmental advice from CEFAS and the Fisheries Research Services. The OCNS applies to all chemicals, which are used in the actual exploration, exploitation and associated offshore processing of petroleum on the UK Continental Shelf. The OCNS therefore applies to those 'operational' chemicals/products, which through their mode of use are expected in some proportion to be discharged.
Monitoring	
Reference	Thompson P *et al* (2000): *Evaluation of Techniques for Monitoring the Abundance and Behaviour of Bottlenose Dolphins – the Kessock Channel as a Case Study*, Scottish Natural Heritage Commissioned Report F99LE01 (unpublished).
Internet Address	Not available
Summary	Not available

4. CONSIDERATION OF IMPACTS ON FISH AND SHELLFISH

4.1 Introduction

Within SACs and SPAs fish and shellfish have to be considered not just as species but also as prey for birds and some mammals. The habitat, including benthos and benthic community, depth of water, location, etc. have to be considered but the wider implications of the fish and shellfish in a particular location as a source of food, must also be understood.

A range of fish could potentially be affected by local electro-magnetic-frequencies (EMF) generated by offshore windfarms. Species of fish that are of principle concern are elasmobranchs, a group of fish which includes sharks, rays and skates and electro-sensitive fish such as lampreys and some teleost (bony) fish. These species can detect the electrical fields emitted by themselves and other organisms, and use this information for predation, orientation and navigation.

Additionally a number of fish species likely to be affected by offshore windfarms are protected under UK law. UK Biodiversity Action Plans (UK BAP) exist for certain species such as the Common Skate, Basking Shark and populations of commercial fish. Additional species that may be of conservation concern include migratory species such as salmon.

Oysters, crabs and lobsters could also be affected by the windfarm, along with shellfish such as mussels, cockles, etc.

Figure 4 presents a flowchart that will help you to move through this section, identifying the information that you need when making a decision as to the likely impacts on fish and shellfish.

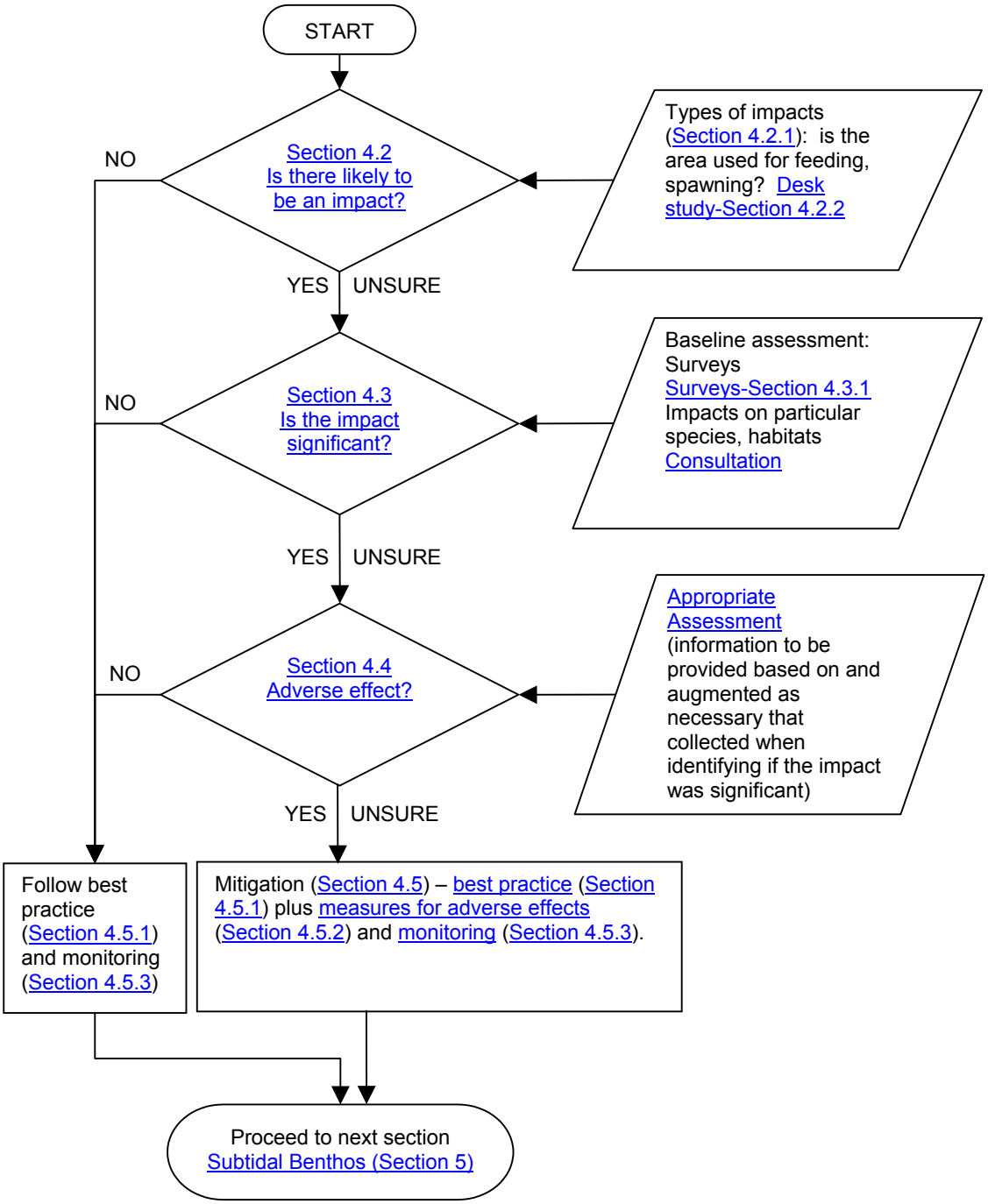

Figure 4: Flowchart for Determining Impacts on FISH AND SHELLFISH

4.2 Is There Likely to be an Impact?

4.2.1 The Types of Impacts

The potential impacts of offshore windfarms on fish species can be divided into two main groups:

- loss or alteration of habitat for feeding and nursery areas; and
- disruption of normal behaviour including feeding and migration due to EMFs from cables, noise and vibration effects.

For shellfish, the main impacts are likely to result from loss or alteration of habitats as a result of construction activities. The potential for generation of artificial reefs may provide a benefit to some shellfish species.

However, the impacts on fish and shellfish which are prey species for birds and marine mammals must also be taken into account when appraising the impacts to those groups.

Currently, there is limited information on the potential impact of windfarms on species of fish considered to be of conservational interest. Additionally, the impacts from windfarms should be placed in context with natural change and other pressures on species populations. For example, elasmobranchs have suffered from a global population decline as a result of unregulated fishing and habitat degradation. Natural factors such as small numbers of offspring and slow maturation periods mean that elasmobranch populations are unable to replace individuals lost at a rate that sustains an adequate population.

There is also evidence from the sea-fishing industry that stocks of rays, common skate and angelsharks, all formerly important fisheries species, have declined rapidly around the British Isles. The status of other commercially important species (such as the thornback ray and the spurdog) is of increasing concern, and subsequently five species have been recommended for protection under the Wildlife and Countryside Act (1981).

(return to Flowchart 4)

4.2.2 Baseline Study

The aim of the baseline study is to collect the following information for the construction, operation and decommissioning phases of the windfarm project:

- a broad description of the species and habitats present in the area and along the cable route; and

- benthos data collected from trawl surveys in combination with data from fish surveys (however trawl surveys may not be appropriate in areas where sensitive habitats may be disturbed), crab surveillance programmes, etc.

Much of the above information may already be available from EIAs, universities and marine laboratories (CEFAS, FRS, etc.). Additional information may be obtained from local Sea Fisheries Committees, local angling records and the Shark Trust. One of the key areas to be focused on should be collecting information on the links between windfarm construction and the impacts on important spawning habitats.

(return to Flowchart 4)

Identifying if an Impact is Likely to Occur

The information collected through the baseline desk study should provide the basis for determining if the area is used by fish and shellfish and if so in what numbers and why and thus provide the necessary starting point for an assessment of whether there is likely to be an impact on those populations during construction, operation and/or decommissioning, together with any impact these may cause to marine mammal or birds for which they are prey. If it cannot be concluded that there will not be an impact (i.e. where it is uncertain whether an impact will occur or not), it should be assumed that there will be an impact (precautionary principle). If there are insufficient data to identify whether an impact is likely or not, it will be necessary to move onto collecting additional data through the use of surveys, thus a lack of data is not sufficient justification for concluding that there will not be an impact.

Table 4.1 presents the criteria to consider when determining if there is likely to be an impact. The criteria are linked to the key factors described above, plus a consideration of the likely cumulative effects.

Table 4.1: Criteria to Determine if an Impact is Likely

Factor	**Criteria**[1]
Distribution	Fish and/or shellfish are likely to occur in the area or fish move through the area.
Number	Area is identified as being used by fish and/or shellfish.
Type of fish	Unlikely to be known in detail at this stage.
Links to environmental factors	Area is an important spawning or nursery habitat.
Behaviour	Fish spawn in the area, it is known to be a nursery area.
Prey status	Utilisation of species as prey by others
Cumulative	Site is located near to other windfarm site(s) (proposed, under construction or operational) and/or other projects are taking place in the area/between the area and important fish/shellfish sites.

Notes:
[1] If at least one factor is possibly affected, it is assumed that an impact is likely.

4.2.3 Key References and Further Reading

Sources of Information for the Desk Study	
Reference	CEFAS (2004): Offshore Windfarms: Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA Requirements: Version 2
Internet Address	http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf
Summary	Sections 5 and 6 provide guidance on data availability, impact assessment, survey design, sampling techniques and data analyses for fish and shellfish
Reference	CMACS (2003): *A Baseline Assessment of Electromagnetic Fields (EMF) Generated by Offshore Windfarm Cables*. COWRIE Report EMF -01-2002-66.
Internet Address	www.thecrownestate.co.uk/1351_emf_research_report_04_05_06.pdf
Summary	Includes the results of a Stage 1 study into the likely EMF emitted from subsea power cables, a method for measuring the EMF which could be applied by windfarm developers, guidance on mitigation measures and identification of issues for further investigation.
Reference	Gill AB Taylor H (2001): *The potential effects of electromagnetic fields generated by cabling between offshore wind turbines upon Elasmobranch Fishes*, CCW Science Report No 488.
Internet Address	Not available
Summary	Not available

4.3 Is the Impact Significant?

Consideration of whether an impact is likely to be significant requires the collection of additional information through surveys and/or consultation with the relevant organisations.

(return to Flowchart 4)

4.3.1 Surveys

Baseline information should consist of a broad description of the seabed habitats and biotopes present at and around the site and along the cable route and specific information on the species present and biological community composition. This may be undertaken using an acoustic survey, for example QTC or multibeam. Additionally, measurements of depth, salinity, temperature and oxygen levels have to be made and recorded. The survey should provide an assessment of the potential impacts of construction activities in the project area and operation of wind turbines in the project area. Table 4.2 sets out the key issues relating to recommended approaches to surveying. These issues include the target area, species to be surveyed, the time period and sampling regime for observations and the different environmental parameters to be measured. Differences between the survey method used and that set out in Table 4.2 should be recorded, with appropriate justification given as to why the

changes were made. Such justifications could relate to the level of detail required when determining if an impact is likely to be significant (or not) and where information collected as part of the desk study has been used to tailor the surveys so that they provide specific data on a species or habitat of particular concern.

The surveys should be tailored such that they provide the information required to answer the question 'is the impact likely to be significant?'. Further information may be required should it be considered that the impact is likely to be significant such that there will be benefits (in terms of costs and time) of planning a phased approach to surveying.

Table 4.2: Key Requirements of the Surveys

Fish Surveys	
Factor	**Details**
Target Area	A single survey of fish fauna in the project area would be required. Species present would then be identified and characterised. Assessments of the impacts of activities in the project area during the construction phase and of the impacts of wind turbine operation in the project area would also be required.
Survey Method	In project areas of more than 100 km^2 the minimum number of hauls should be 30.
Timing	As a minimum the surveys should be undertaken in the spring and autumn (twice a year), or in the spring, summer and autumn (three times a year). If in an area of conservation importance and the development represents a cause for concern surveys should be undertaken at least two consecutive years before the start of construction. This may increase to five years where appropriate. Additionally fish sampling should only be carried out during the day (sunrise to sunset).
Data Analysis	Data to be recorded will include shooting and hauling positions and hydrographic and meteorological data. Data relating to fish species will be as follows: • total number of individuals per area; • total biomass per area; • number of individuals per species and area; • biomass per species and area; • dominance ratios; • diversity; • length frequency; and • community analysis.
Shellfish Surveys	
Factor	**Details**
Target Area	Appropriate surveys to identify the distribution, seasonality and density of crab species (brown, velvets, lobsters) or location of key shellfish habitats (including oysters).
Survey Method	Catch using mesh pots for crabs and lobsters. Samples of individuals from key shellfish locations may be required to assess potential impact of contaminants. The impacts of potential increases in suspended sediment on shellfish should also be considered. For detailed guidance on methodology refer to CEFAS (2004)
Timing	A minimum of 12 months baseline information may be required, collected at monthly intervals. The temporal and spatial spread should be appropriate for the species under investigation.

Table 4.2: Key Requirements of the Surveys

Fish Surveys	
Factor	**Details**
Data Analysis	The survey data should provide information on: • total numbers (based on catch or sample counts); • size range; and • sex ratio.

A reference survey area should be used for the purpose of comparison with the project area. There are several factors that must be considered when selecting a reference area, including:

- the reference area should be outside the planning areas for later windfarm expansion phases;
- the natural ambient conditions in the reference area (location, current conditions, water depth, sediment properties, distance from the coast, size, species diversity etc.) must correspond to the conditions within the project area; and
- the reference area should not be affected by the construction area. This includes noise disturbance and therefore, in the case of fish and epifauna, the minimum distance should be 1km from the project area.

Once the surveys of the project area are complete, and a reference site selected, the information collected can be used to assess whether the impacts are likely to be significant or not. Again, the detail required from the survey should be proportionate to the information needed to determine if impacts are likely to be significant. More detailed information may only be needed when assessing if impacts are likely to cause adverse effect.

Identifying if the Impact is Likely to be Significant

The information collected through the surveys should provide the basis for determining if there is likely to be a significant impact on fish species and habitats. Here, the definition of significance is based upon the following factors:

- magnitude of the impact;
- type of impact;
- extent of impact;
- duration of impact;
- intensity of impact;
- timing of impact; and
- probability of impact.

These factors mean that the definition of significant is not fixed and can vary between different projects. Information on each of these seven factors will, therefore, be required when determining if the impact of the windfarm, either alone or in combination, is likely to be significant on fish or shellfish.

No thresholds are given in this guidance in terms of defining *significant* as the approach to considering whether impacts are significant needs to be considered objectively rather than against somewhat arbitrary thresholds. Thus, it is necessary to consult with the appropriate organisations in order to determine the likely significance of impacts. The provision of information on magnitude, type, extent, duration, intensity, timing and probability should help with the identification of significant impacts. This information will be required if it is concluded that a significant effect is likely and an Appropriate Assessment has to be undertaken (see also Section 4.4). Organisations with whom it may be necessary to consult to discuss the potential significance of effects on fish are given in Table 4.3. In all cases, significance should be considered cumulatively with other projects.

Table 4.3: Potential Consultees for Determining the Significance of Impacts on Fish and Shellfish

England	Scotland	Wales
CEFAS	FRS	CEFAS
JNCC	JNCC	JNCC
English Nature	SNH	CCW

Notes: For more information and contact details see Annex 2, or click on the organisation name in the Table while holding down the 'Ctrl' key.

As an indication of the potential significance of the impacts, examples of types of effects that are likely to be significant are (English Nature, HRGN3):

- changes to the coherence of the site (e.g. introducing a barrier between isolated fragments or indirect change to the physical quality of the environment or habitat within the site);
- a reduction in the area of habitat or of the site;
- direct or indirect change to the physical quality of the environment or habitat within the site;
- on-going disturbance to species or habitats;
- alterations to community structure (species composition);
- direct or indirect damage to the size, characteristics or reproductive ability of populations on the site;
- alteration to the vulnerability of populations, etc. to other impacts; or
- reduction in the resilience of the feature against external damage.

The European Commission (2001) identifies potential significant impacts from disturbance as:

- any event that contributes to the long-term decline of the population of the species;
- any event contributing to the reduction or the risk of reduction of the range of the species; or
- any event that contributes to the reduction of the size of the habitat of the species.

(return to Flowchart 4)

4.3.2Key References and Further Reading

Survey Methods	
Reference	Standards for Environmental Impact Assessments of Offshore Wind Turbines in the Marine Environment.
Internet Address	www.helcom.fi/dps/docs/documents
Summary	Standards informing applicants of the scope of investigations required by approval authorities.
Reference	Buckland ST *et al* (2001): *Introduction to distance sampling. Estimating abundance of biological populations*.
Internet Address	Not available
Summary	Discusses point transect sampling and line transect sampling in addition to other techniques.
Reference	CEFAS (2004): Offshore Windfarms: Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA Requirements: Version 2
Internet Address	http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf
Summary	Sections 5 and 6 provide guidance on data availability, impact assessment, survey design, sampling techniques and data analyses for fish and shellfish

(return to Flowchart 4)

4.4 Will the Impacts Cause Adverse Effect?

4.4.1 Identifying if there is Likely to be an Adverse Effect

The concept of adverse effect is linked to the potential that the integrity of a site designated under the Habitats and Birds Directive would be affected. The conclusion as to whether an adverse effect is likely is undertaken by a competent authority in the Appropriate Assessment. The collection of data as part of the approach to determining if the impact is likely to be significant should provide the competent authority with the information required to undertake the Appropriate Assessment. At a minimum, this information should cover:

- a description of the project;
- a description of the aspects of the environment likely to be affected; and
- a description of the project's likely significant effects.

Furthermore, an examination of potential alternative solutions and mitigation measures may make it possible to determine that, in the light of such solutions and mitigation measures, the project will not adversely affect the integrity of the site.

At present there is limited information concerning the effects of EMFs on organisms in the local environment. There have been studies undertaken to investigate certain impacts, for example the effect of noise, vibration and EMFs on fisheries related species was carried out at the Vindeby windfarm in Denmark. Investigations on electro-sensitive fish and their distribution along cable routes are planned at several offshore windfarms in the UK such as North Hoyle.

(return to Flowchart 4)

4.4.2 Key References and Further Reading

Reference	UK Biodiversity Group (1999): *Tranche 2 Action Plans – Maritime Species and Habitats Vol 5*.
Internet Address	www.ukbap.org.uk
Summary	Provides background information on marine and coastal habitats and species action plans.

(return to Flowchart 4)

4.5 Minimising the Impacts

Mitigation measures fall into two broad categories: best practice measures which should be adopted by any offshore windfarm and should be an industry standard; and additional mitigation which is aimed at reducing an impact specific to a particular development.

(return to Flowchart 4)

4.5.1 Best Practice

Examples of possible best practice measures are summarised as follows:

- adequate briefing of construction and maintenance personnel and, in particularly sensitive locations, the presence of an on-site construction ecologist;
- 'soft' start procedure to construction;
- Sensitive timing and location of construction activities; and
- sensitive timing and routing of maintenance trips to reduce potential disturbance from boats.

(return to Flowchart 4)

4.5.2 Possible Mitigation Measures for Adverse Effects

Adverse impacts should be avoided wherever possible. If adverse effects cannot be avoided, then suitable mitigation measures will need to be used to reduce or remove the effects. For each additional mitigation measure proposed, it is necessary to provide (European Commission, 2001):

- evidence of how it will be secured and implemented and by whom;
- evidence of the degree of confidence in its likely success;
- a timescale of when it will be implemented; and
- evidence of how the measure will be monitored and, should mitigation failure be identified, how that failure will be rectified.

Where mitigation is proposed to alleviate damaging impacts, the effectiveness should be assessed. Any mitigation measure requires monitoring to determine its effectiveness against prescribed targets and a contingency plan in the event of it not meeting those targets.

The mitigation measures described in Table 4.4 are linked to the two main types of impact given in Section 4.2.1. They are organised in a hierarchy of preferred options (European Commission, 2001):

- highest preference: avoid impacts at source (implemented at planning level);
- second highest: reduce impacts at source (implemented at design level);

- third highest: abate impacts on site (implemented during construction, operation and decommissioning); and
- lowest: abate impacts on receptor (implemented for particular species).

It is suggested that consideration be given to the proposed mitigation measures in this hierarchy as this is most likely to result in the reduction of impacts to an acceptable level.

Table 4.4: Potential Mitigation Measures and Impacts they are Intended to Minimise

Avoid Impacts at Source		
Mitigation Measure	Avoid key breeding, spawning or nursery areas used by fish and/or shellfish.	
Impacts Mitigated	**Loss of habitat**	**Disruption**
	✓	
Summary of Likely Effectiveness	Avoidance of key areas will minimise impacts on fish and/or shellfish.	
Reduce Impacts at Source		
Mitigation Measure	Use of armouring material with high permeability.	
Impacts Mitigated	**Loss of habitat**	**Disruption**
		✓
Summary of Likely Effectiveness	Studies have demonstrated that as the permeability of the armouring material is increased (modelled using various permeability values), the resultant electromagnetic field strength outside the cable decreases. This suggests that the use of armouring material with higher permeability may reduce the EMF effects on sensitive fish species. The permeability of steel wire is approximately 300 and steel tape approximately 3000. Use of very high permeability materials could reduce the EMF to below the lowest known level that elasmobranchs can detect.	
Mitigation Measure	Use of armouring material with high conductivity or thicker sheaths.	
Impacts Mitigated	**Loss of habitat**	**Disruption**
		✓
Summary of Likely Effectiveness	A linear relationship was found between conductivity and electromagnetic field strength. A reduction in the strength of the EMF can be achieved by using materials with high conductivity.	
Abate Impacts on Site		
Mitigation Measure	Burial of cables.	
Impacts Mitigated	**Loss of habitat**	**Disruption**
		✓
Summary of Likely Effectiveness	Cable burial to a depth of at least 1m has been found to provide some mitigation for the strongest fields (those that exist within millimetres of the cable), owing to the physical barrier of the sediments.	

Table 4.4: Potential Mitigation Measures and Impacts they are Intended to Minimise

Mitigation measure	Conversion of voltage from 33 kV to 135 kV.	
Impacts Mitigated	**Loss of habitat**	**Disruption**
		✓
Summary of Likely Effectiveness	Reduces the current carried by the cable, reducing induced fields by a factor of four. However, this probably has economic and practical limitations.	
Abate Impacts at Receptor		
Mitigation Measure	Avoid usage of potential contaminants near to shellfish beds.	
Impacts Mitigated	**Loss of habitat**	**Disruption**
		✓
Summary of Likely Effectiveness	Reduces the potential that contaminants will be taken up into the flesh of shellfish. This will be of commercial importance where shellfish are harvested. Otherwise, impacts may affect the short (or long) term viability of the local population.	

(return to Flowchart 4)

4.5.3 Monitoring

Monitoring of fish behaviour is an important factor in the determination of accessibility and vulnerability of individual populations. Therefore detailed monitoring programmes are undertaken within the UK assessing movements of individual fish. This is carried out through the use of electronic tags, ship-based acoustics and through the development of complex behavioural models. The information obtained is used to determine the rates and extent of fish migrations and the key influences on these.

The need for and scope of any monitoring of fish and shellfish should be directed by the potential impacts identified in the ES and the consent conditions.

Table 4.5 summarises the approaches to monitoring that are currently used by organisation such as CEFAS. Such approaches could provide valuable information when assessing the impacts of a proposed offshore windfarm project. Table 4.5 also provides a brief introduction into approaches that can be used for crab/lobster surveillance.

Table 4.5: Summary of Approaches to Monitoring

Aim	To determine the movement of fish populations.
Approach	**The deployment of electronic tags** on individual fish allows research into the vertical and horizontal movements of individuals within a population (information that can be extrapolated over a population). Information is collected through the use of electronic data storage tags (DSTs), acoustic telemetry tags and satellite tags.

Table 4.5: Summary of Approaches to Monitoring

Aim	To locate aggregations of fish.
Approach	**Ship-based acoustics** allow routine and objective collection of fish species identification, biomass and behavioural data that can be integrated with traditional fishing survey data to enhance fish stock assessments. Additionally, acoustic discrimination of sea-bed types with QTC and ROXANNE permit multi-factoral analysis of fish-habitat associations.
Aim	Determination of species interactions.
Approach	**Behavioural modelling** allows the complexities of species interactions to be factored into the calculations of changes in fish stock growth and the advice that is given on allowable catches. Recently, more sophisticated models are being developed which consider the individual behaviour of fish populations and mass-balance models which help to reveal the structure of fisheries.
Aim	Determination of changes in crab/lobster populations.
Approach	**Collection of crab/lobsters through catch** using fine mesh pots. All juvenile brown crabs, lobsters and velvet crabs should be measured for size, biomass and sex, with the by-catch assessed prior to returning to the sea. Environmental parameters such as temperature (sea measured at surface and 5m below surface, air), salinity, turbidity, dissolved oxygen and conductivity should be measured.

In addition to the monitoring approaches summarised in Table 4.5, the English ground fish survey, which began in 1977 and focuses on fish stocks in the North Sea, has provided important data which have been used as a part of the International Bottom Trawl series coordinated by the International Council for the Exploration of the Sea (ICES). Such information would be important when assessing the suitability of an area for a proposed windfarm project. The main aims of the ground fish survey include the following:

- to identify trends in species abundance with time;
- to estimate the abundance and the distribution of species in different parts of the North Sea; and
- to investigate growth differences for selected species in different parts of the North Sea.

(return to Flowchart 4)

4.5.4Key References and Further Reading

Relevant Projects	
Reference	CMACS (2003): *A Baseline Assessment of Electromagnetic Fields Generated by Offshore Wind Cables*, COWRIE Report EMF 01-2002 66.
Internet Address	www.thecrownestate.co.uk/1351_emf_research_report_04_05_06.pdf
Summary	Includes the results of a Stage 1 study into the likely EMF emitted from subsea power cables, a method for measuring the EMF which could be applied by windfarm developers, guidance on mitigation measures and identification of issues for further investigation.
Reference	CATEFA – Combining Acoustic and Trawl Data for Estimating Fish Abundance.
Internet Address	www.cefas.co.uk
Reference	LIFECO – Linking hydrography, ecosystem dynamics and fish recruitment.
Internet Address	www.cefas.co.uk
Summary	Not available
Reference	CEFAS (2004): Offshore Windfarms: Guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements: Version 2
Internet Address	http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf
Summary	Sections 5 and 6 provide guidance on monitoring survey design, sampling technigues and data analyses for fish and shellfish

Useful Internet Sites	
Internet Address	www.cefas.co.uk/fishbehaviour
Summary	Information on the current approaches used by CEFAS for the determination of fish stocks in UK waters.
Reference	The English 3rd Quarter North Sea Groundfish Survey.
Internet Address	www.cefas.co.uk/fishinfo/Surveys.htm

5. CONSIDERATION OF IMPACTS ON SUBTIDAL BENTHOS

5.1 Introduction

Maritime broad and priority habitats include sublittoral sands and gravels, mud habitats in deep water and reefs built from sediment or biogenic material such as Modiolus. These habitats, often associated with stable conditions, provide food sources, spawning grounds and cover to a variety of species.

The term subtidal benthos refers to the plants and animals that live on or within the seabed. Those animals living on, or immediately above, the surface of the seabed are known as epifauna and those living within the sediments are known as infauna. In shallow water, plants may also be present, known as epiflora. This section only includes animals and plants bigger than 0.5 mm. Animals smaller than 0.5 mm are not discussed here.

Figure 5 presents a flowchart that will help you to move through this section, identifying the information that you need when making a decision as to the likely impacts on subtidal benthos.

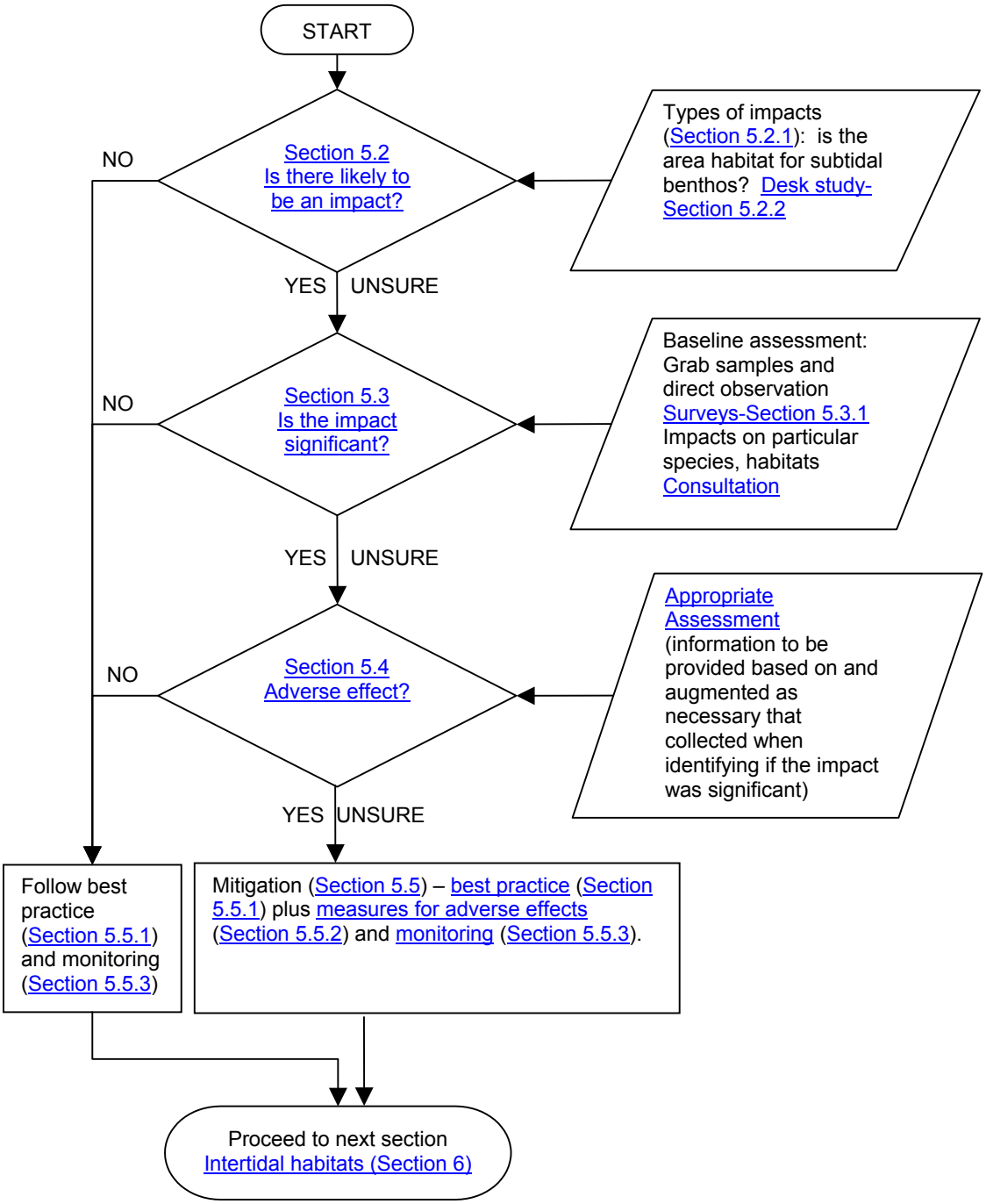

Figure 5: Flowchart for Determining Impacts on SUBTIDAL BENTHOS

5.2 Is There Likely to be an Impact?

5.2.1 The Types of Impacts

The impacts can be divided into four types:

- habitat loss: from placement of the base of each turbine and scour protection, if present;
- smothering: increase in suspended sediments and consequent deposition of sediments with possible smothering;
- scour: causing habitat alteration, altered tidal flow patterns and altered wave exposure; and
- vibration: considered unlikely to cause significant impacts unless the physical composition of the seabed changes (e.g. through liquefaction).

(return to Flowchart 5)

5.2.2 Desk Study

A baseline study should be able to provide a broad description of the seabed habitats and biotopes present at and around the site including along the cable route and specific information on the species present and biological community composition and their importance to other species. Existing data may be available from organisations such as the conservation agencies (EN, CCW, SNH, JNCC), the Environment Agency, CEFAS, FRS or local Universities. At this stage, the aim is to identify whether the area is a habitat for subtidal benthos.

Identifying if an Impact is Likely to Occur

There is very little research data to quantify the noise emitted from turbines or to assess vibration effects. Effects on the benthic community could also have knock-on impacts on fish, marine mammals and birds. Therefore, it is assumed that impacts **will** occur if the windfarm area provides habitats for benthos.

(return to Flowchart 5)

5.2.3 Key References and Further Reading

Sources of Information for the Desk Study	
Reference	Dyer MF, Fry WG, Fry PD & Cranmer GJ (1982): *A series of North Sea benthos surveys with trawl and headline cameras*. Journal of the Marine Biological Association UK, Vol **62**, 297-313.
Internet Address	Not available
Summary	Not available

Sources of Information for the Desk Study	
Reference	Dyer MF, Fry WG, Fry PD & Cranmer GJ (1983): *Benthic regions within the North Sea*. Journal of the Marine Biological Association UK, Vol **63**, 683-693.
Internet Address	Not available
Summary	Not available
Reference	CEFAS (2004): Offshore windfarms: Guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements: Version 2
Internet Address	http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf
Summary	Section 4 provides guidance on data requirements, impact assessment, survey design, sampling techniques and data analyses for benthos

(return to Flowchart 5)

5.3 Is the Impact Significant?

Consideration of whether an impact is likely to be significant requires the collection of additional information through surveys and/or consultation with the relevant organisations.

(return to Flowchart 5)

5.3.1 Surveys

Surveys can be undertaken in two stages:

1. an acoustic survey (e.g. QTC, multibeam) of the whole area that may be affected by construction and operation is initially carried out to determine the different seabed habitats present. This will need to be defined with reference to physical data for the site, e.g. tidal flows, sediment transport; and

2. a stratified benthic sampling design can then be constructed to ensure that all the habitats present are sampled in detail, using appropriate sampling gears.

The surveys should be tailored such that they provide the information required to answer the question 'is the impact likely to be significant?'. Further information may be required should it be considered that the impact is likely to be significant. Where this is the case, there will be benefits (in terms of costs and time) of planning a phased approach to surveying.

Table 5.1 presents the most appropriate approaches in relation to the seabed sediments. Prior to undertaking such a survey the developer should ensure that no other features such as reef (as defined in the

Habitats Directive) are likely to be significantly affected. It is recommend that all benthic baseline surveys and any future monitoring is agreed with both the SNCA and CEFAS, and that guidance documents such as that produced by CEFAS (2002) is consulted. Any differences in the methods used and that recommended by the SNCA and CEFAS/FRS should be recorded, with appropriate justification given as to why the changes were made. Such justifications should relate to the level of detail required when determining if an impact is likely to be significant or not and, where information collected as part of the desk study has been used, to tailor the surveys so that they provide specific data on a species or habitat of particular concern.

Table 5.1: Approaches to Stratified Benthic Sampling Design

Factor	Description of Appropriate Approaches
Sediment Type	
Soft sediments	Suitable sampling gear would generally be a Day grab (which is the most scientifically accurate) or a Van Veen grab.
Mixed sediments with stones, e.g. gravely sand with pebbles	A Hamon grab may be more appropriate. Whatever grab is used the volume of sediment sampled should be at least 5 l. Samples should be sieved through either a 0.5 mm or 1 mm sieve. The issue of sieve size is a complicated one and both 0.5 mm and 1 mm sieves are commonly used for benthic survey work using grabs. Our recommendation is that consultants should initially examine the possible differences to their results of using a 1 mm sieve cf a 0.5 mm sieve and choose their sieve size accordingly. Species should be counted and identified to the lowest taxonomic level possible and particle size analysis should also be carried out.
Harder substrata e.g. bedrock or boulders	The most appropriate survey method is likely to utilise either divers, drop-down video or Remotely Operated Vehicle (ROV).

Table 5.1: Approaches to Stratified Benthic Sampling Design

Factor	Description of Appropriate Approaches
Sabellaria spinulosa reefs	Grabs should not be used in areas where subtidal *Sabellaria* reef features or *Modiolus modiolus* beds and chalk reefs are present in order to avoid possible damage. Recent studies undertaken on *S. spinulosa* reef in the Wash and its approaches by SeaMap (Foster-Smith *et al*, 2001, 2002 & 2003) have shown that the only way to positively identify reef is by direct observation since it can have a very patchy distribution and reef may be broken up during grabbing. This is a high resolution survey technique so the studies recommend a stratified approach to surveying for reef – i.e. broad scale survey to identify areas most likely to support reef followed by more intensive fine scale survey in these areas. For broad scale survey we advise use of sidescan. The sidescan should be used at a frequency of at least 500kHz (experience from survey work in the offshore industry has shown *S. spinulosa* reef is detected at this frequency but not necessarily at lower frequencies). The sidescan fish should be deployed close to the seabed. For fine scale survey and ground truthing of the sidescan data we advise use of ROV. Ideally this should be carried out concurrently with the sidescan (i.e. as and when an anomaly is identified by the sidescan) or failing this, in a follow up survey. Identification of areas not likely to support *Sabellaria spinulosa* can be undertaken using acoustic ground discrimination systems (AGDS), ground-truthed using grab and drop-down video observations. Further information on methodologies for surveying sites where *Sabellaria* is present can be found in English Nature (2003).
Survey Type	
Trawl surveys	To assess the presence of animals living on the surface of the seabed (epifauna).
Timing	
Avoid times of heavy sediment load	Sediment loadings are an important consideration when using acoustic techniques (including sidescan, AGDS) as heavy sediment loadings can interfere with acoustic signals. By reducing underwater visibility heavy sediment loadings can also reduce the effectiveness of video survey. Consequently, we recommend not undertaking surveys immediately after stormy weather and in areas of strong tidal currents undertake surveys around slack water if possible. Best conditions for survey are likely to be in summer.
Ground Truthing	
Acoustic surveys	It is also important that acoustic survey techniques are well ground-truthed using ROV, video, grab etc. to ensure interpretation of acoustic outputs are as accurate as possible. It is also important that the consultants appointed to carry out this work have sufficient expertise and quality control procedures in place to ensure that the work is done to a high standard.

Once the surveys are complete, the information can be used to assess whether the impacts are likely to be significant or not. Again, the detail

required from the survey should be proportionate to the information needed to determine if impacts are likely to be significant. More detailed information may only be needed when assessing if impacts are likely to cause adverse effect.

Identifying if the Impact is Likely to be Significant

The information collected through the surveys should provide the basis for determining if there is likely to be a significant impact on benthos. Here, the definition of significance is based upon the following factors:

- magnitude of the impact;
- type of impact;
- extent of impact;
- duration of impact;
- intensity of impact;
- timing of impact; and
- probability of impact.

These factors mean that the definition of significant is not fixed and can vary between different projects. Information on each of these seven factors will, therefore, be required when determining if the impact of the windfarm, either alone or in combination, is likely to be significant on subtidal benthos.

No thresholds are given in this guidance in terms of defining *significant* as the approach to considering whether impacts are significant needs to be considered objectively (rather than against somewhat arbitrary thresholds). Thus, it is necessary to consult with the appropriate organisations in order to determine the likely significance of impacts. The provision of information on magnitude, type, extent, duration, intensity, timing and probability should help with the identification of significant impacts. This information will be required if it is concluded that a significant effect is likely and an Appropriate Assessment has to be undertaken (see also Section 5.4). Organisations with whom it may be necessary to consult to discuss the potential significance of effects on subtidal benthos are given in Table 5.2. In all cases, significance should be considered cumulatively with other projects as well as the overall impact of a combination of the four impact types (habitat loss, smothering, scour and vibration).

Table 5.2: Potential Consultees for Determining the Significance of Impacts on Subtidal Benthos

England	Scotland	Wales
JNCC	JNCC	JNCC
English Nature	SNH	CCW
CEFAS	FRS	CEFAS
Potential non government organisations		
Marine Biological Association	Marine Biological Association	Marine Biological Association
Marine Conservation Society	Marine Conservation Society	Marine Conservation Society

Notes: For more information and contact details see Annex 2, or click on the organisation name in the Table while holding down the 'Ctrl' key.

5.3.2 Key References and Further Reading

Guidance on Surveys	
Reference	CEFAS (2002): *Guidelines for the conduct of benthic studies at aggregate extraction sites*, London: Department for Transport, Local Government and the Regions, 117pp.
Internet Address	www.cefas.co.uk/publications/files/02dpl001.pdf www.odpm.gov/stellent/groups/odpm_control/documents/contentservertemplate/ odpm_index.hcst?n
Summary	The introduction of EIA requirements for marine dredging has resulted in an increase in the level of information available to assess the impacts on benthos. The report provides guidance on the conduct and reporting of benthic surveys.
Reference	English Nature (2003): Sabellaria spinulosa *in the Wash and North Norfolk Coast cSAC and its Approaches: Stage III Summary of Knowledge, Recommended Monitoring Strategies and Outstanding Research Requirements*, English Nature Research Report No 543.
Internet Address	www.english-nature.org.uk/pubs/publication/PDF/543.pdf
Summary	In the UK, well-developed and stable *S. spinulosa* reefs are only known to date within the Wash and its surrounding waters. The report tests many of the assumptions about the importance of the species and the overall species diversity and richness in the Wash, and attempts to clarify the anecdotal evidence which has suggested a decline in the abundance and distribution of this species in the area.

(return to Flowchart 5)

5.4 Will the Impacts Cause Adverse Effect?

5.4.1 Identifying if there is Likely to be an Adverse Effect

The concept of adverse effect is linked to the potential that the integrity of a site and its contribution to the site network, designated under the Habitats and Birds Directive would be affected. The conclusion as to whether an adverse effect is likely is undertaken by a competent authority in the Appropriate Assessment. The collection of data as part of the approach to determining if the impact is likely to be significant should provide the competent authority with the basic level of information necessary to begin to undertake the Appropriate Assessment. To carry out an Appropriate Assessment, at a minimum, the information necessary should cover:

- a description of the project;
- a description of the aspects of the environment likely to be affected; and
- a description of the project's likely significant effects.

(return to Flowchart 5)

5.4.2 Key References and Further Reading

Reference	UK Biodiversity Group (1999): *Tranche 2 Action Plans – Maritime Species and Habitats Vol 5*.
Internet Address	www.ukbap.org.uk
Summary	Provides background information on marine and coastal habitats and species action plans.

(return to Flowchart 5)

5.5 Minimising the Impacts

Mitigation measures fall into two broad categories: best practice measures which should be adopted by any offshore windfarm and should be an industry standard; and additional mitigation which is aimed at reducing an impact specific to a particular development.

(return to Flowchart 5)

5.5.1 Best Practice

Examples of possible best practice measures are summarised as follows:

- adequate briefing of construction and maintenance personnel and, in particularly sensitive locations, the presence of an on-site construction ecologist;
- 'soft' start procedure to construction;
- careful use of anchors; and
- sensitive routing of maintenance trips to reduce potential disturbance from boats.

(return to Flowchart 5)

5.5.2 Possible Mitigation Measures for Adverse Effects

Adverse impacts should be avoided wherever possible. If adverse effects cannot be avoided, then suitable mitigation measures will need to be used to reduce or remove the effects. For each additional mitigation measure proposed, it is necessary to provide (European Commission, 2001):

- evidence of how it will be secured and implemented and by whom;
- evidence of the degree of confidence in its likely success;
- a timescale of when it will be implemented; and
- evidence of how the measure will be monitored and, should mitigation failure be identified, how that failure will be rectified.

Where mitigation is proposed to alleviate damaging impacts, the effectiveness should be assessed. Any mitigation measure requires

monitoring to determine its effectiveness against prescribed targets and a contingency plan in the event of it not meeting those targets.

The mitigation measures described in Table 5.3 are linked to the four main types of impact given in Section 5.2.1. They are organised in a hierarchy of preferred options (European Commission, 2001):

- highest preference: avoid impacts at source (implemented at planning level);
- second highest: reduce impacts at source (implemented at design level);
- third highest: abate impacts on site (implemented during construction, operation and decommissioning); and
- lowest: abate impacts on receptor (implemented for particular species).

It is suggested that consideration be given to the proposed mitigation measures in this hierarchy as this is most likely to result in the reduction of impacts to an acceptable level.

Table 5.3: Potential Mitigation Measures and Impacts they are Intended to Minimise

Reduce Impacts at Source				
Mitigation Measure	Adjust the positions of turbines to avoid sensitive benthic habitats.			
Impacts Mitigated	**Habitat Loss**	**Smothering**	**Scour**	**Vibration**
	✓	✓		
Summary of Likely Effectiveness	Not known			
Mitigation Measure	Reduce the area of seabed covered by the turbine base and scour protection, by altering turbine design and scour protection methods.			
Impacts Mitigated	**Habitat Loss**	**Smothering**	**Scour**	**Vibration**
	✓	✓	✓	
Summary of Likely Effectiveness	Not known			
Mitigation Measure	Directional drilling should be used for cable laying, reasonable care must be taken to minimise disturbance and re-suspension of seabed sediments. Water jetting should be avoided.			
Impacts Mitigated	**Habitat Loss**	**Smothering**	**Scour**	**Vibration**
		✓	✓	✓
Summary of Likely Effectiveness	Minimises recolonisation time for benthic organisms.			
Abate Impacts on Site				
Mitigation Measure	If there is an issue with sediment deposition in a specific area it may be possible to restrict piling to states of the tide when suspended sediments will be carried away from the sensitive area.			
Impacts Mitigated	**Habitat Loss**	**Smothering**	**Scour**	**Vibration**
		✓	✓	
Summary of Likely Effectiveness	Not known			

Table 5.3: Potential Mitigation Measures and Impacts they are Intended to Minimise

Mitigation Measure	Employing methods of chemical use that minimise release of polluting materials into the water column and only using chemicals selected from the List of Notified Chemicals.			
Impacts Mitigated	**Habitat Loss**	**Smothering**	**Scour**	**Vibration**
	✓			
Summary of Likely Effectiveness	Voluntary code used by oil and gas industry.			
Abate Impacts at Receptor				
Mitigation Measure	Operation of a soft start procedure for all drilling, driving and/or piling operations			
Impacts Mitigated	**Habitat Loss**	**Smothering**	**Scour**	**Vibration**
		✓		✓
Summary of Likely Effectiveness	Not known			

(return to Flowchart 5)

5.5.3 Monitoring

Monitoring may be necessary to focus on key changes that are likely to affect the condition of benthic habitats, including *Sabellaria spinulosa* reefs:

Monitoring may include:

- extent of the habitat or species;
- water clarity (particularly if sediments are going to be disturbed through construction works, scour, etc.); and
- change in number/occurrence/frequency of characteristic or notable species (the identification of indicator organisms of environmental changes can be particularly useful).

Table 5.4 summarises the approaches to monitoring that could be used with an offshore windfarm project. It is recommended that the Marine Monitoring Handbook be referred to where monitoring of reefs may be required. An appropriate agency should also be consulted (EN,CCW, SNH, JNCC).This is also the source of the information provided in Table 5.4.

Table 5.4: Summary of Approaches to Monitoring

Aim	To provide an indication of changes in the extent of habitat, impacts on water clarity, sediment stability and changes in number, occurrence and/or frequency of characteristic or notable species.
Timing/duration	Timing depends upon the extent to which the habitat changes seasonally. It may be possible to identify this from the desk study. Where seasonal variations are not understood, monitoring should be undertaken at the same time each year. Samples should be taken to adequately cover the extent and direction of the full tidal excursion.

Table 5.4: Summary of Approaches to Monitoring

Techniques/ approaches	Techniques are required that are likely to provide comparable measures. This could include AGDS, sidescan sonar, mosaicing sonar images and/or point sample mapping for the extent of subtidal reefs. Physical properties of the seabed can be monitored using drop-down video, ROV, diver-operated video or towed video (but this will be limited by the topography of the seabed and/or risk of damage).
Location	Any sampling programme must ensure that samples are recorded throughout the whole site. This should include a series of 'spot checks' to ensure that any extrapolations are representative of the whole site. Sample locations for ongoing monitoring should be determined by factors such as precise monopole locations, locations of cables, etc. Full account should also be taken of sensitive areas, coastal processes, modelling outputs (for sediment transport/deposition information) and geophysical surveys (to ensure adequate coverage of seabed). Sample locations should include those within the windfarm area, within the near-field area of the monopole foundations to determine scour effects, around the windfarm site to take account of sediment transport and deposition, and along the cable route.
Inclusion of controls	Control areas should be nearby but remote from the windfarm – outside of the tidal excursion and spaced at reasonable distances around the development area. Reference areas allow the impacts of natural changes to be observed such that any difference in changes within the windfarm area and the reference area can be identified.
Colonisation of monopiles and scour protection	Diver-operated video observations and analyses with some accompanying sample collection for verification and identification.
Uncertainties/ difficulties	Weather conditions will affect any monitoring. It is important that meteorological effects are integrated with seasonal effects to ensure that sites can be monitored effectively over time. A standardised approach is required when measuring number of species because the number recorded in directly linked to sampling effort. The approach should be 'effort limited', for example, by restricting the search area or search time. The seasonal reproductive patterns of marine communities may significantly affect the number of individuals present at different times of year.

(return to Flowchart 5)

5.5.4Key References and Further Reading

Mitigation Measures	
Reference	Offshore Chemicals Regulations 2002: *List of Notified Chemicals*.
Internet Address	www.cefas.co.uk/ocns
Summary	The Offshore Chemical Notification Scheme (OCNS) is administered by the Department of Trade and Industry using scientific and environmental advice from CEFAS and the Fisheries Research Services. The OCNS applies to all chemicals, which are used in the actual exploration, exploitation and associated offshore processing of petroleum on the UK Continental Shelf. The OCNS therefore applies to those 'operational' chemicals/products, which through their mode of use are expected in some proportion to be discharged.

Monitoring	
Reference	Davies J *et al* (Eds.) (2001): *Marine Monitoring Handbook*, Peterborough: Joint Nature Conservation Committee, 405pp.
Internet Address	www.jncc.gov.uk/marine/mmh/mmh_0601.pdf
Summary	The Marine Monitoring Handbook assesses the principles behind and the procedures for monitoring Annex 1 habitats and selected Annex II habitats (of the Habitats Directive), within marine SACs in British waters to assess their accordance with the relevant requirements of the Directive and the UK's common standards for site monitoring.
Reference	Foster-Smith & White (2001), Foster-Smith (2002), Foster-Smith & Hendrick (2003): *Sabellaria spinulosa in the Wash and Norfolk cSAC and its approaches: Parts I to III*. English Nature Research Reports Nos 543-545.
Internet Address	Part I: www.english-nature.org.uk/pubs/publication/PDF/545.pdf Part II: www.english-nature.org.uk/pubs/publication/PDF/544.pdf Part III: www.english-nature.org.uk/pubs/publication/PDF/543.pdf
Summary	In the UK, well-developed and stable *S. spinulosa* reefs are only known to date within the Wash and its surrounding waters. The reports test many of the assumptions about the importance of the species and the overall species diversity and richness in the Wash, and attempts to clarify the anecdotal evidence which has suggested a decline in the abundance and distribution of this species in the area.
Reference	Holme NA & McIntyre AD (eds.) (2004): *Methods for the Study of Marine Benthos*, Blackwell. 388pp.
Internet Address	Not available
Summary	Not available
Reference	Kingsford M & Battershill C (eds.) (1998): *Studying Temperate Marine Environments: A handbook for ecologists*, Canterbury University Press, New Zealand. 335pp.
Internet Address	Not available
Summary	Describes procedures for designing descriptive and experimental studies on mobile and sessile organisms of soft and hard substrata in both intertidal and subtidal environments. Also covered are methods for studying reef fish and planktonic assemblages. Data analysis and treatment of specimens are covered in detail. Some emphasis is given to the study of impacts, marine protected areas and processes that influence marine organisms.

Reference	CEFAS (2004): Offshore windfarms: Guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements: Version 2
Internet Address	http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf
Summary	Section 4 provides guidance on monitoring, survey design, sampling techniques and data analyses for benthos

6. CONSIDERATION OF IMPACTS ON INTERTIDAL HABITATS

6.1 Introduction

Intertidal habitats are often associated with extensive areas of soft sediment. The communities found within these areas are determined by the sediment type and its mobility. In general, coarse clean sediments or hard substrates tend to occur off exposed coasts and muddy sediments off sheltered coasts. Priority habitats include seagrass beds, saline lagoons, mudflats and sheltered muddy gravels. Intertidal EU Habitats Directive SAC Annex I habitats, include reefs, mudflats and sandflats, estuaries, large shallow inlets and bays, lagoons and caves, and EU Habitats Directive Annex II species associated with the intertidal habitats, include seals and otters.

These areas are also a valuable source of food for birds. The high biomass of intertidal communities on mudflats can support large numbers of waders and wintering waterfowl. Intertidal estuarine habitats support about 1.7 million waders and 650,000 wildfowl each winter including a number of internationally important species (such as barnacle goose, turnstone and redshank).

Intertidal habitats include those areas between the top of the splash zone (excluding saltmarsh and sand dunes which are covered under coastal and terrestrial habitats) and the low tide mark. They can be muddy or sand sediment habitats, mixed rock and sediment communities, rocky habitats or lagoons. These intertidal habitats support a wide range of species including maritime lichens, invertebrates such as sandhoppers *Talitrus saltator*, crabs *Carcinus maenas* or limpets *Patella vulgata*, seaweeds such as kelps *Laminaria digitata* or wracks *Fucus serratus*, sponges, biogenic reefs such as mussel *Mytilus edulis* beds, and fish.

Figure 6 presents a flowchart that will help you to move through this section, identifying the information that you need when making a decision as to the likely impacts on intertidal habitats.

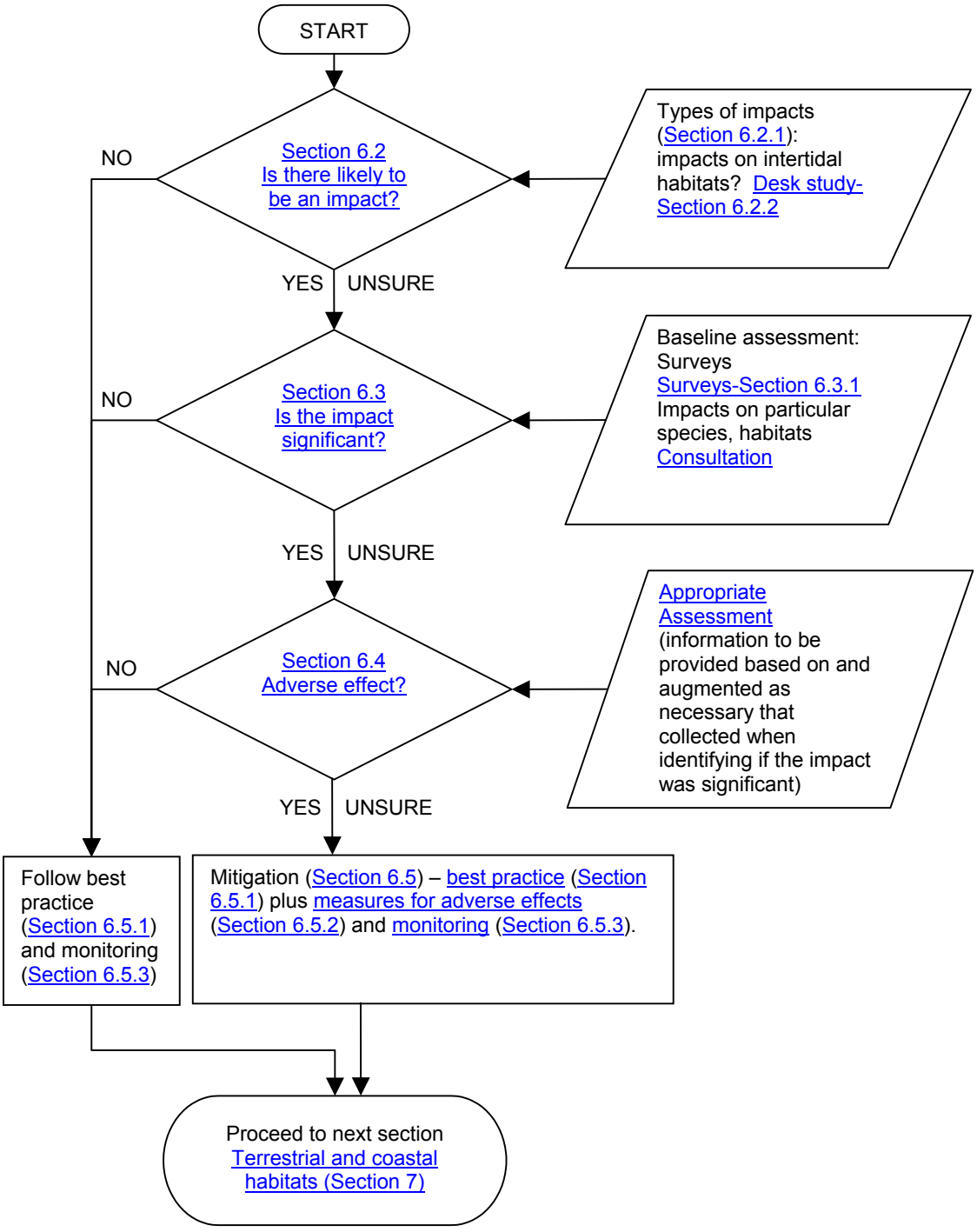

Figure 6: Flowchart for Determining Impacts on INTERTIDAL HABITATS

6.2 Is There Likely to be an Impact?

6.2.1 The Types of Impacts

Impacts on the different intertidal communities arise mainly from cable laying and the associated construction footprint, and could include physical damage to the intertidal habitat and increased turbidity due to offshore construction. Consideration of the impact of any damage or disturbance of the habitat utilised by species for which SACs or SPAs are designated will be paramount.

The severity of these impacts will depend on the shore types present, and their importance to designated species. As a general rule clean mobile exposed sandy shores recover more quickly than other sediment shore types. Bedrock, biogenic reef and muddy gravel shores are the most sensitive.

The sensitivity (recoverability and vulnerability) of designated and BAP habitats and species need special consideration when assessing potential impacts.

(return to Flowchart 6)

6.2.2 Baseline Study

The aim of the baseline study is to collect the following information for the activities relating to the laying down of cables:

- identification and description of the intertidal habitats along the cable route and surrounding area;
- identification and description of species present along the cable route and surrounding area and specific information on the biological community composition; and
- the sensitivity (recoverability and vulnerability) of the habitats and species identified.

Particular attention should be given to designated and BAP habitats and species. Important intertidal designated habitats to consider include:

- SAC, SSSI and Ramsar designations and can include almost any feature on the shore from rockpools to whole shores;
- intertidal SAC Annex 1 habitats, including reefs, mudflats and sandflats, estuaries, large shallow inlets and bays, lagoons and caves, and Annex 2 species associated with the intertidal habitats, including seals and otters;
- SSSI intertidal features including all nationally important and specialised biotopes, several whole shore designations, and nationally rare and scarce species listed in the Guidelines for selection of

biological SSSIs: intertidal marine habitats and saline lagoons (JNCC 1996); and
- Ramsar intertidal features which can include estuaries and coastal areas out to a depth of 6m.

Important BAP habitats and species to consider include:

- maritime cliff and slope, *Sabellaria alveolata* reefs, littoral chalk, *Ascophyllum nodosum* ecad *mackii* beds, seagrass beds, mudflats and sheltered muddy gravels, tidal rapids and saline lagoons; and
- all those species listed in Annex 3 of the UK Biodiversity Group Tranche 2 Action Plans, Volume V – maritime species and habitats.

A good source of data is the Marine Life Information Network for Britain and Ireland (Marlin) web site (www.marlin.ac.uk). In addition, other existing data may be available from organisations such as the conservation agencies (EN, CCW, SNH, JNCC), the Environment Agency, CEFAS or local Universities.

Identifying if an Impact is Likely to Occur

The information collected through the baseline desk study should provide the basis for determining if there is likely to be an impact on intertidal habitats and species during cable laying and associated construction activities. If it cannot be concluded that there will not be an impact (i.e. where it is uncertain whether an impact will occur or not), it should be assumed that there will be an impact (precautionary principle). If there is insufficient data to identify whether an impact is likely or not, it will be necessary to move onto collecting additional data through the use of surveys, thus a lack of data is not sufficient justification for concluding that there will not be an impact.

(return to Flowchart 6)

6.2.3 Key References and Further Reading

Sources of Information for the Desk Study	
Reference	The Marine Life Information Network for Britain and Ireland (Marlin) web site:
Internet Address	www.marlin.ac.uk
Summary	Provides information to support marine environmental management, protection and education, including information on habitats and species sensitivity, survey data and details of marine life surveys and other services such as sensitivity mapping, synthesis and interpretation data.

6.3 Is the Impact Significant?

Consideration of whether an impact is likely to be significant requires the collection of additional information through surveys and/or consultation with the relevant organisations.

(return to Flowchart 6)

6.3.1 Surveys

Where an impact on the intertidal habitats is likely, a habitat mapping survey of the area should be carried out. The survey should include the area where the cable will come ashore and the area where associated works will be undertaken. The surveys should be tailored such that they provide the information required to answer the question 'is the impact likely to be significant?'. Further information may be required should it be considered that the impact is likely to be significant. Where this is the case, there will be benefits (in terms of costs and time) of planning a phased approach to surveying.

Prior to the commencement of the survey, advice should be sought from the relevant SNCA on whether there is sufficient intertidal survey data for the section of coast being surveyed. This is because, if this is the case, no additional survey should be necessary. For those areas where there is not sufficient intertidal survey data, a baseline intertidal Phase 1 survey should be carried out following the methods in the CCW handbook for marine intertidal Phase 1 survey and mapping (Wyn *et al*, 2000). Other information on monitoring of intertidal habitats can be found in the Marine Monitoring Handbook.

The intertidal Phase 1 survey should include:

- mapping on orthorectified aerial photographs;
- assigning biotopes to samples and stations; and
- comparing results with other benthic surveys carried out.

The Environment Agency and maritime local authorities may provide beach topographic detail. On the south coast (Portland to Thames), the SE Regional Strategic Monitoring Programme (www.channelcoast.org) can also be an important source of information.

Once the surveys are complete, the information can be used to assess whether the impacts are likely to be significant or not. Again, the detail required from the survey should be proportionate to the information needed to determine if impacts are likely to be significant. More detailed information may only be needed when assessing if impacts are likely to cause adverse effect. For example, a more detailed Phase 2 survey (Hiscock, 1996) may be required along the chosen cable route. This should include, for the sediment shores, transects and granulometry using a 0.5mm sieve, and organisms identified to species level.

Identifying if the Impact is Likely to be Significant

The information collected through the surveys should provide the basis for determining if there is likely to be a significant impact on intertidal habitats. Here, the definition of significance is based upon the following factors:

- magnitude of the impact;
- type of impact;
- extent of impact;
- duration of impact;
- intensity of impact;
- timing of impact; and
- probability of impact.

These factors mean that the definition of significant is not fixed and can vary between different projects. Information on each of these seven factors will, therefore, be required when determining if the impact of the cables, either alone or in combination, is likely to be significant on intertidal habitats and species.

No thresholds are given in this guidance in terms of defining *significant* as the approach to considering whether impacts are significant needs to be considered objectively (rather than against somewhat arbitrary thresholds). Thus, it is necessary to consult with the appropriate organisations in order to determine the likely significance of impacts. The provision of information on magnitude, type, extent, duration, intensity, timing and probability should help with the identification of significant impacts. This information will be required if it is concluded that a significant effect is likely and an Appropriate Assessment has to be undertaken (see also Section 6.4). Organisations with whom it may be necessary to consult to discuss the potential significance of effects on intertidal habitats are given in Table 6.1. In all cases, significance should be considered cumulatively with other projects as well as the overall impact of a combination of the two impact types (physical damage and increased turbidity).

Table 6.1: Potential Consultees for Determining the Significance of Impacts on Intertidal Habitats

England	Scotland	Wales
JNCC	JNCC	JNCC
English Nature	SNH	CCW
Potential non government organisations		
Marine Biological Association	Marine Biological Association	Marine Biological Association
Marine Conservation Society	Marine Conservation Society	Marine Conservation Society
Local Wildlife Trusts		

Notes: For more information and contact details see Annex 2, or click on the organisation name in the Table while holding down the 'Ctrl' key.

(return to Flowchart 6)

6.3.2Key References and Further Reading

Guidance on Surveys	
Reference	Wyn G Brazier P & McMath M (2000): *CCW Handbook for Marine Intertidal Phase 1 Survey and Mapping*, CCW Marine Science Report: 00/06/01 February 2000.
Internet Address	Not available
Summary	Not available
Reference	Hiscock K (Ed.) (1996): *Marine Nature Conservation Review: Rationale and Methods*, Peterborough, Joint Nature Conservation Committee. (Coasts and seas of the United Kingdom. MNCR series).
Internet Address	Not availablehttp://www.channelcoast.org/
Summary	Not available
Reference	South East Regional Strategic Monitoring Programme.
Internet Address	www.channelcoast.org
Summary	The programme provides a consistent regional approach to coastal process monitoring, providing information for development of strategic shoreline management plans, coastal defence strategies and operational management of coastal protection and flood defence.

(return to Flowchart 6)

6.4 Will the Impacts Cause Adverse Effect?

6.4.1Identifying if there is Likely to be an Adverse Effect?

The concept of adverse effect is linked to the potential that the integrity of a site and its contribution to the site network, designated under the Habitats and Birds Directives would be affected. The conclusion as to whether an adverse effect is likely is undertaken by a competent authority in the Appropriate Assessment. The collection of data as part of the approach to determining if the impact is likely to be significant should provide the competent authority with the basic level of information necessary to begin to undertake the Appropriate Assessment. To carry out an Appropriate Assessment, at a minimum, the information necessary should cover:

- a description of the project;
- a description of the aspects of the environment likely to be affected; and
- a description of the project's likely significant effects.

(return to Flowchart 6)

6.4.2 Key References and Further Reading

Reference	UK Biodiversity Group (1999): *Tranche 2 Action Plans – Maritime Species and Habitats Vol 5*.
Internet Address	www.ukbap.org.uk
Summary	Provides background information on marine and coastal habitats and species action plans.

(return to Flowchart 6)

6.5 Minimising the Impacts

Mitigation measures fall into two broad categories: best practice measures which should be adopted by any offshore windfarm and should be an industry standard; and additional mitigation which is aimed at reducing an impact specific to a particular development.

(return to Flowchart 6)

6.5.1 Best Practice

Examples of possible best practice measures are summarised as follows:

- during the planning and design stages ensure cable route and construction area avoid all major sensitive areas;
- all working routes to be clearly defined and adhered to;
- ensure oil and fuel from machinery does not escape and carry emergency oil spill kits for split hydraulic hose incidents etc.;
- adequate briefing of construction and maintenance personnel and, in particular in sensitive locations, the presence of an on-site construction ecologist;
- timing of phases of construction and maintenance works to avoid sensitive periods and sensitive areas; and
- monitoring the effects using a Before-After-Control-Impact (BACI) study (see also 6.5.3 on monitoring).

(return to Flowchart 6)

6.5.2 Possible Mitigation Measures for Adverse Effects

Adverse impacts should be avoided wherever possible. If adverse effects cannot be avoided, then suitable mitigation measures will need to be used to reduce or remove the effects. For each additional mitigation measure proposed, it is necessary to provide (European Commission, 2001):

- evidence of how it will be secured and implemented and by whom;
- evidence of the degree of confidence in its likely success;
- a timescale of when it will be implemented; and

- evidence of how the measure will be monitored and, should mitigation failure be identified, how that failure will be rectified.

Where mitigation is proposed to alleviate damaging impacts, the effectiveness should be assessed. Any mitigation measure requires monitoring to determine its effectiveness against prescribed targets and a contingency plan in the event of it not meeting those targets.

The mitigation measures described in Table 6.2 are linked to the main types of impact given in Section 6.2.1. They are organised in a hierarchy of preferred options (European Commission, 2001):

- highest preference: avoid impacts at source (implemented at planning level);
- second highest: reduce impacts at source (implemented at design level);
- third highest: abate impacts on site (implemented during construction, operation and decommissioning); and
- lowest: abate impacts on receptor (implemented for particular species).

It is suggested that consideration be given to the proposed mitigation measures in this hierarchy as this is most likely to result in the reduction of impacts to an acceptable level.

Table 6.2: Potential Mitigation Measures and Impacts they are Intended to Minimise

Avoid Impacts at Source		
Mitigation Measure	Avoid areas such as mud, muddy gravel, *Zostera* beds and biogenic reefs because of their long recovery periods.	
Impacts Mitigated	**Physical Damage**	**Increased Turbidity**
	✓	
Summary of Likely Effectiveness	Will protect sensitive habitats.	
Mitigation Measure	Clearly defined working corridors.	
Impacts Mitigated	**Physical Damage**	**Increased Turbidity**
	✓	
Summary of Likely Effectiveness	Will restrict potential damage.	
Reduce Impacts at Source		
Mitigation Measure	Use less damaging methods for cable lying such as directional drilling or ploughing.	
Impacts Mitigated	**Physical Damage**	**Increased Turbidity**
	✓	✓
Summary of Likely Effectiveness	Consult with the appropriate Shoreline Management Plan to ensure that the proposed landfall point and location of inspection chamber is landward from a viable coast defence structure, so as to remove the need for additional work on the shoreline.	

Table 6.2: Potential Mitigation Measures and Impacts they are Intended to Minimise

Mitigation Measure	Use of low ground pressure machinery and/or hover platforms.	
Impacts Mitigated	**Physical Damage**	**Increased Turbidity**
	✓	
Summary of Likely Effectiveness	Will reduce potential damage.	
Abate Impacts on Site		
Mitigation Measure	When trenching, retain upper layers of the sediment in order for it to be replaced once the cable is in place so that sediment profile is maintained and re-colonisation encourage.	
Impacts Mitigated	**Physical Damage**	**Increased Turbidity**
	✓	✓
Summary of Likely Effectiveness	Effective but care needed in storing material in the marine environment.	
Mitigation Measure	Avoid areas such as mud, muddy gravel, *Zostera* beds and biogenic reefs because of their long recovery periods.	
Impacts Mitigated	**Physical Damage**	**Increased Turbidity**
	✓	
Summary of Likely Effectiveness	Effective but may lead to long cable routes.	

(return to Flowchart 6)

6.5.3Monitoring

Whenever an impact is likely on intertidal communities, sampling regimes should be set up to monitor these impacts. Monitoring needs to focus on key changes that are likely to affect the condition of the intertidal habitats:

- extent of the habitat;
- sediment character;
- dynamics of the system including tidal prism;
- nutrient status; and
- change in number/occurrence/frequency of characteristic or notable species.

Table 6.3 summarises the approaches to monitoring that could be used with an offshore windfarm project. It is recommended that the Marine Monitoring Handbook be referred to where monitoring of estuaries, mudflats and sandflats may be required. This is also the source of the information provided in Table 6.3.

Table 6.3: Summary of Approaches to Monitoring

Aim	To provide an indication of changes in the extent of habitat, impacts on water clarity, system dynamics and changes in number, occurrence and/or frequency of characteristic or notable species.

Table 6.3: Summary of Approaches to Monitoring

Recommended approach	The preferred approach is to design a BACI (Before-After-Control-Impact) study. The BACI design enables a comparison to be made before, during and after the construction of the windfarm.
Timing/duration	Many of the physical environmental attributes to be monitored are strongly linked to the tidal cycle or level of freshwater input and are likely to experience considerable seasonal variation. Beach profiles should be monitored three times a year, for example, in September, January and April.
Techniques/ approaches	Techniques are required that are likely to provide comparable measures. Sediment traps or beach profiling to monitor sediment loading. Repeat transect and granulometry surveys to monitor community recovery at the cable landfall. Spatial patterns, such as zonation from the top to bottom of the shore should be captured by the use of transects. Dynamics of the system can be monitored through LIDAR, bathymetric mapping, and current meters. Invertebrate sampling and monitoring should also be carried out. This should include samples at lower, mid and upper shore levels, along 3 transects running perpendicular to the shore.
Location	Regular monitoring of beach profiles may be required to illustrate major changes in annual profiles.
Inclusion of reference areas	Reference or control areas are important to enable a distinction to be made between results that can be attributed to the windfarm and those that can be attributed to other causative factors, such as natural change. Ideally more than one reference area should be used, although, as it may be difficult to find even one suitably matched area, a single reference for each windfarm may have to be sufficient.
Uncertainties/ difficulties	Weather conditions can affect monitoring. Periods of heavy rain can affect sampling programmes. Records should be kept of the weather conditions. Sediment sampling must take care to preserve the fine sediment fraction. Intertidal habitats can form important habitats for birds and seals. Sampling activities should be timed to avoid disturbance during sensitive periods (e.g. breeding).

(return to Flowchart 6)

6.5.4Key References and Further Reading

Monitoring	
Reference	South East Strategic Regional Coastal Monitoring Programme:
Internet Address	www.channelcoast.org
Summary	The programme provides a consistent regional approach to coastal process monitoring, providing information for development of strategic shoreline management plans, coastal defence strategies and operational management of coastal protection and flood defence.

Monitoring	
Reference	Davies J *et al* (Eds.) (2001): *Marine Monitoring Handbook*. Peterborough: Joint Nature Conservation Committee, 405pp.
Internet Address	www.jncc.gov.uk/marine/mmh/mmh_0601.pdf
Summary	The Marine Monitoring Handbook assesses the principles behind and the procedures for monitoring Annex 1 habitats and selected Annex 2 habitats (of the Habitats Directive), within marine SACs in British waters to assess their accordance with the relevant requirements of the Directive and the UK's common standards for site monitoring.

7. CONSIDERATION OF IMPACTS ON TERRESTRIAL AND COASTAL HABITATS

7.1 Introduction

Coastal habitats, especially in low lying areas, are under considerable threat from sea level rise and coastal squeeze. These habitats include saltmarsh, coastal grazing marsh and sand dunes. All these are priority habitats and much of the coast supporting these habitats is designated as SAC or SPA.

Coastal Saltmarshes

Coastal saltmarshes in the UK (also known as 'merse' in Scotland) comprise the upper, vegetated portions of intertidal mudflats, lying approximately between mean high water neap tides and mean high water spring tides. Saltmarshes are usually restricted to comparatively sheltered locations in five main physiographic situations: in estuaries, in saline lagoons, behind barrier islands, at the heads of sea lochs, and on beach plains. The development of saltmarsh vegetation is dependent on the presence of intertidal mudflats:
(http://www.ukbap.org.uk/ukplans.aspx?ID=34).

Saltmarshes are an important resource for wading birds and wildfowl. They act as high tide refuges for birds feeding on adjacent mudflats, as breeding sites for waders, gulls and terns and as a source of food for passerine birds particularly in autumn and winter. In winter, grazed saltmarshes are used as feeding grounds by large flocks of wild ducks and geese. Areas with high structural and plant diversity, particularly where freshwater seepages provide a transition from fresh to brackish conditions, are particularly important for invertebrates. Saltmarshes also provide sheltered nursery sites for several species of fish.

Coastal Sand Dunes

Coastal sand dunes develop where there is an adequate supply of sand in the intertidal zone and where onshore winds are prevalent. Sand dune vegetation forms a number of zones, which are related to the time elapsed since the sand was deposited, the degree of stability which it has attained, and the local hydrological conditions. Embryonic and mobile dunes occur mainly on the seaward side of a dune system where sand deposition is occurring and occasionally further inland in blow-outs. They support very few plant species, the most characteristic being marram grass *Ammophila arenaria*.

Semi-fixed dunes occur where the rate of sand accretion has slowed but the surface is still predominantly bare sand; marram is still common but there is an increasing number of other species. Fixed dune grassland forms largely closed swards where accretion is no longer significant, the

surface is stabilised and some soil development has taken place. Calcareous fixed dunes support a particularly wide range of plant species. On dunes which have become acidified by leaching, acid dune grassland or dune heaths develop. Fixed dunes and dune heath are particularly threatened habitats and are regarded as priorities under the EC Habitats Directive.

Dune grassland and dune slacks, especially on the more calcareous systems, support a wide variety of colourful flowering plants, including a number of species of orchid. Sand dune systems are also very rich in invertebrates, including butterflies, moths and burrowing bees and wasps.

Coastal and Floodplain Grazing Marsh

Grazing marsh is defined as periodically inundated pasture, or meadow with ditches which maintain the water levels, containing standing brackish or fresh water. The ditches are especially rich in plants and invertebrates. Almost all areas are grazed and some are cut for hay or silage. Sites may contain seasonal water-filled hollows and permanent ponds with emergent swamp communities, but not extensive areas of tall fen species like reeds; although they may abut with fen (http://www.ukbap.org.uk/UKPlans.aspx?ID=18) and reed swamp communities (http://www.ukbap.org.uk/UKPlans.aspx?ID=19).

Grazing marshes are particularly important for the number of breeding waders such as Snipe *Gallinago gallinago*, Lapwing *Vanellus vanellus* and Curlew *Numenius arquata* they support. Internationally important populations of wintering wildfowl also occur including Bewick swans *Cygnus bewickii* and Whooper swans *Cygnus cygnus.*

Figure 7 presents a flowchart that will help you to move through this section, identifying the information that you need when making a decision as to the likely impacts on terrestrial and coastal habitats.

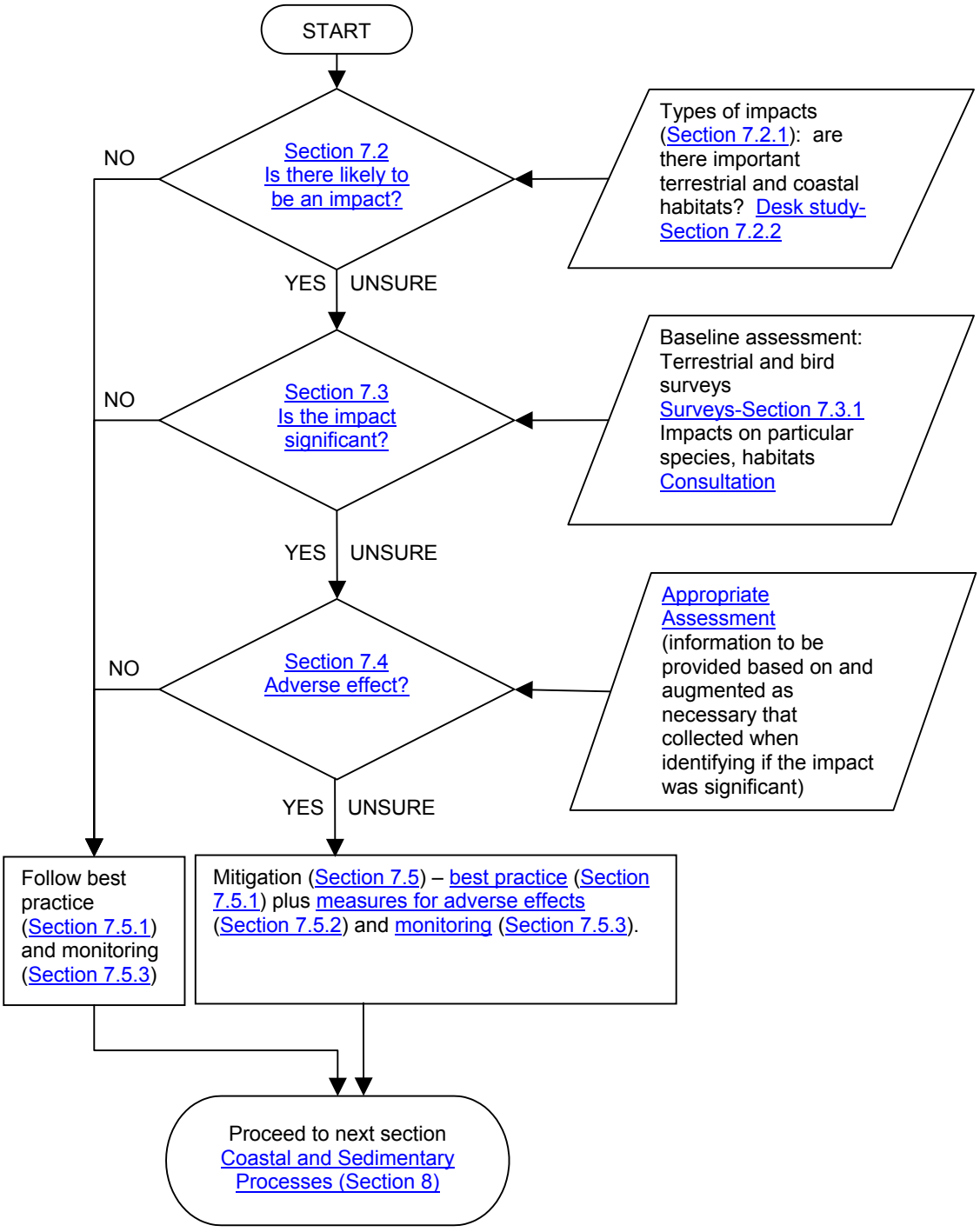

Figure 7: Flowchart for Determining Impacts on TERRESTRIAL AND COASTAL HABITATS

7.2 Is There Likely to be an Impact?

7.2.1 The Types of Impacts

Potential impacts will be associated with:

- cabling through dunes and marshes;
- the building of onshore auxiliary structures associated with the offshore windfarm, whether temporary or permanent; and
- access to the sea.

These can be related to the following impact types:

- habitat loss;
- displacement;
- collision; and
- barrier effects.

(return to Flowchart 7)

7.2.2 Baseline Study

The desk study should use readily available information on habitats in the area likely to be affected by cabling or building of onshore structures.

(return to Flowchart 7)

Identifying if an Impact is Likely to Occur

An impact will occur if any activity is likely to affect saltmarshes, coastal and floodplain grazing marsh, saline lagoons or sand dunes. These habitats are identified as being of particular nature conservation importance such that any impacts upon them are likely to require a consideration of potential significance.

(return to Flowchart 7)

7.2.3 Key References and Further Reading

Sources of Information for the Desk Study	
Reference	National Rivers Authority (now Environment Agency) (1995): *A guide to the Understanding and Management of Saltmarshes*, R&D Note 324.
Internet Address	Not available
Summary	Provides a comprehensive review of saltmarshes, information on existing knowledge and working practices primarily for coastal defence managers. (In the process of being updated).

Sources of Information for the Desk Study	
Reference	Pye K (2000): *Saltmarsh erosion in southeast England; mechanisms, causes and implications* in Sherwood BR *et al* (Eds.) *British Saltmarshes,* Forrest Text, Cardigan, 359-396.
Internet Address	Not available
Summary	Provides a comprehensive review of saltmarshes, information on existing knowledge and working practices primarily for coastal defence managers. (In the process of being updated).
Reference	Carpenter KE & Pye K (1997): *Saltmarsh Change in England and Wales: Its History and Causes*, Environment Agency Technical Report W12, EA Bristol.
Internet Address	Not available
Summary	Not available

7.3 Is the Impact Significant?

Consideration of whether an impact is likely to be significant requires the collection of additional information through surveys and/or consultation with the relevant organisations.

(return to Flowchart 7)

7.3.1 Surveys

At least two types of survey are likely to be required:

- terrestrial survey; and
- bird survey.

The surveys should be tailored such that they provide the information required to answer the question 'is the impact likely to be significant?'. Further information may be required should it be considered that the impact is likely to be significant. Where this is the case, there will be benefits (in terms of costs and time) of planning a phased approach to surveying. A summary of the survey types is given in Table 7.1.

Table 7.1: Approaches to Surveying of Terrestrial and Coastal Habitats

Survey Type	Description of Appropriate Approaches
Terrestrial survey	To establish whether protected species (eg water vole, great crested newt, otter, breeding birds or badger) or BAP species are present on site close to the chosen cable corridor: • for plant communities: Phase I mapping with aerial photography, and NVC surveys with quadrant or belt transect sampling or fixed point photography; • species composition of communities: quadrat sampling; quadrat photography; viewpoint photography; • zonation: the width of zones should be estimated using one or more transects extending from highest to lowest part of marshes and dunes. The GPS information should be collected

Table 7.1: Approaches to Surveying of Terrestrial and Coastal Habitats

Survey Type	Description of Appropriate Approaches
	and marked on a map; and/or • notable plant species: resource mapping; quadrat sampling; visual assessment (look-see).
Bird survey	To identify bird sensitive areas (including wintering and breeding birds) link to Section 2.5.3 (Monitoring).

Once the surveys are complete, the information can be used to assess whether the impacts are likely to be significant or not. Again, the detail required from the survey should be proportionate to the information needed to determine if impacts are likely to be significant. More detailed information may only be needed when assessing if impacts are likely to cause adverse effect.

Identifying if the Impact is Likely to be Significant

The information collected through the surveys should provide the basis for determining if there is likely to be a significant impact on terrestrial and coastal habitats. Here, the definition of significance is based upon the following factors:

- magnitude of the impact;
- type of impact;
- extent of impact;
- duration of impact;
- intensity of impact;
- timing of impact; and
- probability of impact.

These factors mean that the definition of significant is not fixed and can vary between different projects. Information on each of these seven factors will, therefore, be required when determining if the impact of the windfarm, either alone or in combination, is likely to be significant on terrestrial and coastal habitats.

No thresholds are given in this guidance in terms of defining *significant* as the approach to considering whether impacts are significant needs to be considered objectively (rather than against somewhat arbitrary thresholds). Thus, it is necessary to consult with the appropriate organisations in order to determine the likely significance of impacts. The provision of information on magnitude, type, extent, duration, intensity, timing and probability should help with the identification of significant impacts. This information will be required if it is concluded that a significant effect is likely and an Appropriate Assessment has to be undertaken (see also Section 7.4). Organisations with whom it may be necessary to consult to discuss the potential significance of effects on terrestrial and coastal habitats are given in Table 7.2. In all cases, significance should be considered cumulatively with other projects as well as the overall impact of a combination of impacts on offshore and intertidal habitats.

Table 7.2: Potential Consultees for Determining the Significance of Impacts on Terrestrial and Coastal Habitats

England	Scotland	Wales
JNCC	JNCC	JNCC
English Nature	SNH	CCW
Environment Agency	SEPA	Environment Agency
Potential non government organisations		
RSPB/BTO	RSPB/BTO	RSPB/BTO
WWF	WWF	WWF

Notes: For more information and contact details see Annex 2, or click on the organisation name in the Table while holding down the 'Ctrl' key.

7.3.2Key References and Further Reading

Guidance on Surveys	
Reference	National Rivers Authority (now the Environment Agency) (1995): *A Guide to the understanding and Management of Saltmarshes* (1995) R & D Note 324 (In the process of being updated).
Internet Address	Not available
Summary	Provides some guidance on monitoring techniques.

(return to Flowchart 7)

7.4 Will the Impacts Cause Adverse Effect?

7.4.1Identifying if there is Likely to be an Adverse Effect

The concept of adverse effect is linked to the potential that the integrity of a site and its contribution to the site network, designated under the Habitats and Birds Directives, would be affected. The conclusion as to whether an adverse effect is likely is undertaken by a competent authority in the Appropriate Assessment. The collection of data as part of the approach to determining if the impact is likely to be significant should provide the competent authority with the basic level of information necessary to begin to undertake the Appropriate Assessment. To carry out an Appropriate Assessment, at a minimum, the information necessary should cover:

- a description of the project;
- a description of the aspects of the environment likely to be affected; and
- a description of the project's likely significant effects.

(return to Flowchart 7)

7.4.2Key References and Further Reading

Reference	UK Biodiversity Group (1999): *Tranche 2 Action Plans – Maritime Species and Habitats Vol 5*.
Internet Address	www.ukbap.org.uk
Summary	Provides background information on marine and coastal habitats and species action plans.

(return to Flowchart 7)

7.5 Minimising the Impacts

Mitigation measures fall into two broad categories: best practice measures which should be adopted by any offshore windfarm and should be an

industry standard; and additional mitigation which is aimed at reducing an impact specific to a particular development.

(return to Flowchart 7)

7.5.1 Best Practice

Examples of possible best practice measures are summarised as follows:

- during the planning and design stages ensure cable route and construction area avoid all major sensitive areas;
- use of low ground pressure machinery;
- all working routes to be clearly defined and adhered to;
- ensure oil and fuel from machinery does not escape and carry emergency oil spill kits for split hydraulic hose incidents etc.;
- adequate briefing of construction and maintenance personnel and, in particular in sensitive locations, the presence of an on-site construction ecologist;
- timing of phases of construction and maintenance works to avoid sensitive periods and sensitive areas; and
- monitoring the effects using a Before-After-Control-Impact (BACI) study (see also Section 7.5.3 on monitoring).

(return to Flowchart 7)

7.5.2 Possible Mitigation Measures for Adverse Effects

Adverse impacts should be avoided wherever possible. If adverse effects cannot be avoided, then suitable mitigation measures will need to be used to reduce or remove the effects. For each additional mitigation measure proposed, it is necessary to provide (European Commission, 2001):

- evidence of how it will be secured and implemented and by whom;
- evidence of the degree of confidence in its likely success;
- a timescale of when it will be implemented; and
- evidence of how the measure will be monitored and, should mitigation failure be identified, how that failure will be rectified.

Where mitigation is proposed to alleviate damaging impacts, the effectiveness should be assessed. Any mitigation measure requires monitoring to determine its effectiveness against prescribed targets and a contingency plan in the event of it not meeting those targets.

The mitigation measures described in Table 7.3 are linked to the four main types of impact given in Section 7.2.1. They are organised in a hierarchy of preferred options (European Commission, 2001):

- highest preference: avoid impacts at source (implemented at planning level);

- second highest: reduce impacts at source (implemented at design level);
- third highest: abate impacts on site (implemented during construction, operation and decommissioning); and
- lowest: abate impacts on receptor (implemented for particular species).

It is suggested that consideration be given to the proposed mitigation measures in this hierarchy as this is most likely to result in the reduction of impacts to an acceptable level.

Table 7.3: Potential Mitigation Measures and Impacts they are Intended to Minimise

Avoid Impacts at Source				
Mitigation Measure	Avoid areas of high quality/high diversity marsh, and sites where notable species are present. Preference should be given to areas of low structural diversity (i.e. short sward height/grazed). Avoid excavating in dunes; preference should be given to horizontal drilling / coring for cables.			
Impacts Mitigated	**Habitat Loss**	**Displacement**	**Collision**	**Barrier Effects**
	✓	✓	✓	✓
Summary of Likely Effectiveness	Ideally, backfilled trenches should be topped with the original turf. Disturbed areas should be temporarily protected by an open-weave geo-textile to prevent erosion and artificial creek development.			
Reduce Impacts at Source				
Mitigation Measure	Construction methods and timing will need to take account of the results of the baseline survey.			
Impacts Mitigated	**Habitat Loss**	**Displacement**	**Collision**	**Barrier Effects**
		✓		
Summary of Likely Effectiveness	Timing will need to consider habitat and use by birds.			
Mitigation Measure	Minimise footprint of pylons for overhead cables, avoid more sensitive areas (e.g. sites with notable species).			
Impacts Mitigated	**Habitat Loss**	**Displacement**	**Collision**	**Barrier Effects**
	✓	✓	✓	✓
Summary of Likely Effectiveness	Not known			
Abate Impacts on Site				
Mitigation Measure	The EIA should also consider terrestrial habitat that might be damaged or disturbed during installation of the overhead lines or during the storage of cables, pipes and heavy machinery, etc.			
Impacts Mitigated	**Habitat Loss**	**Displacement**	**Collision**	**Barrier Effects**
	✓	✓		✓
Summary of Likely Effectiveness	Mitigation to prevent bird collisions could be as simple as providing the overhead lines with conspicuous markers.			

Table 7.3: Potential Mitigation Measures and Impacts they are Intended to Minimise

Mitigation Measure	Disturbed areas should be temporarily protected by a geo-textile to prevent erosion and blow-outs. Minimise disturbance of marsh surface by heavy plant by covering marsh surface temporarily with excavator mats or use hover platforms.			
Impacts Mitigated	**Habitat Loss**	**Displacement**	**Collision**	**Barrier Effects**
		✓		
Summary of Likely Effectiveness	Techniques used successfully on peatbeds.			
Mitigation Measure	Employing methods of chemical use that minimise release of polluting materials into the water column and only using chemicals selected from the List of Notified Chemicals.			
Impacts Mitigated	**Habitat Loss**	**Displacement**	**Collision**	**Barrier Effects**
	✓			
Summary of Likely Effectiveness	Voluntary code used by oil and gas industry.			

(return to Flowchart 7)

7.5.3 Monitoring

Monitoring of coastal and terrestrial habitats need to include the impacts of changes on:

- extent of habitats;
- changes in water quality or sediment character; and
- changes in number, occurrence or frequency of species composition.

Table 7.4 summarises the approaches to monitoring that could be used with an offshore windfarm project. Much of the information included in Table 7.4 is taken from the Marine Monitoring Handbook.

Table 7.4: Summary of Approaches to Monitoring

Recommended approach	The preferred approach is to design a BACI (Before-After-Control-Impact) study. The BACI design enables a comparison to be made before, during and after the construction of the windfarm.
Timing/duration	Seasonal patterns must be considered when planning a monitoring programme. Ideally, sampling should be undertaken at the same time each year.
Techniques/ approaches	Techniques need to provide comparable results across different factors (species richness, species counts, etc.). Grab sampling, core sampling, suction sampling, drop-down video, ROV, diver-operated video, towed video can all be used to assess species composition and/or richness.
Location	It cannot be assumed that a single sampling station will be representative of the whole habitat. A pilot study may be required to identify the number of sampling stations that are likely to be required.

Table 7.4: Summary of Approaches to Monitoring

Inclusion of reference areas	Reference or control areas are important to enable a distinction to be made between results that can be attributed to the windfarm and those that can be attributed to other causative factors, such as natural change. Ideally more than one reference area should be used, although, as it may be difficult to find even one suitably matched area, a single reference for each windfarm may have to be sufficient.
Uncertainties/ difficulties	There may be seasonal effects that could significantly affect monitoring results. Weather conditions are also likely to affect monitoring. Changes in strength of wave action or frequency of storms could lead to a change in topography of location of coastal habitats (particularly subtidal sandbanks).

(return to Flowchart 7)

7.5.4Key References and Further Reading

Mitigation Measures	
Reference	Offshore Regulations 2002: *List of Notified Chemicals*.
Internet Address	www.cefas.co.uk/ocns
Summary	The Offshore Chemical Notification Scheme (OCNS) is administered by the Department of Trade and Industry using scientific and environmental advice from CEFAS and the Fisheries Research Services. The OCNS applies to all chemicals, which are used in the actual exploration, exploitation and associated offshore processing of petroleum on the UK Continental Shelf. The OCNS therefore applies to those 'operational' chemicals/products, which through their mode of use are expected in some proportion to be discharged.
Reference	DETR: *Policy Guidelines for the Coast* and *Planning Policy Guidance - Coastal Planning* (PPG 20):
Internet Address	www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_606907.pdf
Summary	Covers planning policy for the coastal areas of England and Wales. It sets the general context for policy (Chapter 1) and identifies planning policies for the coast (Chapter 2). Policies for development that require a coastal location are presented in Chapter 3. Guidance is then given on how these policies should be reflected in development plans (Chapter 4).

Mitigation Measures	
Reference	Scottish Office: *Coastal Planning* (NPPG 13):
Internet Address	www.scotland.gov.uk/about/Planning/nppg_13_coastalplann.aspx
Summary	The NPPG: - sets out how planning can contribute to achieving sustainable development and also maintaining and enhancing biodiversity on the coast; - highlights the need to distinguish between policies for the developed, undeveloped and isolated coast; - indicates how planning authorities should respond to the risk of erosion and flooding in the coastal zone; - outlines policy guidance for developments which may require a coastal location; and - identifies the action to be taken by planning authorities in their development plans and in development control decisions.
Reference	Welsh Office: *Coastal Planning* (Technical Advice Note 14)
Internet Address	www.wales.gov.uk/subiplanning/content/tans/tan14/homepage_e/htm
Summary	Sets out the specific issues that should be considered in relation to the coastal zone, plus coast specific considerations that need to be incorporated into the planning process.
Reference	DoE(NI): *Planning Strategy for Rural Northern Ireland*:
Internet Address	www.planningni.gov.uk/AreaPlans_Policy/Strategies/PSNRI_pdf/introduction.pdf
Summary	The Planning Strategy for Rural Northern Ireland covers all of the towns, villages and countryside of Northern Ireland outside Belfast (and adjoining built up areas) and Londonderry.
Reference	MAFF's and WAG's *Strategy for Flood and Coastal Defence in England and Wales*:
Internet Address	www.defra.gov.uk/environ/fcd/policy/strategy.htm
Summary	A new strategy entitled 'Making Space for Water' was published in July 2004, with a consultation period that runs until 1 November 2004.
Reference	DETR's *Coastal Zone Management - Towards Best Practice*. Shoreline Management Plans:
Internet Address	www.defra.gov.uk/environ/fcd/policy/smp.htm www.ukbap.org.uk/
Summary	Not available.

Monitoring	
Reference	Davies J *et al* (Eds.) (2001): *Marine Monitoring Handbook*, Peterborough: Joint Nature Conservation Committee, 405pp.
Internet Address	www.jncc.gov.uk/marine/mmh/mmh_0601.pdf
Summary	The Marine Monitoring Handbook assesses the principles behind and the procedures for monitoring Annex 1 habitats and selected Annex 2 habitats (of the Habitats Directive), within marine SACs in British waters to assess their accordance with the relevant requirements of the Directive and the UK's common standards for site monitoring.

8. CONSIDERATION OF IMPACTS ON COASTAL AND SEDIMENTARY PROCESSES

8.1 Introduction

The seabed of inshore areas comprises a mixture of sands, gravels and soft sediments. The sedimentary process and available materials dictate the final form which is often dynamic. The communities found in, on and around these areas are determined by the sediment type and its mobility. Of particular interest in terms of nature conservation are offshore sandbanks and designated sites on the coast in particular the processes of accretion and erosion of coastal landforms, such as beaches, dunes and saltmarshes.

Sedimentary processes in the coastal zone are the result of complex interactions between tides and tidal currents, and waves and wave-induced currents. When waves (or swells) propagate into shallow water they are modified by refraction, shoaling, and energy losses. Refraction of waves entering shallow coastal waters is often the overriding factor in governing sediment entrainment and deposition, sediment transport paths and ultimately landform evolution. This section also includes impacts on hydrodynamics, which is the study of the motion of wind, waves and tides and is the driving force behind sedimentary processes in the shallow nearshore zone.

Figure 8 presents a flowchart that will help you to move through this section, identifying the information that you need when making a decision as to the likely impacts on coastal and sedimentary processes.

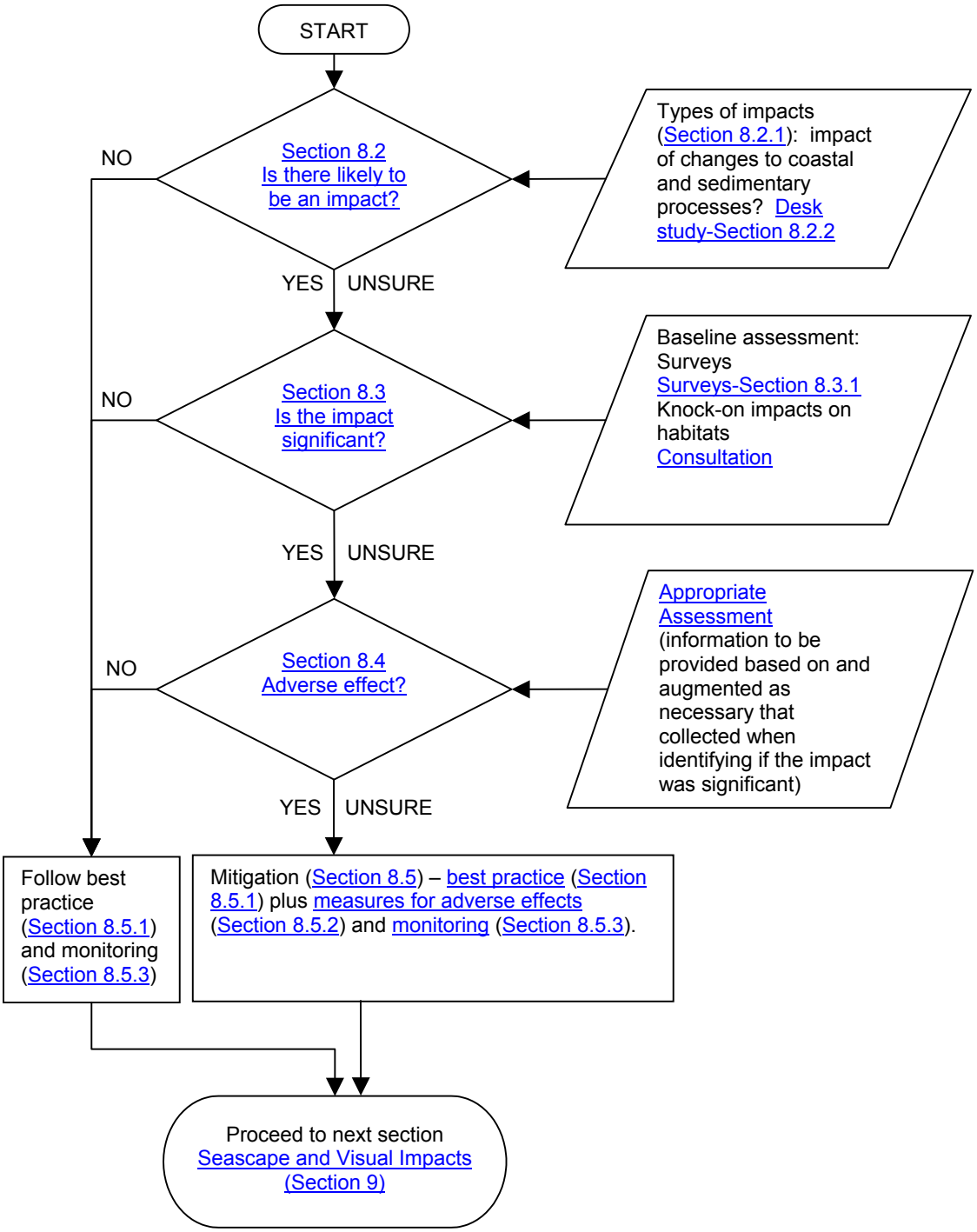

Figure 8: Flowchart for Determining Impacts on COASTAL AND SEDIMENTARY PROCESSES

8.2 Is There Likely to be an Impact?

8.2.1 The Types of Impacts

Impacts could be both direct and indirect through interrupting sediment erosion and deposition patterns. One of the key issues that should be considered in the environmental assessment of offshore windfarm developments is the potential changes to the hydrodynamics and sedimentary processes over a wide area, and potential changes to coastal processes and products, and the knock-on impacts that this may have for the ecology of the region, and in particular the utility of the coastal and sedimentary processes to designated species and habitats on site and remotely affected on nearby designated sites.

Impacts can occur at a number of different phases and it is important to consider the potential impacts at each of these phases (based on CEFAS, 2004):

- during construction;
- post-construction development;
- recovery of sediment, when a new equilibrium is established with the windfarm in place;
- during the operational life of the windfarm; and
- during the decommissioning phase and potential removal of the windfarm.

Table 8.1 summarises the factors that could cause impacts on coastal and sedimentary processes and identifies links to impacts on the environment.

Table 8.1: Potential Effects from Changes to Coastal and Sedimentary Processes

Impact Type	Potential Effects
Change to water flow across the sediment due to presence of the tower and foundations	Alteration of the local water flow across the sediment is likely to result in localised sediment scour in the lee of the tower and deposition to the front of the tower. Sedimentary habitats are primarily controlled by the hydrographic regime and the availability of sediment. Any structure that affects water flow or wave action is likely to change the sediment dynamics locally and potentially over a wide area within any given sediment cell. Sedimentary communities are themselves dependant on the stability of the sediment, its grain size and hence porosity, organic content and nutrient cycling, oxygen content and redox potential. Therefore, an activity or structure that changes the hydrodynamics is likely to affect the benthic communities present (see also Section 5 on subtidal benthos).
Presence of multiple turbines and foundations	Could potentially affect water flow around and through the development area. In addition, diffraction or interference of wave energy through or around the development area could potentially affect the amount of wave energy impinging on the adjacent coastal habitats, affecting wave action. Wave action is an important factor determining the structure and function of both rocky and sedimentary intertidal communities, as well as influencing coastal accretion or erosion.

Table 8.1: Potential Effects from Changes to Coastal and Sedimentary Processes

Impact Type	Potential Effects
Impact of structures themselves	The structures themselves will alter the local hydrodynamics and could potentially lead to local accumulation or loss of sediments over quite a wide area (i.e. much more than is scoured in the immediate vicinity of the monopiles). A decrease in sediment supply to intertidal habitats could result in increased erosion and a decrease in the total intertidal area available for the marine fauna and birdlife that depend on this habitat. Loss of intertidal area could also have a knock-on effect on coastal flooding (see also Section 6 on intertidal habitats).
Cumulative effects	Potential cumulative effects of multiple developments within a region may include potential changes in bed-form and height and hence hydrography, water flow and wave energy impinging on the coast.
Installation of cables	Submarine cables installed for offshore developments will mostly be buried, depending on the properties of the seabed and ecological considerations. To bury the cables, trenches may be dug prior to cable laying or, alternatively they can be ploughed into the seabed after they have been laid.
Removal of foundations and cables during decommissioning	Likely to result in considerable disturbance of the seabed with resultant removal or physical disruption of benthic communities and re-suspension of sediment.

(return to Flowchart 8)

8.2.2 Baseline Study

The baseline study should provide background information on the coastline and seabed. It should include consideration of both local effects (those occurring within the development site) and remote effects (those occurring in the area surrounding the development site, including where appropriate adjacent coastlines). Baseline data to inform the initial assessment of the coastal and sedimentary processes in and around the area may be available from the following:

- British Oceanographic Data Centre (Proudman Oceanographic Laboratory);
- Shoreline Management Plans;
- Defra's Futurecoast (2002);
- UK Hydrographic Office charts (contemporary and historic);
- British Geological Survey (BGS) seabed sediment mapping; and
- published scientific papers and reports.

(return to Flowchart 8)

Identifying if an Impact is Likely to Occur

It is unlikely that the desk study will be able to determine that there is likely to be no impact on coastal and sedimentary processes. Therefore, it is proposed that information collected as part of the desk study be used to assist in the development of the approach to surveying. This means that it will usually be assumed that an impact is likely to occur.

(return to Flowchart 8)

8.2.3 Key References and Further Reading

Sources of Information for the Desk Study	
Reference	CEFAS (2004): Offshore Windfarms: Guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements.
Internet Address	www.cefas.co.uk/publications/files/windfarm-guidance.pdf
Summary	Guidance note developed to assist the offshore wind industry with the gathering, interpretation and presentation of data within an Environmental Impact Assessment (EIA).
Reference	Futurecoast CD Rom:
Internet Address	www.futurecoast.co.uk
Summary	Futurecoast events focus upon the use of Geographical Information Systems, Remote Sensing and the Internet in marine and coastal zone management. Available from Defra Flood Management Division (Ergon House, 17 Smith Square, London SW1P 3JR).
Reference	Shoreline Management Plans:
Internet Address	www.defra.gov.uk/environ/fcd/policy/smp.htm www.ukbap.org.uk/
Summary	Provide preferred long term management option.

8.3 Is the Impact Significant?

Consideration of whether an impact is likely to be significant requires the collection of additional information through surveys and/or consultation with the relevant organisations.

(return to Flowchart 8)

8.3.1 Surveys

The baseline assessment should demonstrate and build on a good understanding and appreciation of the long term evolution of the area, in particular of its coastline and seabed. A report by ABPMer and Metoc

(2002) summarises some of the impacts that might occur during construction, including from cable laying, operation and decommissioning.

It is suggested that collection of baseline data includes the seven key factors described in Table 8.2. The surveys should be tailored such that they provide the information required to answer the question 'is the impact likely to be significant?'. Further information may be required should it be considered that the impact is likely to be significant. Where this is the case, there will be benefits (in terms of costs and time) of planning a phased approach to surveying.

Table 8.2: Approaches to Surveying Coastal and Sedimentary Processes

Approach	Details
Transects of the shoreline in the lee of the OWF	The extent of coastal stretch depending on incident wave direction(s).
Profiling of windfarm site	For sand banks or other subaqueous highs, through seismic survey or with sidescan sonar.
Bathymetric survey	Should be carried out of the entire seabed form on which the windfarm is proposed due to the dynamic nature of sandbanks, rather than just for the grid area of the proposed windfarm footprint.
Wave recording	2 sites for wave recorders: one in luv and one in lee of the windfarm ideally placed 1 year prior to windfarm construction and maintained for another year after completion.
Tidal current recording	3 sites for tidal current recorders: one in luv, one within and one immediately in lee of OWF, ideally placed 1 year prior to windfarm construction and maintained for another year after completion.
Sediment sampling	Together with various sediment analyses.
X-band radar/video recording equipment on the met mast	To record wave train conditions in the vicinity of the proposed windfarm.

Once the surveys are complete, the information can be used to assess whether the impacts are likely to be significant or not. Again, the detail required from the survey should be proportionate to the information needed to determine if impacts are likely to be significant. More detailed information may only be needed when assessing if impacts are likely to cause adverse effect.

Identifying if the Impact is Likely to be Significant

The information collected through the surveys should provide the basis for determining if there is likely to be a significant impact on coastal and sedimentary processes. Here, the definition of significance is based upon the following factors:

- magnitude of the impact;
- type of impact;
- extent of impact;
- duration of impact;
- intensity of impact;
- timing of impact; and
- probability of impact.

These factors mean that the definition of significant is not fixed and can vary between different projects. Information on each of these seven factors will, therefore, be required when determining if the impact of the windfarm, either alone or in combination, is likely to be significant on coastal and sedimentary processes.

No thresholds are given in this guidance in terms of defining *significant* as the approach to considering whether impacts are significant needs to be considered objectively (rather than against somewhat arbitrary thresholds). Thus, it is necessary to consult with the appropriate organisations in order to determine the likely significance of impacts. The provision of information on magnitude, type, extent, duration, intensity, timing and probability should help with the identification of significant impacts. This information will be required if it is concluded that a significant effect is likely and an Appropriate Assessment has to be undertaken (see also Section 8.4). Organisations with whom it may be necessary to consult to discuss the potential significance of changes to the coastal and sedimentary processes are given in Table 8.3. In all cases, significance should be considered cumulatively with other projects as well as the overall (and knock-on) impact of changes to coastal and sedimentary processes on the habitats supported by the seabed. This is likely to require consultation with those organisations representing the affected habitats.

Table 8.3: Potential Consultees for Determining the Significance of Changes to Coastal and Sedimentary Processes

England	Scotland	Wales
JNCC	JNCC	JNCC
English Nature	SNH	CCW
CEFAS	FRS	CEFAS
Environment Agency	SEPA	Environment Agency
Potential non government organisation		
Marine Conservation Society	Marine Conservation Society	Marine Conservation Society

Notes: For more information and contact details see Annex 2, or click on the organisation name in the Table while holding down the 'Ctrl' key.

(return to Flowchart 8)

8.3.2Key References and Further Reading

Guidance on Surveys	
Reference	ABPMer & Metoc (2002): *Potential Effects of Offshore Wind Developments on Coastal Processes*, ETSU W/35/00596/00/REP.
Internet Address	www.abpmer.co.uk/pdf/w3500596.pdf
Summary	The study provides information on the potential effects on coastal processes related to the development of offshore windfarms around the UK coast. Coastal processes covered include diffraction and focusing effects on waves and currents and their effects on longshore drift and erosion. The report also provides generic guidance for use in the planning and consent stage prior to development.
Reference	CEFAS (2004): Offshore Windfarms: Guidance Note for Environmental Impact Assessment in respect of FEPA and CPA Requirements: Version 2
Internet Address	http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf
Summary	Section 3 provides guidance on data availability, impact assessment, survey design, sampling techniques and data analyses for coastal and sedimentary processes

(return to Flowchart 8)

8.4 Will the Impacts Cause Adverse Effect?

8.4.1Identifying if there is Likely to be an Adverse Effect

The concept of adverse effect is linked to the potential that the integrity of a site and its contribution to the site network, designated under the Habitats and Birds Directive would be affected. The conclusion as to whether an adverse effect is likely is undertaken by a competent authority in the Appropriate Assessment. The collection of data as part of the approach to determining if the impact is likely to be significant should provide the competent authority with the basic level of information necessary to begin to undertake the Appropriate Assessment. To carry out an Appropriate Assessment, at a minimum, the information necessary should cover:

- a description of the project;
- a description of the aspects of the environment likely to be affected; and
- a description of the project's likely significant effects.

(return to Flowchart 8)

8.4.2Key References and Further Reading

Reference	UK Biodiversity Group (1999): *Tranche 2 Action Plans – Maritime Species and Habitats Vol 5*.
Internet Address	www.ukbap.org.uk
Summary	Provides background information on marine and coastal habitats and species action plans.

(return to Flowchart 8)

8.5 Minimising the Impacts

Mitigation measures fall into two broad categories: best practice measures which should be adopted by any offshore windfarm and should be an industry standard; and additional mitigation which is aimed at reducing an impact specific to a particular development.

(return to Flowchart 8)

8.5.1 Best Practice

Examples of possible best practice measures are summarised as follows:

- cables should be buried to a depth sufficient to ensure that the cable will remain buried and within the ES developers should demonstrate that sufficient cable burial will be achieved; and

- scour protection is kept to a minimum so as to reduce area of development footprint as far as possible, use of 'soft' rather than hard engineering techniques should be considered for instance the use of frond matting rather than rock dumping. Monitoring (Section 8.5.3) should be used to compare predicted turbine/cable scour with actual to assist predictions about volumes of antiscour material and/or use of devices such as frond mats. This will also help inform monopile design with particular regard to J tube/cable connections.

(return to Flowchart 8)

8.5.2 Possible Mitigation Measures for Adverse Effects

Adverse impacts should be avoided wherever possible. If adverse effects cannot be avoided, then suitable mitigation measures will need to be used to reduce or remove the effects. For each additional mitigation measure proposed, it is necessary to provide (European Commission, 2001):

- evidence of how it will be secured and implemented and by whom;
- evidence of the degree of confidence in its likely success;
- a timescale of when it will be implemented; and
- evidence of how the measure will be monitored and, should mitigation failure be identified, how that failure will be rectified.

Where mitigation is proposed to alleviate damaging impacts, the effectiveness should be assessed. Any mitigation measure requires monitoring to determine its effectiveness against prescribed targets and a contingency plan in the event of it not meeting those targets.

The mitigation measures described in Table 8.4 are linked to the four main types of impact given in Section 8.2.1. They are organised in a hierarchy of preferred options (European Commission, 2001):

- highest preference: avoid impacts at source (implemented at planning level);
- second highest: reduce impacts at source (implemented at design level);
- third highest: abate impacts on site (implemented during construction, operation and decommissioning); and
- lowest: abate impacts on receptor (implemented for particular species).

It is suggested that consideration be given to the proposed mitigation measures in this hierarchy as this is most likely to result in the reduction of impacts to an acceptable level.

Table 8.4: Potential Mitigation Measures and Impacts they are Intended to Minimise

Avoid Impacts at Source				
Mitigation Measure	Position windfarms to avoid impact on coastal and marine sedimentary processes.			
Impacts Mitigated	**Habitat Loss**	**Scour**	**Displacement**	**Wave Energy**
	✓	✓	✓	✓
Summary of Likely Effectiveness	Not known			
Reduce Impacts at Source				
Mitigation Measure	Reduce the area of seabed covered by the turbine base and scour protection, by altering turbine design and scour protection methods.			
Impacts Mitigated	**Habitat Loss**	**Scour**	**Displacement**	**Wave Energy**
	✓	✓	✓	
Summary of Likely Effectiveness	Not known			
Abate Impacts on Site				
Mitigation Measure	Minimise the impact of spoil disposal by adopting standard operating procedures. For large windfarm developments investigate the overall potential spoil production to ensure that the disposal site can accommodate the predicted spoil volume generated. Investigate whether on-site disposal is possible or the preferred option.			
Impacts Mitigated	**Habitat Loss**	**Scour**	**Displacement**	**Wave Energy**
	✓		✓	
Summary of Likely Effectiveness	Not known			

Table 8.4: Potential Mitigation Measures and Impacts they are Intended to Minimise

Mitigation Measure	Employing methods of chemical use that minimise release of polluting materials into the water column and only using chemicals selected from the List of Notified Chemicals.			
Impacts Mitigated	**Habitat Loss**	**Scour**	**Displacement**	**Wave Energy**
	✓			
Summary of Likely Effectiveness	Voluntary code used by oil and gas industry.			

(return to Flowchart 8)

8.5.3Monitoring

Monitoring needs to establish a number of key factors:

- migration of offshore banks. The dynamics and stability of sandbanks in the area needs to be addressed, particularly changes in their form over time; and
- understanding of the extent to which the site is an erosional or depositional environment is an important constraint on, for example, the depth of burial of the cable.

It is also important to note that larger scale modelling studies are required to understand the potential effects of larger windfarm developments. Scaling up from the minimal impact on, for instance the wave field, mixing / dissipation or sediment transport, expected for smaller windfarms to what may happen when there is proportionally much larger geographical coverage, is inappropriate. A possible approach to bathymetric surveying is summarised in Table 8.5.

Table 8.5: Summary of Possible Approach to Bathymetric Surveying

Activity	**Details**
Aim	To monitor potential changes in seabed depth and morphology (including scour) with time.
Area	Around turbines selected to represent a range of seabed types within whole array and at least 4 out of 30 turbines.
Timing	Within 3 months of completion of construction (developers should consider that there may be seasonal/weather difficulties in achieving this since construction likely to take place in summer).
Duration	Repeat every 6 months for 3 years.
Reference/ control sites	A reference or control sites should be geographically separate from development site (outside of tidal excursion) but physically and biologically similar.

Table 8.5: Summary of Possible Approach to Bathymetric Surveying

Other monitoring	**Monitoring of the cable route** may also be required. Ideally monitoring should be linked with benthic monitoring to allow for comparison amongst environmental parameters (see also Section 5 on subtidal benthos). **Monitoring of sediment plumes** may be required, using fixed suspended sediment meters to determine the extent of sediment plumes. Optical Backscatter Sensor (OBS) can be used and, if required, monitoring should last for at least four weeks. **Monitoring of wake effect downstream** can be undertaken using Acoustic Doppler Current Profiler (ADCP) along transects through the wake region. **Monitoring of particle sizes** through the use of laser particle size analysis to identify the various modal sediment sizes, backed up with dry sieving. This approach is used to assess the likely shoreline and seabed response to construction of the windfarm. **Monitoring of beach profiles** can be used to illustrate major changes in the annual profiles. This should be carried out at approximately three month intervals.

If modelling is required, as part of the monitoring programme, it is recommended that approach set out in Table 8.6 is adopted.

Table 8.6: Summary of Recommended Approach to Modelling

Activity	Approach
1	Model using nested rectangular grids of coarse, intermediate and fine dimensions.
2	Using an empirically derived transmission coefficient to overcome the problem of over-representing the turbine masts in size in the refined model grid (this enables wave propagation to be simulated more realistically through a field of these obstacles).
3	Data to be tabulated for an array of wave extraction points along the 5 m depth contour.
4	Parameters extracted from the model and used to assist with the assessment of predicted changes as a result of the windfarm should include: • Significant wave height (H_s); • Mean wave period (T_m); • Mean wave direction (dir); • Energy dissipation (E_{dis}); and • Bottom orbital wave velocity (U_{bot}).
5	Wave model to incorporate wave-current interactions.
6	Modelling of spring tides only, but including low, high and both mid-tide stages.
7	Wave conditions to be modelled for waves incident from a wide spectrum.
8	Modelling of 1 in 1 year wave scenario, as this will undoubtedly best reflect high magnitude/medium frequency events which are most relevant to changes in the sedimentary regime.
9	It may be necessary to compare the results of the model with field measures from other projects (e.g. through the use of UNIBEST_LT with calibration based on as many locations as possible). Validation of the modelling predictions of UNIBEST may also require beach profile monitoring.

(return to Flowchart 8)

8.5.4Key References and Further Reading

Mitigation Measures	
Reference	Offshore Chemicals Regulations 2002: *List of Notified Chemicals*.
Internet Address	www.cefas.co.uk/ocns
Summary	The Offshore Chemical Notification Scheme (OCNS) is administered by the Department of Trade and Industry using scientific and environmental advice from CEFAS and the Fisheries Research Services. The OCNS applies to all chemicals, which are used in the actual exploration, exploitation and associated offshore processing of petroleum on the UK Continental Shelf. The OCNS therefore applies to those 'operational' chemicals/products, which through their mode of use are expected in some proportion to be discharged.

Monitoring	
Reference	Shoreline Management Plans:
Internet Address	www.defra.gov.uk/environ/fcd/policy/smp.htm www.ukbap.org.uk/
Summary	Provide broad policies for managing the coast from flood and coastal erosion risk management perspective.
Reference	Futurecoast CD Rom:
Internet Address	www.futurecoast.co.uk
Summary	Futurecoast events focus upon the use of Geographical Information Systems, Remote Sensing and the Internet in marine and coastal zone management. Available from Defra Flood Management Division (Ergon House, 17 Smith Square, London SW1P 3JR).
Reference	Defra: (AE0262) *Development of Generic Guidance for Sediment Transport Monitoring Programmes in Response to Construction of Offshore Windfarms*.
Internet Address	www.cefas.co.uk/renewables/AE0262.htm
Summary	Project currently underway reports will become available at the end of March 2005: this research will assess the magnitude and significance of changes to the nearshore sediment transport and sediment transport pathways as a result of the construction of an offshore windfarm on Scroby Sands.
Reference	Defra: (AE1227) Assessment of the Significance of Changes to the Inshore Wave Regime as a Consequence of an Offshore Wind Array.
Internet Address	www.cefas.co.uk/renewables/AE1227.htm
Summary	Project currently underway reports will become available at the end of March 2005: this research will assess the significance of changes to the nearshore wave regime as a result of the construction of offshore windfarms, based primarily on unique field measurements, but including scenario-testing using numerical modelling techniques.
Reference	CEFAS (2004): Offshore Windfarms: Guidance Note for Environmental Impact Assessment in respect of FEPA and CPA Requirements; Version 2
Internet Address	http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf
Summary	Section 3 provides guidance on monitoring, survey design, sampling techniques and data analyses for coastal and sedimentary processes

ANNEX 1: COMPENSATION

Introduction

When an assessment has been undertaken and it has been concluded that:

- in the absence of alternative solutions,
- notwithstanding that there will be a likely significant and adverse effect to a Natura 2000 site's integrity
- for imperative reasons of overriding public interest the development should proceed.

compensatory measures will be necessary to ensure that the coherence of the Natura 2000 site is protected.

Methodological guidance to help carry out the assessment of significant effects required under Article 6(3) and (4) of the Habitats Directive has been prepared by the European Commission and should be referred to where additional indicative guidance is needed over and above that included in this guidance document and/or where there is a need to consider providing compensation.

Reference: Assessment of plans and projects significantly affecting Natura 2000 sites – Methodological Guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC November 2001, Oxford Brookes University (wjweston@brookes.ac.uk).

Compensation has to be provided if mitigation measures will not reduce adverse impacts to an acceptable level and if the project is allowed to proceed because the benefits of the windfarm are seen to outweigh the environmental costs. Compensation is therefore a last resort and may be very difficult to provide in the marine environment, particularly in terms of reducing impacts from marine habitat loss.

Possible compensation measures associated with the four impact types are given in Table A1.

Table A1: Possible Compensation Measures

Impact Type	Compensation Measure	Details
Habitat loss	Comparable habitat in the vicinity of the development.	All legal and financial measures have to be secured. Monitoring should be put in place to check that the compensatory habitat is performing as planned. Agreement needed on action to be taken if the compensatory habitat does not perform as expected.

Table A1: Possible Compensation Measures

Impact Type	Compensation Measure	Details
	Habitat enhancement or post-construction habitat restoration.	Further measures may be required to avoid increasing the risk of collision.
Collision mortality (birds)	Development and implementation of species management plan to increase population elsewhere so as to more than offset increased mortality due to collisions.	
Increased turbidity	Development and implementation of species management plan to increase population elsewhere so as to more than offset increased mortality due to increased turbidity.	
Smothering	Development and implementation of species management plan to increase population elsewhere so as to more than offset increased mortality due to smothering.	

ANNEX 2: CONTACT DETAILS FOR CONSULTATION ON SIGNIFICANCE OF IMPACTS

Organisation	Address	Telephone	Email
Centre for Environment, Fisheries and Aquaculture Science (CEFAS)	Burnham Laboratory Remembrance Ave Burnham-on-Crouch Essex, CM0 8HA	01621 787200	a.d.judd@cefas.co.uk
Countryside Agency	**Head Office:** John Dower House Crescent Place Cheltenham GL50 3RA	01242 533222	info@countryside.gov.uk
Countryside Council for Wales (CCW)	Maes y Ffynnon Fordd Penrhos Bangor Gwynedd, LL57 2DW	01248 385737	s.wood@ccw.gov.uk
English Nature	Northminster House Peterborough PE1 1UA	01733 455000	enquiries@english-nature.org allan.drewitt@english-nature.org.uk victoria.copley@english-nature.org.uk
Environment Agency	**Main Office:** Rio House Waterside Drive Aztec West Almondsbury Bristol, BS32 4UD **Wales:** Rivers House St Mellons Business Park St Mellons Cardiff, CF3 0EY	08708 506506	justin.ridgewell@environment-agency.gov.uk (based in Peterborough)
FRS Marine Laboratory	P.O. Box 101 375 Victoria Road Aberdeen AB11 9DB	01224 876544	mckiejc@marlab.ac.uk
Joint Nature Conservation Committee (JNCC)	Marine Advice Dunnet House 7 Thistle Place Aberdeen, AB10 1UZ	01224 655716	Zoe.crutchfield@jncc.gov.uk
Landscape Institute	33 Great Portland Street London, W1W 8DG	020 7299 4500	mail@l-i.org
Marine Biological Association	The Laboratory Citadel Hill Plymouth, PL1 2PB	01752 633207	
Scottish Natural Heritage (SNH)	12 Hope Terrace Edinburgh, EH9 2AS	0131 447 4784	enquiries@snh.gov.uk
Sea Mammal Research Unit (SMRU)	Gatty Marine Laboratory University of St Andrews Fife, KY16 8LB	01334 462630	

CONTACT DETAILS ON NON-GOVERNMENTAL ORGANISATIONS (POTENTIAL CONSULTEES ON IMPACTS)

BirdLife International	Wellbrook Court Girton Road Cambridge, CB3 0NA	01223 277318	birdlife@birdlife.org
British Trust for Ornithology (BTO)	**Main Office:** The Nunnery Thetford Norfolk, IP24 **Scotland**: School of Biological and Environmental Sciences Cottrell Building University of Stirling FK9 4LA	01842 750050 01786 466560	info@bto.org Scot.info@bto.org
Marine Conservation Society	Unit 3 Wolf Business Park Alton Road Ross-on-Wye Herefordshire, HR9 5NB	01989 566017	info@mcsuk.org melissa@mcsuk.org
Whale and Dolphin Conservation Society (WDCS)	Brookfield House 38 St Paul Street Chippenham Wiltshire, SN15 1LJ	01249 449500	Mark.simmonds@wcds.org
Wildfowl and Wetlands Trust (WWT)	WWT Slimbridge Gloucestershire GL2 7BT	01453 891900	enquiries@wwt.org.uk
Wildlife Trusts	The Kiln, Waterside Mather Road, Newark NG24 1WT	0870 036 7711	enquiry@wildlife-trusts.cix.co.uk
WWF	**Main Office:** Panda House Weyside Park Godalming Surrey GU7 1XR **Scotland:** 6 The Square Aberfeldy Perthshire PH15 2DD **Wales:** Baltic House Mount Stuart Square Cardiff, CF10 5FH **Northern Ireland:** 13 West Street Carrickfergus BT38 7AR	01483 426444 01887 820449 02920 454306 028 9335 5166	