ENGLISH NATURE

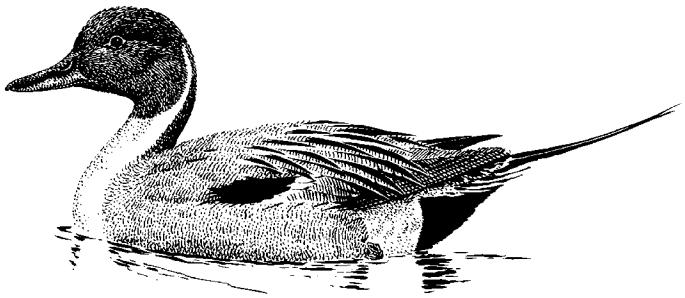
Cyngor Cefn Gwlad Cymru
Countryside Council for Wales

# The Dee Estuary
# European Marine Site

**comprising:**

**Dee Estuary / Aber Dyfrdwy possible Special Area of Conservation**
**The Dee Estuary Special Protection Area & potential Special Protection Area**
**The Dee Estuary Ramsar Site & proposed Ramsar Site**

## English Nature & the Countryside Council for Wales' draft advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994



## Consultation draft
## May 2004

**English Nature and the Countryside Council of Wales' advice for the Dee Estuary European marine site given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994**

# Preface

This document contains the joint advice of English Nature and the Countryside Council for Wales to other competent and relevant authorities as to (a) the conservation objectives and (b) any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the Dee Estuary European marine site is designated. This advice is provided in fulfilment of our obligations under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994.

The extent of the Dee Estuary European marine site is defined in Section 1.

European marine sites are defined in the Conservation (Natural Habitats &c.) Regulations 1994 as any part of a European site covered (continuously or intermittently) by tidal waters or any part of the sea in or adjacent to Great Britain up to the seaward limit of territorial waters. European sites include Special Areas of Conservation designated under the 1992 Habitats Directive[1], which support certain natural habitats and species of European importance, and SPAs classified under the 1979 Birds Directive[2], which support significant numbers of internationally important wild birds. Ramsar sites support internationally important wetlands and wetland species (listed under the Convention on Wetlands of International Importance especially as Waterbirds Habitat). In accordance with Department of the Environment Transport and the Regions' (DETR) *Planning Policy Guidance No. 9* (PPG9), Welsh Office Planning Guidance *Technical Advice Note No. 5* (TAN5), and the DETR and National Assembly for Wales (NAW) statements *Ramsar Sites in England* (November 2000) and *Ramsar Sites in Wales* (February 2001); Ramsar sites must be given the same consideration as European sites when considering plans and projects that may affect them.

This 'Regulation 33 package' is designed to help relevant and competent authorities responsible for complying with the requirements of the Birds and Habitats Directives to:

- understand the international importance of the site;
- understand the underlying physical and ecological processes supporting the species for which the site is designated;
- if appropriate, develop a management scheme under which they shall exercise their functions in accordance with the requirements of the Directives;
- determine the scope and nature of 'appropriate assessment' required in relation to plans and projects (Regulations 48 & 50).

This Regulation 33 package also provides the standards against which the condition of the features of the site can be monitored, enabling judgements to be made about whether that condition is favourable. We will provide more detailed advice to competent and relevant

1 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

2 Council Directive 79/409/EEC on the conservation of wild birds

authorities to assess the implications of any given plan or project under the Regulations, where appropriate, at the time a plan or project is being considered.

English Nature and the Countryside Council for Wales will keep this advice under review and may update it every six years or sooner, depending on the changing circumstances of the European marine site. If as a result of the ongoing SPA Network Review interest features are added to the site or the boundaries are changed, English Nature and the Countryside Council for Wales will revise this advice accordingly.

Richard Leafe, General Manager
English Nature, May 2004

David Parker, Director,
Countryside Council for Wales, May 2004.

# Acknowledgements

English Nature and the Countryside Council for Wales would like to acknowledge the assistance from the following people who have provided advice at various times to help prepare parts of this package

***To be completed following consultation***

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# 1. Introduction

## 1.1 Natura 2000

The European Union Habitats[3] and Birds Directives[4] are international agreements that set out a number of actions to be taken for nature conservation. The Habitats Directive aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements, and sets out measures to maintain or restore, natural habitats and species of European Union interest at favourable conservation status[5]. The Birds Directive protects all wild birds and their habitats within the European Union, and there are special measures for migratory birds and those species that are considered rare or vulnerable.

The Habitats and Birds Directives include requirements for the designation of conservation areas. In the case of the Habitats Directive these are Special Areas of Conservation (SACs) which support certain natural habitats or species, and in the Birds Directive, Special Protection Areas (SPAs) which support wild birds of European Union interest. In 1999, lists of candidate Special Areas of Conservation were submitted to the European Commission for a process known as moderation. Shortfalls across the whole Atlantic Biogeographic Region were identified and in the UK these have been addressed by adding further interest features to existing sites or by extending site boundaries to include more of particular habitats and species. However, 81 new sites were also identified and these included the Dee Estuary pSAC

SACs and SPAs are known as European Sites and will form a network of conservation areas to be known as '*Natura 2000*'. Where SACs or SPAs are designated in areas continuously or intermittently covered by tidal waters or any part of the sea in or adjacent to Great Britain up to the limit of territorial waters, they are referred to as European marine sites.

The Convention on Wetlands of International Importance especially as Waterbirds Habitats (Ramsar Convention) was signed in Ramsar, Iran in 1971). The broad objectives are to stem the loss and progressive encroachment on wetlands now and in the future, through the designation of Ramsar sites. A habitat can qualify as a Ramsar site for its representation of a wetland, the plant or animal species it supports and for its role in supporting internationally important populations of waterbirds. In accordance with DETR's *Planning Policy Guidance No. 9* (PPG9), Welsh Office Planning Guidance *Technical Advice Note No. 5* (TAN5), the DETR and NAW statements *Ramsar Sites in England* (November 2000) and *Ramsar Sites in Wales* (February 2001); Ramsar sites classified under the Convention on Wetlands of International Importance must be given the same consideration as European sites when considering plans and projects that may affect them.

[3] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

[4] Council Directive 79/409/EEC on the conservation of wild birds

[5] A habitat or species is defined as being at favourable conservation status when its natural range and the areas it covers within that range are stable or increasing and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future.

Further guidance on European marine sites can be found within the documents:

*European marine sites in England & Wales: A guide to the Conservation (Natural Habitats &c.) Regulations 1994 and to the Preparation and Application of Management Schemes* (DETR & The Welsh Office, 1998), *Planning Policy Guidance No. 9: Nature Conservation* (Department of the Environment, 1994), *Planning Policy Wales March 2002* (Welsh Assembly Government), *Planning Guidance* (Wales) T*echnical Advice Note (TAN)5 Nature Conservation and Planning* (Welsh Assembly Government).

### 1.2 The role of English Nature and the Countryside Council for Wales

The Conservation (Natural Habitats, &c.) Regulations 1994 transpose the Habitats Directive into law in Great Britain. It gives English Nature and the Countryside Council for Wales a statutory responsibility to advise relevant authorities on the conservation objectives for European marine sites in England and Wales and to advise these authorities regarding any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the sites have been designated. This information will be a key component of any management scheme, which may be developed for this site. It will also aid competent authorities in defining the scope and nature of 'appropriate assessment' which the Habitats Directive requires to be undertaken for plans and projects having a significant effect on the European site (Regulations 20, 48 & 50). Note that English Nature and the Countryside Council for Wales will also advise competent authorities on individual plans and projects as they arise. English Nature and the Countryside Council for Wales are themselves also competent and relevant authorities.

### 1.3 The precautionary principle

The advice on operations contained within this package has been made based on the precautionary principle and the interpretation of any monitoring programmes undertaken by English Nature and the Countryside Council for Wales will also be made on this basis. All forms of environmental risk should be tested against the precautionary principle which means that where there are real risks to the site, lack of full scientific certainty should not be used as a reason for postponing measures that are likely to be cost effective in preventing such damage. It does not however imply that the suggested cause of such damage must be eradicated unless proved to be harmless and it cannot be used as a licence to invent hypothetical consequences. Moreover, it is important, when considering whether the information available is sufficient, to take account of the associated balance of likely costs, including environmental costs, and benefits (DETR & the Welsh Office, 1998).

### 1.4 The role of competent and relevant authorities

The Conservation (Natural Habitats, &c.) Regulations 1994 require competent authorities to exercise their functions so as to secure compliance with the requirements of Habitats Directive. The term 'competent authority' includes all public bodies and statutory undertakers. The Regulations identify a number of competent authorities as 'relevant authorities', with particular functions in relation to European marine sites. In addition to their duties as competent authorities, under Regulation 34, the relevant authorities may establish a management scheme for a European marine site under which they shall exercise their relevant functions. If such a management scheme is established, it should be guided by the information contained in this document. Relevant authorities must, within their areas of

jurisdiction, have regard to both direct and indirect effects on an interest feature of the site. This may include consideration of issues outside the boundary of the European marine site.

Under certain circumstances, where another relevant authority is unable to act for legal reasons, or where there is no other relevant authority, English Nature and the Countryside Council for Wales are empowered to use their bylaw-making powers for Marine Nature Reserves (MNR) and National Nature Reserves (NNR) for use in European marine sites.

### 1.5 Factors outside the control of relevant authorities

Nothing within this Regulation 33 package will require relevant and competent authorities to undertake any actions or ameliorate changes in the condition of interest features if it is shown that the changes result wholly from natural causes[6] or human events outside their statutory functions. English Nature and the Countryside Council for Wales will work with relevant authorities and others to develop a protocol for evaluating all observed changes and to develop our understanding of natural change.

### 1.6 Responsibilities under other conservation designations

In addition to its status under the habitats and birds directives and Ramsar convention parts of the Dee Estuary European marine site are also designated and subject to agreements under other conservation legislation. Parts of it are notified as Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act, 1981, as amended by the Countryside and Rights of Way Act, 2000 (CROW). The obligations of relevant authorities and other organisations under the SSSI designations are not affected by the advice contained in this document. There are Local Nature Reserves (LNRs) at Hilbre Island and Gronant Dunes designated under Section 21 of the National Parks and Access to the Countryside Act, 1949.

### 1.7 Role of conservation objectives

The role of the conservation objectives for a European marine site is to define the nature conservation aspirations for the features of interest, thus representing the aims and requirements of the Habitats and Birds Directives in relation to the site.

The Habitats Directive requires that:

- measures taken under it are designed to maintain or restore habitats and species of European importance at "favourable conservation status" (FCS). According to the Directive, a habitat will be at FCS when its range and area in Europe are stable or increasing, the specific structure and functions necessary for its long term maintenance exist and are likely to continue to exist, and the conservation status of its typical species is favourable;
- appropriate steps be taken in SPAs and SACs to avoid the deterioration of habitats and significant disturbance[7] of species;

[6] Determination of what constitutes natural change will be based on the best available information and scientific opinion at the time

[7] Significant disturbance is defined in the 'European Commission (2000). Managing Natura 2000 sites: The provisions of Article 6 of the "Habitats" Directive 92/43/EEC. DGXI, Brussels' as 'Any event which contributes to the long term decline of the population of the species or, any event contributing to the reductionor to the risk

- any plan or project not directly connected with or necessary to the management of an SAC or SPA (for nature conservation) but likely to have a significant effect on it, be subject to appropriate assessment in view of the site's conservation objectives.

In addition, the Birds Directive requires that, in relation to certain species of birds listed in Annex 1 of the Directive and regularly occurring migratory species, special measures be taken in order to ensure their survival and reproduction in their area of distribution.

Therefore, the conservation objectives for the Dee Estuary SAC, SPA and RAMSAR site represent English Nature and the Countryside Council for Wales' judgement of the appropriate contribution of the site to ensuring the survival and reproduction of the species concerned in their area of distribution. They are intended to guide relevant and other competent authorities in the exercise of their functions to comply with the requirements of the Directives outlined above.

In relation to the Dee Estuary European marine site, English Nature and the Countryside Council for Wales use the term "favourable condition" for the condition represented by the achievement of the conservation objectives, in other words the desired condition for a habitat or a species on an individual site.

### 1.8 Role of advice on operations

The advice on operations set out in Sections 8, 12, and 16 provides the basis for consideration of the nature and extent of the operations taking place within or close to the site and which may have an impact on its interest features.

The advice should also be used to help identify the extent to which existing use and management of the site are, or can be made, consistent with the achievement of the conservation objectives and thereby focus the attention of relevant authorities on factors affecting or likely to affect the interest features of the site.

### 1.9 European sites

A European site is any one of the following, as defined in The Conservation (Natural Habitats, &c.) Regulations 1994, as amended (and a European marine site is any of the following in so far as it consists of marine – including intertidal - areas).

- A special area of conservation (SAC) designated by the UK Government or devolved administrations under the Habitats Directive.
- A site of community importance (SCI). An SCI is a candidate SAC which the government and European Commission have agreed will be designated as an SAC but which has not yet been so designated.
- A site hosting a priority natural habitat type or priority species which is not on the list of candidate SACs submitted by the UK but which the European Commission thinks should be on that list (not relevant in the case of the Dee estuary).
- A Special Protection Area (SPA) classified under the Birds Directive.

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of reduction of the range of species within the site or, any event which contributes to the reduction of the size of the habitat of the species within the site'.

- In England only, a candidate SAC, that is a site submitted by the UK to the EC under the Habitats Directive, but not yet agreed as an SCI (see above). In Wales, a candidate SAC is not in law a European site. The Dee estuary lies partly in England and partly in Wales, so strictly speaking it would become subject to two different legal regimes once submitted as a candidate SAC. However, it is Welsh Assembly Government policy that candidate SACs be treated as if they were European sites. In any case, at the present time, the Dee has not yet been submitted as a candidate SAC.

Also, in accordance with DETR's *Planning Policy Guidance No. 9* (PPG9), Welsh Office Planning Guidance *Technical Advice Note No. 5* (TAN5), and the DETR and NAW statements *Ramsar Sites in England* (November 2000) and *Ramsar Sites in Wales* (February 2001)*;* Ramsar sites must be given the same consideration as European sites when considering plans and projects that may affect them.

Where a European site lies below highest astronomical tide, i.e. land covered (continuously or intermittently) by tidal waters, or any part of the sea, in or adjacent to Great Britain, up to the seaward limit of territorial waters, it is described as a European marine site.

At the time of compiling this advice, the Dee Estuary European marine site comprises the Dee Estuary / Aber Dyfrdwy possible Special Area of Conservation (pSAC), the Dee Special Protection Area (SPA) Phase 1 and Phase 2 and the Dee Ramsar site Phase 1 and Phase 2. Phase 1 of these sites was classified in July 1985; Phase 2 is a revision of these sites proposed in February 2001 and has not yet been classified. (These phase 2 sites are referred to as a potential SPA and proposed Ramsar site).

The marine components of all of these sites qualify as European marine sites, but for simplicity and for the purposes of this advice, the Dee Estuary pSAC, Dee Estuary SPA and Dee Estuary Ramsar site Phases 1 and 2 are referred to as the Dee Estuary European marine site and are covered within this single Regulation 33 package.

The areas of the three designations do not overlap in all areas. In particular it should be noted that the area of North Wirral Foreshore SSSI forms part of the Dee Estuary pSAC but it is not included within the Dee Estuary SPA or potential SPA. Maps showing the boundaries of the different designation are provided in Appendix I-III. North Wirral Foreshore SSSI does form part of the North Wirral Foreshore and Mersey Narrows potential SPA. Regulation 33 Advice relating to North Wirral Foreshore and Mersey Narrows pSPA is therefore not included within this document and will be provided subsequently.

### 1.10 Description of the site

The Dee Estuary is one of the largest estuaries in the UK, with an area of over 14,000 ha, (38,765 acres). It is the largest macro-tidal coastal plain estuary along a long stretch of coast between the larger Severn estuary and the Solway Firth. The River Dee drains an area of 2088 $km^2$ and flows from the mountains of Snowdonia to the Cheshire Plain (Environment Agency, 1998). The Dee Estuary is hyper-tidal with a mean spring tidal range of 7.7 m at the mouth.

The estuary is considered to have been formed as an 'ice-way' cut by a glacier which occupied the Irish Sea during the Pleistocene period (Gresswell, 1964 in NCC, 1978). Following the retreat of the glaciers, alluvial deposits of sand, silt and mud were laid down on

the valley floor as it gradually silted up, now reaching a depth of approximately 40 m covering the bedrock (NCC, 1978).

The estuary historically stretched as far inland as Chester and its form has been modified considerably over the past 300 years as a direct result of human intervention. The canalisation of the upper Dee in 1737 with the creation of the 'New Cut' moved the main channel towards the southern shore. This was done in an attempt to maintain the viability of the Port of Chester. The canalisation subsequently facilitated land claim along either side of the original channel in the upper reaches of the estuary. Since 1732 nearly 5,000 ha of land have been claimed from the estuary (NCC, 1978).

The effects of land claim upon the estuary have been substantial although sedimentation had been occurring within the estuary prior to man's intervention. In the Norman period Chester was a flourishing port with direct access to the sea, yet by the 1700's an outport was in use at Parkgate due to siltation making navigation difficult (NCC, 1978). The estuary continues to receive suspended sediment both from the river and the sea. The sea is the most important source with material being carried into the estuary by the process of long shore drift acting in an easterly direction along the North Wales coast, as well as by seabed currents (Binnie and Partners, 1971, in NCC, 1978). The estuary tends to act as a sink for the sediment reaching it for a number of reasons: the alignment of the estuary to the prevailing wind means that waves within the estuary tend to be constructive not destructive (NCC, 1978); the flood currents are stronger than the ebb currents; and finally saltmarsh vegetation within the estuary tends to trap sediment. Sediment flows and fluxes affecting the estuary are of particular importance for estuarine processes and ecology and the morphology of the estuary is constantly changing due to the complex hydrodynamics. Sediment deposits provide material essential to maintenance of the mudflats, sandflats and saltmarsh.

Sea defences now enclose much of the estuary protecting industrial complexes, farmland, railway lines and residential areas built on land claimed from the sea. Historic industrial activity has also left a legacy of contaminated land, along the Welsh shore in particular. There are approximately 30 ha of the European marine site in Wales which are made up of non-natural substrates including seawalls, riprap revetment, outfalls, and tip waste (Jones *et al.,* 2002). Today the Dee Estuary is an important recreational area; it is also a commercial waterway providing access to the Port of Mostyn, to Shotton and in future to Broughton. The estuary supports a range of industries along its coast including power stations, paper mills, steel mills, and chemical plants. The Estuary also supports a large cockle fishery of high economic importance as well as smaller fisheries for shrimp and finfish. Alongside all these competing activities, the Estuary supports a wide array of habitats and species of international importance for nature conservation.

The intertidal area is currently dominated by mudflats and sandflats with the remainder being largely saltmarsh. At low water spring tides, over 90% of the estuary dries out. The extensive intertidal flats of the Dee Estuary form the fifth largest such area within an estuary in the UK. Where water movements are greatest towards the estuary mouth the sediments tend to be sandy, and populated with polychaete worms and amphipod crustaceans. Much of the mid-upper part of the estuary consists of fine muddy sand, dominated by ragworms *Hediste diversicolor* and Baltic tellins *Macoma balthica*. Areas of muddy sand are also found in the outer estuary, but here they are often dominated by cockles and polychaetes. The intertidal mud flats of the sheltered inner estuary in particular support populations of marine worms, molluscs and other invertebrates, which often occur at high densities and with

high biomass. These invertebrates provide an abundant food source for fish and are of particular importance for waterbirds, with over 120,000 birds visiting the site during the winter months.

The Dee Estuary includes approximately 2,480 ha of saltmarsh representing about 7% of the total area of saltmarsh in the UK (Dargie, 2001). Today, the Dee Estuary saltmarsh is among the few estuarine saltmarshes in the UK showing a full transition from pioneer saltmarsh species through to non-tidal vegetation. The elaborate creek system in the Dee Estuary creates a more diverse array of habitats than are found in more continuous fringing saltmarshes such as those of Morcambe Bay and several nationally scarce plant species also occur. Unlike most western estuaries large areas of the saltmarsh remain ungrazed favouring plants that are otherwise susceptible to grazing. The combination of historical land claim and canalisation of the upper estuary may have reduced the total area of saltmarsh in the Dee from what was present previously, yet the area of saltmarsh within the Dee has expanded rapidly over the last century as the estuary's morphology has adapted to these reclamations.

Saltmarshes have an important role to play in estuarine processes, both through the recycling of nutrients within the estuary and through their role as 'soft' sea defences, dissipating wave energy. They are highly productive biologically, providing nutrients that support other features within the marine ecosystem. They also have an important physical role, acting as a sediment store for the estuary as a whole and in providing roosting sites for waders and wildfowl at high tide. The seeds and foliage of saltmarsh plants provide an important food resource for visiting wildfowl.

The subtidal zone of the Dee is believed to provide an important breeding, sheltering and nursery area for coastal fish species. In recent years, 21 species of fish have been recorded in the Dee Estuary (Potts & Swaby, 1993). The Dee Estuary also supports a number of migratory fish species including river lamprey *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus*, Atlantic salmon *Salmo salmar*, sea trout *S. trutta*, Twaite shad *Alosa fallax*, smelt *Osmerus eperlanus*, and eels *Anguilla anguilla*. Although lamprey numbers have declined over the last 100 years, the UK is still one of their strongholds. Sea and river lampreys spend their adult life in the sea or estuaries but spawn and spend the juvenile phase in rivers. They use the Dee as a migratory passage to and from their spawning and nursery grounds in the River Dee upstream of the estuary.

In addition to the habitats to be found within the intertidal zone of the estuary, other valuable habitats occur adjacent to the intertidal area that are associated with the estuary's form and function. Talacre Warren and Gronant Dunes to the west of the estuary mouth are the largest remaining areas of a once extensive dune system to be found along the north east coast of Wales. These dunes include the early stages of dune formation (embryonic shifting dunes), mobile dunes with marram grass, and stable 'fixed' dunes, which have been colonised by a variety of grasses and other plants. There are also damp hollows between the dunes known as dune slacks supporting their own specialised plant communities. On the seaward fringe of the dunes accumulations of nutrient rich debris can build up along the strandline and provide habitats for annual plants, such as sea rocket *Cakile maritima* and sea holly *Eryngium maritimum*. The dune habitats associated with the Dee Estuary support many nationally scarce invertebrates including five Red Data Book species such as the sandhill rustic moth *Luperina nickerlii gueneei*, the sand wasp *Podalonia affinis*, and the mining bee *Colletes cunicularis*.

On the English side of the estuary the sandstone Hilbre Islands and Red Rocks form low uneven cliffs and flat intertidal rock platforms. These locations support some of the very few examples of rocky shore and vegetated sea cliff habitats found between the Little Orme to the west and St. Bees Head to the north. The cliffs support a range of plants, including common scurvy grass *Cochlearia officinalis*, thrift *Armeria maritima*, the scarce rock sea lavender *Limonium britannicum celticum* and sea spleenwort *Asplenium marinum* (Dargie, 2001).

Many estuaries in the UK are of great importance to migratory and wintering wildfowl and waders. The Dee Estuary forms part of the complex of estuaries, which provide habitats for migratory waterbirds along the shores of Liverpool Bay, which in turn form part of the chain of such sites along the western coast of the UK. The relatively mild winter weather conditions found here compared to continental Europe can be of additional importance to the survival of wintering waterbirds during periods of severe weather. The Dee Estuary ranks amongst the top ten British estuaries for the size of its wintering waterbird population (Musgrove *et. al.*, 2001). Outside of this period, the Dee Estuary is also of particular importance as a staging area for migratory waterbirds on autumn and spring passages it lies on the East Atlantic Flyway route.

# 2. Qualifying interest features under the EU Habitats and Birds Directives and the Convention on Wetlands of International Importance

## 2.1 Interest features of the Dee Estuary European marine site under the EU Habitats Directive

The Dee Estuary possible Special Area of Conservation (pSAC), as designated under the Habitats Directive, qualifies as a SAC for the following **Annex I** habitats as listed in the EU Habitats Directive:

- Estuaries
- Mudflats and sandflats not covered by seawater at low tide (intertidal mudflats and sandflats)
- *Salicornia* and other annuals colonising mud and sand
- Atlantic salt meadows
- Annual vegetation of drift lines

The Dee Estuary possible Special Area of Conservation, as designated under the Habitats Directive, also qualifies as a SAC for the following **Annex II** species as listed in the EU Habitats Directive:

- *Lampetra fluviatilis* (river lamprey)
- *Petromyzon marinus* (sea lamprey).

The Dee Estuary possible Special Area of Conservation has yet to be given candidate status. This Regulation 33 advice is based on the consultation citation dated February 2001. Figures showing the boundary of the Dee Estuary possible Special Area of Conservation are provided in Appendix I.

## 2.2 Interest features of the Dee Estuary European marine site under the EU Birds Directive

The Dee Estuary Special Protection Area qualifies under **Article 4.1** of the EU Birds Directive by supporting:

- Internationally important populations of regularly occurring Annex I species including;
- Sandwich tern *Sterna sandicensis*
- Little tern *Sterna albifrons*
- Common tern *Sterna hirundo*
- Bar tailed godwit *Limosa lapponica*

It also qualifies under **Article 4.2** of the EU Birds Directive in that it supports:

- internationally important populations of regularly occurring migratory species including;
- Redshank *Tringa totanus*
- Shelduck *Tadorna tadorna*
- Teal *Anas crecca*
- Pintail *Anas acuta*
- Oystercatcher *Haematopus ostralegus*
- Grey Plover *Pluvialis squatarola*
- Knot *Calidris canutus islandica*
- Dunlin *Calidris alpina*
- Black tailed godwit *Limosa limosa islandica*
- Curlew *Numenius arquata*
- and an internationally important assemblage of waterbirds

The Dee Estuary Special Protection Area Phase 1, with an area of 13,065.8 ha was classified on 17 July 1985. The Dee Estuary Special Protection Area Phase 2, with an area additional area of 1,185.1 ha has yet to be classified. In the event that the citation for the Phase 2 area is adopted this may also result in the deletion of 19.3 ha from the Phase 1 area.

It is the citation for the SPA Phases 1 and 2, dated December 2000 on which this Regulation 33 advice is based. Figures showing the boundary of the Dee Estuary proposed Special Protection Area are provided in Appendix II.

**2.3 Interest features of the Dee Estuary European marine site under the Ramsar Convention on Wetlands of International Importance Especially as Waterbirds Habitat**

The Dee Estuary Ramsar site qualifies under **Criterion 5** as it regularly supports

- 20, 000 or more waterbirds.

The Dee Estuary Ramsar site qualifies under **Criterion 6** as it regularly supports

- 1% or more of the individuals in a population of one species or sub-species of waterbirds.

The Dee Estuary Ramsar site Phase 1, with an area of 13,065.8 ha was listed on 17 July 1985. The Dee Estuary Ramsar site Phase 2, with an additional area of 1,196.8 ha has yet to be listed. In the event that the citation for the Phase 2 area is adopted this may also result in the deletion of 19.3 ha from the Phase 1 area.

It is the citation for the Ramsar site Phases 1 and 2, dated December 2000 on which this Regulation 33 advice is based. Figures showing the boundary of the Dee Estuary proposed Ramsar Site are provided in Appendix III.

## 2.4 Other qualifying features or features of interest within the SAC, SPA and Ramsar designations outside the European marine Site

The following features also qualify for each designation (SAC, SPA and Ramsar site) but do not, however, occur within the European marine site as they occur above the highest astronomical tide (HAT). Consequently, there are no specific conservation objectives within this document for these habitats and species. Objectives to maintain these features in favourable condition are identified within English Nature and the Countryside Council for Wales' conservation objectives for the relevant SSSIs within each European site boundary and will be dealt with elsewhere. However, relevant authorities need to have regard to such adjacent interests as they may be affected by activities taking place within, or adjacent to the European marine site.

### 2.4.1 Dee Estuary pSAC

The Dee Estuary also qualifies as a possible SAC for the Annex I habitats **fixed dunes with herbaceous vegetation ("grey dunes")** (a priority interest feature); **shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"), embryonic shifting dunes ,humid dune slacks, and vegetated sea cliffs of the Atlantic and Baltic coasts.** These do not however, occur within the European marine site as they lie above highest astronomical tide and therefore are not considered further within this document.

### 2.4.2 Dee Estuary SPA

There are a number of habitats within the SPA, which support the qualifying bird species, but which do not, occur within the European marine site as they occur above highest astronomical tide. These habitats include coastal grazing marsh used by waterbirds for feeding, roosting and loafing, and the nesting areas of common terns. Conservation objectives covering the use of such coastal habitats by the qualifying bird species are appended to the SPA conservation objectives. They are provided for information only and do not constitute advice under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994.

### 2.4.3 Dee Estuary Ramsar site

There are a number of habitats, such as wet grazing marsh**, which** occur within the boundary of the Ramsar site and support the bird species comprising the waterbird assemblage under Criterion 5 and those listed individually under Criterion 6 of the Ramsar Convention on Wetlands of International Importance. Conservation objectives covering the use of such coastal habitats by the qualifying bird species are appended to the Ramsar conservation objectives. They are provided for information only and do not constitute advice under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994.

Coastal habitats supporting a breeding colony of Natterjack toads *Bufo calamita* (listed under Criterion 2 of the Ramsar Convention) also occur within the Dee Estuary but are outside the European marine site.

# 3. Background to favourable condition tables

- The favourable condition table for the pSAC can be found in Section 7
- The favourable condition table for the SPA / pSPA can be found in Section 11
- The favourable condition table for the Ramsar / pRamsar is referred to in Section 15

The favourable condition table specifies the following (in columns from left to right):

- **Features**: interest features for which the SAC, SPA or Ramsar site is selected.
- **Subfeatures**: ecologically important sub-divisions of an interest feature. In the case of a habitat interest feature, subfeatures would be component habitats or communities (egg defined by type and/or by geographic location within the site). In the case of species interest features, subfeatures include the population itself, or any ecologically relevant subdivisions of the population, and any habitats or communities on which it/they depend.
- **Attributes**: particular characteristics of the features or sub-features which provide an indication of the condition of the feature (egg total population size, extent of a habitat type).
- **Measures**: what exactly about the attributes will be measured, in terms of the units of measurement to be used, arithmetic nature and frequency at which the measurement is taken. An indication of the method that is likely to be used to obtain the observed values of attributes. The method is closely linked to the way in which the measure is expressed. It is important to note that in many cases the precise monitoring method to be used may not be known at this stage.
- **Targets**: These define the attribute values that equate to favourable condition. If changes are observed that are 'significantly' different from the target, this will act as a trigger for further investigation as to the cause of the change, or remedial management action. In general the targets in the favourable condition table are subject to natural processes as set out in the conservation objectives; i.e. where natural processes alone dictate that targets are not met this will not result in the condition of the feature being classed as unfavourable. The term 'subject to natural processes' is explained further in section 6.1.
- **Comments**: notes on the rationale for the use of each attribute and measure.

The favourable condition table is intended to supplement the conservation objectives only in relation to management of established and ongoing activities and future reporting requirements on monitoring the condition of the features of the site. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under Regulations 20, 48-50 and 62, but, together with the conservation objectives it does provide a basis to inform the scope and nature of any appropriate assessment that may be needed. It should be noted that appropriate assessments are a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects. English Nature and the Countryside Council for Wales will provide more detailed advice to competent and relevant authorities to assess the implications of any given plan or project under the Regulations, where appropriate, at the time a plan or project is being considered.

The favourable condition table specifies the main types of information that English Nature and the Countryside Council for Wales may use to assess the condition of interest features. On many terrestrial European sites, we know sufficient about the preferred or target condition of qualifying species and habitats to be able to define measures and associated targets for all attributes. In European marine sites favourable condition is generally harder to define precisely since our knowledge of features is still developing. Accordingly, in the absence of such information, condition of interest features in European marine sites will be assessed against targets based on their condition at the time the sites were selected, which may need to be established through baseline surveys in many cases.

The information contained within the favourable condition table is not necessarily what will be monitored but provides the basis for discussions with management and advisory groups. The attributes and associated measures and targets may be modified over time. The selection of attributes is based on the current understanding of the habitats and species and the available measuring techniques. The aim is to produce a single agreed set of attributes that will then be monitored in order to report on the condition of features.

The appropriateness of individual attributes as indicators of condition will be reviewed as more knowledge of the condition of interest features is obtained and/or survey and monitoring techniques develop. Monitoring of the attributes may be of fairly coarse methodology, underpinned by more rigorous methods on specific areas within the site.

The favourable condition table will be an important, but not the only, driver of the site monitoring programme. Other data, such as results from compliance monitoring and appropriate assessments, will also have an important role in assessing condition of interest features. The monitoring programme will be developed as part of the management scheme process through discussion with the relevant authorities and other interested parties. English Nature and the Countryside Council for Wales will be responsible for collating the information required to assess condition, some of which may be collected by other organisations, and for judging the condition of each feature within the site, taking into account all available information and using the favourable condition table as a guide.

# 4 Advice on operations

English Nature and the Countryside Council for Wales have a duty under Regulation 33(2)(b) of the Conservation (Natural Habitats &c.) Regulations 1994 to advise other relevant authorities as to any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated. Information on how English Nature and the Countryside Council for Wales have developed this advice is given in section 4.2 and on how it may be reviewed and updated in the future, in section 4.4.

The advice is provided in summary form in Table 1 with more detail in Tables 3 and 7 and in Sections 8, 12 and 16 including advice in relation to specific interest features and their sub-features.

## 4.1 Purpose of advice

The aim of this advice is to enable all relevant authorities to direct and prioritise their work on the management of activities that pose the greatest potential threat to the favourable condition of interest features on the Dee Estuary European marine site. The advice is linked to the conservation objectives for interest features and will help provide the basis for detailed discussions between Relevant Authorities with a view to the possible development of a management scheme for the site. The advice given here will inform on, but is without prejudice to, any advice given under Regulation 48 or Regulation 50 on operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

## 4.2 Methods for assessment

To develop this advice on operations English Nature and the Countryside Council for Wales have used a three step process involving:

- an assessment of the **sensitivity** of the interest features or their component sub-features to operations;
- an assessment of the **exposure** of each interest feature or their component sub-features to operations; and
- a final assessment of **current vulnerability** of interest features or their component sub-features to operations.

This three-step process builds up a level of information necessary to manage activities in and around the European marine site in an effective manner. Through a consistent approach, this process enables English Nature and the Countryside Council for Wales to both explain the reasoning behind our advice and identify to competent and relevant authorities those operations which pose the most current threats to the favourable condition of the interest features on the European marine site.

The assessment of relative sensitivity, exposure and vulnerability is derived using best available scientific information and informed scientific interpretation and judgement. The process uses sufficiently coarse categorisation to minimise uncertainty in information, reflecting the current state of our knowledge and understanding of the marine environment.

Information has been gathered from a range of sources including reports such as ABP Research (1999).

### 4.2.1 Sensitivity assessment

The sensitivity assessment used is an indication of the relative sensitivity of the interest features or the component sub-features of the Dee Estuary European marine site to the effects of broad categories of human activities. In relation to this assessment, sensitivity has been defined as the intolerance of a habitat, community or individual (or individual colony) of a species to damage, or death, from an external factor (Hiscock, 1996). With regard to the SPA features the sensitivity of the supporting habitats has been assessed in relation to the use of habitats by birds. For example, all habitat features are highly sensitive to the physical loss of their component communities by removal; and wintering birds are highly sensitive to loss of their roosting or feeding grounds.

The sensitivity assessments of the interest features or their component sub-features of the Dee Estuary European marine site are based upon a series of scientific review documents. These include reports produced for the UK Marine SACs LIFE Project (Elliott *et al* 1998, Jones *et al*, 2000), the Countryside Council for Wales Science Report (Holt *et al*, 1995) and the Marine Habitats Review (Jones *et al*., 2000).

The sensitivity assessments are based on current information but may develop with improvements in scientific knowledge and understanding. In particular, English Nature and Scottish Natural Heritage have commissioned the Marine Biological Association of the UK, through its Marine *Life* Information Network (MarLIN) to provide detailed sensitivity information to underpin this advice which is available online (www.marlin.ac.uk).

### 4.2.2 Exposure assessment

Exposure assessment has been undertaken for the Dee Estuary European marine site by assessing the relative exposure of the interest features or their component sub-features to the effects of broad categories of human activities currently occurring on the site (as at February 2003). Again for the SPA features the exposure of the supporting habitats has been assessed in relation to the use of these habitats by birds.

### 4.2.3 Vulnerability assessment

The third step in the process is to determine the vulnerability of interest features or their component sub-features to operations. This is an integration of sensitivity and exposure. Only if a feature is both sensitive and exposed to a human activity will it be considered vulnerable. In this context therefore, 'vulnerability' has been defined as the exposure of a habitat, community or individual (or individual colony) of a species to an external factor to which it is sensitive (Hiscock, 1996). The process of deriving and scoring relative vulnerability is laid out in the key to Tables 3 and 7.

## 4.3 Format of advice

The advice is provided within six broad categories of operations, which may cause deterioration of natural habitats or the habitats of species, or disturbance of species. This approach therefore:

- enables links to be made between human activities and the ecological requirements of the habitats or species, as required under Article 6 of the Habitats Directive;
- provides a consistent framework to enable relevant authorities in England to assess the effects of activities and identify priorities for management within their areas of responsibility; and
- is appropriately robust to take into account the development of novel activities or operations which may cause deterioration or disturbance to the interest features of the site and should have sufficient stability to need only infrequent review and updating by English Nature and the Countryside Council for Wales.

These broad categories provide a clear framework against which relevant authorities can assess activities under their responsibility. The more detailed information in Tables 3 and 7 provides relevant authorities with a context against which to consider an assessment of 'significant effect' or any plans or projects that may affect the site and a basis to inform on the scope and nature of appropriate assessments required in relation to plans and projects. It is important to note that this advice is only a starting point for assessing impacts. It does not remove the need for the relevant authorities to consult English Nature and / or the Countryside Council for Wales formally over individual plans and projects where required to do so under the Regulations.

### 4.4 Update and review of advice

Information as to the operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated, is provided in light of what English Nature and the Countryside Council for Wales know about current activities and patterns of usage in the area of the Dee Estuary European marine site. English Nature and the Countryside Council for Wales expect that the information on current activities and patterns of usage (which was used in part to derive Tables 3 and 7) will be supplemented as part of the process of developing the management of the site, and through further discussion with the relevant authorities. As such, it is important that future consideration of this advice by relevant authorities and others takes account of changes in the usage patterns that have occurred at the site, over the intervening period, since the advice was issued. In contrast, the information provided in this advice on the sensitivity of interest features or sub-features (Tables 3 and 7) is relatively stable and will only change as a result of an improvement in our scientific knowledge, which will be a relatively long term process. Advice for sites will be kept under review and may be periodically updated through discussion with relevant authorities and others to reflect significant changes in our understanding of sensitivity together with the potential effects of plans and projects on the marine environment.

### 4.5 Summary of advice on operations for the SAC, SPA and Ramsar interest features

Table 1 is a summary of the advice on operations for the SAC, SPA and Ramsar interest features. In pursuit of the conservation objectives for all the interest features, the relevant and competent authorities for the Dee Estuary European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance of the habitats through any of the categories of operation listed in the table.

### 4.6 Plans and projects

Under Regulation 48(1), an appropriate assessment must be undertaken by competent authorities in respect of any plan or project which:

a. either alone or in combination with other plans or projects is likely to have a ***significant effect*** on a European Site; and

b. is not directly connected with or necessary to the management of the site for nature conservation.

This legal requirement applies to all European sites. Regulation 48 is also applied, as a matter of Government policy, to proposed SPAs and listed Ramsar sites.

Tables 3 and 7 provide competent authorities with a guide against which to initiate an assessment of the 'significance' of any plans or projects (and ongoing operations or activities) proposed for the site although this will only be the starting point for assessing impacts and does not remove the need for competent authorities to formally consult English Nature or the Countryside Council for Wales over individual plans and projects where required under the Regulations.

### 4.7 Review of consents

Regulation 50 of the Conservation (Natural Habitats, &c.) Regulations 1994 requires a competent authority to undertake a review of any existing consent or permission to which Regulation 48(1) would apply if it were to be reconsidered as of the date on which the site became a European site. Where a review is required under these provisions it must be carried out as soon as reasonably practicable after classification of the European marine site. Consents will need to be reviewed in the light of these objectives.

**Table 1 Summary of operations that may cause deterioration or disturbance to the Dee Estuary European marine site interest features at current levels of use [8]**

The advice below is not a list of prohibitions but rather a checklist for operations for discussion with the management group, which may need to be subject to some form of management measure(s) or further measures where actions are already in force. Examples of activities under relevant authority jurisdiction are also provided. Operations marked with a √ indicate those features (habitats and/or species) that are considered to be highly or moderately vulnerable to the effects of the operations.

| Categories of operations which may cause deterioration or disturbance | SAC interest features | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Estuaries** | **Intertidal mudflats and sandflats** | ***Salicornia* and other annuals** | **Atlantic salt meadow** | **Annual Vegetation of drift lines** | **Sea lamprey (*Petromyzon marinus*)** | **River lamprey (*Lapetra fluviatilis*)** |
| **Physical Loss** | | | | | | | |
| Removal (e.g. land claim, dredging) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Smothering (e.g. depositing dredge spoil, beach feeding) | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| **Physical Damage** | | | | | | | |
| Siltation (e.g. dredging, outfalls) | ✓ | ✓ | | | | | |
| Abrasion (e.g. recreational activity, vehicles) | ✓ | ✓ | | ✓ | ✓ | | |
| Selective extraction (e.g. aggregate extraction) | ✓ | | | | | | |
| **Non-physical disturbance** | | | | | | | |
| Noise (e.g. land/water-based recreation, marine traffic) | | | | | | | |
| Visual presence (e.g. land/water-based recreation, marine traffic) | | | | | | | |
| **Toxic contamination** | | | | | | | |
| Introduction of synthetic compounds (e.g. TBT, PCBs from industrial effluent outfalls) | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |

| Categories of operations which may cause deterioration or disturbance | SAC interest features | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Estuaries** | **Intertidal mudflats and sandflats** | ***Salicornia* and other annuals** | **Atlantic salt meadow** | **Annual Vegetation of drift lines** | **Sea lamprey (*Petromyzon marinus*)** | **River lamprey (*Lapetra fluviatilis*)** |
| Introduction of non-synthetic compounds (e.g. domestic effluent outfalls, crude oil) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Introduction of radionuclides | | | | | | | |
| **Non-toxic contamination** | | | | | | | |
| Changes in nutrient loading (e.g. agricultural run-off, domestic effluent outfalls) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Changes in organic loading (e.g. domestic effluent outfalls, aquaculture) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Changes in thermal regime (e.g. power station discharges) | | | | | | ✓ | ✓ |
| Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil) | ✓ | ✓ | | | | | |
| Changes in salinity (e.g. water abstraction, effluent outfalls) | | | | | | | |
| **Biological disturbance** | | | | | | | |
| Introduction of microbial pathogens (e.g. domestic/industrial effluent outfalls) | | | | | | | |
| Introduction of non-native species and translocation | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Selective extraction of species (e.g. glasswort collection, bait collection) | ✓ | ✓ | | | | | |

| Categories of operations which may cause deterioration or disturbance | SPA interest features | | | Ramsar interest features | |
|---|---|---|---|---|---|
| | Annex I species | Migratory species | Waterbird Assemblage | Criterion 5: Regularly supports 20,000 or more waterbird species Criterion | 6: Regularly supports 1% or more of a species or sub-species of waterbird |
| **Physical Loss** | | | | | |
| Removal (e.g. land claim, dredging) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Smothering (e.g. depositing dredge spoil, beach feeding) | ✓ | | | | |
| **Physical Damage** | | | | | |
| Siltation (e.g. dredging, outfalls) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Abrasion (e.g. recreational activity, vehicles) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Selective extraction (e.g. aggregate extraction) | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Non-physical disturbance** | | | | | |
| Noise (e.g. land/water-based recreation, marine traffic) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Visual presence (e.g. land/water-based recreation, marine traffic) | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Toxic contamination** | | | | | |
| Introduction of synthetic compounds (e.g. TBT, PCBs) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Introduction of non-synthetic compounds (e.g. domestic effluent outfalls, crude oil) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Introduction of radionuclides | | | | | |
| **Non-toxic contamination** | | | | | |
| Changes in nutrient loading (e.g. agricultural run-off, domestic effluent outfalls) | ✓ | ✓ | ✓ | ✓ | ✓ |

| Categories of operations which may cause deterioration or disturbance | SPA interest features | | | Ramsar interest features | |
|---|---|---|---|---|---|
| | Annex I species | Migratory species | Waterbird Assemblage | Criterion 5: Regularly supports 20,000 or more waterbird species Criterion | 6: Regularly supports 1% or more of a species or sub-species of waterbird |
| Changes in organic loading (e.g. domestic effluent outfalls, aquaculture) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Changes in thermal regime (e.g. power station discharges) | | | | | |
| Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil) | ✓ | ✓ | ✓ | ✓ | ✓ |
| Changes in salinity (e.g. water abstraction, effluent outfalls) | | | | | |
| **Biological disturbance** | | | | | |
| Introduction of microbial pathogens (e.g. domestic/industrial effluent outfalls) | | | | | |
| Introduction of non-native species and translocation | ✓ | ✓ | ✓ | ✓ | ✓ |
| Selective extraction of species (e.g. samphire picking, bait collection) | ✓ | ✓ | ✓ | ✓ | ✓ |

[8] This advice has been developed using best available scientific information and informed scientific interpretation and judgement (as at February 2003). This process has used a coarse grading of relative sensitivity, exposure and vulnerability of each interest feature to different categories of operation based on the current state of our knowledge and understanding of the marine environment. The advice is indicative only, and is given to guide relevant authorities and others on particular operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the site has been designated. The advice, therefore, is not a list of prohibitions but rather a check list for operations which may need to be subject to some form of management measure(s) or further measures where actions are already in force.

The precise impact of any category of operation occurring on the site will be dependant upon the nature, scale, location and timing of events. More detailed advice is available from English Nature and the Countryside Council for Wales to assist relevant authorities in assessing actual impacts and cumulative effects. Assessment of this information should be undertaken in the development of management of the site through wider consultation.

In accordance with Government policy guidance, the advice on operations is feature and site specific, and provided in the light of current activities and patterns of usage at the site as at February 2003. As such, it is important that future consideration of this advice by relevant authorities, and others, takes account of changes in usage patterns that have occurred at the site over the intervening period. Advice for sites will be kept under review and may be periodically updated through discussions with relevant authorities, and others, to reflect significant changes in our understanding of sensitivity together with the potential effects of plans or projects on the marine environment. The provision of the statutory advice given here, on operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated, under Regulation 33(2), is provided without prejudice to specific advice given under Regulation 48(3) or Regulation 50 on individual operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

# Special Area of Conservation

# 5 The Dee Estuary pSAC interest features

The Dee Estuary pSAC includes both marine areas (i.e. land covered continuously or intermittently by tidal waters) and land that is not subject to tidal influence. The marine part of the pSAC is termed a European marine site. The seaward boundary of the European marine site is concurrent with that of the pSAC. The landward boundary of the European marine site is the upper boundary of the pSAC, or where that extends above land covered continuously or intermittently by tidal waters, it is at the limit of the marine habitats (highest astronomical tide).

Where the pSAC qualifying species or habitats occur within the European marine site, they are referred to as interest features. Sub-features (habitats / communities) have also been identified to highlight the ecologically important components of the European marine site for each interest feature (Figure 1). Maps showing the extent of the habitat features of the Dee Estuary pSAC and their component sub-features are shown in Appendix IV.

The Dee Estuary European marine site includes seven of the interest features of the possible Special Area of Conservation that qualify under Annex I and Annex II of the Habitats Directive. This section describes and explains the importance of each of these interest features together with their component sub-features.

## 5.1 Estuary

### 5.1.1 Definition

Estuaries are complex and highly productive ecosystems supporting a wide range of habitats and species. They form the interface between freshwater and marine environments and extend from the upper limit of tidal influence to the open sea. Where freshwater and seawater meet and where current flows are reduced in the shelter of estuaries, fine sediments are deposited, often forming extensive intertidal mudflats and sandflats. These are typically inhabited by a variety of infaunal invertebrates, many of which provide important sources of food for fish, waterbirds and seabirds. At higher elevations within the tidal range the mudflats and sandflats are exposed for sufficient periods to become vegetated with salt-tolerant plants forming saltmarshes, which play an important role in the nutrient and sediment cycling processes within the estuarine ecosystem. Saltmarshes also provide essential feeding and roosting areas for waterbirds. Towards the mouth of an estuary, where the water gradually becomes more saline, the silt content of the sediment declines and infaunal communities are dominated by invertebrates such as polychaete worms and infaunal bivalve molluscs. The prevailing physical conditions within estuaries are the result of geomorphology and the natural processes of tidal flow, the wind and wave environment and river flow. Natural processes within estuaries are a key control on the distribution of estuarine habitats and many of the habitats within an estuary are interdependent and inextricably linked to the structure and functioning of others.

The UK has a particularly large number of estuaries. Infact, more than a quarter of the total area of the north-western European estuaries is to be found in the UK (Brown *et al.*, 1997). The wide range of estuary types occurring in the UK is also unusual in a European context. Sites in the UK have been selected to represent the geographical range of estuaries and include examples of four geomorphological types (coastal plain, bar-built, complex estuaries and rias) and a range of substrates and associated fauna. The intertidal and subtidal

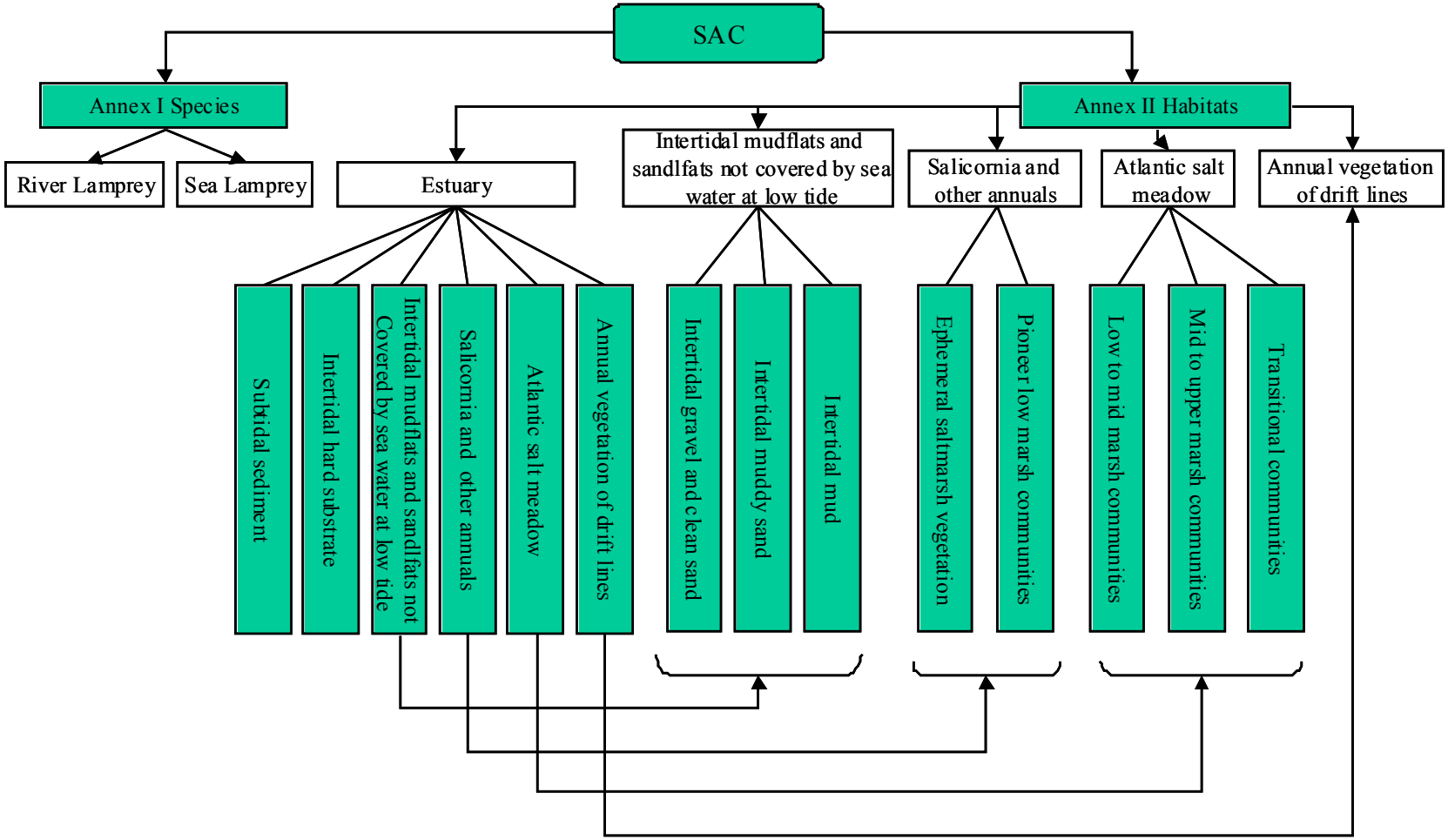


Figure 1. Flow chart showing the relationship between the interest features for which the Dee Estuary / Aber Dyfrdwy pSAC qualifies under the EU Habitats Directive, and their component sub features. Features are shown in 'open' boxes with sub features in shaded vertical boxes.
NB Some habitats that are sub features of the Annex II estuary feature are also features in their own right with their own sub features.

sediments of estuaries support biological communities that vary depending on their geographic location, sediment type, tidal currents and the salinity gradients within the estuary.

### 5.1.2 Importance of the estuary interest feature in the Dee Estuary European marine site

Estuaries in the UK have been selected to take account of the UK's EU responsibility for this habitat type and so the site series contains a high proportion of the total UK resource. Sites have generally been selected as entire units, extending from the tidal limit or extent of brackish influence to the estuary mouth and including all habitats that are important to the integrity of the site. In particular, the entire water column has been included due to its importance not only in the biological functioning of the system, but also as the means by which sediment is mobilised and transported.

The Dee Estuary is a funnel-shaped coastal plain estuary formed partly by erosion of Irish Sea ice moving landward up the estuary (CCW, 1993). It is the sixth largest estuary in the UK, covering an area of around 14,000 ha and contributing approximately 6% of the UK estuarine resource.

The estuary is characteristic of coastal plain estuaries in general having a large width to depth ratio; though long shore drift has caused a spit to form at the estuary mouth, a feature more characteristic of bar-built estuaries. The Dee is a hyper tidal estuary with a mean spring tidal range of 7.7 m at the mouth, which occasionally produces a tidal bore in the upper estuary (NCC, 1978; Parr, 1988). The majority of the estuary is composed of intertidal habitats drying at low tide with less than 10% of the estuary remaining underwater at low water on spring tides. In the outer estuary sand bars and beaches are exposed to constant reworking by wave action and tidal currents in what is a highly dynamic environment, whereas in the upper estuary, flat expanses of mud accumulate in a much more sheltered regime. Freshwater inputs into the Estuary are dominated by the highly regulated flow of the River Dee with other 'stream inputs' accounting for only 8% of the total (Parr, 1988). The history of human influence on estuary morphology has also affected the prevailing conditions that we see today (see section 1.10).

The Dee Estuary provides conditions covering the complete range of salinities, from fully marine to fresh water, and also of wave exposures from open coasts to fully sheltered environments. As a result of this wide range of physical conditions the estuary is able to support a variety of estuarine habitats and communities; 41 different biotope communities have been recorded from the Welsh side of the estuary alone (Jones *et al.*, 2002). Some of these habitats qualify as features of the European marine site in their own right; these include the extensive intertidal mud and sandflats, Atlantic salt meadows, *Salicornia* beds and vegetated driftlines. As described in chapter 1 several important terrestrial habitats are also associated with the estuary including the dune system between Talacre and Prestatyn to the west of the mouth of the estuary and the vegetated sea cliffs of the Hilbre Islands.

The intertidal mudflats and sandflats of the Dee Estuary comprise the fifth largest area within an estuary in the UK. Large areas of saltmarsh occur at the head of the estuary and along the north-eastern shore. The saltmarsh shows a range of stages of development, from young, recently formed vegetation communities to old, well-established ones. The elaborate creek

system in the Dee Estuary creates a more diverse array of habitats than are found in more continuous fringing salt marshes, such as those of Morecambe Bay.

The subtidal zone of the Dee Estuary is believed to provide an important breeding, sheltering and nursery area for coastal fish species. The estuary also forms an essential part of the route of migratory fish species, which have their breeding grounds in the River Dee. Species present include Atlantic salmon *Salmo salar*, sea trout *S. trutta*, smelt *Osmerus eperlanus*, twaite shad *Allosa fallax* and eels *Anguilla anguilla* as well as sea lamprey *Petromyzon marinus* and river lamprey *Lampetra fluviatilis*. The lamprey species qualify as features of both the Dee Estuary pSAC and River Dee cSAC, whilst Atlantic salmon are an additional feature of the River Dee cSAC.

The estuary is important for its waterbird populations, including waders, wildfowl and terns. For this reason the estuary has been designated as a Ramsar site under the Ramsar Convention of Wetlands of International Importance and as a Special Protection Area (SPA) under the EC Birds Directive.

A large grey seal *Halichoerus grypus* 'haul out' of 300-500 individuals is to be found on the eastern side of Salisbury Middle, adjacent to Hilbre Island which form part of the North Wales grey seal population. Grey seals are a feature of the Pen Llyn a'r Sarnau cSAC and reference should be made to the Regulation 33 advice for this site with respect to the grey seal population within the Dee Estuary European marine site.

### 5.1.3 Sub-features

**Subtidal sediment communities** - subtidal areas and the communities they support, are considered to form an important component of the estuarine system. Sub-tidal habitats will act as a refuge for estuarine fish communities at low tide, as well as supporting a variety of benthic species.

The Dee supports important fish stocks; and the outer estuary acts as a nursery ground for species such as bass *Dicentrarchus labrax*, flounder *Pleuronectes flesus*, and grey mullet species *Chelon labrosus* and *Liza ramada* (NRA, 1993; Potts & Swaby, 1993). Indeed the Dee Estuary is a designated bass nursery area under the Sea Fisheries (Bass Regulation) Order 1990. Both salmon and sea trout are commercially important in the estuary and the Dee supports a salmon net fishery controlled by a Net Limitation Order. There is also a fishery for brown shrimp (*Crangon crangon*) between May and July (Mealor, *pers. comm.*). Whitebait and sand eels *Ammodytes* spp. within the estuary create a food resource for the estuaries' breeding tern colonies (NCC, 1978).

Due to the lack of information regarding the subtidal communities present within the Dee no specific areas are identified as being of sub-feature status at present though this may change if further data becomes available.

**Intertidal hard substrate communities** - The rocky shore areas around Hilbre Islands provide one of the few localities along this stretch of coastline where communities are found on natural rocky substrata. The 1990 Marine Nature Conservation Review intertidal survey of the coast between Rhos Point and New Brighton (Garwood & Foster-Smith, 1991) identified several sites with rocky shore communities within the site as being of local importance, these include the extensive vertical cliff face at Shell Bay on the west side of

Hilbre Island. The recent intertidal biotope survey of the Welsh shore identified 21 different rocky shore biotopes altogether, though many of these were only present in very small quantities (Jones *et al*., 2002).

While there are a large range of hard substrate communities present within the site only those which are considered particularly notable are considered worthy of inclusion as part of hard substrate 'sub-feature' of the estuary feature. Three communities present within the Dee Estuary meet this criteria being either, specialised biotopes, or nationally important biotopes:

- An area of Holocene peat deposits occurs on Salisbury Bank and supports the nationally important biotope *Mytilus edulis* and piddocks on eulittoral firm clay (Jones *et al*., 2002).
- The specialised biotope community hydroids, ephemeral seaweeds and *Littorina littorea* in shallow eulittoral mixed substrata pools has recently been recorded south of Mostyn Quay within a mussel bed on the lower shore (Jones *et al*., 2002).
- The nationally important biotope and a priority national Biodiversity Action Plan habitat, *Sabellaria alveolata* reefs on sand-abraded eulittoral rock, is recorded on the north west, east and southwest shores of Hilbre Island.

**Intertidal mudflats and sandflats communities -** 'Mudflats and sandflats not covered by seawater at low tide' are classified in the Habitats Directive as interest features in their own right and are therefore described separately in sections 5.2 below.

***Salicornia* and other annuals -** '*Salicornia* and other annual plants colonising mud and sand' are classified in the Habitats Directive as interest features in their own right and are therefore described separately in sections 5.3 below.

**Atlantic salt meadow - '**Atlantic salt meadows' are classified in the Habitats Directive as interest features in their own right and are therefore described separately in sections 5.4. below.

**Annual vegetation of drift lines** - 'Annual vegetated drift line' are classified in the Habitats Directive as interest features in their own right and are therefore described separately in sections 5.5 below.

### 5.2 Mudflats and sandflats not covered by seawater at low tide

#### 5.2.1 Definition

Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide. They form a major component of estuaries and embayments in the UK, but also occur extensively along the open coast. The physical structure of the intertidal flats ranges from the mobile, coarse sand beaches of wave-exposed coasts to the stable, fine sediment mudflats of estuaries and other embayments. This habitat type can be divided into three broad categories, clean sands, muddy sands and muds; although in practice there is a continuous gradation between them. Plant and animal communities present vary according to the type of sediment, its stability and the salinity of the water.

Intertidal mudflats and sandflats are a widespread habitat type that occurs throughout the UK. European marine sites were selected to encompass the ecological variation across the geographical range of this habitat type in the UK. Sites with large areas of intertidal flats, as well as a range of environmental conditions and an associated diversity of communities were favoured (JNCC, 2003).

### 5.2.2 Importance of the mudflats and sandflats not covered by seawater at low tide interest feature in the Dee Estuary European marine site

The intertidal mudflats and sandflats of the Dee Estuary cover an area of over 10,000 ha, comprising approximately 3 % of the total UK resource of this habitat type. Only five other p or c SACs in the UK series have larger areas of intertidal mudflats and sandflats than the Dee Estuary. They are highly dynamic and change in shape from one year to the next.

The estuary has the full range of sand, muddy sand and mud biotopes although the intertidal flats are somewhat sandier than other coastal plain estuaries in the northeastern Irish Sea, the relatively sandy nature of the upper estuary sediments may be attributed to the shortening of the estuary following canalisation (Jones *et al*., 2002). The communities present are highly representative of estuarine mudflats and sandflats in general (CCW, 2002) and the invertebrates provide a rich source of food for the internationally important bird populations of the estuary.

In the inner section of the estuary, large areas are dominated by the ragworm *Hediste diversicolor* and the Baltic tellin *Macoma balthica*. Slightly higher up the shore the sediments are more often dominated by amphipods *Bathyporeia pilosa* and *Corophium arenarium*. Sheltered muddy areas sometimes contain high numbers of invertebrates including the ragworm *H. diversicolor*, the peppery furrow shell *Scrobicularia plana* and polychaete worms such as *Eteone longa*. Some areas of the intertidal are dominated by dense cockle beds, which are harvested by hand raking. These are situated towards the outer section of the estuary, on both the English and Welsh shores. The sandy areas either side of the estuary mouth, between Prestatyn and the Point of Ayr and off the north Wirral coast mainly consist of mobile sands dominated by amphipods and polychaetes.

### 5.2.3 Sub-features

**Intertidal gravel and clean sand communities** - This sub-feature generally occurs particularly on open coast beaches and in estuaries and bays where wave action or strong tidal currents prevent the deposition of finer silt. Sandy communities are very extensive within the Dee Estuary and extend well into the mid and upper estuary, especially on the Welsh side of the estuary where the more mobile sediments are to be found associated with the main channel. The estuaries outer sand banks such as Salisbury Middle and Salisbury Bank consist of moderately exposed sand. These areas experience moderately strong tidal streams particularly along the channel edges. Consequently the sediment is extremely mobile forming large sand waves, the tops of which are dryer and more aerated than the wet compacted sand between them (Jones, *et al*., 2002). The greater part of these banks comprise extensive areas of fine sand with ripples, small waves and standing water

The nationally scarce thumbnail crab *Thia scutellata* has recently been recorded on the outer sandbanks of the estuary (Jones *et al*., 2002).

Strandlines form on the sandy beaches present at the mouth of the Dee. Standlines provide sheltered, moist conditions for some specialised plants and both terrestrial and marine invertebrate species. The organic matter which is deposited helps to bind sand particles together and stabilise the upper shore. In addition strandlines can act as sand traps initiating sand dune formation. Two nationally scarce species, the woodlouse *Armadillidium album,* and the spider *Enoplagnatha crucifera*, are recorded from the drift line at Talacre (Liverpool Museum, 2003).

The **nationally scarce species** occurring within intertidal gravel and clean sand sub feature of mudflats and sandflats not covered by seawater at low tide interest feature in the Dee Estuary European marine site are;

- thumbnail crab *Thia scutellata*
- the woodlouse *Armadillidium album*
- the spider *Enoplagnatha crucifera*

**Intertidal muddy sand communities -** These communities are found in areas of intermediate exposure including relatively sheltered areas of the outer estuary, large areas of the mid estuary and in the upper estuary close to the main channel. A wide range of species colonise these sediments including dense populations of lugworm *Arenicola marina*, other polychaete worms and bivalve molluscs.

The muddy sand habitats of the Dee support extensive cockle beds of particular importance for the wading birds which depend upon them; they are also a valuable economic resource. The nationally rare species *Ophelia bicornis* was recorded from an area of sandy mud on Mostyn Bank (Record to be confirmed - EA NMMP littoral survey 1999-2000, in Jones *et al.*, 2002).

The **nationally scarce species** occurring within intertidal muddy sand sub feature of mudflats and sandflats not covered by seawater at low tide interest feature in the Dee Estuary European marine site are;

- the worm *Ophelia bicornis*

**Intertidal mud communities -** These form in the most sheltered areas of the estuary and are recorded towards the head of the estuary and at the bottom of the saltmarsh in the middle estuary (Jones, *et al.*, 2002; Jones updated, after Environment Agency, 1998). The width of the muddy sediment zone is apparently much wider to the north of the main channel than to the south. The stable sediment supports communities whose component species are often highly abundant, typically they are dominated by polychaete worms such as the lugworm *Arenicola marina* and the rag worm *H. diversicolor*, and by bivalve molluscs including Baltic tellin *M. balthica* and peppery furrow shell *S. plana*. Very high densities of the mud-snail *Hydrobia ulva*e also occur. The high biomass of invertebrates in such sediments provides an important food source for a diverse range and large number of fish and benthic predators. Mudflats also provide a valuable feeding, roosting and resting area for species of wading birds and waterfowl.

## 5.3 Salicornia and other annuals colonising mud and sand (pioneer saltmarsh)

### 5.3.1 Definition

Pioneer saltmarsh vegetation colonises intertidal mud and sand flats in areas protected from strong wave action and is an important precursor to the development of more stable saltmarsh vegetation. It develops at the lower reaches of the saltmarshes where the vegetation is frequently flooded by the tide, and can also colonise open creek sides, depressions or pans within a saltmarsh, as well as disturbed areas of upper saltmarsh.

There can be upto 13 separate communities that could be considered pioneer saltmarsh in which either cord grasses *Spartina* spp., annual glassworts *Salicornia* spp., annual seablite *Suaeda maritima* and/or common saltmarsh-grass *Pucinellia maritima* generally form a prominent component of the vegetation with, more unevenly, sea aster *Aster tripolium* and sea purslane *Atriplex portulacoides* (Rodwell, 2000).

The annex I habitat 'Salicornia and other annuals colonising mud and sand (pioneer saltmarsh)' is divided into two main types of vegetation; the first type consists of communities which include open stands of perennial glasswort *Sarcocornia perennis*, annual glassworts *Salicornia* spp., or annual seablite *Suaeda maritima* (National vegetation classification types SM7, SM8 and SM9). Other species that may be found include common saltmarsh-grass *Puccinellia maritima*, common cord grass *Spartina anglica* and sea aster *Aster tripolium*. These communities occur in many saltmarshes in the UK and represent an integral part of a sequence of habitats, from sand and mud flats to more stable saltmarsh vegetation.

The second form of pioneer vegetation consists of ephemeral communities colonising open pans in upper saltmarshes. Characteristic plants of this vegetation type include sea pearlwort *Sagina maritima* and knotted pearlwort *S. nodosa*. Such vegetation corresponds to the SM27 NVC community.

### 5.3.2 Importance of the *Salicornia* and other annuals colonising mud and sand interest feature in the Dee Estuary European marine site

The Dee Estuary supports around 4% of the national UK resource for this feature based on figures obtained in 2000 by Dargie (2001) as a proportion of the national total from the national saltmarsh survey carried out over seven years in the 1980's (Burd 1989). Larger areas can be found in only three other p or cSACs: the Wash and North Norfolk Coast cSAC, the Essex Estuaries cSAC and the Solway Firth cSAC. Glassworts *Salicornia* spp. and other annuals such as seablite *Suaeda maritima* are highly specialised plants, totally dependent on a narrow habitat zone on the seaward fringes of saltmarsh. In the Dee the seaward fringes of the accreting marsh provide ideal conditions and it is here that the feature is concentrated.

Research by Ball and Brown (1970, in NCC 1978) discovered that two different species of *Salicornia* were present within the Dee, common glasswort S*alicornia europeae* and long-spiked glasswort *S. dolichostachya*. Long-spiked glasswort was found to be more abundant in open situations as a primary coloniser whereas common glasswort was more common higher up the marsh in association with other species.

In some places the character of the *Salicornia* community has been affected by the presence of common cord grass *Spartina anglica*, which was introduced in the 1930s.

Pioneer saltmarsh also provides an important feeding area and a food source for many species of waterbirds.

### 5.3.3 Sub-features

**Pioneer low marsh communities -** The annual glasswort *Salicornia* community (SM8) is the dominant pioneer marsh community in the Dee Estuary pSAC with 105 ha recorded in 2000 (Dargie, 2001). This community forms a classical pioneer vegetation front to the low saltmarsh along the north side of the estuary, forming very extensive swards on areas of sandy mud with reduced tidal scour. The lower limit of the glasswort community is set by the time between tides and the time taken for the seeds to become firmly anchored. Glasswort species are tolerant of frequent tidal inundations, enduring around 600 flooding per year at its lower limits where it forms the familiar pioneer stands. Glasswort is also found in smaller patches higher in the main body of the saltmarsh, here it is concentrated in circular pans linked to shallow creeks. Sea-blite *Suaeda maritima* saltmarsh community (SM9) is an annual pioneer community that is rare on the Dee Estuary and very restricted in area. SM9 vegetation on the Dee is dominated by Sea-blite with associations of common cord grass, with occasional sea purslane *Atriplex portulacoides*, glasswort and sand couch *Elytrigia juncea*. On the Dee this community is developed best on small areas of mud adjacent to creek confluences. Very rarely it forms on creek levees in the pioneer zone, usually close to the transition to middle marsh conditions. This community is considered to be much less frequent in the estuary than in the 1980's (M. Hill, in Dargie 2001).

**Ephemeral saltmarsh vegetation -** Small quantities of ephemeral saltmarsh vegetation with sea pearlwort *Sagina maritima* (SM27) were recorded by Dargie in 2000. In contrast to the classical pioneer low marsh communities discussed above, this community occurs towards the top of the saltmarsh on well-drained sites and at levels that are rarely flooded by tides. In the Dee Estuary it occurs primarily on sand dune to saltmarsh transitions within the Gronant Dunes and Talacre Warren SSSI at Gronant. The nationally scarce seaside centaury *Centaurium littorale* is found here (Dargie, 2001). The sward is generally open with a high proportion of bare ground being colonised by sea pearlwort *Sagina maritime*. Hard grass *Parapholis strigosa* is also usually present.

The **nationally scarce species** ocurring with the ephemeral saltmarsh vegetation sub feature of the *Salicornia* and other annuals colonising mud an sand interest feature in the Dee Estuary European marine site are;

- seaside centaury *Centaurium littorale*

## 5.4 Atlantic salt meadows Glauco-Puccinellietalia

### 5.4.1 Definition

Atlantic salt meadows *Glauco-Puccinellietalia*, develop when salt-tolerant vegetation colonises intertidal sediments of mud and sand in areas protected from strong wave action. This vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation

occurs with decreasing frequency and duration. The vegetation varies depending on the climate and position in the marsh. In the UK, Atlantic salt meadows occur on the North Sea, English Channel and Atlantic shores, with the largest examples in the sheltered estuaries of England. There are more than 29,000 hectares of this habitat in the UK (Brown *et al.*, 1997), which suggests that up to two-thirds of British saltmarshes are represented by this category. Sites have been selected to cover the geographical range and ecological variation of this habitat type, and for the most part they are the largest examples, supporting a well-developed donation of plant communities. Many have transitions to terrestrial habitat assemblages, such as freshwater reedbed, sand dunes, vegetated shingle and woodland. There are marked regional variations in Atlantic salt meadow communities in the UK and those which are grazed differ significantly from those which are ungrazed, in terms of both structure and species composition.

Saltmarshes play a fundamental role in the life of an estuary, bringing stability to its margins and also operating as a source of primary production. They are a rare and specialised habitat in their own right and many of the plants that occur there survive nowhere else. Saltmarshes provide an important habitat for both marine and terrestrial fauna and serve as roosting and feeding areas for internationally important waterbirds.

### 5.4.2 Importance of the Atlantic salt meadow interest feature in the Dee Estuary European marine site

The Dee Estuary supports about 7% of the total area of saltmarsh in the UK based on figures obtained in 2000 by Dargie (2001) as a proportion of the national total from the national saltmarsh survey carried out over seven years in the 1980's (Burd, 1989). Unlike many estuaries elsewhere the Dee saltmarsh is presently a predominantly accreting system (Dargie, 2001). Much of the saltmarsh of the Dee Estuary is typical of Atlantic salt meadow, with sea aster *Aster tripolium* forming an important component of most of its subdivisions (CCW, 2002). Approximately 13% (2040 ha) of the Dee Estuary pSAC comprises Atlantic salt meadow, and the estuary contains what is probably the third largest single expanse of this habitat in Britain (CCW, 2002).

There is an excellent balance in the types of vegetation present including 31 communities or sub-communities (see section 6.4 Box 4). These communities support a number of often rare or scarce obligate saltmarsh plant species, including slender hare's-ear *Bupleurum tenuissimum* (Dargie, 2001).

The Dee Estuary saltmarsh also exhibits excellent local and estuary wide habitat zonations. These include the presence of many localities with a complete sequence from low marsh to mid marsh via a middle marsh zone, and excellent examples of succession controlled by grazing. There is also excellent donation of major habitats in relation to their position within the estuary, including the development of pioneer vegetation as a rolling front to the main saltmarsh, low-middle marsh as the dominant vegetation type overall, upper marsh dominant on the oldest saltmarsh surfaces, extensive swamp on the inner saltmarsh edge where there is groundwater seepage from inland (Dargie, 2001).

The area of saltmarsh in the Dee Estuary has expanded relatively rapidly over the last century. This is most reasonably attributed to a combination of anthropogenic factors affecting the estuary's form; combined with the natural tendancy of the estuary to accrete. These factors include the historic land claim in the upper estuary, the diversion and

canalisation of the upper estuary channel, the introduction of training walls, regulation of flow volumes in the river Dee, and the introduction of the invasive saltmarsh species, common cord grass *Spartina anglica* in 1928, when 1,000 plants were planted opposite Connah's Quay (Masey, 1937, in NCC 1978). Yet, historically the area of saltmarsh within the Dee Estuary may previously have been greater still, since the overall length of the estuary has been shortened by approximately 30% in the last three hundred years, primarily as a result of the canalisation and land claim in the upper estuary.

The available information indicates that the Dee saltmarsh has changed markedly even over the last two decades with the saltmarsh increasing in both area and in height. The total extent of saltmarsh in the estuary has increased from 2,103 ha in 1983 to 2,832 ha in 2000 (Dargie, 2001). However, this increase has occurred at the same time as saltmarsh erosion has occurred along much of the Welsh shoreline. There has also been a reduction of about 95% in the area of marsh dominated by cord grass *S. anglica*, and the area of other pioneer saltmarsh habitats has also declined (Dargie, 2001). The replacement of *Spatina* dominated vegetation by middle marsh vegetation was evident during the mid 1980's during monitoring by the Nature Conservancy Council (Hill, 1987). This reduction in pioneer habitats has been balanced by gains in the area of common saltmarsh grass *Puccinellia maritima* and sea purslane *Atriplex portulacoides*. Common saltmarsh grass in particular seems to have prospered in areas where cord grass was once dominant. There have also been increases in the area of the middle – upper saltmarsh zones since 1983 (Dargie, 2001). Thus evidence points to conversion of pioneer habitats to middle and upper marsh conditions with new pioneer vegetation becoming established along the seaward edge. Further net accretion is considered likely to generate additional areas of saltmarsh in the short term, though the rate of accretion has reduced in recent years (J. Potter, *pers. comm.*).

Unlike most western estuaries, sizable areas of saltmarsh within the Dee Estuary remain ungrazed and therefore plant species which are susceptible to grazing are relatively widespread, for example sea purslane. However, heavy sheep grazing is maintained as a deliberate management policy on some areas of marsh on the Welsh shore in the mid to upper estuary to provide habitat for wildfowl. Heavy grazing also occurs on limited areas of Burton Marsh on the English shore where grazing is concentrated due to stock being repeatedly forced inland by high spring tides (Dargie, 2001).

The invertebrate fauna of the saltmarsh within the Dee Estuary is yet to be studied in detail across most of the site. A survey of saltmarsh habitats at eight locations within the upper estuary in 1993 revealed seven nationally scarce species, including three species characteristic of saltmarsh pools (Liverpool Museum, 1994). The invertebrate saltmarsh fauna at Bagillt, Oakenholt and Burton Point are considered likely to be of regional significance (Liverpool Museum, 1994). A detailed study of coastal habitats within Gronant Dunes and Talacre Warren SSSI, revealed a further seven nationally scarce species associated with very small areas of saltmarsh habitats, including the *Red Data Book* planthopper species *Calligypona reyi* (Liverpool Museum, 2003).

The **nationally scarce, notable and red data book species** occurring with the Atlantic salt meadow feature in the Dee Estuary European marine site are (this list is not exhaustive);

- planthopper *Calligypona reyi*
- beetle *Aphodius plagiatus*
- meniscus midge *Dixella attica*

- water beetle *Haliplus apicalis*
- water beetle *Helophorus fulgidicollis*
- water beetle *Ochthebius auriculatus*
- hoverfly *Platycheirus immarginatus*
- weevil *Polydrusus pulchellus*

### 5.4.3 Sub-features

**Low to mid marsh communities -** The low to mid marsh zone is by far the most extensive component of the Dee saltmarsh; lying immediately landward of the pioneer saltmarsh zone, the low to mid marsh communities experience a greater number of tidal inundations than the mid to upper marsh, usually more than 360 a year. As a result of this, the vegetation communities of the low and mid marsh are often relatively species-poor, composed of halophytic plants that can withstand such conditions. Communities of saltmarsh grass and sea purslane typify the low to mid marsh zone.

**Mid to upper marsh communities -** The mid to upper marsh community is dominated by red fescue *Festuca rubra* and common saltmarsh grass together with sea milkwort *Glaux maritima* and small areas of the saltmarsh rush *Juncus gerardii*. In the mid marsh zone, as the number of tidal inundations becomes less frequent, the vegetation becomes more diverse, with a more complex structure and a greater proportion of herbs. At the upper levels of the marsh, tidal inundation only occurs on the highest spring tides. The vegetation communities here reflect this with a greater diversity of species and some being restricted to this zone.

**Transitional communities -** A large number of small freshwater streams enter the estuary, especially between Heswall and Shotton, where there are also freshwater springs at the top of the marsh. In areas where there is a significant influence of fresh water in the upper reaches of the estuarine system, and where the marsh joins higher ground, important transitional communities are found.

Sea couch *Elytrigia atherica* vegetation is characteristic of the drift line of the Dee Estuary saltmarsh. This vegetation type is a key element driving the dynamics of vegetation change in the Dee Estuary (Dargie, 2001). As well as occurring on drift lines sea couch can be found extending out into the marsh on creek levees. The stems act as an efficient sediment trap, further raising ground levels beside creeks and thus creating depressions on the high marsh where water logging occurs

Notable areas of brackish swamp vegetation occur at the rear parts of the Dee Estuary saltmarsh, particularly on Burton Marsh and further northwards along the English shore. Most of these communities are found in areas receiving freshwater seepage from slopes inland (Dargie, 2001). Sea club rush *Bolboshoenus maritimus* swamp occurs most frequently but significant areas of reedbed with *Phragmites australis* are also present

Small areas of relatively well-drained *Festuca rubra – Agrostis stolonifera – Potentilla anserina* grazed grasslands which are only subject to a few tidal inundations each year occur on the highest levels of saltmarsh. Even when flooded these communities usually only experience brackish conditions and they represent the transition from saltmarsh to wet grassland (Dargie, 2001).

The upper saltmarsh and wet grassland transitions of the Dee are notable for their populations of nationally and locally scarce plant species; in particular slender hare's-ear *Bupleurum tenuissimum,* seaside centaury *Centaurium littorale* and sea rush *Juncus maritimus* (Dargie, 2001).

The **nationally scarce species** ocurring with the transitional communities sub feature of the Atlantic salt meadow interest feature in the Dee Estuary European marine site are;

- slender hare's-ear *Bupleurum tenuissimum*
- seaside centaury *Centaurium littorale*

## 5.5 Annual vegetation of drift lines

### 5.5.1 Definition

Annual vegetation of drift lines comprise annuals or annuals and perennials, occupying accumulations of drift material and gravel rich in nitrogenous organic matter.

Most shingle or sand/shingle beaches are too dynamic to sustain permanent drift-line vegetation. Many of the fringing beaches with drift-line vegetation are small, and annual vegetation may exist in one location in one year but not another. Therefore, although widespread around the UK, sites where this Annex I type is persistent are rare, and even the largest sites probably support less than 10 ha of this habitat. At most sites the habitat is naturally species-poor, and there is a limited range of ecological variation. (JNCC, 2003).

In the UK drift-line vegetation has been divided into two communities – the *Honkenya peploides – Cakile maritima* strandline community (NVC code SD2) and the *Matricaria maritima – Galium aparine* strandline community (SD3). The first (SD2) occurs all around the British coastline, while the second (SD3) is mainly restricted to northern Britain and the west coast.

### 5.5.2 Importance of the annual vegetation of drift lines interest feature in the Dee Estuary European marine site

Approximately 1.3 ha of the Dee Estuary pSAC comprises strandline vegetation (CCW, 2002). This comprises around 0.7 % of the UK national resource. Level, gently sloping, high-level mobile beaches, with little or no human disturbance, support the best examples of this vegetation. The level of human disturbance on the shores of the Dee Estuary is variable, with relatively low disturbance at some sites.

Although much of the strandline vegetation in the Dee Estuary pSAC could not be described in terms of the National Vegetation Classification, they still support many characteristic strandline species. Plants of unstable, impoverished sandy beaches such as sea rocket *Cakile maritima* and sea sandwort *Honkenya peploides* occur at various locations around the estuary including at Point of Ayr, Mostyn and Heswall. In addition, these communities also include several locally uncommon species such as grass-leaved orache *Atriplex littoralis* and hard grass *Parapholis strigosa*. About 70 % of the strandline vegetation in the Dee Estuary pSAC was classified as a recognised NVC community (CCW, 2002). The remaining stands are thought to represent undescribed vegetation types and have been provisionally labelled as

either *Leymus arenaria – Elytrigia repens* strandline or as *Atriplex glabriuscula – A. prostrata* strandline.

The nationally scarce sand dart moth *Agrotis ripae* occurs along the dune frontage between Gronant and Talacre. This is associated with the vegetated drift line, the larvae feeding on sea rocket.

### 5.6 River lamprey Lampetra fluviatilis

#### 5.6.1 Description

Lampreys are one of the most primitive of all living vertebrate animals. They are distinct from all other kinds of fish in the British Isles, as they have no lower jaw. Their mouth is surrounded by a round sucker-like disc within which the adults have strong, rasping teeth. Other characteristic features are their eel-like shape, lack of paired fins or scales and a skeletal structure made of strong but flexible cartilage, rather than bone.

Most species of lamprey have similar life cycles and ecologies that involve the migration upstream into rivers to reach spawning grounds – normally stony or gravely stretches of running water. Here they spawn in pairs or groups, laying eggs in crude 'nests'. After hatching, the young, elongate larvae, known as ammocoetes swim, or are carried downstream by the flow to areas of depositional sediments in slow flowing water. The distribution of the larvae depends on the hydrodynamic regime of the river. Where the gradient of a river is low there may be little downstream movement, in such circumstances ammocoetes burrow within the river sediment. Here they spend the next few years feeding and growing larger.

The metamorphosis from larvae to adult is physiologically demanding and takes place within a relatively short time, usually within a few weeks after several years of larval development. They then migrate downstream, away from the nursery areas and into the estuary where they may remain for some time to allow their osmoregulatory mechanisms to acclimatise to increased salinity before moving offshore to feeding grounds. Young river lampreys are known to congregate in large numbers in the estuaries of major rivers, where they feed upon a variety of estuarine fishes, but particularly herring *Clupea harengus*, sprat *Sprattus sprattus* and flounder *Platichthys flesus* (Life in UK Rivers Project, 2003).

As adults, lampreys feed by attaching to the sides of other fish. They rasp through the skin, feeding on the blood and tissues beneath. Although the lamprey is a parasitic species, there is no evidence of any significant damage to native fish stocks in Europe. Furthermore, it is a beneficial species to the ecology of rivers, both in helping to stabilise and aerate silt beds and in providing food for a range of other wildlife.

On reaching sexual maturity, the adult lamprey stop feeding and migrate up stream to their spawning grounds. After spawning it is thought that they die.

Although considerable information is available on the biology of the river lamprey in freshwater, much less is known about its habits in estuaries and the sea (Maitland, 1997). River lamprey must not be confused with the brook lamprey *Lampetra planeri*, which are confined to the river for the duration of their life-cycle. The average adult length of the river lamprey is around 30cm with a weight of some 60g. It is confined to Western Europe, migrating from the sea to spawn in silt beds of many UK rivers.

### 5.6.2 Importance of the river lamprey interest feature in the Dee Estuary European marine site

River lampreys are present in the River Dee and must therefore use the Dee Estuary as part of their migratory route. As mentioned above lampreys are known to congregate in large estuaries of major rivers. Such feeding behaviour has yet to be documented for the Dee Estuary. However it is known that several potential river lamprey prey species are found within the Dee Estuary including herring *Clupea harengu*s, sprat *Sprattus sprattu*s, flounder *Platichthys flesu*s and small gadoids such as whiting *Merlangius merlangu*s and pout *Trisopterus luscu*s (Henderson, 2003).

Records of river lamprey caught at the fish trap at Chester weir indicate that mature adults undertake their upstream migration at two different periods of the year, either early spring (March-April) or late summer/autumn (August-November). These records suggest the presence of a 'praecox' (early) form, which spend only one year at sea rather than the usual two-three years (Potter & Hatton-Ellis, 2003).

Fish trap counts at Chester over eight years between 1992 and 2002 recorded highly variable numbers of river lamprey each year, counts range between 0 in 1997 and 206 in 2002 with a mean of 81 (I. Davidson, Environment Agency Wales, *pers comm*.). However, these count data should not be viewed as an estimate of population size. The trap at Chester is not designed to sample lampreys, which are able to swim through its bars. The trap therefore operates at low efficiency for lamprey because it is being selective for larger species such as salmon and sea trout. In addition, the trap is inactive for around 40% of the time. Actual run size may be significantly greater. A survey of ammocoete beds in the lower River Dee in 2002 revealed three cohorts of *Lampetra* spp. amocoetes, though these may have included both river lamprey and brook lamprey *Lampetra planeri* individuals, which are indistinguishable at this stage of their life history (Potter & Hatton-Ellis, 2003)

## 5.7 Sea lamprey Petromyzon marinus

### 5.7.1 Description

The sea lamprey is the largest and least common of the three lamprey species found in the UK and may reach a length of 100cm and weigh 2.5kg, although more usually is around 50cm. Relatively little is known about the precise habitats occupied by adult sea lamprey, but it is thought to occur over much of the North Atlantic, both in shallow coastal waters and deep offshore. Like the river lamprey the species is anadromous, growing to maturity in the sea and then migrating into fresh water to spawn. The larvae spend several years in silt beds before metamorphosing and migrating downstream to the sea. Like all species of lamprey, it requires clean gravel for spawning and marginal silt or sand for the burrowing juvenile fish.

Relatively little is known about the precise habitats occupied by adult sea lampreys, nor is it certain which fish species are the main hosts (Life in UK Rivers Project, 2003). There is some anecdotal evidence to indicate that sea lamprey feed on much bigger species than river lamprey including basking sharks (W. Sanderson, *pers. comm*.)

The sea lamprey has a widespread distribution within the UK, although populations have declined over the last hundred years due to pollution and barriers to migration. Sea lamprey favour warmer water conditions than other species of lamprey and also appear to be

particularly poor at ascending obstacles to migration (Hatton-Ellis, *pers. comm.*). They have become extinct in a number of rivers (Maitland, 1997).

### 5.7.2 The importance of the sea lamprey in the Dee Estuary European marine site

Like river lamprey, sea lamprey are also present in the River Dee and thus the Dee Estuary forms an essential part of their migratory route. Records of sea lamprey caught at the fish trap at Chester Weir indicate that mature adults migrate upstream almost exclusively during the months of May and June (Potter & Hatton-Ellis, 2003). Fish trap counts at Chester over eight years between 1992 and 2002 again recorded highly variable numbers of sea lamprey each year. Counts range between 2, recorded in 2000 and 59, recorded in 2001 with a mean of 20 (I. Davidson, Environment Agency Wales, *pers com*m.). Again these count data should not be viewed as an estimate of population size. The actual run size of sea lamprey may also be significantly greater than these data suggest.

# 6 The Dee Estuary pSAC conservation objectives

**Under Regulation 33(2)(a) of the Conservation (Natural Habitats &c.) Regulations 1994, English Nature and the Countryside Council for Wales have a duty to advise other relevant authorities as to the conservation objectives for the European marine site.**

The conservation objectives for the Dee Estuary pSAC interest features are provided below and should be read in the context of other advice given in this package, particularly:

- the maps showing the extent of the sub-features provided in Appendix IV;
- summary information on the interest of each of the features; and
- the favourable condition, providing information on how to recognise favourable condition for the interest feature and which will act as a basis for the development of a monitoring programme.

All the conservation objectives are subject to review by English Nature and the Countryside Council of Wales.

## 6.1 Interest feature 1: The conservation objective for the estuary

**The conservation objective for the "estuaries" feature of the Dee Estuary pSAC is to maintain the feature in favourable condition, as defined below:**

The "**estuaries**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the aggregate total extent of all estuarine communities[2] within the site is maintained;

ii. the spatial distribution[3] of estuarine communities[2] within the site is maintained;

iii. the extent of individual estuarine habitat features[4] within the site is maintained;

iv. the variety and relative proportions of sediment and rocky substrates within the estuary is maintained;

v. the variety and extent of any notable subtidal sediment communities[5] is maintained;

vi. the variety and extent of notable intertidal hard substrata communities[6] is maintained;

vii. the spatial and temporal patterns of salinity, suspended sediments and nutrients concentrations are maintained within limits sufficient to satisfy the requirements of statements (i) to (vi) above.

Further explanatory information clarifying the meaning of terms [1-6] above is provided in **Box 1**.

**NB.** Detailed requirements for the maintenance of favourable condition for the other estuarine habitat features[4] and their typical species are provided under their respective conservation objectives.

## Box 1: Explanatory information for the "estuaries feature" conservation objective

**[1] Natural processes:**

Each feature may be subject to both natural processes and human influence. Human influence on the interest features is acceptable provided that it is proved to be / can be established to be compatible with the achievement of the conditions set out under the definition of favourable condition for each interest feature. A failure to meet these conditions, which is entirely a result of natural process will not constitute unfavourable condition, but may trigger a review of the definition of favourable condition.

Dynamic physical process within estuaries can stem from variable weather conditions including one off storm events, and result in changes in wave exposure, riverine floods or tidal surges. These events can move large quantities of sediments and alter channel morphology, which affect current patterns and sediment transport within the estuary. Where these processes occur without significant anthropogenic influence they fall under the umbrella of 'natural change'. Because estuaries are dynamic systems we can expect the amount and gross distribution of habitats to change in the future. In general estuarine communities and their supporting habitats are intrinsically more dynamic over short time scales when compared to other marine and terrestrial habitats. Some estuarine communities occur in cycles dependant upon the prevailing physical conditions. Features should not necessarily be considered in unfavourable condition due to the short term disappearance of a particular community due to natural processes.

An important example of natural processes occurring over a longer timescale is that estuaries have a natural tendency to accumulate sediment, thereby changing their form from their original glacial morphology to a state where tidal energy is dissipated by sediment banks and other features such as salt marsh. This, with other forces of natural change, will therefore cause the width and depth of the estuary to change over time, moving towards a state of dynamic equilibrium or 'most probable state'. As part of this process, the location and extent of saltmarshes and mudflats may change, provided there is capacity to accommodate readjustment. Future developments should aim to avoid impact on the future evolution of the system as where this process is constrained by human influence, the capacity of habitats to accommodate readjustment may be affected.

**[2] All estuarine communities**:

- Subtidal sediment communities.
- Intertidal hard substrate communities.
- Intertidal mudflats and sandflats communities.
- *Salicornia* and other annual plants colonising mud and sand.
- Atlantic salt meadow.
- Annual vegetated shingle.

**Box 1(continued): Explanatory information for the "estuaries feature" conservation objective**

**[3] Spatial distribution**

Spatial distribution of estuarine communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Individual estuarine habitat features**:

- Intertidal mudflats and sandflats communities.
- *Salicornia* and other annual plants colonising mud and sand.
- Atlantic Salt meadow.
- Annual vegetated shingle.

**[5] Notable subtidal sediment communities**:

- Any notable subtidal sediment communities that may be identified including those important for estuarine fish.

**[6] Notable intertidal hard substrata communities**:

- *Mytilus edulis* and piddocks on eulittoral firm clay.
- *Sabellaria alveolata* reefs on sand-abraded eulittoral rock.
- Hydroids, ephemeral seaweeds and *Littorina littorea* in shallow eulittoral mixed substrata pools.
- Any other notable intertidal hard substrate communities that may be identified.

**NB.** The four individual estuarine habitat features[4] together with the notable subtidal sediment communities[5] and the notable hard substrate communities[6] together comprise the six "sub-features" of the "estuary" feature.

### 6.2 Interest feature 2: The conservation objective for mudflats and sandflats not covered by seawater at low tide

**The conservation objective for the "mudflats and sandflats" feature of the Dee Estuary pSAC is to maintain the feature in favourable condition, as defined below:**

The "**mudflats and sandflats**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the total extent of mudflat and sandflat communities[2] within the site is maintained;

ii. the proportions of individual mudflat and sandflat communities[2] within the site are maintained;

iii. the topography of the intertidal flats and the dynamic processes of channel migration and sinuosity across the flats are maintained;

iv. the abundance of typical species[3] of the mudflat and sandflat feature within the site is maintained.

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 2**.

## Box 2: Explanatory information for the "mudflats and sandflats" conservation objective

**[1] Natural processes**:

The meaning of 'natural processes' is explained in Box 1.

**[2] Mudflat and sandflat communities**:

- Intertidal gravel and clean sand communities

i. Barren coarse sand shores;
ii. Burrowing amphipods and *Eurydice pulchra* in well drained clean sand shores;
iii. Burrowing amphipods and polychaetes in clean sand shores.
iv. Talitrid amphipods in decomposing seaweed on the strandline
v. Dense *Lanice conchilega* in tide-swept lower shore sand
vi. Barren shingle or gravel shores

- Intertidal muddy sand communities including cockle beds:

i. Polychaetes and *Cerastoderma edule* in fine sand or muddy sand shores
ii. *Bathyporeia pilosa* and *Corophium spp.* in upper shore slightly muddy fine sand shores
iii. *Macoma balthica* and *Arenicola marina* in muddy sand shores.
iv. *Arenicola marina, Macoma balthica* and *Mya arenaria* in muddy sand shores.
v. *Echinocardium cordatum* and *Ensis sp.* in lower shore or shallow sublittoral muddy fine sand

- Intertidal mud communities:

i. *Hediste diversicolor* and *Macoma balthica* in sandy mud shores;
ii. *Hediste diversicolor, Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores
iii. *Hediste diversicolor, Macoma balthica* and *Mya arenaria* in sandy mud shores.
iv. *Hediste diversicolor* and *Scrobicularia plana* in reduced salinity mud shores
v. *Hediste diversicolor* and oligochaetes in low salinity mud shores

**NB.** These three community types comprise the "sub-features" of the "Mudflats and sandflats not covered by seawater at low tide" feature. Maps provided in Appendix IV show the extent of these sub-features based on the best available information.

[3] **Typical species of the intertidal mudflats and sandflats**:

*Hediste diversicolor*
*Macoma balthica*
*Hydrobia ulvae*
*Arenicola marina*
*Mya arenaria*
*Scrobicularia plana*
*Nephtys hombergii*
*Cerastoderma edule*
*Bathyporeia spp.*
*Corophium spp.*
*Echinocardium cordatum*
*Ensis ensis*
*Eurydice pulchra*
*Haustorius arenarius*
*Nephtys cirrosa*
*Orchestia gammarellus*
*Talitrus saltator*
*Lanice conchilega*
*Scoloplos armiger*

Typical species of the intertidal mudflats and sandflats may also include oligochaetes and insects yet to be identified.

### 6.3 Interest feature 3: The conservation objective for Salicornia and other annuals colonising mud and sand

**The conservation objective for the "*Salicornia* and other annuals colonising mud and sand" feature of the Dee Estuary pSAC is to maintain the feature in favourable condition, as defined below**:

The "***Salicornia* and other annuals colonising mud and sand**" feature will be considered to be in favourable condition when both:

- subject to natural processes[1], each of the following conditions (i) to (v) are met:

i. the total extent of pioneer saltmarsh vegetation communities[2] within the site is maintained;

ii. the presence of pioneer saltmarsh vegetation communities[2] as part of transitions from intertidal sediment communities to higher saltmarsh are maintained;

iii. the abundance of the typical species[3] of the pioneer saltmarsh vegetation communities[2] is maintained;

iv. the abundance of the notable species[4] of the pioneer saltmarsh vegetation communities[2] is maintained.

- and, regardless of natural processes[1], condition (v) is also met:

v. the overall extent and abundance of common cord grass *Spartina anglica* is not increasing within the pioneer saltmarsh zone.

Further explanatory information clarifying the meaning of terms [1-4] above is provided in **Box 3**.

## Box 3: Explanatory information for the "*Salicornia* and other annuals colonising mud and sand" conservation objective

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Pioneer saltmarsh vegetation communities**:

- Pioneer low marsh communities:

i. Annual *Salicornia* saltmarsh SM 8
ii. *Suaeda maritima* saltmarsh SM 9

- Ephemeral saltmarsh vegetation :

i. Ephemeral saltmarsh vegetation with *Sagina maritima* SM 27

**NB**. These two community types comprise the "sub-features" of the "*Salicornia* and other annuals colonising mud and sand" feature. Maps provided in Appendix IV show the extent of these sub-features based on the best available information.

**[3] Typical species of the pioneer saltmarsh**:

*Salicornia* spp.
*Suaeda martitima*

**[4] Notable pioneer saltmarsh species**:

*Centaurium littorale* [this species occurs within the ephemeral saltmarsh only]

## 6.4 Interest feature 4: The conservation objective for Atlantic salt meadow

**The conservation objective for the "Atlantic salt meadow" feature of the Dee Estuary pSAC is to maintain the feature in favourable condition, as defined below:**

The "**Atlantic salt meadow feature**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the total extent of Atlantic salt meadow vegetation communities[2] within the site is maintained;

ii. the proportions of individual Atlantic salt meadow vegetation communities[2] within the site are maintained;

iii. the donation of Atlantic salt meadow vegetation communities[2] and their transitions to fresh water and terrestrial vegetation are maintained;

iv. the morphology of saltmarsh creeks and pans and the process of their evolution are maintained;

v. the extent of ungrazed areas of salt meadow within the estuary is maintained and there is no increase in grazing intensity over the rest of the salt meadow;

vi. the relative abundance of the typical species[3] of the Atlantic salt meadow vegetation communities[2] is maintained;

vii. the abundance of the notable species[4] of the Atlantic salt meadow vegetation communities[2] is maintained.

Further explanatory information clarifying the meaning of terms [1-4] above is provided in **Box 4**.

## Box 4: Explanatory information for the "Atlantic salt meadow" conservation objective

[1] Natural processes:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Atlantic salt meadow vegetation communities:**

- Low to mid marsh communities:

i. Transitional low saltmarsh with *Puccinellia maritima*, annual *Salicornia* sp. and *Suaeda maritima* SM10
ii. *Aster tripolium* (rayed) saltmarsh SM12
iii. *Puccinellia maritima* saltmarsh SM13
   - *Puccinellia maritima* sub-community SM13a
   - *Glaux maritima* sub-community SM13b
   - *Plantago maritima - Armeria maritima* sub-community SM13d
   - *Atriplex portulacoides* saltmarsh SM14
   - *Atriplex portulacoides* sub-community SM14a
   - *Puccinellia maritima* sub-community SM14c

- Mid to upper marsh communities:

i. *Festuca rubra* salt-marsh SM16
   - *Puccinellia maritima* sub-community SM16a
   - *Juncus gerardii* sub-community SM16b
   - *Glaux maritima* sub-community SM16c
   - *Festuca rubra* sub-community SM16d
   - *Leontondon autumnalis* sub-community SM16e
   - Provisional new *Carex extensa* sub-community SM16x
ii. *Juncus maritimus* salt-marsh SM18
   - *Oenanthe lachenalii* sub-community SM18b

- Transitional high marsh communities:

i. *Elytrigia atherica* saltmarsh SM24
ii. *Elytrigia repens* saltmarsh SM28
iii. *Festuca rubra - Agrostis stolonifera - Potentilla anserina* inundation grassland MG11
iv. *Lolium perenne* sub-community MG11a
v. *Agrostis stolonifera - Alopecurus geniculatus* inundation grassland MG13
vi. *Phragmites australis* reedbed S4
vii. *Phragmites australis* sub-community S4a
viii. *Atriplex prostrata* sub-community S4d
ix. *Bolboshoenus maritimus* swamp S21
x. *B. maritimus* sub-community S21a
xi. *Atriplex prostrata* sub-community S21b
xii. *Agrostis stolonifera* sub-community S21c
xiii. *Phalaris arundinacea* tall-herb fen S28

**NB**. These three community types comprise the "sub-features" of the "Atlantic salt meadow" feature. Maps provided in Appendix IV show the extent of these sub-features based on the best available information.

**Box 4 (continued): Explanatory information for the "Atlantic salt meadow" conservation objective**

**[3] Typical species of the Atlantic Saltmeadow**:

*Puccinellia maritima,*
*Salicornia spp.*
*Suaeda martitima*
*Aster tripolium*
*Glaux maritima*
*Plantago maritima*
*Armeria maritima*
*Atriplex portulacoides*
*Festuca rubra*
*Juncus gerardii*
*Triglochin maritima*
*Leontodon autumnalis*
*Trifolium repens*
*Carex extensa*
*Agrostis stolonifera*
*Juncus maritimus*
*Oenanthe lachenalii*
*Elymus pycnanthus*
*Atriplex prostrata*
*Elymus repens*
*Potentilla anserina*
*Lolium perenne*
*Alopecurus geniculatus*
*Phragmites australis*
*Bolboshoenus maritimus*
*Phalaris arundinacea*

**[4] Notable saltmarsh species:**

*Centaurium littorale*
*Bupleurum tenuissimum*
*Parapholis incurva* (record to be confirmed)

### 6.5 Interest feature 5: The conservation objective for annual vegetation of drift lines

**The conservation objective for the "annual vegetation of drift lines" feature of the Dee Estuary pSAC is to maintain the feature in a favourable condition, as defined below:**

The "**annual vegetation of drift lines**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the extent of coarse sediment / shingle formations capable of supporting drift line vegetation communities[2] within the site is maintained;

ii. the presence of annual drift line vegetation communities[3] within the site is maintained;

iii. the presence of the typical species[4] of the annual drift line vegetation communities[2] is maintained.

Further explanatory information clarifying the meaning of terms [1-4] above is provided in **Box 5**.

## Box 5: Explanatory information for the "annual vegetation of drift lines" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] Coarse sediment / shingle formations capable of supporting annual drift line vegetation communities include:

Coarse sediment / shingle formations at or above mean high-water spring tides, including accumulations of drift material and gravel rich in nitrogenous organic matter, with varying amounts of sand interspersed in the shingle**.**

[3] **Annual driftline vegetation communities include**:

i. SD2 *Honkenya peploides* - *Cakile maritima* strandline community
ii. SD2 / SD5b Strandline community transitional between SD2 *Honkenya peploides* - *Cakile maritima* strandline community and SD5b *Leymus arenarius* mobile dune community
iii. SD1 / SD3 Strandline community intermediate between SD1 *Rumex crispus* - *Glaucium flavum* shingle and SD3 *Tripleurospermum maritimum* - *Galium aparine* strandline
iv. SDxx *Leymus arenarius* - *Elytrigia repens* strandline community
v. SDy *Atriplex glabriuscula* - *A. prostrata* strandline community

[4] **Typical species of supporting annual drift line vegetation communities**:

*Cakile maritime*
*Honkenya peploides*

### 6.6 Interest feature 6: The conservation objective for *Lampetra fluviatilis* (river lamprey)

**The conservation objective for the "*Lampetra fluviatilis* (river lamprey)" feature of the Dee Estuary pSAC is to maintain the feature in a favourable condition, as defined below:**

The "**river lamprey**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the migratory passage of both adult and juvenile river lamprey through the Dee Estuary between Liverpool Bay and the River Dee is unobstructed by physical barriers and / or poor water quality;

ii. the five year mean count of river lampreys recorded by the Chester Weir fish trap is no less than 55 under the monitoring regime[2] in use prior to notification [*i.e. 100% of the mean annual count during the five years for which data are available prior to notification: 1993, 1997-2000*];

iii. the abundance of prey species[3] forming the river lamprey's food resource within the estuary, is maintained.

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 6**.

**NB.** Other conservation objectives are to be produced relating to the requirements of the Dee catchment's river lamprey population; in particular regarding to their use of supporting habitats in the River Dee cSAC, which directly abuts the Dee Estuary pSAC. These habitats, including spawning and nursery areas are essential for the fulfilment of the species' lifecycle and therefore the Dee Estuary river lamprey feature can only be in favourable condition if the conservation objectives pertaining to the River Dee river lamprey feature are also met in full.

## Box 6: Explanatory information for the "*Lampetra fluviatilis* (river lamprey)" conservation objective

**[1] Natural processes:**

**River lamprey population**

The size of the population is subject to external factors such as food / host availability in Liverpool Bay and breeding success in the River Dee pSAC.

**Supporting habitats**

The general meaning of 'natural processes' with respect to the supporting habitats of river lamprey within the estuary is explained in **Box 1**.

**[2] Monitoring regime at Chester Weir fish trap**:

Over the five years for which data are available prior to notification (1993, 1997-2000) Chester Fish trap operated for a mean of 394 hours per month, throughout the year, each year (I. Davidson, *pers. comm.*). Any change in the operation of the fish trap especially changes in the total hours the trap is active for per month or per year may require the count in the objective to be revised.

[3] **Prey species**:

Herring *Clupea harengu*s, sprat *Sprattus sprattu*s, flounder *Platichthys flesu*s and small gadoids such as whiting *Merlangius merlangu*s and pout *Trisopterus luscu*s are all potential prey species for the river lamprey found within the Dee Estuary (Henderson, 2003).

## 6.7 Interest feature 7: The conservation objective for *Petromyzon marinus* (sea lamprey)

**The conservation objective for the "*Petromyzon marinus* (sea lamprey)" feature of the Dee Estuary pSAC is to maintain the feature in a favourable condition, as defined below:**

The "**sea lamprey**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the migratory passage of both adult and juvenile sea lampreys through the Dee Estuary between Liverpool Bay and the River Dee is unobstructed by physical barriers and / or poor water quality;

ii. the five year mean count of sea lampreys recorded by the Chester Weir fish trap is no less than 18 under the monitoring regime[2] in use prior to notification. [*i.e. 100% of the mean annual count during the five years for which data are available prior to notification: 1993, 1997-2000*].

Further explanatory information clarifying the meaning of terms [1-2] above is provided in **Box 7**.

**NB.** Other conservation objectives are to be produced relating to the requirements of the Dee catchment's sea lamprey population; in particular regarding to their use of supporting habitats in the River Dee pSAC, which directly abuts the Dee Estuary pSAC. These habitats, including spawning and nursery areas are essential for the fulfilment of the species' lifecycle and therefore the Dee Estuary sea lamprey feature can only be in favourable condition if the conservation objectives pertaining to the River Dee sea lamprey feature are also met in full.

## Box 7: Explanatory information for the "*Petromyzon marinus* (sea lamprey)" conservation objective

**[1] Natural processes:**

**Sea lamprey population**

The size of the population is subject to external factors such as food / host availability in Liverpool Bay and breeding success in the River Dee cSAC.

**Supporting habitats**

The general meaning of 'natural processes' with respect to the supporting habitats of sea lamprey within the estuary is explained in Box 1.

**[2] Monitoring regime at Chester Weir fish trap**:

Over the five years for which data are available prior to notification (1993, 1997-2000) Chester Fish trap operated for a mean of 427 hours in May and 367 hours in June (I. Davidson, *pers. comm.*). May and June being the two key months for upstream migration of sea lamprey (Potter & Hatton-Ellis, 2003). Any change in the operation of the fish trap especially changes in the total hours the trap is active in these two months may require the count in the objective to be revised.

# 7. Table 2, Favourable Condition Table for pSAC interest features of the Dee Estuary European marine site

NB Background information on the role of favourable condition tables, the information provided in each column, and a concise glossary of terms used is provided in Section 3 of this document.

**NB** – It will be possible to monitor many of the attributes at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline. Where relevant, abbreviations of National Vegetation Classification codes (NVCs) are used for simplicity (Rodwell, 2000)

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Estuary** | All sub-features | Extent | Total area (ha) of estuarine communities within the site measured periodically using a combination of remote sensing and ground truthing using GPS (frequency to be determined). | No decrease in extent from an established baseline. | Extent is an attribute on which reporting is required by the Habitats Directive.<br><br>Estuarine communities comprise the following:<br>• Subtidal sediment communities<br>• Intertidal hard substrate communities<br>• Intertidal mudflats and sandflats communities<br>• *Salicornia* and other annual plants colonising mud and sand<br>• Atlantic Salt meadow<br>• Annual vegetated shingle<br><br>Aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline |
| | | Spatial distribution of estuarine communities | Macro spatial pattern of estuarine communities measured periodically using a combination of remote sensing and ground truthing using GPS (frequency to be determined). | Donation of clean sands to muddy sands to mud from the mouth of the estuary to the upper estuary is maintained. Salt marsh remains along sheltered shores of the mid to upper estuary. | Together the CCW Intertidal Biotope Survey (Jones *et. al*., 2002) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline.<br><br>English Nature's survey of the Dee in 2004 will provide a further baseline.<br><br>Dargie (2001) provides a baseline for saltmarsh |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Estuary** | All sub-features | Morphological equilibrium | Intra and inter-estuarine Tidal Prism/Cross Section ratio (TP/CS ratio) measured during the reporting cycle using remote sensing (frequency to be determined). | The intra- and inter-estuarine TP/CS relationship should not deviate significantly from an established baseline. Baseline to be established. | TP = Tidal Prism = total volume of water crossing a given cross section during the flood tide ($m^3$).<br>CS = Area of a given cross section at high water springs ($m^2$).<br><br>The relationship between TP & CS provides a measure of the way the estuary has adjusted to tidal energy. Substantial departures from this characteristic relationship (determined on a regional basis) may indicate the influence of anthropogenic factors and this would trigger more detailed evaluation of potential problems.<br><br>Environment Agency LIDAR survey in 2003 may provide baseline. |
| | | Long-term trends in the horizontal location of the saltmarsh/mudflat boundary. | Change in location of saltmarsh / mudflat boundary along a series of fixed transects measured annually or bi-annually during September using GPS (transect locations to be determined). | The location of the saltmarsh / mudflat boundary should not deviate significantly from an established baseline. | Monitoring the saltmarsh boundary is a practical means of securing data that may indicate changes in the TP/CS relationship. Deviation from long-term trends would act as a trigger for a second tier response involving detailed bathymetric survey and evaluation of changes in the TP/CS relationship (as above).<br><br>In the absence of saltmarsh, vertical change in mudflat position can act as a surrogate for, or in addition to, saltmarsh boundary.<br><br>Historical aerial photographs allow determination of baseline trends. |
| | | Substrata / geomorphology | Sediment size distribution provided by granulometric sampling within the estuary (sample locations and frequency to be determined). | Sediment size distribution should not deviate from an established baseline. Baseline to be further established. | Granulometric monitoring can provide early warning of changes in degree of exposure and geomorphological processes and providing information on likely changes in the extent of biological communities.<br><br>Granulometry data collected by Environment Agency during AMP3 investigation in 2002 (Potter, 2003) may provide a partial baseline. |
| | | Water density - temperature and salinity | Water temperature and salinity over a tidal cycle measured periodically at a series of locations during the reporting cycle (methodology, sample locations and frequency to be determined). | Average temperature and salinity should not deviate significantly from an established baseline. Baseline to be established. | Temperature and salinity are characteristic of the overall hydrography of the area. Changes in temperature and salinity influence the presence and distribution of species (along with recruitment processes and spawning behaviour) including those at the edge of their geographic ranges and non-natives. |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Estuary** | All sub-features | Nutrient status | Average phytoplankton concentration in summer, measured periodically during the reporting cycle (methodology, sample locations and frequency to be determined). | Average phytoplankton concentration should not increase significantly from an established baseline. | Nutrient enrichment stimulating excessive growth of phytoplankton is a common factor contributing to a reduction in water clarity. Single species-dominated phytoplankton blooms can also have harmful effects on shellfish.<br><br>Algal cell count data collected by the Environment Agency at seven locations within the estuary between 1998 and 2000 (Howarth *et al*., 2001) may provide a partial baseline. |
| | | Levels of toxic contaminants in the water column | Concentrations of contaminants monitored at intervals during the tidal cycle (methodology, sampling locations and frequency to be determined). | No increase in concentrations of dangerous substances above an established baseline and compliance with all appropriate water quality standards. Baseline to be further established. | Elevated concentrations of toxic contaminants have the potential to cause harm to many features and sub-features.<br><br>Data already collected by the Environment Agency to fulfil their duties under the Dangerous Substances Directive may provide a partial baseline. |
| **Estuary** | Notable subtidal sediment communities | Extent | Total area (ha) of subtidal sediment biotopes, measured periodically during the reporting cycle by remote sensing (frequency to be determined). | No decrease in extent from an established baseline. Baseline to be established | No notable subtidal sediment communities have yet been identified within the Dee Estuary European marine site although this may well be due to the paucity of existing survey information.<br><br>Loss of subtidal sediment communities is likely to be detrimental to the structure of the interest feature, e.g. associated with a change in sediment budget or geomorphological regime, and may indicate long term changes in the physical conditions of the estuaries interest feature.<br><br>Environment Agency LIDAR survey 2003 may provide a partial baseline. |
| | | Different associations of plants, animals and their habitats | Number of different notable subtidal communities measured during reporting cycle (methodology and frequency to be determined). | No decrease in the variety of notable subtidal sediment communities from an established baseline. Baseline to be established | No notable subtidal sediment communities have yet been identified within the Dee Estuary European marine site although this may well be due to the paucity of existing survey information. |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Estuary** | Notable intertidal hard substrate communities | Extent | Area (ha) of individual notable hard substrate biotopes, measured periodically during the reporting cycle using GPS (frequency to be determined). | No decrease in extent from an established baseline. Baseline to be further established | Loss of subtidal sediment communities is likely to be detrimental to the structure of the interest feature, e.g. associated with a change in sediment budget or geomorphological regime, and may indicate long term changes in the physical conditions of the estuaries interest feature.<br><br>Notable hard substrate biotopes recorded within the Dee Estuary comprise the following (in each case the source quoted provides the best available baseline):<br><br>• *Mytilus edulis* and piddocks on eulittoral firm clay<br>[A nationally important biotope recorded on an area of Holocene peat deposits on Salisbury Bank by CCW Intertidal Phase 1 Intertidal Survey (Jones *et al*., 2002)]<br>• *Sabellaria alveolata* reefs on sand-abraded eulittoral rock<br>[A nationally important biotope and a priority habitat under the UK Biodiversity Action Plan, recorded by Dr. Martin. Bailey (English Nature) at Hilbre Island in 2002)]<br>• Hydroids, ephemeral seaweeds and *Littorina littorea* in shallow eulittoral mixed substrata pools.<br>[A 'specialised biotope' under the JNCC Guidelines (1996) for the selection of biological SSSIs, recorded south of Mostyn Quay by CCW Intertidal Phase 1 Intertidal Survey (Jones *et al*., 2002)] |
| | Intertidal mudflat and sandflat communities | *For information on the attributes of the intertidal mudflat & sandflat communities sub-feature see the sections of this table which relate to the intertidal mudflats and sandflats feature, pages 73-78* | | | |
| | *Salicornia* and other annual plants colonising mud and sand | *For information on the attributes of the Salicornia and other annual plants colonising mud and sand communities sub-feature see the sections of this table which relate to the mudflats and sandflats not covered by seawater at low tide feature, pages 78-79* | | | |
| | Atlantic salt meadow | *For information on the attributes of the Atlantic salt meadow communities sub-feature see the sections of this table which relate to Atlantic salt meadow feature, pages 80-82* | | | |
| | Annual vegetated shingle | *For information on the attributes of the annual vegetated shingle communities sub-feature see the sections of this table which relate to annual vegetated shingle feature, pages 82-83* | | | |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Mudflats and sandflats not covered by sea water at low tide** | All sub-features | Extent | Total area (ha) of intertidal mudflat and sandflat communities within the site measured periodically during the reporting cycle using a combination of remote sensing and ground truthing of boundaries between communities using GPS (frequency to be determined). | No decrease in extent of intertidal mudflats and sandflats from an established baseline. | Extent is an attribute on which reporting is required by the Habitats Directive. In the long term loss of intertidal mudflat / sandflat communities is likely to be detrimental to the structure of the interest feature, e.g. associated with a change in sediment budget or geomorphological regime, and may indicate long term changes in the physical conditions of the estuaries interest feature.<br><br>Some fluctuations in extent may occur which are directly attributable to natural coastal processes. These include reduced extent following storms or due to a change to another feature habitat such as saltmarsh. Such types of change in extent would form under the umbrella of 'natural change'<br><br>Together the CCW Intertidal Biotope Survey (Jones *et. al*., 2002) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Intertidal mudflat and sand flat communities comprise three biotope types (sub-features):<br>• Intertidal gravel and clean sand biotopes<br>• Intertidal muddy sand biotopes including cockle beds<br>• Intertidal mud biotopes<br><br>See below for lists of individual biotopes comprising sub-features. |
| | | Topography | Tidal elevation and shore slope, measured along a series of transects across the estuary periodically during the reporting cycle using remote sensing or traditional surveying techniques (transect locations and survey frequency to be determined). | Shore profile should not deviate significantly from an established baseline. Baseline to be established. | In the intertidal zone topography reflects the energy conditions and stability of the sediment, which is key to the structure of the interest feature. Topography is a major influence on the distribution of communities throughout the intertidal flats. Assessing topography also provides information on the position of channels through the interest feature.<br><br>Environment Agency LIDAR survey 2003 may provide a baseline. |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Mudflats and sandflats not covered by sea water at low tide** | All sub-features | Sediment character | 1. Particle size analysis (PSA). Parameters include percentage sand / silt / gravel, mean and median grain size, and sorting coefficient, used to characterise sediment type; measured at a series of locations across the estuary in summer, once during the reporting cycle (sampling locations to be determined). | Average PSA parameters should not deviate significantly from an established baseline. Baseline to be further established. | Sediment character defined by particle size analysis is key to the structure of the feature, and reflects all of the physical processes acting on it. Particle size composition varies across the feature and can be used to indicate spatial distribution of sediment types thus reflecting the stability of the feature and the processes supporting it.<br><br>A partial baseline may be provided by granulometry data collected by Environment Agency during AMP3 investigation in 2002 (Potter, 2003). |
| | | | 2. Sediment penetrability (degree of sinking) measured at a series of locations across the estuary during summer, once during the reporting cycle (methodology and sampling locations to be determined). | Average measure should not deviate significantly from an established baseline. Baseline yet to be established. | Penetrability is an indicator of sediment stability and degree of compaction; it indicates the shear strength of the sediment and thus the susceptibility of that sediment type to erosion. Compaction of the sediment influences the biological community within the sediment.<br><br>Penetrability of the sediment is determined by a combination of grain size and water content, which may provide a surrogate index of the penetrability of the sediments. |
| | | | 3. Sediment organic content (% carbon) measured at a series of locations across the estuary, once during the reporting cycle (sampling locations to be determined). | Average organic carbon content should not deviate significantly from an established baseline. Baseline to be further established. | Organic content critically influences the infaunal community and can cause deoxygenation of the feature, which can be detrimental to the biota. However, a balance needs to be struck as organic content provides a measure of the material available to detritivores. A reduction in organic content could lead to a reduction in detritivores, with subsequent knock on effects throughout the food chain.<br><br>Granulometry data collected by Environment Agency during AMP3 investigation in 2002 (Potter, 2003) may provide a partial baseline. |
| | | | 4. Oxidation - reduction potential (depth of black anoxic layer) measured at a series of locations across the estuary, once during the reporting cycle (sampling locations to be determined). | Average black layer depth should not deviate significantly from an established baseline. Baseline yet to be established. | Degree of oxidation / reduction, reflecting oxygen availability within the sediment, critically influences the infaunal community and the mobility of chemical compounds. It is an indicator of the structure of the feature. |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Mudflats and sandflats not covered by sea water at low tide** | All sub-features | Toxic contamination of sediments | Concentrations of List I and List II substances under the Dangerous Substances Directive measured at a series of locations across the estuary (sampling locations and frequency to be determined). | Comply with Probable Effects Level s (PEL) derived for the interim sediment quality guidelines adopted by Environment Canada (Cole *et al*., 1999). Baseline to be further established | Environmental Quality Standards (EQS) are only applicable in the water column and there are no equivalent standards for sediments used in the UK. In the absence of any UK standards, these Canadian guidelines can be used as a first approximation in assessing whether organisms are at risk from sediment concentrations of toxic substances (Cole *et al*., 1999).<br><br>Concentrations of metal determinands from sediment samples collected by Environment Agency during AMP3 investigation in 2002 (Potter, 2003) may provide a partial baseline. |
| | Intertidal gravel and clean sand communities | Community composition | Number of different gravel and clean sand biotopes measured by field visit periodically during the reporting cycle (frequency to be determined). | No decrease in the variety of biotopes from an established baseline. Baseline to be further established | Different associations of plants, animals and their habitat are an important structural and functional aspect of the feature. Changes in the biotopes present within an area of a particular type of sediment may indicate long-term changes in physical conditions at the site.<br><br>Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes<br><br>The CCW Intertidal Biotope Survey (Jones *et. al*., 2002) provides a partial baseline. Intertidal gravel and clean sand biotopes recorded within the European marine site include:<br><br>• Barren coarse sand shores;<br>• Burrowing amphipods and *Eurydice pulchra* in well drained clean sand shores;<br>• Burrowing amphipods and polychaetes in clean sand shores.<br>• Talitrid amphipods in decomposing seaweed on the strandline<br>• Dense *Lanice conchilega* in tide-swept lower shore sand<br>• Barren shingle or gravel shores |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Mudflats and sandflats not covered by sea water at low tide** | Intertidal gravel and clean sand communities | Broad scale distribution of communities within the estuary | Spatial distribution of gravel and clean sand biotopes measured along a series of fixed transects periodically during the reporting cycle using GPS (frequency and transect locations to be determined). | Spatial distribution of biotopes should not deviate significantly from an established baseline. Baseline to be further established. | Changes in the spatial distribution of biotopes within an area of a particular type of sediment may provide the first indications of long-term changes in physical conditions at the site.<br><br>Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes.<br><br>The CCW Intertidal Biotope Survey (Jones *et. al*., 2002) provides a partial baseline. |
| | Intertidal muddy sand communities | Community composition | Number of different muddy sand biotopes measured by field visit periodically during the reporting cycle (frequency to be determined). | No decrease in the variety of biotopes from an established baseline. Baseline to be further established | Different associations of plants, animals and their habitats are an important structural and functional aspect of the feature. Changes in the biotopes present within an area of a particular type of sediment may indicate long-term changes in physical conditions at the site.<br><br>Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes<br><br>The CCW Intertidal Biotope Survey (Jones *et. al*., 2002) provides a partial baseline. Intertidal muddy sand biotopes recorded within the European marine site include:<br><br>• Polychaetes and *Cerastoderma edule* in fine sand or muddy sand shores<br>• *Bathyporeia pilosa* and *Corophium spp*. in upper shore slightly muddy fine sand shores<br>• *Macoma balthica* and *Arenicola marina* in muddy sand shores.<br>• *Arenicola marina, Macoma balthica* and *Mya arenaria* in muddy sand shores.<br>• *Echinocardium cordatum* and *Ensis sp*. in lower shore or shallow sublittoral muddy fine sand |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Mudflats and sandflats not covered by sea water at low tide** | Intertidal muddy sand communities | Distribution | Spatial distribution of muddy sand biotopes measured along a series of fixed transects periodically during the reporting cycle using GPS (frequency and transect locations to be determined). | Spatial distribution of biotopes should not deviate significantly from an established baseline. Baseline to be further established. | Changes in the spatial distribution of biotopes within an area of a particular type of sediment may provide the first indications of long-term changes in physical conditions at the site.<br><br>Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes.<br><br>The CCW Intertidal Biotope Survey (Jones *et. al*., 2002) provides a partial baseline. |
| | Intertidal mud communities | Community composition | Number of different mud biotopes measured on field visits periodically during the reporting cycle (frequency to be determined). | No decrease in the variety of biotopes from an established baseline. Baseline to be further established | Different associations of plants, animals and their habitats are an important structural and functional aspect of the feature. Changes in the biotopes present within an area of a particular type of sediment may indicate long-term changes in physical conditions at the site. Littoral mud biotopes often support a high number of polychaete worms and bivalve molluscs, which form an important food source for birds and marine predators such as fish.<br><br>Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes<br><br>The CCW Intertidal Biotope Survey (Jones *et. al*., 2002) provides a partial baseline. Intertidal mud biotopes recorded within the European marine site include:<br><br>• *Hediste diversicolor* and *Macoma balthica* in sandy mud shores<br>• *Hediste diversicolor, Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores<br>• *Hediste diversicolor, Macoma balthica* and *Mya arenaria* in sandy mud shores<br>• *Hediste diversicolor* and *Scrobicularia plana* in reduced salinity mud shores<br>• *Hediste diversicolor* and oligochaetes in low salinity mud shores |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Mudflats and sandflats not covered by sea water at low tide** | Intertidal mud communities | Distribution | Spatial distribution of mud biotopes measured along a series of fixed transects periodically during the reporting cycle using GPS (frequency and transect locations to be determined). | Spatial distribution of biotopes should not deviate significantly from an established baseline. Baseline to be further established. | Changes in the spatial distribution of biotopes within an area of a particular type of sediment may provide the first indications of long-term changes in physical conditions at the site.<br><br>Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes.<br><br>The CCW Intertidal Biotope Survey (Jones *et. al*., 2002) provides a partial baseline. |
| ***Salicornia* and other annuals colonising mud and sand** | All sub-features | Extent | Area (ha) of individual *Salicornia* and other annuals NVC communities, measured at low water periodically during the reporting cycle using a combination of remote sensing and GPS (frequency to be determined). | No decrease in extent of individual pioneer saltmarsh communities from an established baseline | Pioneer saltmarsh communities recorded in the Dee Estuary include: SM8, SM9 and SM27. Monitoring will need to take account of the dynamic nature of these habitats and seasonal and periodic random variations in vegetation types.<br><br>The extent of low pioneer vegetation habitat is dependent on particular combinations of tide and weather conditions in spring and early summer and will naturally vary from year to year. The extent and distribution of ephemeral pioneer saltmarsh within the Dee Estuary saltmarsh is likely to be subject to substantial year on year variation.<br><br>The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 provides a baseline. Further work is required to attempt to quantify the extent of yearly variation in extent. |
| | Pioneer low marsh communities | Species composition of characteristic pioneer marsh communities SM8 and SM9 | Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined). | Abundance of typical species of characteristic pioneer marsh communities should not deviate significantly from an established baseline. | The typical species of pioneer low marsh communities are *Suaeda maritima* and *Salicornia* species<br><br>The NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 provides a baseline. |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| ***Salicornia* and other annuals colonising mud and sand** | Pioneer low marsh communities | Distribution and extent of common cordgrass *Spartina anglica* community SM6 within the pioneer saltmarsh zone. | Area (ha) of *Spartina anglica* community (SM6), measured at low water once during the reporting cycle using a combination of remote sensing and GPS. | No increase in extent of *Spartina anglica* within the pioneer saltmarsh from an established baseline. | *Spartina anglica* is generally considered to be an invasive species and may impact on pioneer and low-mid marsh communities. However, *Spartina* stands may have a role in sediment trapping following periods of erosion, although under certain tidal conditions, erosion around stands may be greater. Natural dieback of *Spartina* has also been observed along the east and south coasts of England.<br><br>If *S. anglica* increases to cover 20% or more of a site unit, then an intensive monitoring programme may be advisable, possibly followed by control measures.<br><br>The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 provides a baseline. |
| | Ephemeral salt-marsh vegetation | Species composition of the characteristic ephemeral marsh community SM27 | Abundance of component species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined). | Abundance of component species of characteristic pioneer marsh communities should not deviate significantly from an established baseline. | The very nature of this community means that recurrent assemblages are rare and there is a large element of chance in the floristic composition. For this reason the National Vegetation Classification does not define constant species for this community (Rodwell, 2000). Species recorded on the Dee Estuary from this community include *Sagina maritima*, *Festuca rubra*, *Parapholis strigosa*, *Puccenellia maritime*, *Agrostis stolonifera* and *Spergularia media*.<br><br>The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 provides a baseline. |
| | | Abundance of the notable ephemeral marsh species *Centaurium littorale*. | Number of discrete locations within the estuary where *Centaurium littorale* is found and its abundance at each location. | No decrease in abundance of *Centaurium littorale* from an established baseline. | The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 provides a baseline |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Atlantic salt meadows** | All sub-features | Extent | Total area (ha) of Atlantic saltmarsh communities within the site measured periodically during the reporting cycle using a combination of remote sensing and ground truthing of boundaries between communities using GPS (frequency to be determined). | No decrease in total extent of Atlantic salt meadow communities from an established baseline. | Monitoring will need to take account of the dynamic nature of these habitats and seasonal and periodic random variations in vegetation types.<br><br>Coastal squeeze may result in the replacement of Atlantic salt meadows with pioneer saltmarsh. A reduction in extent could be further by a ground survey to assess for signs of erosion such as toppled vegetation blocks, signs of roots in intertidal mud, signs of stress/damage to plants. Extent needs to be measured at low tide.<br><br>Together the NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Atlantic salt meadow communities comprise three sub-features:<br><br>• Low to mid marsh communities<br>• Mid to upper marsh communities<br>• Transitional high marsh communities<br><br>See below for lists of individual NVC communities comprising sub-features. |
| | | Creek system and salt pan pattern | Density and morphology of creek systems and salt pans measured periodically during the reporting cycle using remote sensing (frequency to be determined) | No anthropogenic alteration of creek patterns or loss off pans from an established baseline. | Meanders in creeks help to absorb tidal energy. Creeks transport sediment to and from the saltmarsh and act as drainage channels. The efficiency of this process depends on creek pattern.<br><br>Vegetation cover, suspended sediment load and the height and duration of tidal inundation influence creek density. Creeks allow pioneer vegetation to establish along their banks higher in the saltmarsh system than they would normally be found.<br><br>Widening, lengthening and flattening of creeks are an indication of sea level rise/ increase in tidal energy. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins.<br><br>Together the NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Environment Agency LIDAR survey in 2003 may provide further data. |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Atlantic salt meadows** | All sub-features | Donation of vegetation | Width of pioneer, low-mid marsh, mid-upper marsh, and transitional high marsh saltmarsh zones, measured along a series of transects around the estuary, periodically during the reporting cycle, using a combination of remote sensing and ground survey (transect locations and frequency of survey to be determined). | The donation of saltmarsh communities around the estuary should not deviate significantly from an established baseline. | Together the NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Environment Agency LIDAR survey in 2003 may provide further data. |
| | | Sward structure | Sward height of Atlantic salt meadow communities measured periodically during the reporting cycle in late summer using a combination of remote sensing and field visits. | The extent and distribution of vegetation communities exhibiting different sward heights should not deviate significantly from an established baseline. Baseline to be established | Vegetation structure is largely affected by the impact of grazing (of wild or domesticated herbivores) interacting with different vegetation communities.<br><br>Not all Atlantic salt meadow within the Dee Estuary is grazed, but where this has been an established practice, the stocking levels need to be appropriate to the interest of the site. Over grazing can lead to a loss of structural diversity of rare plant species and affect bird breeding and feeding habitats while under grazing can lead to a loss of plant diversity by competitive exclusion. Introduction of grazing to previously ungrazed sites can result in deleterious changes to plant community composition.<br><br>Environment Agency LIDAR survey in 2003 may provide baseline. |
| | | Abundance of locally occurring rare / scare plant species | Number of discrete locations within the estuary where rare / scarce species are found and their abundance at each location. | No decrease in abundance of rare / scarce species from an established baseline. | Nationally scarce species: *Centaurium littorale*, *Bupleurum tenuissimus* and *Parapholis incurva*<br><br>Other Locally rare or scarce species:<br>*Puccinellia distans,* and *Zannichellia palustris*.<br><br>The NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 provides a baseline |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
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| **Atlantic salt meadows** | Low to mid marsh communities | Species composition. | Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined). | Abundance of typical species of characteristic low to mid marsh communities should not deviate significantly from an established baseline. | The recent NVC survey by Dargie in 2000 recorded the following low to mid marsh NVC communities: SM10, SM12, SM13a, SM13b, SM13d, SM14a, SM14c.<br><br>The typical species for these NVC communities include: *Puccinellia maritima, Salicornia* spp., *Suaeda martitima, Aster tripolium, Glaux maritima, Plantago maritima, Armeria maritima, Atriplex portulacoides and Triglochin maritima.*<br><br>This NVC survey of saltmarsh in the Dee Estuary provides a baseline |
| | Mid to upper marsh communities | Species composition | Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined). | Abundance of constant species of characteristic mid to upper marsh communities should not deviate significantly from an established baseline. | The recent NVC survey by Dargie in 2000 recorded the following mid to upper marsh NVC communities: SM16a, SM16b, SM16c, SM16d, SM16e, SM16x, SM18b.<br><br>The typical species for these NVC communities include *Puccinellia maritima, Aster tripolium, Glaux maritima, Plantago maritima, Armeria maritima, Festuca rubra, Juncus gerardii, Triglochin maritimum, Leontodon autumnalis, Agrostis stolonifera, Juncus maritimus and Oenanthe lachenalii.*<br><br>This NVC survey of saltmarsh in the Dee Estuary provides a baseline |
| | Transitional communities | Species composition | Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined). | Abundance of constant species of characteristic transitional communities should not deviate significantly from an established baseline. | The recent NVC survey by Dargie in 2000 recorded the following transitional saltmarsh NVC communities: SM24, SM28, MG11a, MG13, S4, S21a, S21b, S21c, S28<br><br>The typical species for these NVC communities include *Festuca rubra, Agrostis stolonifera, Elymus pycnanthus, Atriplex prostrata, Elymus repens, Potentilla anserina, Lolium perenne, Alopecurus geniculatus, Phragmites australis, Bolboshoenus maritimus, Phalaris arundinacea.*<br><br>This NVC survey of saltmarsh in the Dee Estuary provides a baseline |
| **Annual vegetation of drift lines** | | Frequency of occurrence | Presence of annual vegetation of drift lines at suitable habitats within the site to be assessed at least biannually during the reporting cycle | No decrease in frequency of occurrence at suitable habitats from an established baseline. Baseline to be further established. | This vegetation type is by nature quite ephemeral and may not be present in all years even where suitable conditions exist. Data on frequency of occurrence are currently related to survey frequency and more information is needed to determine the baseline frequency of occurrence within the site. |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Annual vegetation of drift lines** | | Extent | Total area (ha) of annual vegetation of drift lines within the site periodically during the reporting cycle in June using GPS (frequency to be determined). | No decrease in extent of annual vegetation of drift lines communities from an established baseline. Baseline to be further established. | Monitoring will need to take account of the dynamic nature of these habitats and seasonal and periodic variations in vegetation types.<br><br>The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and the Sand Dune survey of Great Britain (Ashall *et al.,* 1991) together provide a partial baseline. |
| | | Species composition | Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined). | Abundance of constant species should not deviate significantly from an established baseline. Baseline to be further established. | The typical species for this feature include: *Cakile maritima* and *Honkenya peploides*<br><br>The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and the Sand Dune survey of Great Britain (Ashall *et al.,* 1991) together provide a partial baseline. |
| **River lamprey** *Lampetra fluviatilis* and **Sea lamprey** *Petromyzon marinus* | | Population size (returning adults) | Number of returning adults measured using the fish trap at Chester Weir, monitoring should be continuous and data provided for at least fortnightly intervals. | No decline in number of returning adults from existing baseline. | Counts of returning adults passing the fish trap at Chester weir together provide a baseline.<br><br>The fish trap count data should not be viewed as an accurate measure of true number of adults returning to spawn. The trap at Chester is not designed to sample lamprey, which are able to swim through the bars of the fish trap and the trap therefore operates at low efficiency. In addition, the trap is currently inactive for around 40% of the time. However the counts should provide a consistent indicator of fluctuations in population size. Work may be required to improve the efficiency of the trap and reduce the variability of the estimate. Also in the future there may be a requirement to establish the sex ratio of returning fish. |
| | | Ammocoete population age structure | Abundance of ammocoetes in the River Dee by age class measured using electric fishing to be undertaken at a series of locations once during reporting cycle (survey locations and exact methodology to be determined). | No decrease in the abundance of ammocoetes by age class from existing baseline. Baseline to be further established | At least three distinct size classes should normally be present.<br><br>Potential locations for sampling on the River Dee include Erbistock downstream of the weir (SJ355425), Bangor-on-Dee (SJ388455), Worthenbury (SJ415475), Holt (SJ414540) and at the Alyn confluence (SJ398561).<br><br>The survey of ammocoete abundance and distribution in the River Dee undertaken by the Environment Agency in 2002 provides a baseline (Potter & Hatton-Ellis, 2003). |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **River lamprey** *Lampetra fluviatilis* and **Sea lamprey** *Petromyzon marinus* | | Ammocoete distribution within catchment | Spatial distribution of ammocoetes in the River Dee measured using electric fishing to be undertaken at a series of locations once during reporting cycle (survey locations and exact methodology to be determined). | No decrease in the distribution of ammocoetes within the catchment from an established baseline. Baseline to be further established | Distribution in catchment should be appropriate to the natural geomorphology. Any silt beds adjacent to or downstream of known *Petromyzon* spawning sites should contain *Petromyzon* ammocoetes. If the distribution of *Petromyzon* in the catchment is unknown, surveys of spawning sites should be carried out in June-July. For *Petromyzon*, it may be more practical to monitor spawning activity. This will be investigated by the LIFE project.<br><br>Where barriers to migration or pollution issues are thought to be a problem, the population should be classed as being in unfavourable condition and targets for an appropriate increase should be set.<br><br>The survey of ammocoete abundance and distribution in the River Dee undertaken by the Environment Agency in 2002 provides a baseline (Potter & Hatton-Ellis, 2003). |
| | | Ammocoete density | Density of ammocoetes in River Dee measured using electric fishing at a series of suitable locations to be undertaken once during reporting cycle (survey locations and exact methodology to be determined). | No decrease in ammocoete density from an established baseline. | *Lampetra* ammocoetes cannot be distinguished in the field, so it will not normally be possible to set separate targets for *L. fluviatilis* and *L. planeri*. However, lampreys upstream of a natural barrier to migration will always be *L. planeri*. *Petromyzon* ammocoetes can be distinguished in the field, but typically occur at very much lower densities than *Lampetra* – approximately 1 ammocoete in 50 in UK rivers is normally *Petromyzon*. |
| | | Water quality (physio-chemical properties) | Water quality measured regularly throughout the reporting cycle (frequency to be determined). | No significant variation in temperature, salinity, turbidity and pH, and no reduction in dissolved oxygen levels, from an established baseline. | Significant variation in these physio-chemical parameters may be injurious to lamprey populations or act as barriers to migration. For example, the timing, duration and consistency of lamprey's upstream migration is believed to be closely related to temperature changes as well as pheromone triggers from the juvenile lamprey during periods of high water flow. Peak migration usually coincides with temperatures that remain above 10°C and continues until temperatures reach 18°C. Dissolved oxygen can also be significantly reduced in stretches receiving significant BOD inputs, or through the resuspension of organic rich sediments.<br><br>Monitoring may be targeted at the most sensitive locations along the migration route such as the canalised section of the upper Dee Estuary and lower River Dee.<br><br>Water quality sampling undertaken by the Environment Agency provides a baseline. |

| Interest Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **River lamprey** *Lampetra fluviatilis* and **Sea lamprey** *Petromyzon marinus* | | Access | Mapping and quantification of potential obstructions in relation to height, type and water depth below obstruction once during the reporting cycle. | No artificial barriers significantly impairing, adults from reaching existing and historical spawning grounds, or juveniles from moving downstream. | Dams, navigation and other weirs may prevent lamprey from reaching their spawning grounds. In particular, sea lamprey are known to be poor at ascending obstacles.<br><br>Lamprey can pass some potential barriers by attaching themselves to structures or riverbanks by their suctorial discs and creeping up by strong bursts of swimming. |

**NB**: Extreme events (such as storms reducing or increasing salinities or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Dee Estuary European marine site and may well be missed by routine monitoring

# 8 Detailed operations advice for the Dee Estuary SAC interest features

## 8.1 Background

This section provides information to help relate general advice to each of the specific interest features of the Special Area of Conservation. These interest features are:

- Estuary
- Mudflats and sandflats not covered by seawater at low tide
- *Salicornia* and other annuals colonising mud and sand
- Atlantic salt meadows
- Annual vegetation of drift lines
- River lamprey (*Lampetra fluviatilis*)
- Sea lamprey (*Petromyzon marinus*)

This advice relates to the vulnerability of the interest features and sub-features of the pSAC within the Dee Estuary European marine site boundary as summarised in Table 1 and set out in more detail in Table 3. The sensitivity and exposure of the features is described for each category of operation. Assessments of the features vulnerability to the various categories of operations are also provided based upon the interaction between sensitivity and exposure in each case. This enables links between the categories of operation and the ecological requirements of the European marine site's interest features, as set out in Section 6, to be made.

Operations may cause damage or disturbance to the interest features and sub-features of the European marine site, either alone or in combination.

The Dee Estuary European marine site covers a large geographical area and this operations advice refers to the interest features across the estuary. Therefore, activities have been allocated an 'average' exposure score based on their occurrence within the estuary. The following text will reflect where activities only occur in a small area of the site but may be undertaken intensively or frequently. Also, there may often be a difference in the intensity of activities occurring in different parts of the site, especially on either shore of the estuary.

Features are generally dealt with in the order presented above for each operation category. However only the intertidal hard substrate and subtidal sediment subfeatures are considered initially under the estuary feature as all the other estuary sub-features are also features in their own right.

## 8.2 Physical loss

Physical loss may result from a range of activities causing the removal or smothering of the interest features. The Dee Estuary is a complex system comprising one of the largest estuaries in the UK and supporting several estuarine habitat types, each of which contributes to the biodiversity of the system. In turn, these habitats support a rich variety of marine communities, many of which are dependent upon the ecological functioning of other

communities. Therefore physical loss of any single habitat as a result of activities such as coastal development could have wider implications for the survival of other communities, thus detrimentally affecting the favourable condition of the European marine site.

### 8.2.1 Physical loss by removal

Physical loss by removal may arise from developments such as infrastructure construction and modification, coastal protection works, and land claim. In these instances the physical loss occurs when areas of habitat are used for new purposes. In addition coastal developments and other anthropogenic activities may also cause the indirect loss of estuarine habitats through the interruption of existing coastal processes such as sediment transport. Sediments will enter the estuary either suspended in the water column, in the case of fine sand and silt, or moving along the seabed as 'bedload' in the case of coarser sand and gravel. Sediment supply may be interrupted either at source, for example by placing coastal defences in front of soft cliffs, or during transport where structures such as groynes in particular may disrupt and intercept the movement of bedload sediment. Such interruptions to sediment supply may occur either within the site or outside it. Eventually a lack of sediment supply will tend to cause habitat deterioration and then erosion. Indirect physical loss can also arise from changes to the estuaries morphology affecting the hydro-dynamic regime, for example widening or deepening of channels at the mouth of an estuary may increase the volume of water entering the estuary causing the erosion of sub-tidal sediments or sandbanks higher up the estuary.

In the future the hard frontages such as embankments and sea walls found along much of the estuary coastline will compromise its ability to evolve in response to rising sea levels and climate change. This will result in the erosion of saltmarsh and other intertidal communities. This process of coastal squeeze may result in significant loss of estuarine habitats in the long term, yet in the medium term it is likely that the estuary will continue to accrete and that the effects of coastal squeeze will not be apparent. Thus although the impacts from coastal squeeze may eventually be extensive they are not taken into account in the assessment of current exposure presented here.

Due to the severity of the effects of physical loss all the estuary's habitat communities are considered to be highly sensitive to removal. Lamprey species are also considered highly sensitive to their own 'removal' for example by entrainment in abstracted waters.

The **subtidal sediment communities** within the estuary are subject to physical loss resulting from capital and maintenance dredging associated with the maintenance of navigation channels. Dredging leads to physical loss of subtidal material in where removed, and smothering of benthic communities, both in areas adjacent to dredging activity as well as in the vicinity of deposition sites. Due to the scale of recent and proposed dredging operations, and the proportion of the subtidal channel affected, the level of exposure of subtidal sediment communities to both removal and smothering is considered to be high. Thus these communities are **highly vulnerable** to removal.

The communities comprising the **intertidal hard substrate** subfeature are widely distributed around the estuary. They include, an area of Holocene clay on Salisbury Middle in the outer estuary supporting the nationally important biotope mussels *Mytilus edulis* and piddocks *Pholas dacytylus* on eulittoral firm clay, pools with mixed substrata south of Mostyn Quay supporting hydroids and ephemeral seaweeds, and honeycomb worm *Sabellaria alveolata*

reefs on the rocky shore at the north end of Hilbre Island. These widely spread communities differ in their individual exposure to removal. Exposure to removal is regarded as high for the Holocene clay deposits, which are currently eroding. This erosion may be exacerbated by dredging activities affecting current flows in the outer estuary. The *Sabellaria* communities on Hilbre Island may be highly exposed to removal as a consequence of possible coastal protection works. Thus the intertidal hard substrate communities are regarded as highly exposed and therefore **highly vulnerable** to physical loss by removal.

Development pressures still exist within the estuary that could result in removal of areas of the **intertidal mudflats and sandflats**. Those areas close to existing terrestrial development may be most at risk. Recent examples of developments resulting the removal of areas of this feature include the expansion of the Port of Mostyn, development of the West Kirby Marine Lake and the tipping of coal waste on the upper shore at Point of Ayr. In addition removal of intertidal mudflat and sandflat communities may also occur due to capital or maintenance dredging operations associated with improving and maintaining vessel access to the Port of Mostyn. This leads to direct removal and indirectly to erosion and scour associated with consequent changes in current flows. In the long term there is again a significant risk of mudflats being lost due to coastal squeeze.

Although the estuary as a whole may be accreting, the overall area of intertidal sediment communities has declined due to the estimated 700 ha expansion in the area of saltmarsh over the last 20 years (Dargie, 2001). This expansion of saltmarsh has principally occurred at the expense of muddy sediments in the upper and middle estuary to the east of the main channel. Saltmarsh expansion is most reasonably attributed to a combination of factors including: fore-shortening of the estuary system caused by historic land claim in the upper estuary leading to in-filling and a narrower equilibrium morphology; diversion and canalisation of the upper estuary channel; introduction of training walls; and the colonisation of the estuary by the invasive saltmarsh species common cord grass *Spartina anglica*. Strictly, none of these factors can be regarded as an ongoing activity/operation, yet the ongoing effects of this historic habitat removal continue to impact upon the morphology of the estuary, in particular the extent of mud communities and this must be taken into account in any assessment of exposure.

Thus the intertidal mud communities are considered to be highly exposed to removal, although this is mainly due to the continued accretion of saltmarsh over the mudflats than any current activity. Muddy sand communities are considered to have a medium exposure to removal as they occur in areas where recent developments requiring land claim have taken place along the Welsh shore. The exposure of the intertidal clean sand and gravel communities found in the mid and outer estuary, was considered to be low due to the much lower development pressures in these areas. Thus **mud** and **muddy sand communities** are therefore **highly vulnerable** to removal, **gravel and clean sand communities** are **moderately vulnerable**.

All the constituent sub-features of the ***Salicornia* and other annuals** and the **Atlantic salt meadow** features are considered highly sensitive to removal. The mid to upper marsh communities, transitional high marsh communities, and ephemeral saltmarsh are similarly highly sensitive to smothering; while the low to mid marsh and both the *Salicornia* and *Suaeda maritima* communities are only moderately sensitive due to their adaptations to lower shore conditions.

As discussed for the mudflats and sandflats feature the distribution of saltmarsh within the estuary is currently changing. While there is much accretion of saltmarsh to the east of the main estuary channel, saltmarsh along the Welsh shore to the south of Greenfield, is subject to severe erosion with the lower saltmarsh communities declining or absent. This erosion along the Welsh shore may be attributed to historic human activities, especially the canalisation of the upper estuary and the construction of the training walls. This erosion must be taken into account when considering the exposure of the low to mid marsh sub-feature.

In general, the exposure of the saltmarsh communities including both the *Salicornia* and other annuals, and Atlantic salt meadow features to physical loss through removal was considered to be low. This was however, with the exception of the low to mid marsh communities and the transitional high marsh communities whose exposure to removal was medium. The elevated exposure of the low-mid marsh communities reflects the severe erosion they currently experience along the Welsh shore, although the exposure is not considered high due to the proportion of the sub-feature affected. The medium exposure of the transitional high marsh communities is due to the position they occupy at the top of the marsh. This area is most likely to be affected by even minor coastal developments as well as the maintenance of coastal defences.

Thus the current **vulnerability** assessment for the ***Salicornia* and other annuals**, and **Atlantic salt meadow** features to operations causing loss by removal is **moderate for all their sub-features**, with the **exception of the low to mid marsh communities and the transitional high marsh communities** whose **vulnerability** to physical loss is **high** due to its greater exposure.

**Annual vegetation of drift lines** within the Dee Estuary European marine site is considered to have a low exposure to removal. Thus its **vulnerability** to removal is **moderat**e, due its high sensitivity.

The level of exposure of **river lamprey** and **sea lamprey** to physical loss through removal in the Dee Estuary is difficult to establish. Unfortunately, very little is known about the way these species make use of benthic habitat within the estuary. There are two possible aspects to physical loss for these species - loss of individual fish and loss of their habitat. Lamprey species can be susceptible to being 'sucked up' in significant numbers by large abstractions, such as those for power station cooling water systems. However, the water intakes at both the Powergen and National Power power stations in the upper estuary were designed to avoid fish entrainment in order to minimise their ability to trap salmon and other migratory fish (Jim Morris, IPC Inspector, EAW, *pers. comm.*). Based on the limited evidence available the exposure of both lamprey species to removal is regarded as low, thus lampreys are considered to have **moderate vulnerability** to removal due to their high sensitivity. Yet the possibility of lamprey entrainment remains and needs to be investigated further.

### 8.2.2 Physical loss by smothering

Physical loss due to smothering occurs where accretion occurs so rapidly that the nature of the surface substrate is changed, for example gravel habitats may be smothered by rapid deposition of sand. Alternatively the nature of the 'smothering material' may be the same as the existing substrate, yet the rate of deposition is such that the existing community is unable to maintain a presence at the surface. As is the case for removal, smothering may be caused directly by the deposition of dredged spoil or beach feeding, as well as indirectly due to

anthropogenic influence on coastal processes; for example, due to construction of coastal structures altering sediment transport patterns resulting in much increased sedimentation.

Again, due to the severity of the effects of physical loss, all the estuary's habitat communities are considered to be highly or moderately sensitive to smothering. Sensitivity to smothering is often less than to removal for some habitats depending upon the likelihood of recovery particularly where this is aided by adaptation. Soft sediment communities and vegetated drift lines are considered moderately sensitive since they occupy niches where smothering naturally occurs due to the dynamic nature of their environment. Low to mid saltmarsh and *Salicornia* and *Suaeda maritima* communities are also moderately sensitive to smothering due to their adaptations to lower shore conditions. Lamprey species are considered to have only a low sensitivity to smothering due to their mobility.

As well as causing removal of **subtidal sediment communities** dredging and disposal of sediment also has the capacity to cause the smothering of benthic communities again resulting in physical loss. Thus as in the case of removal, the exposure of subtidal sediment communities to physical loss due to smothering is considered to be high and therefore these communities are **highly vulnerable** to smothering.

As mentioned above the communities comprising the **notable hard substrate** subfeature are widely distributed around the estuary. Of these communities both the Holocene clay deposits and pools with mixed substrata may be exposed to sedimentation as a result of disposal of dredged sediment in Mostyn Deep, while the others may have a generally low exposure to smothering. Thus overall the intertidal hard substrate communities are regarded as having medium exposure to physical loss by smothering. Due to their high sensitivity to smothering this results in the notable hard substrates being considered **highly vulnerable** to smothering.

Current operations and future proposals for beach recharge along the beach frontage at Talacre could result in the smothering of **clean sand communities** present on the beach. In addition the intertidal mudflats and sandflats may be exposed to smothering in localised areas from jetting and flushing of drainage outfalls. However, across the rest of the intertidal communities exposure to smothering is considered to be low. Thus the overall assessment for exposure to smothering is medium for gravel and clean sand communities and low for mud and muddy sand communities. Therefore the gravel and clean sand communities are considered moderately vulnerable to smothering, the other intertidal sediment sub-features considered to have **low vulnerability**.

The exposure of saltmarsh communities to smothering is considered to be low for all sub-features, with the exception of the transitional high marsh communities, which are considered to have medium exposure, again due to their position towards the top of the shore. Thus only **ephemeral saltmarsh** and **mid to upper marsh communities** have **moderate vulnerability** due to their high sensitivity, while the **vulnerability** of the **transitional high marsh** is **high**.

**Annual vegetation of drift lines** is considered to have a high exposure to smothering. This is because the habitat tends to occur along the section of coast fronting Gronant Dunes and Talacre Warren SSSI in the general vicinity of where beach recharge is proposed as described above. Thus the feature is considered **highly vulnerable** to smothering.

There is little evidence to indicate the exposure of **lamprey species** to smothering within the estuary. Since these species are regarded as having only low sensitivity to smothering their **vulnerability** to smothering may provisionally be regarded as **low**.

### 8.3 Physical damage

Physical damage may result from a range of activities causing either siltation, abrasion or selective extraction to affect the interest features.

#### 8.3.1 Physical damage by siltation

Siltation can result from particulate matter being carried in effluent discharged into the estuary, or from maintenance dredging and dredged spoil disposal. Most estuarine communities are not considered to be particularly sensitive to siltation, as estuaries are naturally silty environments. However, hard substrate communities are the exception to this rule, being highly sensitive to siltation. Gravel and clean sand communities, and annual vegetation of drift lines are also moderately sensitive; though the latter is unlikely to be frequently exposed. Silt in the water column can smother or block the feeding and respiratory organs of marine invertebrates living in the substrate. It can also affect recruitment processes of both marine flora and fauna and can contribute to a reduction in light penetration through the water column.

Exposure to siltation varies between different estuarine communities. Exposure to siltation is considered to be high for the estuary's subtidal sediment communities, which are most likely to be affected by proposed dredging operations. The intertidal hard sediment communities located nearest to the area of dredging activity are considered to have medium exposure to siltation. Thus the **hard substrate** communities are considered **highly vulnerable** to siltation due to their high sensitivity whereas the **subtidal sediment communities** are considered **moderately vulnerable** to siltation due to their high exposure.

The intertidal muddy sand, clean sand and gravel communities, many of which are located near to the area of dredging activity are also considered to have medium exposure to siltation. Thus **clean sand and gravel communities** are also considered **moderately vulnerable** due to their combination of medium exposure and moderate sensitivity.

#### 8.3.2 Physical damage by abrasion

Abrasion can physically damage individual marine organisms and plants, as well as causing deterioration to the structure of saltmarshes and sediment communities. The sensitivity to abrasion is moderate for the majority of the estuary's features, though annual vegetation of drift lines is highly sensitive to abrasion due to the potential for damage to succulent plants and their root systems. Abrasion of muddy soft sediment communities can alter the habitat structure and may lead to a change in species composition, though clean sand communities have only low sensitivity. Excessive damage may ultimately result in the destabilisation of the sediment and lead to rapid erosion. Lampreys and hard substrate communities are considered to have a low sensitivity to the effects of abrasion.

Exposure to abrasion varies across the European marine site and it can be attributed to three main sources, dredging operations, fisheries (in particular the commercial gathering of cockles), and recreational pressures, the latter are mainly associated with the upper shore.

**Subtidal sediment communities** are considered highly exposed to abrasion, mainly due to dredging activities, but also by the use of mobile benthic fishing gear such as beam trawling used to catch shrimp, plaice and Dover sole. Thus the **vulnerability** of the subtidal sediments to physical damage by abrasion is considered **high.**

Both the **mud** and **muddy sand communities** are considered to have potentially a high exposure to abrasion. This is due primarily to the scale of the cockle fishery, while the gravel and clean sand communities are considered to have a medium exposure due to recreational pressure on both the English and Welsh shores. Recently the commercial cockle fishery on the estuary has involved large numbers of people; in 2002 approximately 1000 people were issued with permits to harvest cockles, although there were only 11 fishing days in total. Such intense activity, even over relatively short periods, may cause damage through disturbance to the sediment structure. This may be caused both by raking for cockles but also by trampling or the use of vehicles to gain access to the beds, though such vehicle use is currently prohibited. Tractor dredging for cockles has occurred in the estuary and has the potential to cause a high level of abrasion, though this is also prohibited within the estuary at present.

Bait digging is practised at low intensity within the site in particular on North Wirral Foreshore and recently significant numbers of people have been observed collecting razor fish (*Ensis* spp.) (Keith Williams, Environment Agency Bailiff, *pers. comm.*). As with cockling, such activities disturb the sediment through digging and to a lesser extent trampling. They may be sustainable where traditional methods are employed; however, a distinction should be made between traditional activities and commercial exploitation of the resource. The latter may impact on the favourable condition of the European marine site.

Particularly during the summer months there is a high degree of recreational usage of the **intertidal sandflats** between Gronant and Point of Ayr and between West Kirby and Hoylake. Activities practised include walking, horse riding, use of motorcycles and sand yachts; these contribute to the sandflats' assessment of medium exposure to abrasion, though their vulnerability is low due to low sensitivity.

Thus the **vulnerability** of mud and **muddy sand communities** is considered **high** due to their high exposure. **Gravel and clean sand communities** have **moderate vulnerability** to abrasion due to their moderate sensitivity and exposure.

**Annual vegetation of drift lines** is an extremely ephemeral plant assemblage, which has been recorded in the vicinity of the Point of Ayr and near Heswall on the English shore (Dargie, 2001). As these areas experience some of the most intense recreation pressure in the European marine site, the vegetation is considered to be highly exposed to abrasion. Thus its **vulnerability** to abrasion is also **high.**

The exposure to abrasion is considered to be low for all the ***Salicornia* and other annuals** and the **Atlantic salt meadow** sub-features except for the transitional high marsh communities, which experience medium exposure. This abrasion is primarily caused by recreational pressure including, walking and cycling, though the most severe abrasion results from motorcycle use. Thus **only** the **traditional high marsh communities** experience **moderate vulnerability**.

### 8.3.3 Physical damage by selective extraction

Selective extraction is the removal of a particular type of substrate from within a habitat or community, for example the removal of fine sand from the gravel and clean sand sub-feature. More indiscriminate removal of habitat such as that involved in dredging to allow port access is dealt with as physical loss through removal. All the estuarine communities within the site are considered to be moderately sensitive to selective extraction, except the rocky shore communities, which are considered highly sensitive due to their dependence on a fixed substrate.

Exposure to selective extraction is low across the European marine site. Despite their low exposure **hard substrate communities** are considered to have **moderate vulnerability** to selective extraction, due to their high sensitivity to such operations.

## 8.4 Non-physical disturbance

Non-physical disturbance comprises noise and visual presence. Exposure to activities with these impacts varies across the estuary with some areas experiencing high levels of disturbance. However, none of the habitat features of the site have any degree of sensitivity to these activities in their own right. The two lamprey species are both considered to have low exposure and sensitivity to activities causing these categories of impacts.

## 8.5 Toxic contamination

Toxic contamination of all varieties may reach the European marine site from both marine and terrestrial sources, by a variety of pathways including tidal currents, river flow, terrestrial run-off and atmospheric deposition. Toxic contaminants can be categorised as synthetic compounds, non-synthetic compounds and radionuclides.

Many toxic compounds, especially synthetic compounds such as PCBs, are known to have toxic effects even in very low concentrations, and a high degree of bioaccumulation can occur within many benthic organisms. Such compounds may then 'biomagnify' as they are transferred along the food chain if these organisms are predated upon. Thus, even relatively low concentrations of contaminants in discharges can cause impacts upon features towards the top of the food chain such as wading birds. The problem of biomagnification is compounded by the fact that many synthetic compounds such as PCBs are very stable in the environment and are rarely degraded.

The potential effects of toxic pollutants vary according to the state and availability of the compound and the characteristics of the receiving environment. Where the effects are lethal and result in the removal of individual species, key grazers or predators may be lost and a dominance of pollution tolerant organisms may result. Toxic compounds may also have sub-lethal effects on the healthy functioning of an organism affecting its reproductive capacity, physiology or causing genetic mutation, which may ultimately reduce the organism's fitness for survival. Faunal communities within sediments, which primarily consist of species relying on larval dispersal for recruitment, are recognised as being particularly sensitive to toxic contamination. In sheltered low energy environments such as estuaries, where muddy sediments can act as a sediment sink, synthetic and non-synthetic compounds may bind to fine sediments. They may then be remobilised if the sediment is disturbed (for example by dredging) making them available once more as potential pollutants in the water column.

### 8.5.1 Toxic contamination by synthetic toxic compounds

Estuarine species and communities are generally highly sensitive to synthetic toxic compounds such as pesticides, PCBs (polychlorinated biphenyls) and biocides such as TBT (tributyltin). The effects of individual synthetic compounds upon many species found within the habitats of the Dee Estuary are poorly understood, but there is evidence from elsewhere of synthetic compounds causing high levels of toxicity to a variety of marine organisms (Cole *et al.*, 1999). Some synthetic compounds have the capacity to mimic animal hormones, or prevent their production or break down. These compounds are referred to as endocrine disrupting chemicals, they can affect physiological processes such as immunoresponse, reproduction and development.

The communities of all the habitats of the Dee Estuary except annual vegetation of drift lines are considered highly sensitive to toxic contamination by synthetic compounds. Annual vegetation of drift lines is considered to have a lower sensitivity to synthetic contaminants because it is found on a generally dry and free draining substrate.

As mentioned above toxic compounds, both synthetic and none synthetic, can reach estuarine communities from many sources. Many of these sources discharge both categories of contaminant. Within the Dee Estuary their are numerous legally consented industrial discharges, though these are mainly confined to the Welsh shore. Over the last two decades there is believed to have been a reduction in the level of pollutants discharged to the estuary from industrial sites. Available data have revealed no failures to comply with any of the standards required by the Dangerous Substances Directive in recent years (Howarth *et al.*, 2001).

Historic discharges may have left a legacy of pollution due to the persistent nature of many of the contaminants released, therefore these discharges have a bearing upon our assessment of current exposure. Much of this historic contamination of the estuary is likely to be bound within the sediments. Contemporary activities resulting in the disturbance of such contaminated sediments can therefore have an impact upon the levels of toxic substances available to estuarine communities. Historic industry has also left a legacy of contaminated land around the estuary that still presents problems due to contaminants leaching into the estuary, as well as the suspected historic contamination of intertidal sediments. Synthetic substances present at contaminated land sites include asbestos and a variety of solvents.

Studies of synthetic compounds within the species and habitats of the Dee Estuary have provided mixed results. In a general investigation into relative water quality in estuarine waters of the UK, the Dee Estuary was ranked the 9$^{th}$ most contaminated out of the 10 estuaries investigated (Kirby *et al.*, 1998). However, a narrower study looking at concentrations of two chemical products emitted during industrial production and from incinerators and car exhausts, polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), found that concentrations within the Dee Estuary were the highest of the six estuaries studied (Tyler *et al.*, 1994). Grey seals *Halichoerus grypus* may be regarded as being at the top of the food chain within the Dee Estuary, and therefore most likely to bioaccumulate contaminants within their tissues. Tissue samples taken from seals in the Dee Estuary in 1988 and 1989 were found to be highly contaminated with PCBs (Simmonds, *et al.*, 1993).

Due to the dynamic nature of the estuarine environment with tidal mixing and resuspension of sediment, pollutants are readily mobilised within the estuary. Thus the levels of exposure of all intertidal features / sub-features may be reasonably similar; with the possible exception of those habitats located in the outer estuary, where currents flush these habitats more readily, and those in the upper reaches of the intertidal zone which experience less frequent periods of inundation and consequently less exposure to contaminants carried in the water column.

Based on this view of the estuary, the wide geographical distribution of potential sources of contaminants and the absence of more precise information, it was determined that there should be an assessment of medium exposure to synthetic toxic contamination for each of the following sub-features: **subtidal sediment communities** and **intertidal hard substrate communities**; all three **mudflats and sandflats sub-features**; ***Salicornia* and other annuals** and the **low to mid marsh communities of Atlantic salt meadow**. All of these sub-features are highly sensitive to the introduction of **toxic synthetic compounds** and thus should be considered **highly vulnerable.**

Despite their low exposure **ephemeral saltmarsh** and the **mid to upper** and **transitional high marsh communities** are **moderately vu**lnerable to **synthetic toxic contamination** due to their high sensitivity.

### 8.5.2 Toxic contamination by non-synthetic toxic compounds

Non-synthetic compounds may naturally be present at very low levels in the environment, but many become toxic at elevated concentrations. They include many hydrocarbons including fuel oils, as well as heavy metals, which occur naturally at low concentrations. Estuarine communities are generally moderately sensitive to non-synthetic compounds, such as heavy metals and hydrocarbons, although annual vegetation of drift lines is considered to be highly sensitive to oil pollution. Oil pollution can cause deterioration of communities in intertidal and shallow subtidal environments, and can persist in low energy environments, where natural degradation and weathering of the oil tends to be slow. Oil can also have a significant smothering effect on marine communities especially in the intertidal and supralittoral (spray) zones. Saltmarshes are sensitive to oil and oil products, even at low levels, mainly due to their ability to trap sediments. Acute events such as an oil spill can be particularly damaging to saltmarsh plants, and the dispersants used to treat the spill can sometimes have an even more toxic effect on the plants than the oil itself. The use of dispersants to clean up oil spills on saltmarshes is therefore, not recommended (Briggs Marine Environmental Services Ltd, 2003). Saltmarshes have been reported to take up to 10 years to recover from chronic oil pollution, although recovery depends largely on the degree to which oil is retained in the sediment and the clean up procedures used.

There are a series of wastewater treatment works around the estuary discharging effluent from the populations of West Kirby, Heswall, Neston, Burton, Queensferry, Connah's Quay, Flint, Greenfield, Mostyn and Llanasa, and although the sewage is treated, toxic contaminants remain. Zinc loadings in sewage effluent discharged to the estuary are much higher than other metals, with Chester and Queensferry wastewater treatment works being the major contributors (Potter, 2003). Water samples taken both upstream and down stream of Queensferry wastewater treatment works between 1997 and 1998 revealed mean zinc concentrations of 15.6 ug/l and 7.1ug/l respectively, both below the UK EQS of 40ug/l although one sample upstream of the works had a concentration of 52ug/l (Potter, 2003). However some authors have recommended that the EQS should be reduced to as low as 10

ug/l as an annual average due to zinc's effects on species of molluscs and crustaceans (Hunt & Hedgecott, 1992 and Matthiessesn *et al.*, 1999, in Potter, 2003). Chester wastewater treatment works is also known to be a high contributor of lead, copper and nickel loadings compared to other wastewater treatment works (Potter, 2003).

As discussed above, there are several sources of industrial effluent within the Dee Estuary. Historically the Courtaulds factories at Flint and Greenfield were a major polluter within the estuary. Prior to 1976 the estuary received high levels of zinc pollution from Courtaulds and moderate levels until 1985 (Jemmett, 1993).

Historic industry has also left a legacy of contaminated land along the coast around the estuary, as described above. Non-synthetic compounds associated with this contamination include a variety of heavy metals, hydrocarbons and organic chemicals.

The Dee Estuary is potentially quite exposed to accidental chemical or oil spillage and maritime pollution due to its proximity to shipping access routes to the Port of Mostyn and the Mersey Ports as well as the development of the Liverpool Bay oil and gas field. Consequently, procedures to respond to oil spill incidents within and adjacent to the Dee Estuary European marine site need to be kept under review.

As described above due to the dynamic nature of the estuarine environment the level of exposure to most contaminants is likely to be comparable between habitats. Again, based on this view of the estuary, the wide geographical distribution of potential sources of contaminants and the absence of more precise information, it was determined that there should be an assessment of medium exposure to toxic contamination by non-synthetic compounds for each of the following sub-features: **subtidal sediment communities** and **intertidal hard substrate communities**; all three **mudflats and sandflats sub-features**; ***Salicornia* communities** and ***Suaeda maritima* communities**; and the **low to mid marsh communities of Atlantic salt meadow**. All these communities are considered moderately sensitive to the introduction of **non-synthetic toxic compounds** and are therefore **moderately vulnerable** in this respect. Despite its low exposure **annual vegetation of drift lines** is also considered **moderately vulnerable** to **non-synthetic toxic contamination** due to its high sensitivity**.**

Ammonia loadings from treated sewage effluent have decreased since 1997 at Chester and Queensferry wastewater treatment works (Potter, 2003). However elevated ammonia concentrations may still occur in the upper estuary channel and the lower canalised section of the river, particularly during periods of warm weather and low flows. As **lamprey species** must pass through this area of potentially elevated contamination on migration to and from the waters of the Dee catchment in order to fulfill their life cycle, both species' exposure to non-synthetic toxic contamination is considered to be high, while their exposure to synthetic contaminants is considered to be medium. Thus both sea lamprey and river lamprey are considered **highly vulnerable** to **non-synthetic contamination**.

### 8.5.3 Toxic contamination by radioactive compounds

The effects of radionuclides have been demonstrated in a number of marine organisms, such as invertebrates and fish (Cole *et al.*, 1999). Depending on the radioactive dosage, lethal, genetic or reproductive effects may result. There is also evidence to show that radionuclides accumulate in biota, particularly benthic crustaceans, molluscs and saltmarsh grasses (Cole *et*

*al*., 1999). However sensitivity to radionuclides is generally considered to be low for all communities.

There are currently no major sources of radioactive contamination within the Dee Estuary itself, although there are several discharging installations around Liverpool Bay and the eastern Irish Sea. These include the Sellafield nuclear reprocessing plant, which is the dominant source of radioactive waste discharge to the coastal waters of the UK (Hutchinson, 1994). Airborne gamma spectrometry surveys have revealed elevated levels of $^{137}$Caesium in the saltmarshes and tidal flats of major estuaries in the eastern Irish Sea environments including the Dee Estuary (Narayana *et al*., 2001). Doses received by man from exposure to such artificial radionuclides have been the subject of most scientific investigation. In the Dee Estuary the largest dose of radioactivity received by the most exposed group, people working on the marshes, is estimated to be only 6% of the recommended annual dose limit (Rose *et al*., 1996). In the absence of more specific data relating to particular habitats or species the exposure to radioactivity for all features within the site is considered to be low.

Since **all the features** of the site are considered to exhibit only low sensitivity to the introduction of radionuclides, and exposure is universally considered to be low, the features' **vulnerability** to radionuclides is also considered **low**.

### 8.6 Non-toxic contamination

Certain contaminants can have non-toxic, but nevertheless harmful effects on the features of the European marine site. These non-toxic contaminants are generally present in much higher concentrations than the toxic contaminants discussed above. They can enter the estuarine environment in large quantities from sewage outfalls and industrial discharges, riverine inputs and agricultural run-off. Water quality may be affected by contaminants altering factors such as nutrient levels, organic loading, heat, turbidity and salinity.

There is much variation in the sensitivity of subfeatures of the European marine site to the various categories of non-toxic contamination; this variation is discussed below.

#### 8.6.1 Non-toxic contamination by changes in inorganic nutrient loading

Non-toxic nutrient levels can have profound direct effects upon estuary habitats and result in further indirect effects upon particular species (Cole, *et al*., 1999). Elevated inorganic nutrient (nitrate and phosphate) levels, can contribute to the stimulation of phytoplankton growth, leading to eutrophication and the subsequent deoxygenation of the water column, particularly in areas of limited or reduced water circulation and shallow areas with good light penetration. Increased nutrient levels also have the potential to lead to the localised growth of opportunistic algae such as gutweed *Enteromorpha* species and sea lettuce *Ulva lactuca* on the foreshore, which can cause smothering and deoxygenation of sediment communities (Cole *et al*., 1999). Nutrient pollution may result in reductions in species diversity and some species may be unable to recover, due to their slow growth and low larval dispersal.

Sensitivity to changes in inorganic nutrient loading is considered to be high for the muddy sand and gravel and clean sand communities and moderate for all other subfeatures except the hard substrate communities and the two lamprey species, which have low sensitivity.

As for toxic compounds, both inorganic and organic nutrients, can reach estuarine communities from many sources and many of these sources discharge both categories of contaminant. Thus the exposure and vulnerability of the features of the European marine site to both types of nutrients is discussed together in the next section below.

### 8.6.2 Non-toxic contamination by changes in organic nutrient loading

Increased levels of organic matter can also lead to a localised depletion of oxygen levels due to the increased activity of aerobic bacteria that break down organic matter. A good supply of oxygen within the sediments and water column is important for the healthy functioning of most marine species. Elevated levels of organic matter can alter this natural balance, potentially causing changes to the species composition and distribution within the sediments and saltmarsh communities. Primarily there will be increased growth of opportunistic species at the expense of more sensitive species (Cole *et al.*, 1999).

Studies in North America have suggested that saltmarshes are unlikely to be highly sensitive to changes in water quality due to nutrient enrichment (Holt *et al.*, 1995). However, increased growth of algal species, as a result of eutrophication may cause localised smothering of lower saltmarsh species and have been known to have a detrimental effect on glasswort in particular.

Sensitivity to changes in organic loading is considered to be moderate for all sub-features, again with the exception of hard substrate and the lamprey species, which have low sensitivity.

The degree of exposure and vulnerability of the features to non-toxic contamination by changes in the levels of both **synthetic** and **non-synthetic** contaminants is outlined blow:

The requirements for wastewater treatment works (WwTW) to be 'secondary treated' in recent years has led to reduction in the amount of organic matter discharged into estuaries and coastal waters. Inorganic nutrients are generally not removed in significant quantities by this process.

There are five main sources of inorganic and organic nutrients present within the Dee Estuary:

- *River input* - nutrients flowing into the estuary from the River Dee and other watercourses in the catchment influenced by agricultural run off, sewage discharges and industry in the catchment;
- *Tidal mixing* - nutrients are carried into the estuary from Liverpool Bay by the tidal regime;
- *Organic production* - biological productivity within the estuary system itself, chiefly comprising inputs from the saltmarsh, benthic communities in the intertidal sands and mudflats and phytoplankton living in the water column;
- *Direct discharge* - nutrients are discharged into the estuary from the numerous water treatment works and combined sewerage outfalls situated around its shores. In addition there are inputs of paper pulp fibres from paper mills.
- *Atmospheric deposition* - nitrogen is discharged to the atmosphere as $NO_x$ from the burning of fossil fuels; this is of particular relevance due to the presence of two power stations and the Padeswood Cement Works close to the estuary.

The relative importance of these input categories is not well understood, although the relative contributions from Liverpool Bay are considered highly significant (Howarth *et al.*, 2001). In addition freshwater inputs to the estuary both from the River Dee and other freshwater discharges are considered to contribute significantly to the estuary's nitrogen loading (Howarth *et al.*, 2001). Among wastewater treatment works Chester and Queensferry are mainly responsible for the highest nutrient loadings being discharged to the estuary, they contribute the most oxidised nitrogen, phosphate and orthophosphate (Potter, 2003).

In 2001, the Dee Estuary from Chester Weir to its mouth was proposed by EAW as a Sensitive Area to Eutrophication under the Waste Water Treatment Directive, as the estuary exceeded chemical and biological criteria indicative of eutrophic conditions (Howarth *et al.*, 2001). Evidence for eutrophication includes chemical data, reduced dissolved oxygen concentration in summer and elevated nitrogen concentrations in winter, Chlorophyll-*a* measurements, and evidence of algal scum. Two algal blooms were reported within the estuary between 1999 and 2001 (Howarth *et al.*, 2001).

Recent investigations of faunal communities in the vicinity of the wastewater treatment works around the estuary found that the composition of these communities was generally classified as unbalanced and slightly polluted (Potter, 2003).

In the upper estuary the picture is further complicated by an interaction between nutrient loading and river flows. Nutrient levels in the canalised section of the lower river are believed to be particularly high due to sewage discharges and their limited dilution by freshwater river flow. During low flows and periods of warm weather, elevated water temperatures may still combine with the high nutrient levels to create suitable conditions for an algal bloom, causing oxygen depletion (Hodgson in, Shoreline Management Partnership, 2002). This set of circumstances has resulted in fish kills in the upper estuary in the past.

On the basis of evidence used to support the proposal to designate the Dee Estuary as a Sensitive Area to Eutrophication it was determined that all the sub-features that are subject to frequent inundation are highly exposed to changes in both organic and inorganic nutrient loading. These sub-features are: subtidal sediment communities and rocky shore communities; all three mudflats and sandflats sub-features; *Salicornia* and other annuals colonising mud and sand; and the low to mid marsh communities of Atlantic salt meadow. The ephemeral, upper and high marsh communities and vegetated drift lines are less frequently inundated and considered to have a medium exposure.

The potential exposure of the lamprey species must be regarded as high since to complete their life cycle they must pass along the full length of the river channel, including the section considered prone to periodic eutrophication.

These exposure scores resulted in **most sub-features**, being **moderately or highly vulnerable** to **inorganic and organic nutrient loading**, with the exception of the vegetated strandline communities, and the two lamprey species due to their low sensitivity to eutrophic conditions.

### 8.6.3 Non-toxic contamination by changes in the thermal regime

Lamprey species are considered highly sensitive to changes in the thermal regime. This is because their upstream migration is thought to be temperature dependent, relying on the detection of a small change in water temperature, as well as the interaction between water temperature and oxygen levels described above. Only subtidal sediment and hard substrate communities have moderate sensitivity to changes in the thermal regime, other communities have lower sensitivity.

Although there are several warm water discharges around the estuary, including cooling water outfalls from two power stations in the upper estuary channel, their effects upon the temperature regime of the estuary are believed to be localised. Heat energy is a dissipating 'pollutant' in this context, thus the impact of these outfalls is thought to be concentrated around the point of discharge. The habitat features of the European marine site were therefore determined to have at most a low exposure to changes in thermal regime. However, the lamprey species were considered to have potentially moderate level of exposure, as they must pass along the full length of the channel to complete their life cycle. Therefore, the **river** and **sea lamprey** were determined to be **highly vulnerable** to changes in thermal regime, while the other features have only low vulnerability.

### 8.6.4 Non-toxic contamination by changes in turbidity

The Dee Estuary is a naturally turbid system; therefore any increases in turbidity from anthropogenic actions may fall within the natural range that the estuary communities generally experience. The gravel and clean sand communities have the highest sensitivity to turbidity, being moderately sensitive; the sensitivity of all other sub-features is less.

Primarily due to ongoing possibility of dredging works and disposal of dredged materials within the estuary the exposure to changes in turbidity was determined to be high for the subtidal sediment communities and medium for most other communities experiencing frequent tidal inundation. Based on these assumptions, only the **subtidal sediment communities** and **gravel and clean sand communities** are **moderately vulnerable** to turbidity, other sub-features having low vulnerability.

### 8.6.5 Non-toxic contamination by changes in salinity

Estuaries naturally exhibit a large degree of variability in salinity associated with the interaction between the tidal cycle and river flow. There will be a gradient in the average salinity experience by communities at different stages up the estuary though the salinity at any point will vary substantially. Despite the adaptation of estuarine communities to variable salinity significant changes in salinity due to either discharge of hyper-saline or fresh water can also have indirect effects on community composition. In addition changes in salinity can cause indirect effects on communities as salinity can affect the chemical availability of various contaminants.

Sensitivity to changes in salinity is moderate for all subfeatures apart from subtidal sediments, *Salicornia* and other annual species, subtidal sediment communities, and the lamprey species; these are all considered to have low sensitivity to salinity changes. These less sensitive communities naturally experience a wider variation in salinity than most of the other communities. Hyper-saline discharges may be harmful to most estuarine communities, although these effects will generally be localized. Estuarine communities will generally be

unaffected by short term changes in salinity within the limits of their normal exposure, however long term impacts upon the salinity regime, may affect the donation of communities within the estuary having far reaching effects on community distribution.

Presently only the power stations are thought to discharge hyper-saline water. The main influences on the salinity of the estuary would be tidal inundation and rainfall. Thus exposure to anthropogenic changes in salinity is determined to be low throughout the estuary and **vulnerability** to changes in salinity is therefore **low for all features**.

### 8.7 Biological disturbance

Biological disturbance includes the introduction of microbial pathogens, introduction and translocation of non-native species, and the selective extraction of species.

#### 8.7.1 Biological disturbance by introduction of microbial pathogens

The sensitivity of the features to the introduction of microbial pathogens is considered to be either low or undetectable for all sub-features.

Mainly as a result of recent improvements to waste water treatment exposure to microbial pathogens within the estuary is generally perceived to be low, although elevated levels may occur in the upper estuary and canalised lower river due to reduced dilution of sewage discharges. This leads to an assessment of medium exposure for the mud communities and lamprey species. Yet the resulting **vulnerability** is **low** for **all features**.

#### 8.7.2 Biological disturbance by introduction of non-native species

Introduced species may thrive at the expense of native species, resulting in a change in the composition of estuarine communities, and affecting the structure and functioning of estuarine habitats. However the sensitivity of the features to introductions of non-native species is considered to be generally moderate or low.

New introductions of non-native marine species may be most likely to occur through the discharge of ballast water within the estuary by ships embarking from foreign ports. A great variety of species have been shown to be able to survive transhipment in ballast water (e.g. Wasson *et al.*, 2001; Reise *et al.*, 1999). There is also the possibility of non-native species entering the estuary on the hulls of boats. The Dee Estuary has received relatively little long distance trade in recent years although this may change with the expansion of the Port of Mostyn. Presently small coasters or 'Rhine barges' which visit Mediterranean and Northern European Ports are calling at Mostyn approximately once a week, and may have the potential to bring alien species from Europe and further a field. Further work is needed to establish which non-native marine species may already be present in the waters of the Dee Estuary and to investigate the likelihood of current shipping activities resulting in further introductions. **Subtidal sediment communities**, **hard substrate communities**, and **gravel and clean sand communities** would be most likely to be exposed to the introduction of non-native species through ballast water movements. However due to the low level of traffic currently visiting the estuary the exposure of these subfeatures to introductions of non-native species is provisionally considered to be **low**, as is their **vulnerability**.

As mentioned under Physical Loss, the overall extent of saltmarsh within the estuary continues to expand. Over the last two decades there has been an increase of about 35% in

saltmarsh extent, mainly on the north side of the main channel, especially in the mid and upper estuary (Dargie, 2001). This expansion is of particular concern with respect to the loss of **muddy sediment communities** and the potential for displacement of native pioneer saltmarsh communities principally comprising glasswort *Salicornia* species and seablite *Suaeda martitima*.

Continued saltmarsh expansion is occurring in response to the ongoing siltation within the estuary as a result of historic impacts upon the form of the estuary. The spread of the invasive common cord grass *Spartina anglica* within the estuary is also believed to play an important role in this process. Common cord grass was introduced to the Dee in the late 1920's at Connah's Quay in order to accelerate land claim (Parr, 1988). Once present in an area it acts to accelerate accretion by trapping sediment directly and slowing current speeds causing further deposition (Parr, 1988).

Common cordgrass is a fertile strain of a hybrid between a native and introduced *Spartina* species. It demonstrates vigorous growth and is able to grow low down on the shore where the sediments are highly mobile, being a particularly aggressive coloniser of bare mud. Yet cordgrass encroachment is not restricted to the mud communities; it is also present on the sandy sediments at West Kirby and Hoylake.

Since 1945 the spread of cord grass both within existing vegetation communities and as a pioneer species, has played an important part in the development of the Dee saltmarsh (NCC, 1978). In 1966, the area of cordgrass dominated marsh was estimated to be 405 ha (Hubbard and Stebbings, 1967); by 1983 this had increased to 620 ha (Burd, 1989). However over the last two decades there is good evidence, first from Hill (1986) and most recently Dargie (2001), that succession is occurring within areas previously dominated by *Spartina*, which are being colonised by other saltmarsh species such as saltmarsh grass *Puccinellia maritima*; indeed Dargie was able to map only 34 ha of cord grass dominated marsh in 2000, although Dargie also confirms that the process of saltmarsh expansion continues (Dargie, 2001).

Thus **mud communities** and the native pioneer ***Salicornia* and *Suaeda maritima* communities** are considered to be highly exposed to the introduction and translocation of *Spartina anglica*. **Muddy sand communities** and **low to mid marsh communities** are considered to have **medium** exposure. All of these sub-features are considered to be moderately sensitive to the introduction of non-native species thus their **vulnerability** is the same as their exposure assessment.

### 8.7.3 Biological disturbance by selective extraction of species

Selective extraction of species within the estuary results from various forms of exploitation of living resources. These include commercial shellfish and finfish fisheries, sport fishing (both sea angling and coarse fishing), and wildfowling.

The unsustainable removal of particular species from estuarine habitats may affect the ecological balance of the marine communities and predator species, such as birds and fish that may rely upon them as a food source.

All the estuarine communities of the European marine site are considered to be moderately sensitive to the selective extraction of their constituent species.

The Dee supports sea fisheries for both shell fish and fin fish: there is a cockle (*Cerastoderma edule*) fishery of high economic importance, and smaller mussel *Mytilus edulis* fishery; in addition there is small scale collection of razor fish *Ensis* spp. and bait digging for lug worms *Arenicola marina*. The Dee supports a notable fishery for species such as flounder *Pleuronectes flesus*, mullet species *Chelon labrosus* and *Liza ramada,* cod *Gadus morhua*, and shrimps *Crangon crangon*, as well as a salmon *Salmo salmar* net fishery controlled by a Net Limitation Order (NRA, 1993; Potts & Swaby, 1993).

Cockles are found within areas of both **mud** and **muddy sand sediments**. As mentioned under the section on physical damage by abrasion the cockle fishery may have undesirable effects caused by raking for cockles and their removal. In addition to direct effects upon the particular bird species that utilise cockles as a food source, the regular disturbance of sediment due to raking during the fishery affect infaunal community composition, either through causing death or injury to other species or through changes in sedimentology (Kaiser *et al*., 2001). Persistent raking activity associated with the cockle fishery may have the potential to lead to long term changes in the sedimentology of the cockle beds by allowing "winnowing" of the fine fraction (Jemmett, 1993). In addition some raking may cause smaller cockles to be damaged, killed or washed from the bed, as well as potentially facilitating the release of toxic metals, bound within the sediment.

Existing powers available to the Environment Agency to manage the cockle fishery are limited in scope and resources with no control available upon the numbers of fishermen that may take part. However shellfishery management within the estuary is currently under review and in the future existing problems may be resolved. The limited cockle stocks found on North Wirral Foreshore, and the Gronant Dunes and Talacre Warren shoreline fall under the jurisdiction of North Wales and North Western Sea Fisheries Committee and cockling here is less restricted. Thus, achieving sustainable management of the whole fishery within the European site is problematic at present. In the future any deleterious effects of the cockle fishery could be offset by the potential benefits that arise from sustainable management of the stock according to traditional principles. These include the prevention of widespread 'shelling up' of beds, creation of space to allow improved spat fall, reduced volatility of cockle population dynamics, and the maintenance of a better managed stock within the estuary. In addition a reduction in disturbance would also likely to be of benefit to overwintering birds.

Mussel harvesting within the Dee Estuary is less regulated that the cockle fishery but occurs with less intensity. Within the estuary, mussels occur on hard substrates, especially the 'artificial' rocky shores around Port of Mostyn, and the rocky shore of the Hilbre Islands as well as on the intertidal mudflats and sandflats off West Kirby and Thurstaston. Mussel settlement may also take place on very dense cockle beds, which have undergone or are in the process of 'shelling up'.

Excessive exploitation of mussels resulting in the removal of long established areas of mussel beds, or the total removal of mussels over extensive stretches of rocky shore, is considered highly undesirable as it is likely to result in a significant medium or long term change in community composition. Mussel beds provide habitats for a wide range of other species and repeated removal would be likely to prevent these species from becoming established. However the impacts of sustainable low intensity mussel collection or the occasional removal of 'mussel crumble' from a cockle bed could be minimal.

Bait digging and razor shell collection are practised within the site at low intensity, in particular within the sand communities of the North Wirral Foreshore. As with cockling such activities disturb the sediment through digging and to a lesser extent trampling. This exploitation may also be sustainable at low intensities where traditional methods are employed; however commercial exploitation of these resources may impact on the favourable condition of the European marine site through widespread disturbance of the sediment structure and changes to sediment community composition.

Thus the current exposure of **mud** and **muddy sand communities** to the selective extraction of shellfish is considered to be high due to the current scale of the cockle fishery; the exposure of clean sand and gravel communities is considered to be medium. As the sensitivity of these communities to selective extraction is moderate, their **vulnerability** is **high** and **moderate** respectively.

The majority of the rocky shore communities on artificial substrates around the Port of Mostyn or on Hilbre Island or do not form part of the **notable hard substrate communities** sub-feature. The exposure of the notable hard substrate communities within the estuary to selective extraction in general is currently regarded as low. Thus they are also considered to have only **low vulnerability**.

The exposure of the **subtidal sediment communities** to selective extraction is also considered to be moderate due to the continued beam trawling for shrimps, flounder and other flatfish, although this is currently carried out at relatively low intensity. Thus the subtidal sediment communities are also considered to be **moderately vulnerable** to selective extraction.

Both wildfowling and cockling activities are significant with regard to their possible effects upon SPA / Ramsar features and these are dealt with in the SPA / Ramsar Advice on Operations Section.

**Table 3. Assessment of the relative sensitivity, exposure and vulnerability of SAC interest features and sub-features of the Dee Estuary European marine site to different categories of operations. Exposure assessment is derived for February 2003**.

Categories of operations to which the features or sub-features of the site are highly or moderately vulnerable are indicated by shading, light grey for moderate vulnerability and dark grey for high vulnerability. Table also incorporates the relative sensitivity scores, used in part to derive vulnerability[9]

**Key:** Matrix used to determine relative vulnerability (i.e. Sensitivity x Exposure = Vulnerability)

| | | | | | |
|---|---|---|---|---|---|
| **High sensitivity** | O O O O | **High Exposure** | × × × × | **High vulnerability** | ⊗⊗⊗⊗<br>⊗⊗⊗O<br>⊗⊗⊗× |
| **Moderate sensitivity** | O O O | **Medium Exposure** | × × × | **Moderate vulnerability** | ⊗⊗OO<br>⊗⊗× ×<br>⊗⊗⊗ |
| **Low sensitivity** | O O | **Low Exposure** | × × | **Low vulnerability** | ⊗⊗O<br>⊗⊗×<br>⊗⊗ |
| **No detectable sensitivity** | O | **No exposure** | × | **No vulnerability** | ⊗O<br>⊗×<br>⊗ |

| Categories of operations which may cause deterioration or disturbance | SAC interest features | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Estuaries | | | | | | Mudflats and sandflats not covered by seawater at low tide | | |
| | Subtidal sediments | Intertidal hard substrate communities | Intertidal mudflats and sandflats | *Salicornia* and other annuals | Atlantic salt meadow | Annual vegetated shingle | Mud communities | Muddy sand communities | Gravel and clean sand communities |
| **Physical Loss** | | | For information on the exposure of this sub-feature see the intertidal mudflats and sandflats not covered by sea water at low tide feature in this table | For information on the exposure of this sub-feature see the *Salicornia* and other annuals colonising mud and sand feature in this table | For information on the exposure of this sub-feature see the Atlantic salt meadow feature in this table | For information on the exposure of this sub-feature see the annual vegetated shingle feature in this table | | | |
| Removal (e.g. land claim, dredging) | ⊗⊗⊗⊗ | ⊗⊗⊗⊗ | | | | | ⊗⊗⊗⊗ | ⊗⊗⊗O | ⊗⊗OO |
| Smothering (e.g. depositing dredge spoil, beach feeding) | ⊗⊗⊗× | ⊗⊗⊗O | | | | | ⊗⊗O | ⊗⊗O | ⊗⊗⊗ |
| **Physical Damage** | | | | | | | | | |
| Siltation (e.g. dredging, outfalls, coastal development) | ⊗⊗×× | ⊗⊗⊗O | | | | | ⊗⊗ | ⊗⊗× | ⊗⊗⊗ |
| Abrasion (e.g. recreational activity, vehicles) | ⊗⊗⊗× | ⊗⊗× | | | | | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗⊗ |
| Selective extraction (e.g. aggregate extraction) | ⊗⊗O | ⊗⊗OO | | | | | ⊗⊗O | ⊗⊗O | ⊗⊗O |
| **Non-physical disturbance** | | | | | | | | | |
| Noise (e.g. land/water-based recreation, marine traffic) | ⊗×× | ⊗×× | | | | | ⊗× | ⊗× | ⊗×× |
| Visual presence (e.g. land/water-based recreation, marine traffic) | ⊗ | ⊗×× | | | | | ⊗× | ⊗× | ⊗×× |
| **Toxic contamination** | | | | | | | | | |
| Introduction of synthetic compounds (e.g. TBT, PCBs from industrial effluent outfalls) | ⊗⊗⊗O | ⊗⊗⊗O | | | | | ⊗⊗⊗O | ⊗⊗⊗O | ⊗⊗⊗O |
| Introduction of non-synthetic compounds (e.g. domestic effluent outfalls, crude oil) | ⊗⊗⊗ | ⊗⊗⊗ | | | | | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗⊗ |
| Introduction of radionuclides | ⊗⊗ | ⊗⊗ | | | | | ⊗⊗ | ⊗⊗ | ⊗⊗ |

| Categories of operations which may cause deterioration or disturbance | SAC interest features | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Estuaries | | | | | | Mudflats and sandflats not covered by seawater at low tide | | |
| | Subtidal sediments | Intertidal hard substrate communities | Intertidal mudflats and sandflats | *Salicornia* and other annuals | Atlantic salt meadow | Annual vegetated shingle | Mud communities | Muddy sand communities | Gravel and clean sand communities |
| **Non-toxic contamination** | | | | | | | | | |
| Changes in nutrient loading (e.g. agricultural run-off, domestic effluent outfalls) | ⊗⊗⊗× | ⊗⊗× × | | | | | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗⊗× |
| Changes in organic loading (e.g. domestic effluent outfalls, aquaculture) | ⊗⊗⊗× | ⊗⊗× × | | | | | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗⊗× |
| Changes in thermal regime (e.g. power station discharges) | ⊗⊗O | ⊗⊗O | | | | | ⊗⊗ | ⊗⊗ | ⊗⊗ |
| Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil) | ⊗⊗× × | ⊗⊗× | | | | | ⊗⊗× | ⊗⊗× | ⊗⊗⊗ |
| Changes in salinity (e.g. water abstraction, effluent outfalls) | ⊗⊗ | ⊗⊗O | | | | | ⊗⊗O | ⊗⊗O | ⊗⊗O |
| **Biological disturbance** | | | | | | | | | |
| Introduction of microbial pathogens (e.g. domestic / industrial effluent outfalls) | ⊗⊗ | ⊗⊗ | | | | | ⊗⊗× | ⊗⊗ | ⊗⊗ |
| Introduction of non-native species and translocation | ⊗⊗O | ⊗⊗ | | | | | ⊗⊗⊗× | ⊗⊗⊗ | ⊗⊗O |
| Selective extraction of species (e.g. samphire picking, bait collection) | ⊗⊗⊗ | ⊗⊗O | | | | | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗⊗ |

| Categories of operations which may cause deterioration or disturbance | SAC Interest Features | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Salicornia and other annuals | | | Atlantic Saltmeadow | | | Annual Vegetation of drift lines | Sea Lamprey (*Petromyzon marinus*) | River Lamprey (*Lampetra fluviatilis*) |
| | *Salicornia* communities | *Suada maritima* communities | Ephemeral saltmarsh (with *Sagina maritima*) | Low to mid marsh communities | Mid to upper marsh communities | Transitional high marsh communities | | | |
| **Physical Loss** | | | | | | | | | |
| Removal (e.g. land claim, dredging) | ⊗⊗O O | ⊗⊗O O | ⊗⊗O O | ⊗⊗O O | ⊗⊗O O | ⊗⊗⊗O | ⊗⊗O O | ⊗⊗O O | ⊗⊗O O |
| Smothering (e.g. depositing dredge spoil, beach feeding) | ⊗⊗O | ⊗⊗O | ⊗⊗O O | ⊗⊗O | ⊗⊗O O | ⊗⊗⊗O | ⊗⊗⊗ | ⊗⊗ | ⊗⊗ |
| **Physical Damage** | | | | | | | | | |
| Siltation (e.g. dredging, outfalls, coastal development) | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗O | ⊗⊗× | ⊗⊗× |
| Abrasion (e.g. recreational activity, vehicles) | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗⊗ | ⊗⊗⊗⊗ | ⊗⊗× | ⊗⊗× |
| Selective extraction (e.g. aggregate extraction) | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O |
| **Non-physical disturbance** | | | | | | | | | |
| Noise (e.g. land/water-based recreation, marine traffic) | ⊗× | ⊗× × | ⊗× × | ⊗× × | ⊗× × | ⊗× × | ⊗× × × | ⊗⊗ | ⊗⊗ |
| Visual presence (e.g. land/water-based recreation, marine traffic) | ⊗× | ⊗× × | ⊗× × | ⊗× | ⊗× × | ⊗× × | ⊗× × | ⊗ O | ⊗ O |
| **Toxic contamination** | | | | | | | | | |
| Introduction of synthetic compounds (e.g. TBT, PCBs from effluent outfalls) | ⊗⊗⊗O | ⊗⊗⊗O | ⊗⊗O O | ⊗⊗⊗O | ⊗⊗O O | ⊗⊗O O | ⊗⊗ | ⊗⊗⊗ | ⊗⊗⊗ |
| Introduction of non-synthetic compounds (e.g. effluent outfalls, crude oil) | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗O | ⊗⊗⊗ | ⊗⊗O | ⊗⊗O | ⊗⊗O O | ⊗⊗⊗× | ⊗⊗⊗× |
| Introduction of radionuclides | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗× | ⊗⊗ | ⊗⊗ |
| **Non-toxic contamination** | | | | | | | | | |
| Changes in nutrient loading (e.g. agricultural run-off, effluent outfalls) | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗⊗ | ⊗⊗⊗× | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗× × | ⊗⊗× × |
| Changes in organic loading (e.g. effluent outfalls, aquaculture) | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗⊗ | ⊗⊗⊗× | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗× × | ⊗⊗× × |

| Categories of operations which may cause deterioration or disturbance | SAC Interest Features | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Salicornia and other annuals | | | Atlantic Saltmeadow | | | Annual Vegetation of drift lines | Sea Lamprey (*Petromyzon marinus*) | River Lamprey (*Lampetra fluviatilis*) |
| | *Salicornia* communities | *Suada maritima* communities | Ephemeral saltmarsh (with *Sagina maritima*) | Low to mid marsh communities | Mid to upper marsh communities | Transitional high marsh communities | | | |
| Changes in thermal regime (e.g. power station discharges) | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗× | ⊗⊗⊗O | ⊗⊗⊗O |
| Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil) | ⊗⊗× | ⊗⊗× | ⊗⊗ | ⊗⊗× | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗× | ⊗⊗× |
| Changes in salinity (e.g. water abstraction, effluent outfalls) | ⊗⊗ | ⊗⊗ | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗ | ⊗⊗ |
| **Biological disturbance** | | | | | | | | | |
| Introduction of microbial pathogens (e.g. effluent outfalls) | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗× | ⊗⊗× | ⊗⊗× |
| Introduction of non-native species and translocation | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗O | ⊗⊗⊗ | ⊗⊗O | ⊗⊗⊗ | ⊗⊗× | ⊗⊗⊗ | ⊗⊗⊗ |
| Selective extraction of species (e.g. samphire picking, bait collection) | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗O |

[9] English Nature and the Countryside Council for Wales' advice on operations is derived from an assessment combining relative sensitivity of the features or sub-features with information on human usage of the site (as at February 2003), to identify relative vulnerability to categories of operations. In accordance with Government policy guidance this advice is provided in the light of current activities and patterns of usage at the site. It is important therefore that future consideration of this advice by relevant authorities, and others, takes account of changes in the usage patterns at the site. In contract the sensitivity of interest features, or sub-features, is relatively stable with alterations reflecting improvement in our scientific knowledge and understanding. To this end, information on sensitivity has been included in this table to assist the management and advisory groups with the future management of the site.

# Special Protection Area

# 9 Dee Estuary SPA interest features

The Dee Estuary European marine site includes a Special Protection Area qualifying under the EU Birds Directive. Revisions to the existing SPA were consulted upon in February 2001, including the addition of particular areas and qualifying species, but these have not yet been entered in the European Sites Register. The area covered by these revisions is therefore referred to as a potential SPA (pSPA).

Where SPA qualifying bird species occur within the European marine site, they are referred to as interest features. Supporting habitat sub-features (or simply supporting habitats) have also been identified to highlight the ecologically important components of the European marine site for each interest feature (Figure 2). The interest features and supporting habitats for the Dee Estuary European marine site are discussed in more detail below and the supporting habitats are mapped in Appendix V to show their distribution and extent.

This section applies to both the classified site and to the potential SPA. It describes and explains the importance of each of the SPA interest features of the Dee Estuary European marine site.

The Dee Estuary SPA and pSPA include both marine areas (i.e. land covered continuously or intermittently by tidal waters) and land that is not subject to tidal influence. The marine part of the SPA or pSPA is termed a European marine site. The seaward boundary of the European marine site is concurrent with that of the SPA or pSPA. The landward boundary of the European marine site is the upper boundary of the SPA or pSPA, or where that extends above land covered continuously or intermittently by tidal waters, it is at the limit of the marine habitats.

As mentioned in section 1.9 the area of North Wirral Foreshore SSSI forms part of the Dee Estuary pSAC but it is not included within the Dee Estuary SPA or potential SPA. North Wirral Foreshore SSSI does form part of the Mersey Narrows and North Wirral Foreshore potential SPA. Regulation 33 Advice relating to Mersey Narrows and North Wirral Foreshore pSPA is therefore not included within this document and will be provided separately in due course.

## 9.1 Background and context

A major aim of the Birds Directive is to take special measures to conserve the habitats of qualifying birds in order to ensure their survival and reproduction within the European Union. A key mechanism in achieving this is the classification by Member States of the most suitable sites as SPAs.

English Nature's and the Countryside Council for Wales' conservation objectives at the site level focus on maintaining both the populations of the qualifying species and the habitats used by them. Site management should therefore aim to avoid both damage to the supporting habitats and disturbance to the birds. In reporting on conservation status, account will need to be taken both of habitat condition and the status of the bird populations

Accordingly, English Nature and the Countryside Council for Wales will use annual counts, in the context of five year peak means for qualifying species, together with available

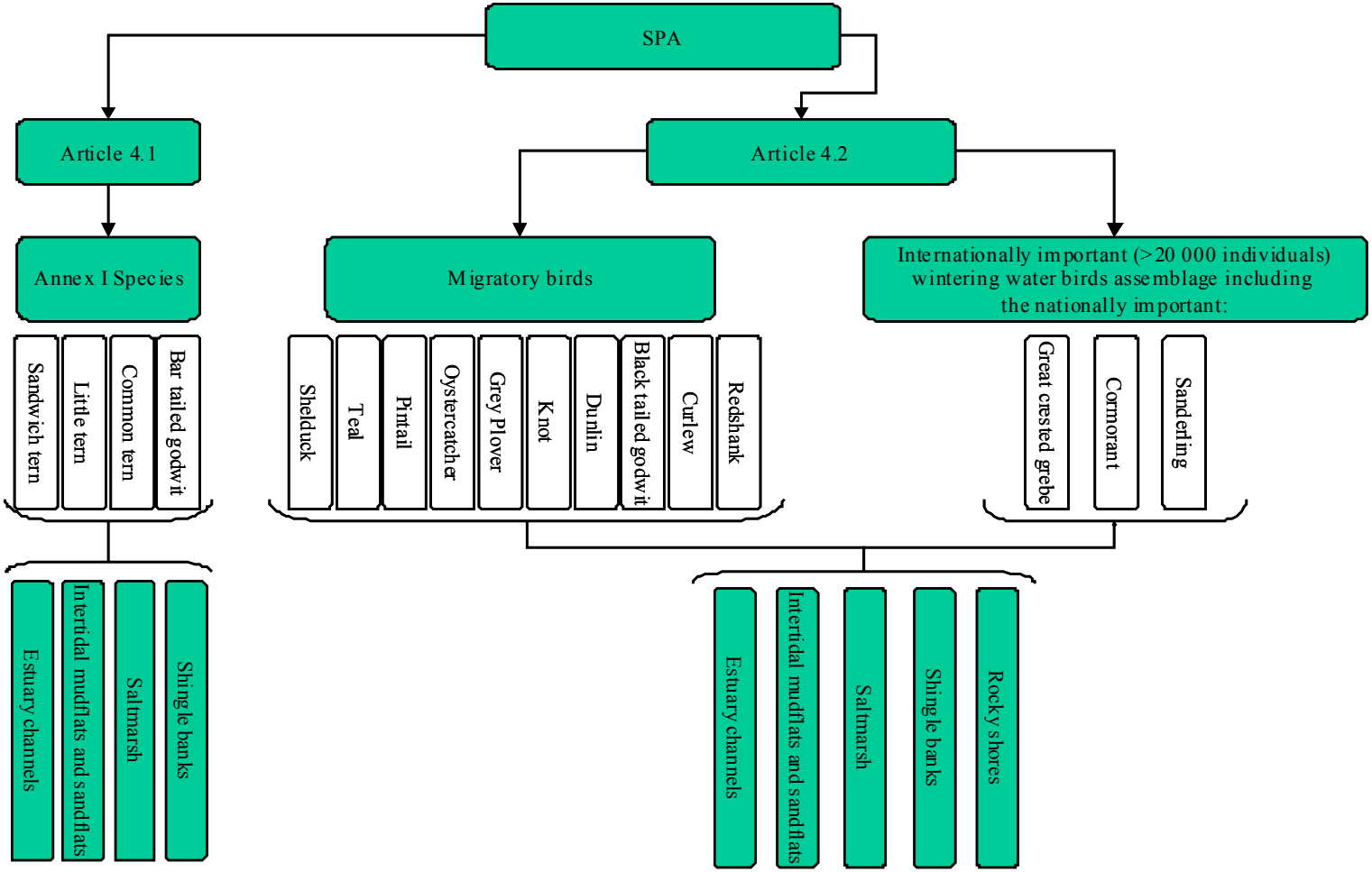


Figure 2. Flow chart showing the relationship between the qualifying bird species of The Dee Estuary SPA/pSPA and their supporting habitat sub features. Bird species are in 'open' vertical boxes with supporting habitat sub features in shaded vertical boxes.

information on population and distribution trends, to assess whether a SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species. Count information will be assessed in combination with information on habitat condition, at the appropriate time within the reporting cycle, in order to report to the European Union.

In addition to focusing on avoiding deterioration to the habitats of the qualifying species, the Habitats Directive also requires that actions be taken to avoid significant disturbance to the species for which the site was designated. Such disturbance may result in alterations in population trends and/or distribution patterns. Avoiding disturbance to qualifying species is mentioned in the favourable condition table accompanying the conservation objectives for the SPA. In this context, five-year peak mean population data from monthly high water Wetland Bird Survey (WeBS) counts will be used in conjunction with information from more infrequent low water WeBS counts as the basis for assessing whether disturbance is significant.

Attention is also directed to the inclusion of disturbance in the advice on operations provided in Section 12. Where disturbance is highlighted in such advice, relevant authorities need to avoid significant disturbance to qualifying species when exercising their functions under the Directive.

### 9.2 Reduction in organic and inorganic inputs

Under the Urban Waste Water Treatment (UWWT) Directive, all coastal discharges above a certain volume must have had secondary treatment installed by the end of 2000. Secondary treatment of sewage will significantly reduce organic loading and to a lesser extent reduce concentrations of dissolved nutrients. Also, improvements to water quality in the upper catchment may result in a reduction in riverine nutrients. Also, currently, Liverpool bay is one of the most eutrophic areas in the UK, thus the estuary receives an enhanced 'marine' input of nutrients. The effects of these reductions on coastal features and the birds they support are difficult to predict. On the one hand, it might be expected that there would be a redistribution of feeding birds or a reduction in the overall capacity of a coastal area to support some bird populations. Wildfowl and waders will prey upon the invertebrates found in the sediments close to wastewater outfalls and other species on the fish that exploit these resources (Burton *et al.*, 2002). Improvements to discharges have been shown to lead to reductions in these resources. Recent research has also provided evidence that numbers of waterbirds have declined on two estuaries, the Orwell and the Mersey, following changes to waste water treatment (Burton *et al.*, 2002). On the other hand, where bird populations are currently adversely affected by eutrophication, or on the most grossly polluted sites cleaner discharges may contribute to improving site condition.

English Nature and the Countryside Council for Wales support the improvement in coastal discharges. On balance, the overall ecological benefits of cleaner discharges tend to outweigh any subsequent local decline in bird numbers, although there is presently insufficient knowledge to accurately predict the effects on the bird populations of individual SPA sites. Therefore it is necessary that each proposal that may affect nutrient loading with the Dee Estuary European marine site be considered on a case by case basis.

Under the Conservation (Natural Habitats & c.) Regulations, 1994, if significant effects are likely from such activities, the competent authority (in this case the Environment Agency) will be required to undertake an appropriate assessment to determine whether there is an

adverse effect on site integrity. An important point is that even if adverse effects are predicted then the project may still proceed if there are imperative reasons of overriding public interest. These include reasons relating to public health and beneficial consequences of primary importance for the environment.

### 9.3 General description

In recognition of the fact that bird populations on a site may change in response to wider, national or international trends or events, this Regulation 33 advice addresses the habitat conditions on the site necessary to support the bird populations, as well as the bird populations themselves. "Supporting habitats" are identified which describe the key habitats within the European marine site necessary to support the qualifying species. The "favourable condition table" (see section 3 and 11) contains further detail on habitat conditions.

Bird usage of the site varies seasonally, with different areas being favoured over others at certain times of the year. However, annual counts for qualifying species will be used by English Nature and the Countryside Council for Wales, in the context of five-year peak means, together with available information on UK populations and distribution trends, to assess whether this SPA is continuing to make an appropriate contribution to the Favourable Condition Status of the species.

Bird communities are highly mobile and exhibit patterns of activity related to tidal water movements and many other factors. Different bird species exploit different parts of a marine area and different prey species. Changes in the habitat may therefore affect species differentially. The most important factors related to this are:

- current extent and distribution of suitable feeding and roosting habitat (e.g. saltmarsh, mudflats, shingle and rocky shores);
- sufficient food availability (e.g. crustaceans, small fish, molluscs, worms and seeds);
- minimal levels of disturbance in feeding and roosting areas;
- water quality necessary to maintain intertidal plant and animal communities; and
- fresh water quantity, tidal flows and salinity gradients necessary to maintain saltmarsh conditions suitable for bird feeding and roosting.

As explained in section 2.4.2 there are a number of habitats within the SPA, which support the qualifying bird species, but which do not, occur within the European marine site as they occur above highest astronomical tide. These habitats include coastal grazing marsh used by waterbirds for feeding and roosting, and the nesting areas of common terns. Conservation objectives covering the use of such coastal habitats by the qualifying bird species are appended to the SPA conservation objectives. They are provided for information only and do not constitute advice under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations, 1994.

Some species will also use areas of land and coastal waters outside the boundaries of both the European marine site and the SPA. Relevant authorities need to have regard to such adjacent interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

**Table 4: A summary of the qualifying SPA features and their associated supporting habitats within the Dee Estuary European marine site**

| Qualifying features | Protected Supporting habitats | | | | |
|---|---|---|---|---|---|
| | Estuary channels | Intertidal mudflats and sandflats | Saltmarsh communities | Shingle banks | Rocky shore |
| Annex I species[9] | √ | √ | √ | √ | |
| Migratory species[10] | √ | √ | √ | √ | √ |
| Waterbird assemblage[11] | √ | √ | √ | √ | √ |

## 9.4 Internationally important populations of the regularly occurring Annex I species

The species listed in Annex I of the Birds Directive are the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. Species listed on Annex I are in danger of extinction, rare or vulnerable. Annex I species that regularly occur at levels over 1% of the national population, meet the SPA qualifying criteria.

The Dee Estuary SPA supports internationally important populations of four Annex I species (see Table 5 and below).

The qualifying wintering species that occurs within the European marine site is:

- bar-tailed godwit *Limosa lapponica*

The qualifying breeding species that occur within the European marine site are:

- common tern *Sterna hirundo*
- little tern *Sterna albifrons*

The qualifying species that occur on autumn passage within the European marine site is:

- Sandwich tern *Sterna sandicensis*

The following Annex I species also occur in the Dee Estuary SPA: Leach's petrel *Oceanodroma leucorhoa,* little egret *Egretta garzetta*, Bewick's swan *Cygnus columbianus bewickii,* whooper swan *Cygnus cygnus*, smew *Mergellus albellus*, hen harrier *Circus cyaneus*, merlin *Falco columbarius,* peregrine falcon *Falco peregrinus*, golden plover *Pluvialis apricaria*, ruff *Philomachus pugnax*, wood sandpiper *Tringa glareola*, short-eared

9 Qualifies under article 4.1 of the EC Birds Directive by supporting regularly occurring Annex 1 bird species in numbers of European importance

10 Qualifies under article 4.2 of the EC Birds Directive by supporting regularly occurring migratory species in numbers of European importance

11 Qualifies under article 4.2 of the EC Birds Directive by supporting an internationally important assemblage of waterbirds

owl *Asio flammeus* and kingfisher *Alcedo atthis*. However, they occur in numbers of less than European importance (i.e. less than 1% of the Great Britain population).

### 9.4.1 Key sub-features for the Annex I species

**Estuary channels (subtidal sediment communities and the water column) -** common terns, little terns and Sandwich terns all exploit the food resources provided within the estuary. The only breeding little tern colony in Wales is found at Gronant. The largest common tern colony in Wales is found at Shotton Lagoons and Reedbeds SSSI, just outside the European marine site. The estuary also provides a staging post for large numbers of Sandwich terns beginning their autumn migration.

All three species of terns feed on small fish including sprats *Sprattus sprattus* and sandeels *Ammodytes* spp. and the fry of other fish found in the water column, these are confined to the sub-tidal channels at low water. The tern species will also feed on small crustaceans, and marine worms (Kirby *et al.*, 2000). When the tide is in, terns fish right across the estuary including in waters covering the intertidal flats.

Common terns make regular feeding flights from their breeding site at Shotton Lagoons to feed within the estuary. They appear to utilise the whole estuary for feeding and can be seen off Hilbre Islands at the mouth of the estuary and within the canalised section of Dee, upstream from Connah's Quay.

**Intertidal mudflats and sandflats** – The Dee Estuary European marine site possesses an extensive area of intertidal mudflats and sandflats, supporting rich populations of intertidal invertebrate species. In turn these populations provide a crucial food source for many species of waterbirds including the Annex I species, bar-tailed godwit.

Numbers of bar-tailed godwit found feeding on the invertebrate populations of the Dee Estuary's intertidal mudflats are highly variable. At low water bar-tailed godwits occur almost exclusively on the outer estuary, which historically was a more favoured feeding area than is now the case, currently virtually the entire wintering population of bar-tailed godwit are believed to feed outside the Dee Estuary SPA at Mockbeggar Wharf within North Wirral Foreshore SSSI (Musgrove, in press). Mudflats off Mockbeggar Wharf support very high numbers of feeding bar-tailed godwit at low tide, averaging over 8,000 in winter 2001-2002 (Musgrove, in press) and they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA. Lower numbers of bar-tailed godwit do feed within the estuary SPA at low tide. Their numbers peak in January with smaller numbers present in December, February and March, very few occur outside this period (Percival & Percival, 1998).

Historically an area of upper shore at West Kirby has provided an important roosting site for bar-tailed godwit (C. Wells, RSPB Warden, *pers. comm.*). In the past much greater numbers of bar-tailed godwit roosted within the estuary than is now the case. More recently many birds have roosted either on the Alt Estuary or along North Wirral Foreshore and it is suspected that this change is due to disturbance of the West Kirby roost area. Birds may still make limited use of their historic roost site within the Dee Estuary SPA, for example roosting at night might still occur but this requires further investigation.

The beaches at Point of Ayr and Gronant are used as a roosting area by little terns, common terns and Sandwich terns, especially at high water (Nicholas Pearson Associates, 1993).

Terns also make use of the intertidal flats off West Kirby and Hoylake at this time (C. Wells, RSPB Warden, *pers. comm.*) Peak counts of Sandwich terns occur during their late summer/autumn passage in July and are regularly in excess of 1,000 birds (Musgrove *et al.*, 2001). Yet such counts give no idea of the turn over of individuals and the true number of birds visiting the area during each season may be substantially greater. Common terns make particular use of these roosting sites at the end of the breeding season, though it is possible that at this time the breeding population of common terns is augmented by birds from elsewhere beginning their autumn migration (Nicholas Pearson Associates, 1993).

**Saltmarsh Communities -** Bar-tailed godwit require unrestricted views when roosting, and in general will utilise areas of saltmarsh with short sward heights as a roost site. However although bar-tailed godwit may periodically roost in large numbers in areas of saltmarsh within the site no regular usage is recorded in recent years (C. Wells, RSPB Warden, pers. *comm*.).

Historically, until encouraged to use the Shotton Steelworks lagoons, common terns used to nest on Burton Marshes where they were generally unsuccessful because young and eggs were lost to tidal inundation. They now nest on specially developed habitats on Lagoons within the Shotton Steelworks complex outside of the European marine site but within the SPA.

**Shingle banks –** Since 1989 the little tern colony on a shingle ridge at Gronant has been the sole surviving breeding colony in Wales. The terns nest on a bare sand and shingle ridge above mean high water but below the level of the highest astronomical tide. Prior to moving to the shingle ridge at Gronant in the 1970's the little terns nested on the shingle bank at Point of Ayr where they suffered more frequent tidal inundation

Little terns prefer to nest in an area with little vegetation cover, generally less than 10%, so that they can see approaching predators (Kirby *et al*., 2000). The colony at Gronant has moved over time as the shingle ridges have developed and become vegetated. Active accretion of sand/shingle has meant that new breeding sites have become available as earlier nest sites have become vegetated and unusable.

### 9.5 Internationally important populations of regularly occurring migratory bird species

Migratory species that regularly occur at levels of 1% or more of the total biogeographical population meet the SPA criteria and qualify in their own right.

The Dee Estuary SPA supports internationally important numbers of a regularly occurring migratory species on passage:

- redshank *Tringa totanus*

It also supports internationally important numbers of regularly occurring migratory species over winter:

- shelduck *Tadorna tadorna*
- teal *Anas crecca*
- pintail *Anas acuta*

- oystercatcher *Haematopus ostralegus*
- grey plover *Pluvialis squatarola*
- knot *Calidris canutus islandica*
- dunlin *Calidris alpina alpina*
- black-tailed godwit *Limosa limosa islandica*
- curlew *Numenius arquata*
- redshank *Tringa totanus*

### 9.5.1 Key sub-features for the migratory bird species

***Estuary channels (Subtidal sediment communities and the water column)*** - Pintail make use of the upper estuary channel as a key low water loafing area when they are not feeding on the adjacent saltmarsh or intertidal flats. The main low water loafing area is to be found in the main estuary channel between Oakenholt and Bagillt (C. Wells, RSPB Warden, *pers. comm*.). At certain times nearly the entire Dee Estuary pintail population may utilise this area.

***Intertidal mudflats and sandflats*** - The extensive mudflats and sandflats of the Dee Estuary support rich populations of invertebrate species, which in turn provide an important food source for several species of migratory birds occurring in internationally important numbers. The intertidal flats of the Dee Estuary are among the three the most important areas in the UK for some species of wading birds including oystercatcher, black-tailed godwit, curlew, and redshank (Musgrove *et al*., 2001). These large aggregations of migratory waterbirds are generally highly mobile, feeding and roosting in different areas, depending on food availability and the state of the tide. Within an estuary individual wader species tend to aggregate where their favourite prey species are most common (Prater, 1981). In general, more sheltered areas with relatively high silt content such as Caldy Blacks, support a richer biomass than more exposed areas. The invertebrate community of the Dee Estuary's intertidal mudflats and sandflats includes key wader prey species such as mudsnails *Hydrobia ulvae*, cockles *Cerastoderma edule*, Baltic tellin *Macoma balthica,* polychaete worms such as ragworms *Hediste diversicolor* and lugworms *Arenicola marina* and crustaceans such as the amphipod *Corophium volutator*.

As well as feeding areas the intertidal mudflats and sandflats provide important low tide roosting sites for both wildfowl and waders. In addition the larger sand bars may be used as high water roosting areas on neap tides (Nicholas Pearson Associates, 1993).

Shelduck are dependant upon the rich resources of invertebrates found in the intertidal mudflats. Their common prey species include the mudsnail *Hydrobia* spp, and small crustaceans such as amphipods (Kirby *et al.*, 2000). Shelduck have a particular preference for feeding on areas with very high density of mudsnails in excess of 1,000 snails per square metre (Kirby *et al*., 2000). They are present on the estuary throughout the year but numbers increase rapidly in the autumn with peak counts occurring in October, numbers then decline gradually through the winter until February.

Shelduck feed in groups, on the flats of the mid to outer estuary. At low water the greatest numbers of duck are found feeding on the intertidal flats of Dawpool Bank and Gayton Sands, with peak densities at Caldy Blacks of over 8 birds per hectare in 2001-2002

(Musgrove, in press). Other important feeding areas are found on Mostyn Bank to the west. Shelduck also tend to congregate at the same locations over high water, usually spending their time loafing on the water at the saltmarsh edge. The interitdal flats of the Dee Estuary support the third largest wintering population of shelduck of all UK wetlands (Musgrove *et al.*, 2001).

In contrast to the wildfowl species most waders feed largely in the outer parts of the estuary at low water, as well as along the North Wirral Foreshore (Waters, *et al.*, 1998). They favour areas that have abundant invertebrate prey species and unrestricted views for the early detection of predators.

At low water the most important area for oystercatchers is the area of Caldy Blacks between Caldy and Thurstaston with average densities of over 40 birds per hectare recorded off Thurstaton in 2001-2002 (Musgrove, in press). Large numbers of oystercatchers are also recorded at low water on the intertidal flats of Salisbury Bank and Mostyn Bank in the outer estuary, Holywell Bank and Dawpool Bank in the mid estuary, and in the inner estuary along the Welsh shore (Musgrove, in press). The intertidal sediments of North Wirral Foreshore are also an important feeding area for the oystercatchers of the Dee Estuary, though this area lies outside of the Dee Estuary SPA. Oystercatcher preferred prey species include cockles and mussels between 15 and 35 mm in length as well as lugworms (Kirby, *et al.*, 2000).

Oystercatcher numbers increase substantially in August following the breeding season; peak numbers usually appear in October, there is then a gradual decline through till April (Percival & Percival, 1998). Over 42,500 oystercatchers were recorded on the Dee Estuary in 1981/2 (Wells & Friswell, 2001). However, between 1992/3 and 1999/2000 there was a gradual decline from 34,610 to 12,506. This trend was particularly marked between 1996 and 1999. The species has triggered a 50 % WeBS Alert over the 10-year period prior to 1999/2000 (Armitage, *et al.*, 2002.).

At low water the largest concentrations of grey plover occur on North Wirral Foreshore with smaller numbers occurring to the west of Hilbre Island (Musgrove, in press). Numbers of grey plover on the estuary begin to increase in the autumn reaching a peak over the winter period. Numbers usually peak in November to January, after which numbers decline as birds move from the estuary to breed. Plovers have the shortest bills of the estuarine waders and feed on a variety of invertebrates on or close to the surface of the sediment (Prater, 1981). Prey species include polychaete worms including ragworms and lugworms, small molluscs and crustaceans (Kirby *et al.*, 2000)

The largest concentrations of feeding knot also occur along North Wirral Foreshore at East Hoyle Bank and Mockbeggar Wharf where average bird densities of over 50 birds per hectare were recorded at low water during winter 2001-2002 (Musgrove, in press). Knot are also a feature of the Mersey Narrows and North Wirral Foreshore pSPA. Within the estuary very large numbers of knot also feed on the intertidal flats of Dawpool Bank and Caldy Blacks. Knot require an abundance of surface and sub-surface invertebrates including the molluscs: Baltic tellin, mussel spat *Mytilus edulis* and cockle spat, and mud snails (Kirby *et al.*, 2000). Numbers of knot normally peak very late in the year or early in the next. Knot abundance tends to fluctuate widely, for example during the 1990's the maximum number recorded in 1988-1999 was only 6,675 where as in 1996-1997 the maximum count was 58,376 (Wells & Friswell, 2000). In the past one of their principle roosts within the estuary was on the foreshore at West Kirby. Disturbance of this roost due to recreational activities and possibly

the extension of the marine lake has seen birds flighting from their low tide feeding areas within the Dee Estuary to the Alt Estuary over the high tide period. Higher counts at low water than high water suggest this continues to be the case (Wells & Friswell, 2001).

The very highest densities of dunlin are to be found along North Wirral Foreshore, though large numbers also feed at the mouth of the estuary, and on Dawpool Bank and in the mid estuary. Dunlin feed on a variety of surface and subsurface invertebrates present on the intertidal flats including ragworms, Baltic tellins, mud snails, brown shrimp *Crangon crangon*, and small shore crabs *Carcinus maenas* (Kirby *et al.*, 2000). Dunlin show a similar pattern to knot and grey plover increasing gradually from September to a mid winter peak in December and January and a gradual decline through to April.

At low water feeding black-tailed godwit concentrate in areas just of Heswall and Caldy in the mid estuary, and off Flint and Bagillt in the upper estuary (Musgrove, in press). Black-tailed godwit winter on the estuary in numbers of international importance and remain in numbers of national importance throughout the rest of the year. This indicates that non-breeding and immature birds are present throughout. The Dee is now the third most important site in UK for wintering black-tailed godwit (Musgrove *et al.*, 2001). The birds wintering on the estuary are from the Icelandic breeding population, which has been wintering in the British Isles in increasing numbers over the last forty years. Black-tailed godwit feed on molluscs including tellins, cockles and polychaete worms including ragworms (Kirby *et al.*, 2000). Peak over wintering numbers can occur in any month throughout the October to March period and numbers tend to remain at internationally important levels throughout the winter.

Curlew feed across the inner and middle estuary, densities are very low in the outer estuary with the exception of Mostyn Bank. Their favoured prey species include shore crab and ragworms (Kirby *et al.*, 2000). Curlew occur in the estuary throughout the year, their numbers increase rapidly in July post-breeding when adult birds return to the coast to moult, reaching a peak in the autumn, frequently in October. From January onwards populations tend to become smaller as birds disperse to return to their breeding grounds.

At low water dunlin, redshank and curlew are much more evenly distributed across the estuary than other wader species. Redshank feed right across the estuary, though the shores at Heswall, Flint, Dawpool Bank and Mockbeggar Wharf are of most importance. Interestingly, the very highest densities of redshank are found on the mudflats within the two redundant flushing lagoons at Point of Ayr and Bagillt (Musgrove, in press). Their preferred prey species include the amphipod crustaceans *Corophium* spp., mud snails, Baltic tellins and ragworms (Kirby *et al*, 2000). Redshank numbers peak on the estuary between August and October, though substantial numbers also stay throughout the winter (Percival & Percival, 1998).

***Saltmarsh Communities*** – The Dee Estuary supports about 7% of the total area of saltmarsh in the UK and contains what is probably the third largest single expanse of saltmarsh in Britain found between Heswall and Shotton (CCW, 2002; Dargie, 2001). The majority of the Dee saltmarsh has traditionally been grazed by stock at differing intensities, though the newer areas of marsh remain ungrazed. This management is designed to cater for the needs of internationally important regularly occurring migratory species both grazing wildfowl and roosting waders as well as regionally important breeding populations of redshank and skylark.

The Dee saltmarshes provide a rich feeding habitat for several species of migratory wildfowl and waders. Wildfowl species feed on a variety of soft leaved and seed bearing saltmarsh plants, as well as many invetebrate species in particular those of the saltmarsh creeks. Wading birds also feed on invertebrates associated with the saltmarsh vegetation as well as those present in the sediments of the pioneer marsh communities, creeks, pans and flashes, such as the mudsnail *Hydrobia ulvae*. The lower edge of the saltmarsh is a valuable feeding area for many species, especially where the larger creeks flow out across the mudflats.

At low water teal are found on the upper saltmarsh off Neston and Parkgate, as well as off Oakenholt and Flint (Musgrove, in press). They are again found in similar areas at highwater (Percival & Percival, 1998). Large flocks of teal are attracted to flashes in the grazed upper marsh (Wells & Gouldstone, 1999). Numbers of teal wintering on the estuary increase gradually between August and December, then declining from January to March (Percival & Percival, 1998). Teal feed on seed-bearing saltmarsh plants including glasswort and sea purslane (Kirby *et al*., 2000).

The Dee is the most important site for wintering pintail in the UK (Wells & Friswell, 2002). The nearby Mersey estuary is also an important site and birds are known to fly between the two estuaries. Pintail generally feed in shallow water close to the waters edge preferring the pioneer saltmarsh zone along the lower edge of the saltmarsh (Percival and Percival, 1998). As the tide comes in they move up the marsh with the advancing water being found on the mid to upper saltmarsh of Parkgate and Neston at high tide (Percival & Percival, 1998). Pintail feed on a variety of soft leaved saltmarsh plants as well as surface and near surface invertebrates in the low and pioneer saltmarsh, mud snails are among their preferred prey species (Kirby, *et al*., 2000). Pintail are virtually absent from the estuary during summer, their numbers increase rapidly following their arrival in September to a peak in October, numbers than remain high through to December decreasing in January and February (Percival & Percival, 1998).

According to Buxton (1978 In: Nicholas Pearson Associates, 1993) the majority of wintering Shelduck in the estuary tend not to roost over high water, but continue feeding along the saltmarsh between Neston and Heswall at the waters edge.

The saltmarshes have an important function providing a safe haven from the tides that flood the mudflats twice a day. Areas of low-growing vegetation less than 10 cm in height provide a suitable roosting habitat for many waders, which prefer to roost on areas of short vegetation ensuring good visibility (Kirby *et al*., 2000). The saltmarshes throughout the estuary provide an important communal roosting site for oystercatcher, grey plover, knot, dunlin, black-tailed godwit, curlew and redshank. In particular a series of wader roosting areas occur on the mid to upper saltmarsh in the inner estuary.

During spring tides important high tide roosts of oystercatcher occur on the saltmarsh at West Kirby, Gayton Sands, Burton Marsh and Oakenholt (Percival & Percival, 1998). Important roosts of knot, dunlin and grey plover also occur on the upper marsh in the inner estuary on Gayton Sands, Burton Marsh and Oakenholt (Wells & Gouldstone, 1999).

Wintering black-tailed godwit principally use a roost site at Oakenholt Marsh although flocks are occasionally found on the Wirral shoreline. They also make use of the RSPB reserve at Inner Marsh Farm outside the European marine site

Both curlew and redshank also roost in the upper marsh and have important roosts in the marsh off Heswall and further east, with birds being forced onto Burton Marsh on the highest tides (Nicholas Pearson Associates, 1993; Percival & Percival, 1998).

Ungrazed saltmarsh at Point of Ayr forms an important roost site for dunlin, curlew and redshank (Wells & Gouldstone, 1999).

***Shingle banks*** - Banks of shingle occur on the upper shore at Gronant and at Point of Ayr. The shingle spit at Point of Ayr is the largest single oystercatcher roost within the estuary (Percival & Percival, 1998). Other qualifying migratory species that make regular use of these areas as high tide roosts are dunlin and knot.

***Rocky shore*** - Areas of rocky shore on Hilbre Island and Little Eye provide important roosts for several species of wader including oystercatcher (Percival & Percival, 1998).

### 9.5.2 Internationally important assemblage of waterbirds

The Dee Estuary is one of the key estuaries in the UK for wintering waterbirds. In addition to supporting internationally important species populations, it also qualifies for its wintering waterbird assemblage, since it regularly supports over 20,000 birds (Musgrove *et al.,* 2001). The wintering waterbird assemblage, consisting of over 120,000 birds, includes all regularly occurring waterbirds. It is numerically dominated by wader species with over 84,000 waders regularly occurring compared to only about 26,000 wildfowl (C. Hall, Wildfowl and Wetlands Trust, *pers comm*.). Species present in nationally important numbers or species whose populations exceed 2,000 individuals between 1994/5 and 1998/9 include:

Great crested grebe *Podiceps cristatus*, cormorant *Phalacrocorax carbo*, shelduck, wigeon *Anas penelope*, teal, pintail, oystercatcher, grey plover, lapwing *Vanellus vanellus*, knot, sanderling *Calidris alba*, dunlin, black-tailed godwit, bar-tailed godwit, curlew and redshank.

### 9.5.3 Key sub-features for the waterbird assemblage

Since a number of species comprising the waterbird assemblage are qualifying species in their own right, their habitat requirements are described in sections 9.4 and 9.5 above. This section therefore mainly deals with the habitat requirements of the non-qualifying species which form part of the waterbird assemblage.

***Estuary Channels (Subtidal sediment communities and the water column)*** Wigeon winter on the Dee Estuary in numbers of international importance. Like pintail, wigeon also make use of the upper estuary channel between Oakenholt and Bagillt as a key low water loafing area (C. Wells, RSPB Warden, *pers. comm*.).

The Dee Estuary SPA supports nationally important numbers of both cormorant, and great crested grebe. Cormorants occur throughout the year with peaks in June and September, numbers of great crested grebes are highest in the autumn when birds moult on the estuary (Percival & Percival, 1998). Grebes in particular occur in the estuary channel at low water with the majority of birds to be found off Greenfield (Musgrove, in press). Cormorants and grebes feed on a variety of small fish of less than 21 and 25 cm in length respectively (Kirby *et al*, 2000). The subtidal channels act as a refuge for small fish species at low water. Relatively small numbers of fish eating ducks including goldeneye *Bucephala clangula*, and

red-brested merganser *Margus serrator* are also regularly recorded in the estuary. Scaup *Aythya marila* also occur in the outer channels.

Common scoter *Melanitta nigra* have been observed in significant numbers just outside the boundary of the SPA in the area of the dredged channel off Gronant with a maximum of 4,000 observed during low water counts in 2001-2002 (C. Wells, RSPB Warden, *pers. comm.*; Musgrove, in press).

***Intertidal mudflats and sandflats*** - The Dee Estuary supports massive populations of birds, supporting over 120,000 wintering waterbirds. The majority of the wintering waterbird assemblage is composed of wading birds from species of international importance, and the dependence of these birds upon the invertebrate communities of the intertidal mudflats and sandflats is described in detail earlier in this document (see Section 9.5.1). However a variety of other waterbirds regularly winter on the Dee Estuary in variable numbers and like the internationally important migratory species these birds are also generally dependent upon the intertidal invertebrate communities. Other species of waders contributing to the wintering waterbird assemblage include ringed plover *Charadrius hiaticula*, golden plover *Pluvialis apricaria*, lapwing, and sanderling.

Ringed plover winter on the estuary in small numbers with a five year peak mean of 177 individuals between 1994/5 and 1998/9 (C. Hall, Wildfowl and Wetlands Trust, *pers. comm.*). They favour the intertidal flats at the mouth of the estuary on Mostyn Bank, and to west of Hilbre Island. Higher concentrations are found outside the Dee Estuary SPA on North Wirral Foreshore (Musgrove, in press). Much higher numbers of ringed plover occur during the autumn passage period in August than winter on the estuary; in recent years passage number have exceed the criterion for national importance (Wells & Friswell, 2000).

With a 5 year mean peak count of approximately 8,000 birds, lapwing are the most numerous species wintering on the estuary not attaining sufficient numbers to meet the criteria for international importance, (Wells & Friswell, 2002). Lapwing make use of a variety of habitats across the estuary including the intertidal flats, saltmarsh and coastal fields. At low water an average of over 1,000 lapwings concentrate off Leasow Lighthouse on North Wirral Foreshore outside the Dee Estuary SPA, smaller numbers are to be found within the estuary on Dawpool Bank (Musgrove, in press).

Sanderling also favour the outer estuary with nationally important numbers feeding on the foreshore between Gronant and Talacre (Wells & Friswell, 2003); though larger numbers may occur on North Wirral Foreshore (Musgrove, in press).

At low water cormorants roost on the intertidal flats with the main aggregations occurring at Gronant, where numbers of national importance have been recorded, and in the inner estuary at Oakenholt (Bolas & Day, 1998; Musgrove, in press).

***Saltmarsh Communities*** - Large areas of saltmarsh occur throughout the Dee Estuary, providing important feeding and roosting habitats for many of the wildfowl and waders. In addition to the internationally important migratory species pintail and teal, the saltmarsh of the Dee Estuary also supports substantial numbers of other wildfowl including nationally important numbers of wigeon.

Wigeon particularly favour the saltmarsh of the inner estuary off Parkgate, Neston, Oakenholt and Flint (Musgrove, in press). They feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccinellia maritima* and glasswort *Salicornia* spp. (Kirby *et al*., 2000).

Mallard *Anas platyrhynchos* also overwinter on the estuary in substantial, though less than nationally significant numbers, feeding on the saltmarsh. Mallard exhibit a very similar distribution to teal with highest numbers recorded off Parkgate at low water (Musgrove, in press). They feed on seed-bearing plants present on the saltmarsh including glasswort, sea purslane *Atriplex portulacoides* and sea blite *Suaeda maritima*; they also feed on invertebrates present on the sediment of the lower marsh including mudsnails (Kirby *et al*., 2000).

As described in detail for the migratory species of international importance the upper saltmarsh provides a series of roosting sites used by a variety of wader species. The saltmarsh also provides important feeding areas for several species of waders. Large numbers of lapwing are found on Burton Marsh and the saltmarsh at Oakenholt at low water (Musgrove, in press). In addition snipe *Gallinago gallinago* overwinter on the saltmarsh within the Dee Estuary with Parkgate Marsh holding the major proportion of the estuary population. Counts are believed to be under-estimates of the true total however an average of 277 snipe were recorded over four low water WeBS counts in 2001-2002 (Wells & Friswell, 2002).

The saltmarsh provides a safe haven for the feeding waders and wildfowl from the tides that flood the mudflats twice a day, the extensive areas of marsh in the mid to upper estuary as especially important in this respect. Areas of upper saltmarsh make ideal highwater roost sites, although the actual levels of usage are affected by the degree of disturbance the birds experience. Waders in particular also require areas of very short vegetation to afford unrestricted views for the early detection of predators.

***Shingle banks*** **-** Banks of shingle occur on the upper shore at Gronant and at Point of Ayr. These shingle features are of particular importance for roosting sanderling in addition to the qualifying species (Bolas & Day, 1998). Other waders roosting in these areas at high tide include ringed plover (Gouldstone, 1994).

***Rocky shore communities*** **-** Although not a qualifying as regularly occurring migratory species in their own right turnstone *Arenaria interpres* occur in substantial numbers within the Dee Estuary SPA. They feed on areas of rocky shore including both the natural rocky shore communities to be found around Hilbre Island and on areas of cobbles, small boulders and artificial hard substrates found along the Welsh shore. Turnstone also roost on the upper shore in these areas, in particular on Hilbre Island and on the shore close to Warwick Chemicals at Mostyn. Turnstone are a feature of the adjacent Mersey Narrows and North Wirral Foreshore pSPA. Purple sandpiper *Calidris melanotos* is another regularly occurring species in the Dee Estuary that is dependant upon areas of rocky shore habitat feeding and roosting on the rocky shore at Hilbre Island (Nicholas Pearson Associates, 1993). Both turnstone and purple sandpiper feed on a variety of invertebrates amongst rotting algae including mussels, periwinkles *Littorina* spp., whelks *Nucella* spp and kelp-fly larvae (Kirby *et al*., 2000).

In recent years small numbers of light-bellied brent geese *Branta bernicla bernicla* have over-wintered on the Dee Estuary, they feed on green alga in the area of Hilbre Island (Wells & Friswell, 2002).

**Table 5. Information on populations of bird species qualifying under the Birds Directive using the Dee Estuary SPA at the time the pSPA citation was compiled**

**Internationally important populations of regularly occurring Annex I species.**

| Species | Population (5 yr peak mean)[12] | Importance | Period |
|---|---|---|---|
| Bar-tailed Godwit *Limosa lapponica* | 1,150 individuals - wintering | 2.2 % of GB population | 1994/5-1998/9 |
| Common Tern *Sterna hirundo* | 392 pairs – breeding (Five year mean) | 3.2 % of GB population | 1995-1999 |
| Little Tern *Sterna albifrons* | 69 pairs – breeding (Five year mean) | 2.9 % of GB population | 1994-1998 |
| Sandwich Tern *Sterna sandvicensis* | 957 individuals – autumn passage | 2.3 % of GB population | 1995-1999 |

**Internationally important populations of regularly occurring migratory bird species[13]**

| Species | Population (5 yr peak mean)[12] | Importance | Period |
|---|---|---|---|
| Redshank *Tringa totanus* | 8,795 individuals - passage | 5.9 % Eastern Atlantic | 1994/5 – 1998/9 |
| Shelduck *Tadorna tadorna* | 7,725 individuals - wintering | 2.6 % North-western Europe | 1994/5 – 1998/9 |
| Teal *Anas crecca* | 5,251 individuals – wintering | 1.3 % North-western Europe | 1994/5 – 1998/9 |
| Pintail *Anas acuta* | 5,407 individuals – wintering | 9.0 % North-western Europe | 1994/5 – 1998/9 |
| Oystercatcher *Haematopus ostralegus* | 22,677 individuals – wintering | 2.5 % Europe & North-western Africa (wintering) | 1994/5 – 1998/9 |
| Grey plover *Pluvialis squatarola* | 1,643 individuals - wintering | 1.1 % Eastern Atlantic | 1994/5 – 1998/9 |
| Knot *Calidris canutus islandica* | 12,394 individuals - wintering | 3.5 % North-eastern Canada / Greenland / Iceland / North-western Europe | 1994/5 – 1998/9 |
| Dunlin *Calidris alpina alpina* | 27,769 individuals - wintering | 2.0 % Northern Siberia / Europe / West Africa | 1994/5 – 1998/9 |
| Black-tailed Godwit *Limosa limosa islandica* | 1,747 individuals - wintering | 2.5 % Iceland (breeding) | 1994/5 – 1998/9 |
| Curlew *Numenius arquata* | 3,899 individuals - wintering | 1.1 % Europe (breeding) | 1994/5 – 1998/9 |
| Redshank *Tringa totanus* | 5,293 individuals - wintering | 3.5 % Eastern Atlantic (wintering) | 1994/5 – 1998/9 |

**Internationally important numbers of waterbirds**

| Importance | Population (5 yr peak mean)[12] | Season | Period |
|---|---|---|---|
| The Dee Estuary regularly supports over 20,000 waterbirds | 120,726 individuals | Wintering | 1994/5 – 1998/9 |

12 pSPA citation (December 2000).
13 The Dee Estuary is regularly used by 1% or more of the biogeographical population of a regularly occurring species (other than those listed on annex I) in any season (Cranswick *et al.*, 1995).

## Nationally important bird populations within the internationally important assemblage of waterbirds

| Species | Population (5 yr peak mean)[12] | Importance | Period |
|---|---|---|---|
| Great crested grebe* *Podiceps cristatus* | 195 individuals | 2.0 % of GB population | 1994/5 – 1998/9 |
| Cormorant *Phalacrocorax carbo* | 393 individuals | 3.0 % of GB population | 1994/5 – 1998/9 |
| Sanderling *Calidris alba* | 526 individuals | 2.3 % of GB population | 1994/5 – 1998/9 |

* Based on low water WeBS counts

# 10. The Dee Estuary SPA / pSPA conservation objectives

**Under Regulation 33(2)(a) of the Conservation (Natural Habitats &c.) Regulations 1994, English Nature and the Countryside Council for Wales have a duty to advise other relevant authorities as to the conservation objectives for the European marine site.**

The conservation objectives for the Dee Estuary SPA qualifying features are provided below and should be read in the context of other advice given in this package, particularly:

- the maps showing the extent of the supporting habitats provided in Appendix V;
- summary information on the interest of each of the features; and
- the favourable condition table, providing information on how to recognise favourable condition for the interest feature and which will act as a basis for the development of a monitoring programme.

All the conservation objectives are subject to review by English Nature and the Countryside Council of Wales.

### 10.1 Interest feature 1: Conservation objective for the internationally important population of the regularly occurring Annex I species: wintering bar-tailed godwit

**The conservation objective for the "wintering bar-tailed godwit" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering bar-tailed godwit**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering bar-tailed godwit population is no less than 1,150 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flat*s*[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the extent and spatial distribution[3] of vegetation less than 10cm in height across the saltmarsh[5] is maintained;

iv. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[6] and feeding areas;

v. aggregations of bar-tailed godwit roosting[6] or feeding or on the intertidal flats or saltmarsh[4] saltmarsh are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-6] above is provided in **Box 1**.

**NB.** Other conservation objectives are to be produced relating to the use of North Wirral Foreshore SSSI by bar-tailed godwits because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts the Dee Estuary SPA and forms part of the area of the Dee Estuary pSAC. North Wirral Foreshore includes the key feeding areas for the Dee Estuary bar-tailed godwit population and therefore the Dee Estuary bar-tailed godwit feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA bar-tailed godwit feature are also met in full.

**Box 1: Explanatory information for the "wintering bar-tailed godwit" conservation objective**

**[1] Natural processes**:

Each interest feature is subject to both natural processes and human influences. Human influence on the interest features is acceptable provided that it is compatible with the achievement of the conditions set out under the definition of favourable condition for each interest feature. A failure to meet these conditions which is entirely a result of natural processes will not constitute unfavourable condition, but will trigger a review of the definition of favourable condition. This qualification is necessary because:

(a) the bird populations themselves are subject to natural factors, many of which arise outside the SPA, such as breeding success and winter temperatures;

(b) the supporting habitats of the birds are influenced by the evolution of the estuary. Natural adjustments within estuaries can take many forms. One important example is the tendency of estuaries to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by subtidal and intertidal sediment banks or features. This, with other natural processes, will therefore cause the width and depth of the estuary to change over time, moving towards a state of dynamic equilibrium or 'most probable state'. As part of this process, the location and extent of saltmarshes and mudflats may change, provided there is capacity to accommodate readjustment. However, where this process is constrained, the capacity of habitats to accommodate readjustment may be affected.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices VI and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Saltmarsh extent and spatial distribution**:

Saltmarsh extent and distribution is shown in Appendix V

**[6] Bar-tail godwit roosting areas**:

Roosting sites regularly used by bar-tailed godwit are shown in Appendix VI

### 10.2 Interest feature 2: Conservation objective for the internationally important population of the regularly occurring Annex I species: breeding common tern

**The conservation objective for the "breeding common tern" feature of the Dee Estuary pSPA is to maintain the feature in a favourable condition, as defined below**:

The interest feature "**breeding common tern**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year mean population size for the breeding common tern population is no less than 392 breeding pairs [*i.e. the 5 year mean between 1995-1999*];

ii. the five year mean productivity of the breeding common tern population is no less than 1.34 chicks fledging per breeding pair per year [*i.e. the 5 year mean between 1995-1999*];

iii. the abundance of common tern prey species[2] within the estuary is maintained;

iv. common terns are able to pass freely between the Dee Estuary and their breeding site at Shotton Lagoons and Reedbeds without obstruction;

v. aggregations of common terns roosting[3] on the upper shore over high tide are not subject to significant disturbance;

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 2.**

**NB**. Additional conservation objectives are provided relating to the use by common terns of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the artificial islands used by the breeding colony at Shotton Lagoons and Reedbeds SSSI. Thus the Dee Estuary SPA breeding common tern feature can only be in favourable condition if the conservation objectives pertaining to their use of Shotton Lagoons are also met. These objectives (*a-b*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994.

a) the size of the breeding colony is not limited by availability of space on artificial nesting platforms;
b) breeding birds are not subject to significant disturbance.

**Box 2: Explanatory information for the "breeding common tern" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Common tern prey species**:

Common tern prey species include sand eel and sprat (Kirby *et al.*, 2000).

**[2] Common tern roosting areas**:

Areas frequently used by roosting common terns are shown in Appendix VII

### 10.3 Interest feature 3: Conservation objective for the internationally important population of the regularly occurring Annex I species: breeding little tern

**The conservation objective for the "breeding little tern" feature of the Dee Estuary pSPA is to maintain the feature in a favourable condition, as defined below**:

The interest feature "**breeding little tern**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year mean population size for the breeding little tern population is no less than 69 breeding pairs [*i.e. the 5 year mean between 1995-1999*];

ii. the five year mean productivity of the breeding little tern population is no less than 0.80 chicks fledging per breeding pair per year [*i.e. the 5 year mean between 1995-1999*];

iii. the breeding site[2] is not subject to significant disturbance;

iv. the extent of shingle habitat[3] at Gronant, which is suitable for nesting little terns is maintained;

v. aggregations of little terns roosting on the beach at Gronant or Point of Ayr over high tide are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 3**.

**Box 3: Explanatory information for the "breeding little tern" conservation objective**

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Little tern breeding site**:

The location of the little tern breeding site is shown in Appendix VII.

[3]. **Little tern nesting habitat**:

Little terns require shingle banks with vegetation cover of less than 10%, which are high enough on the shore to avoid regular inundation (Bolas & Day, 1998; Kirby *et al.* 2000).

### 10.4 Interest feature 4: Conservation objective for the internationally important population of the regularly occurring Annex I species: passage sandwich tern

**The conservation objective for the "passage sandwich tern"" feature of the Dee Estuary pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**passage sandwich tern**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year mean peak population size for the autumn passage sandwich tern population is no less than 957 individuals [*i.e. the 5 year mean peak between 1995-1999*];

ii. aggregations of Sandwich terns roosting[2] on the upper shore over high tide are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-2] above is provided in **Box 4**.

**Box 4: Explanatory information for the "passage Sandwich tern" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Sandwich tern roosting areas**:

Areas frequently used by roosting Sandwich terns are shown in Appendix VII

## 10.5 Interest feature 5: Conservation objective for the internationally important population of the regularly occurring migratory species: passage redshank

**The conservation objective for the "passage redshank" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below**:

The interest feature "**passage redshank**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met**:**

i. the 5 year peak mean population size for the passage redshank population is no less than 8,795 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the abundance and dispersion[5] of redshank prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] redshank are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 5**.

NB. Additional conservation objectives are provided relating to the use by redshank of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by redshank for feeding. Thus the Dee Estuary SPA passage redshank feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland with standing water including, pools, ditches and channels is maintained;
d) the abundance of redshank prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of redshank roosting or feeding on the coastal fields are not subject to significant disturbance.

Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by redshank because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts the Dee Estuary SPA and forms part of the area of the Dee Estuary pSAC. North Wirral Foreshore includes some of the key feeding areas for the Dee Estuary redshank population and therefore the Dee Estuary passage redshank feature can only be in favourable condition if the conservation objectives pertaining the Mersey Narrows and North Wirral Foreshore pSPA wintering redshank feature are also met in full.

**Box 5: Explanatory information for the "passage redshank" conservation objective**

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices VI and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Redshank prey species**:

Redshank prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp., tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Redshank roosting areas**:

Roosting sites regularly used by redshank are shown in Appendix VI.

[8] **Redshank feeding areas**:

Feeding areas regularly used by redshank are shown in Appendix VI.

## 10.6 Interest feature 6: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering shelduck

**The conservation objective for the "wintering shelduck" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering shelduck**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering shelduck population is no less than 7,725 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the abundance and dispersion[5] of shelduck prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

v. aggregations of loafing[7] or feeding[8] shelduck are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 6**.

**Box 6: Explanatory information for the "wintering shelduck" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices VI and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6] Shelduck prey species**:

Shelduck prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp. tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

**[7]. Shelduck loafing areas**:

Loafing areas regularly used by shelduck are shown in Appendix VIII.

**[8] Shelduck feeding areas**:

Feeding areas regularly used by shelduck are shown in Appendix VIII

## 10. 7 Interest feature 7: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering teal

**The conservation objective for the "wintering teal" feature of the Dee Estuary pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering teal**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering teal population is no less than 5,251 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the extent of saltmarsh[5] and the spatial distribution[3] of its constituent vegetation community types[6] is maintained;

iv. greater than 25% cover of seed bearing plants[7] is maintained during winter across the saltmarsh;

v. the extent of standing water pools or 'flashes' in the saltmarsh is maintained;

vi. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[8] and feeding areas[9];

vii. aggregations of loafing[8] or feeding[9] teal are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-9] above is provided in **Box 7.**

**NB**. Additional conservation objectives are provided relating to the use by teal of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields and pools along the Welsh shore within the Dee Estuary SSSI and at Inner Marsh Farm SSSI, which are used for loafing and feeding. Thus the Dee Estuary SPA wintering teal feature can only be in favourable condition if the conservation objectives pertaining to their use of these habitats are also met. These objectives (*a-d*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) aggregations of teal loafing or feeding on pools and coastal fields are not subject to significant disturbance.

**Box 7: Explanatory information for the "wintering teal" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Saltmarsh extent and spatial distribution:**

Saltmarsh extent and distribution is shown in Appendix V.

**[6] Saltmarsh community types**:

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

**[7] Seed bearing plants:**

Teal feed on seed-bearing saltmarsh plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. (Kirby *et al*., 2000).

**[8] Teal loafing areas:**

Loafing areas regularly used by teal are shown in Appendix VIII.

**[9] Teal feeding areas**:

Feeding areas regularly used by teal are shown in Appendix VIII.

## 10.8 Interest feature 8: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering pintail

**The conservation objective for the "wintering pintail" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering pintail**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering pintail population is no less than 5,407 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the extent of saltmarsh[5] and the spatial distribution[3] of its constituent vegetation community types[6] is maintained;

iv. the abundance and dispersion[7] of pintail prey species[8] is maintained at levels required to support the population size in (i);

v. greater than 25% cover of soft leaved herbs and grasses[9] is maintained during winter across the saltmarsh;

vi. existing unrestricted bird sightlines of at least 200m are maintained in every direction around loafing areas[10], and feeding areas[11];

vii. aggregations of loafing[10] or feeding[11] pintail are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-11] above is provided in **Box 8.**

**NB**. Additional conservation objectives are provided relating to the use by pintail of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields and pools at Inner Marsh Farm SSSI, which are used for loafing and feeding. Thus the Dee Estuary SPA wintering pintail feature can only be in favourable condition if the conservation objectives pertaining to their use of these habitats are also met. These objectives (*a-d*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) aggregations of pintail loafing or feeding on pools and coastal fields are not subject to significant disturbance.

**Box 8: Explanatory information for the "wintering pintail" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Saltmarsh extent and spatial distribution**:

Saltmarsh extent and distribution is shown in Appendix V.

**[6] Saltmarsh community types**:

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

**[7] Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

**[8] Pintail prey species**:

Pintail feed on surface and near surface invertebrates including mudsnails *Hydrobia* spp. (Kirby *et al.*, 2000).

**[9] Soft leaved herbs and grasses**:

Pintail feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccenellia maritima* and glasswort *Salicornia* spp. (Kirby *et al.*, 2000).

**[10] Pintail loafing areas:**

Low water loafing areas regularly used by pintail are shown in Appendix VIII

**[11] Pintail feeding areas:**

Feeding areas regularly used by pintail are shown in Appendix VIII.

## 10.9 Interest feature 9: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering oystercatcher

**The conservation objective for the "wintering oystercatcher" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below**:

The interest feature "**wintering oystercatcher**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering oystercatcher population is no less than 22,677 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of oystercatcher prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. the extent of rocky shore[7] at Hilbre Island, Middle Eye Little Eye and Tanskey rocks is maintained;

vi. the extent and height of the shingle spit[8] at Point of Ayr is maintained;

vii. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[9] and feeding areas[10];

viii. aggregations of roosting[9] or feeding[10] oystercatcher are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-10] above is provided in **Box 9.**

**NB**. Additional conservation objectives are provided relating to the use by oystercatcher of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by oystercatcher for feeding. Thus the Dee Estuary SPA wintering oystercatcher feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of oystercatcher prey species including earthworms and leatherjackets is maintained;

e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of oystercatcher roosting or feeding on the coastal fields are not subject to significant disturbance.

Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by oystercatcher because they are a feature of this SSSI, which directly abuts the Dee Estuary SPA and forms part of the area of both the Dee Estuary pSAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary oystercatcher population and therefore the Dee Estuary passage oystercatcher feature can only be in favourable condition if the conservation objectives pertaining to the North Wirral Foreshore SSSI oystercatcher feature are also met in full.

**Box 9: Explanatory information for the "wintering oystercatcher" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6] Oystercatcher prey species:**

Oystercatcher prey species include cockles *Cerastoderma edule* and mussels *Mytilis edulis* between 15 and 35 mm in length as well as lugworms *Arenicola marina* (Kirby *et al*, 2000).

[7] **Rocky shore extent:**

Rocky shore extent at Hilbre Island, Middle Eye Little Eye and Tanskey Rocks is shown in Appendix V.

[8] **Shingle ridge extent and height:**

The location of the shingle ridge at Point of Ayr is shown in Appendix V.

[9] **Oystercatcher roosting areas:**

Roosting sites regularly used by oystercatcher are shown in Appendix VI.

[10] **Oystercatcher feeding areas:**

Feeding areas regularly used by oystercatcher are shown in Appendix VI.

## 10.10 Interest feature 10: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering grey plover

**The conservation objective for the "wintering grey plover" feature of the Dee Estuary pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering grey plover**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering grey plover population is no less than 1,643 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of grey plover prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution of saltmarsh vegetation less than 10 cm in height is maintained

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] grey plover are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 10.**

**NB.** Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by grey plover because they are a feature of this SSSI, which directly abuts the Dee Estuary SPA and forms part of the area of both the Dee Estuary pSAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary grey plover population and therefore the Dee Estuary wintering grey plover feature can only be in favourable condition if the conservation objectives pertaining to the North Wirral Foreshore SSSI grey plover feature are also met in full.

**Box 10: Explanatory information for the "wintering grey plover" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

**[6] Grey plover prey species**:

Grey plover prey species include polychaete worms, small molluscs and crustaceans (Kirby *et al.*, 2000)

**[7] Grey plover roosting areas:**

Roosting sites regularly used by grey plover are shown in Appendix VI.

**[8] Grey plover feeding areas:**

Feeding areas regularly used by grey plover are shown in Appendix VI.

## 10.11 Interest feature 11: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering knot

**The conservation objective for the "wintering knot" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering knot**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering knot population is no less than 12,394 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of knot prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] knot are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 11.**

**NB.** Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by knot because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts the Dee Estuary SPA and forms part of the area of the Dee Estuary pSAC. North Wirral Foreshore includes the key feeding areas for the Dee Estuary knot population and therefore the Dee Estuary wintering knot feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA wintering knot feature are also met in full.

**Box 11: Explanatory information for the "wintering knot" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

**[6] Knot prey species:**

Knot prey species include the small molluscs, Baltic tellin *Macoma balthica*, mussel spat *Mytilus edulis* and cockle spat *Cerastoderma edule*, and mud snails *Hydrobia* spp. (Kirby *et al.*, 2000).

**[7] Knot roosting areas:**

Roosting sites regularly used by knot are shown in Appendix VI.

**[8] Knot feeding areas:**

Feeding areas regularly used by knot are shown in Appendix VI.

## 10.12 Interest feature 12: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering dunlin

**The conservation objective for the "wintering dunlin" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering dunlin**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering dunlin population is no less than 27,769 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. The abundance and dispersion[5] of dunlin prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] dunlin are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 12**.

**NB**. Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by dunlin because they are a feature of this SSSI, which directly abuts the Dee Estuary SPA and forms part of both the area of the Dee Estuary pSAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary dunlin population and therefore the Dee Estuary wintering dunlin feature can only be in favourable condition if the conservation objectives pertaining to the North Wirral Foreshore SSSI dunlin feature are also met in full.

**Box 12: Explanatory information for the "wintering dunlin" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

**[6] Dunlin prey species:**

Dunlin prey species include ragworms *Hediste diversicolor*, Baltic tellin *Macoma balthica*, mud snails *Hydrobia* spp., brown shrimp *Crangon crangon*, and small shore crabs *Carcinus maenas* (Kirby *et al.*, 2000).

**[7] Dunlin roosting areas**:

Roosting sites regularly used by dunlin are shown in Appendix VI

**[8] Dunlin feeding areas:**

Feeding areas regularly used by dunlin are shown in Appendix VI.

## 10.13 Interest feature 13: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering black-tailed godwit

**The conservation objective for the "wintering black-tailed godwit" feature of the Dee Estuary pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering black-tailed godwit**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering black-tailed godwit population is no less than 1,747 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. The abundance and dispersion[5] of black-tailed godwit prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] and feeding[8] black-tailed godwit are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 13.**

**NB**. Additional conservation objectives are provided relating to the use by black-tailed godwit of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI, and at Inner Marsh Farm SSSI, used by black-tailed godwit for feeding and roosting. Thus the Dee Estuary SPA wintering black-tailed godwit feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of black-tailed godwit prey species including earthworms, leatherjackets and chironomids is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;

f) aggregations of black-tailed godwit feeding or roosting on the coastal fields are not subject to significant disturbance.

**Box 13: Explanatory information for the "wintering black-tailed godwit" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6] Black-tailed godwit prey species:**

Black-tailed godwit prey species include Baltic tellins *Macoma balthica*, cockles *Cerastoderma edule* and polychaete worms including ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

**[7] Black-tailed godwit roosting areas:**

Roosting sites regularly used by black-tailed godwit are shown in Appendix VI.

**[8] Black-tailed godwit feeding areas:**

Feeding areas regularly used by black-tailed godwit are shown in Appendix VI.

## 10.14 Interest feature 14: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering curlew

**The conservation objective for the "wintering curlew" feature of the Dee Estuary pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering curlew**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering curlew population is no less than 3,899 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of curlew prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] curlew are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 14.**

**NB**. Additional conservation objectives are provided relating to the use by curlew of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI for feeding and roosting. Thus the Dee Estuary SPA wintering curlew feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of curlew prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of curlew feeding or roosting on the coastal fields are not subject to significant disturbance.

**Box 14: Explanatory information for the "wintering curlew" conservation objective**

**[1]. Natural processes:**

The meaning of 'natural processes' is explained in **Box 1.**

**[2]. Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4]. Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5]. Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6]. Curlew prey species:**

Curlew prey species include shore crab *Carcinus maenas* and polychaete worms including ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

**[7]. Curlew roosting areas:**

Roosting sites regularly used by curlew are shown in Appendix VI.

**[8]. Curlew feeding areas:**

Feeding areas regularly used by curlew are shown in Appendix VI.

## 10.15 Interest feature 15: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering redshank

**The conservation objective for the "wintering redshank" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering redshank**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering redshank population is no less than 5,293 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of redshank prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10 cm is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] redshank are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 15.**

**NB**. Additional conservation objectives are provided relating to the use by redshank of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by redshank for feeding. Thus the Dee Estuary SPA wintering redshank feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland with standing water including, pools, ditches and channels is maintained;
d) the abundance of redshank prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of redshank feeding or roosting on the coastal fields are not subject to significant disturbance.

Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by redshank because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts the Dee Estuary SPA and forms part of the area of the Dee Estuary pSAC. North Wirral Foreshore includes some of the key feeding areas for the Dee Estuary redshank population and therefore the Dee Estuary wintering redshank feature can only be in favourable condition if the conservation objectives pertaining the Mersey Narrows and North Wirral Foreshore pSPA wintering redshank feature are also met in full.

**Box 15: Explanatory information for the "wintering redshank" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6] Redshank prey species:**

Redshank prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp. tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

**[7] Redshank roosting areas:**

Roosting sites regularly used by redshank are shown in Appendix VI.

**[8] Redshank feeding areas:**

Feeding sites regularly used by redshank are shown in Appendix VI.

### 10.16 Interest feature 16: Conservation objective for the internationally important assemblage of regularly occurring waterbirds

**The conservation objective for the "internationally important assemblage of regularly occurring waterbirds" feature of the Dee Estuary SPA / pSPA is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**internationally important assemblage of regularly occurring waterbirds**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering waterbird assemblage is no less than 120,726 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the relative proportions[2] of waders and wildfowl comprising the wintering waterbird assemblage is maintained;

iii. the extent of intertidal flats[3] and the spatial distribution[4] of their constituent sediment community types[5] is maintained;

iv. the extent of saltmarsh[6] and the spatial distribution[4] of its constituent vegetation community types[7] is maintained;

v. the extent and spatial distribution[4] of saltmarsh vegetation less than 10 cm in height is maintained;

vi. the extent of rocky shore[8] at Hilbre Island, Middle Eye Little Eye and Tanskey rocks is maintained;

vii. the extent and height of the shingle spit[9] at Point of Ayr is maintained;

viii. The abundance of waterbird prey species[10] are maintained at levels sufficient to support the population size in (i);

ix. Greater than 25% cover of both seed bearing plants[11] and soft leaved herbs and grasses[12] is maintained during winter across the saltmarsh;

x. existing unrestricted bird sightlines of at least 200m are maintained in every direction around roosting sites[13], loafing[14] and feeding areas[15];

xi. aggregations of roosting[13], loafing[14] or feeding[15] waterbirds are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-15] above is provided in **Box 16.**

**NB**. Additional conservation objectives are provided relating to the use by waterbirds of areas of the Dee Estuary SPA / pSPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh

shore within the Dee Estuary SSSI, and at Inner Marsh Farm SSSI, used by waterbirds for feeding, roosting and loafing. Thus the Dee Estuary SPA internationally important assemblage of regularly occurring waterbirds feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of waterbird prey species including earthworms, leatherjackets and chironomids is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of waterbirds roosting, loafing or feeding on the coastal fields are not subject to significant disturbance.

**Box 16: Explanatory information for the "internationally important assemblage of regularly occurring waterbirds" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Relative proportions of waders wildfowl and other waterbirds**

Waders currently make up about 70% of the of the wintering waterbird assemblage, wildfowl comprise about 22% and other waterfowl the remaining 8%.

**[3] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[5] is shown in Appendices V and IV respectively.

**[4] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[5] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[6] Saltmarsh extent and spatial distribution:**

Saltmarsh extent and spatial distribution of community types is shown in Appendices V and IV respectively.

**[7] Saltmarsh vegetation community types:**

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

**[8] Rocky shore extent**:

Rocky shore extent and distribution is shown in Appendix V.

**[9] Shingle ridge extent and height:**

The location of the shingle ridge at Point of Ayr is shown in Appendix V.

**[10] Waterbirds prey species:**

Prey species favoured by the waterbirds of the Dee Estuary include the following:

Polychaete worms: rag worm *Hediste diversicolor*, lug worm *Arenicola marina*,
Molluscs: Mud snails *Hydrobia* spp., mussels *Mytilus edulis*, cockles *Cerastoderma edule*, Baltic tellins *Macoma balthica*;
Crustaceans: amphipods *Corophium spp*., shore crab *Carcinus maenas*, brown shrimp *Crangon crangon*;

**[11] Seed bearing plants**:

Wildfowl feed on seed-bearing saltmarsh plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. (Kirby *et al*., 2000).

**[12] Soft leaved herbs and grasses**:

Wildfowl feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccenellia maritima* and glasswort *Salicornia* spp. (Kirby *et al*., 2000).

**[13] Waterbird roosting areas:**

Roosting sites regularly used by waders, and other waterbirds are shown in Appendices VI and VIII

**[14] Waterbird loafing areas:**

Loafing areas regularly used by wildfowl are shown in Appendices VIII.

**[15] Waterbird feeding areas:**

Feeding areas regularly used by waders, wildfowl and other waterbirds are shown in Appendices VI and VIII.

# 11. Tables

### Table 6a. Favourable Condition Table for the SPA features' supporting habitats in the Dee Estuary European marine site

Numbers of bird species using these habitats are given in Table 5. Background information on the favourable condition table can be found in section 3.

**NB** – It will be possible to monitor many of the attributes at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline.

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important Annex 1 species**: bar-tailed godwit, common tern, little tern and Sandwich tern | Estuary channels (subtidal sediment communities and water column) | Food availability | Presence and abundance of small fish including sprats and sandeels, small crustaceans and marine worms measured periodically during the reporting cycle (frequency and methodology to be determined). | Abundance of small fish including sprats and sandeels, small crustaceans and marine worms should not decrease below an established baseline. Baseline to be established. | All three tern species feed within the estuary on small fish, crustaceans and marine worms. These prey species tend to be confined to the sub-tidal channels at low water. |
| | Intertidal mudflats and sandflats | Habitat extent | Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS. | No decrease in extent of intertidal mudflats and sandflats from an established baseline. | Together the CCW Intertidal Biotope Survey (Jones *et al*., 2002) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline.<br><br>Intertidal mud and sand flats support the invertebrate prey species of bar-tailed godwits, they also provide foraging areas for tern species when covered by the tide. |

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important Annex 1 species**: bar-tailed godwit, common tern, little tern and Sandwich tern | Intertidal mudflats and sandflats | Distribution of constituent communities | Spatial distribution of sediment community types measured along a series of fixed transects once during the reporting cycle using GPS (transect locations to be determined). | Spatial distribution of sediment community types should not deviate significantly from an established baseline. Baseline to be further established. | The CCW Intertidal Biotope Survey (Jones *et al*., 2002) provides a partial baseline<br><br>The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.<br><br>The distribution and extent of these broad community types provides a coarse measure of the ability of the estuary to provide habitat supporting the prey species of waders including bar-tailed godwit. Changes in the spatial distribution of these communities may provide an early indication of long-term changes in prey availability. |
| | Saltmarsh | Extent of roosting habitat | Total area (ha) of saltmarsh vegetation less than 10 cm in height measured once during the reporting cycle using a combination of remote sensing and ground truthing using GPS (frequency to be determined). | No decrease in total extent of roosting habitat from an established baseline. Baseline to be further established. | Saltmarsh provides an important roosting habitat for wintering bar-tailed godwit. Waders such as bar-tailed godwit prefer to use areas of short vegetation as roost sites as these provide them with unrestricted views.<br><br>Together the NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a partial baseline. The Environment Agency LIDAR survey of 2003 may provide more detailed information. |
| | | Spatial distribution of roosting habitat | Proportion of saltmarsh vegetation less than 10cm in height present on either shore in the outer, middle and inner estuary measured once during the reporting cycle using methodology given above. | Maintain the existing distribution of suitable roosting habitat in accordance with an established baseline. Baseline to be further established. | The location of suitable roosting habitat around the estuary is of importance in terms of bird's energy requirements. Specifically birds will use less energy and potential feeding time moving between feeding areas and roosting sites where these areas are further apart.<br><br>Baseline data is as described above. |
| | Shingle ridges | Extent of shingle banks with less than 10% vegetation cover and avoid regular inundation | Area (ha) of suitable habitat measured periodically during the reporting cycle (frequency to be determined). | At Gronant Dunes, no decrease in the extent of suitable habitat from an existing baseline. Baseline to be established. | Little terns require shingle banks with vegetation cover of less than 10%, which are high enough on the shore to avoid regular inundation (Bolas & Day, 1998; Kirby *et al*. 2000).<br><br>If these features are unable to keep pace with sea level rise inundation of nesting areas will become more frequent.<br><br>Together aerial photographs taken in 1999 by Liverpool Bay Coastal Group and the Environment Agency's LIDAR survey of 2003 may provide a baseline. |

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important populations of regularly occurring migratory species**<br><br>and<br><br>**Internationally important assemblage of waterbirds** | Intertidal mudflats and sandflats | Habitat extent | Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS. | No decrease in extent of intertidal flats from an existing baseline. | Together the CCW Intertidal Biotope Survey (Jones *et al*., 2002) provides and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline.<br><br>Intertidal mud and sand flats support the invertebrate prey species of bar-tailed godwits, they also provide foraging areas for tern species when covered by the tide. |
| | | Distribution of constituent communities | Spatial distribution of sediment community types measured along a series of fixed transects once during the reporting cycle using GPS (transect locations to be determined). | Spatial distribution of sediment community types should not deviate significantly from an existing baseline. Baseline to be further established. | The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.<br><br>The distribution and extent of these broad community types provides a coarse measure of the ability of the estuary to provide habitat supporting the prey species of both waders and wildfowl. Changes in the spatial distribution of these communities may provide an early indication of long-term changes in prey availability<br><br>The CCW Intertidal Biotope Survey (Jones *et al*., 2002) provides a partial baseline. |
| | | Prey abundance and dispersion | Presence and abundance of suitable prey species measured periodically at sampling sites across the estuary during the reporting cycle (sampling locations, methodology and frequency to be determined). | Presence and abundance of suitable prey species should not deviate significantly from an established baseline. Baseline to be established. | Invertebrate prey species favoured by the waders and wildfowl of the Dee Estuary include:<br><br>Polychaete worms: rag worm *Hediste diversicolor*, lug worm *Arenicola marina*; Molluscs: Mud snails *Hydrobia* spp., mussels *Mytilus edulis*, cockles *Cerastoderma edule*, Baltic tellins *Macoma balthica*; Crustaceans: amphipods *Corophium spp*., shore crab *Carcinus maenas*, brown shrimp *Crangon crangon*.<br><br>Monitoring of cockle stocks has been undertaken on an annual basis by the environment agency, e.g. Hazlewood (2002) and this data provides an interim baseline.<br><br>Ongoing research is being undertaken on behalf of The Countryside Council for Wales, English Nature and the Environment Agency by the Centre of Ecology and Hydrology to establish a target stock level sufficient to meet the food requirements of the bird populations using the Dee Estuary. |

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important populations of regularly occurring migratory species**<br><br>**and**<br><br>**Internationally important assemblage of waterbirds** | Saltmarsh | Habitat extent | Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS. | No decrease in extent of saltmarsh from an existing baseline | Together the NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. |
| | | Distribution of constituent communities | Spatial distribution of vegetation community types measured once during the reporting cycle (methodology to be determined). | Spatial distribution of vegetation community types should not deviate significantly from an existing baseline. Baseline to be further established. | Together the NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline.<br><br>Saltmarsh communities comprise four community types:<br><br>Pioneer saltmarsh (SM8, SM9)<br>Low to mid marsh communities (SM10, SM12, SM13, SM14)<br>Mid to upper marsh communities (SM16, SM18)<br>Transitional high marsh communities (SM24, SM28, MG11, MG13, S4, S21, S28).<br><br>The distribution and extent of these broad community types provides an estimate of the area of the marsh able to support different vegetation communities, which in turn provide food for wildfowl species. Changes in the spatial distribution of these communities may provide an early indication of long-term changes in the composition of the marsh and of its capacity to support species favoured by the wildfowl. |
| | | Extent of roosting habitat | Total area (ha) of saltmarsh vegetation less than 10 cm in height measured once during the reporting cycle using a combination of remote sensing and ground truthing using GPS (frequency to be determined). | No decrease in total extent of roosting habitat from an established baseline. Baseline to be further established. | Together the NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a partial baseline. An Environment Agency LIDAR survey in 2003 may provide more detailed information.<br><br>Saltmarsh provides an important roosting habitat for wintering waders. These species prefer to use areas of short vegetation as roost sites as these provide them with unrestricted views. |

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important populations of regularly occurring migratory species**<br><br>**and**<br><br>**Internationally important assemblage of waterbirds** | Saltmarsh | Spatial distribution of roosting habitat | Proportion of saltmarsh vegetation less than 10cm in height present on either shore in the outer, middle and inner estuary measured once during the reporting cycle using methodology given above. | Maintain the existing distribution of suitable roosting habitat in accordance with an established baseline. Baseline to be further established. | Baseline data is as described above.<br><br>The location of suitable roosting habitat around the estuary is of importance in terms of bird's energy requirements. Specifically birds will use less energy and potential feeding time moving between feeding areas and roosting sites where these areas are further apart. |
| | | Extent of standing water pools or 'flashes' | Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS. | No decrease in extent of standing water pools from an existing baseline | Together the CCW Intertidal Biotope Survey (Jones *et. al*., 2002) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline.<br><br>Standing water pools are important habitats for teal which loaf on the water and feed on adjacent vegetation. |
| | | Food plant abundance | Presence and abundance of suitable food plants measured periodically at sampling sites across the saltmarsh during the reporting cycle (sampling locations, methodology and frequency to be determined). | Presence and abundance of favoured food plants should not deviate significantly from an established baseline.<br><br>In addition during winter cover of both seed bearing plants and soft leaved herbs and grasses should each be maintained at least 25% averaged across the area of the marsh. | The NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 provides a baseline.<br><br>Food plants favoured by the wildfowl of the Dee Estuary include both:<br><br>a) Seed bearing plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp.<br><br>b) Soft leaved herbs and grasses including common saltmarsh grass *Puccinellia maritima* and glasswort *Salicornia* spp. |
| | Rocky shore | Habitat extent | Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS. | No decrease in extent of rocky shore at Hilbre Island, Middle Eye, Little Eye and Tanskey Rocks from an existing baseline | Aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline.<br><br>Rocky shore provides important roosting sites for several species of wader including oystercatchers |
| | Shingle Ridges | Habitat extent / height | Area (ha) of unvegetated shingle at Point of Ayr above 9.0m and 10.0m above chart datum using Lidar or traditional survey techniques combined with GPS | No decrease in extent of shingle habitat above 9.0m and 10.0m above chart datumn from an existing baseline | The shingle ridge at Point of Ayr is an important roost site for several species of migratory waders, in particular oystercatcher.<br><br>Roosting birds require sufficient area for roosting safe from tidal inundation and with sight lines not obscured by high vegetation. |

**NB**. Extreme events (such as storms reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Dee Estuary and may well **be missed by routine monitoring.**

## 11.1 Table 6b. Favourable Condition Table for the SPA features in the Dee Estuary European marine site

**NB** - Many of the attributes will be able to be monitored at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline.

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important Annex 1 species: bar-tailed godwit, common tern, little tern and Sandwich tern** | Across all sub-features | Population size | Rolling 5 year peak mean number of individuals derived on an annual basis from monthly WeBS counts and breeding tern surveys | Target number of Annex I bird species:<br><br>wintering bar-tailed godwit: 1,150 individuals;<br>breeding common tern: 392 breeding pairs;<br>breeding little tern: 69 breeding pairs;<br>passage Sandwich tern: 957 individuals.<br><br>[i.e. not less than the 5 year peak mean between 1994/5 and 1998/9] | Monthly WeBS counters carried out once a month on a high spring tide will provide this information together with additional surveys for breeding terns. The counts are undertaken by volunteers on behalf of the WeBS partners, which include English Nature and the Countryside Council for Wales.<br><br>Population size is a key attribute of the feature. Use of the five year peak mean as a measure of population size means that short-term fluctuations in population size are 'averaged out' and a measure of population over a five year is used. |
| | | Proportion of biogeographic population | Rolling five year mean proportion of relevant international biogeographic population using annual peak WeBS counts | Target percentage of biogeographic populations for Annex I bird species:<br><br>wintering bar-tailed godwit: 1.15%<br>breeding common tern: 0.13%<br>breeding little tern: 0.40%<br>passage Sandwich tern: 0.64% | WeBS counts together with the breeding tern survey provide this information.<br><br>Changes in the proportion of the biogeographic population can be used in conjunction to determine whether changes in the number of birds using the site may be attributable to 'external factors' affecting the size of the wider biogeographic population. |
| | | Productivity of breeding colonies | Rolling 5 year mean productivity derived annually using the number of chicks fledged within a colony per breeding pair. | Common terns 1.34 chicks per breeding pair.<br><br>Little terns 0.8 chicks per breeding pair<br><br>[i.e. not less than the 5 year mean between 1995 and 1999] | Productivity is perhaps the best indications of the current condition of a colony as it is likely to be more sensitive to changes in the habitat condition within the site than the number of pairs returning each year. Factors such as disturbance, food availability, and predation levels may affect productivity. |

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important Annex 1 species: bar-tailed godwit, common tern, little tern and Sandwich tern** | Across all sub-features | Distribution of individuals within the site | Number and location of WeBS sectors occupied at low tide measured using low water WeBS counts | No decrease in the number of sectors used by each species in significant numbers (5% of the five year mean peak) from an established baseline. | WeBS low tide counts in 2001/2 provide a baseline. Birds tend to use certain sectors to a greater or lesser degree from year to year however the failure of a particular species to use a sector previously favoured by a significant portion of the population could indicate a reduction in habitat quality. |
| | | Disturbance in feeding, and roosting areas | Reduction in bird numbers using the site or displacement of birds within the site measured using both low and high water WeBS counts | No significant reduction in numbers or displacement of birds attributable to disturbance from an established baseline. | Significant disturbance attributable to human activities can result in reduced food intake and/or increased energy expenditure. Five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.<br><br>Key roosting sites used by bar-tailed godwit and terns are shown in Appendices VI and VII respectively. |
| | | Disturbance at little tern breeding colony | Frequency of incidents of anthropogenic disturbance recorded daily during the breeding season | No increase in the frequency of disturbance incidents from an established baseline. | 24-hour wardening is in place at the little tern colony at Gronant throughout the majority of the breeding season. Wardens keep records of disturbance incidents, these records provide a baseline. |
| | | Unimpeded sightlines at feeding, breeding and roosting sites | Openness of terrain unrestricted by obstructions | No increase in obstructions to existing bird sightlines.<br>Areas of habitat with an effective field size of at least 10 ha. | Bar-tailed godwit require unrestricted views >200m to allow early detection of predators when feeding and roosting.<br><br>Little terns also benefit from unrestricted views at breeding sites. |
| | | Unimpeded access for common terns between feeding / roosting and breeding sites | Annual tern mortality from road deaths or collision with overhead power cables | No increase in tern mortality associated with traffic or power cables from an existing baseline. Baseline to be established. | Terns require unimpeded passage between the feeding and breeding sites to be able to make enough foraging journeys a day to provide sufficient food for their chicks. Any increase in mortality could result in a reduction in colony size and productivity.<br><br>Information in the 2002 BTO Study of the risk of collision with power lines by common terns and waterbirds at Shotton Steel Works (Balmer *et al*., 2002) may provide a partial baseline. |

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important populations of regularly occurring migratory species**<br><br>**and**<br><br>**Internationally important assemblage of waterbirds** | Across all sub-features | Population size | Rolling 5 year peak mean number of individuals derived on an annual basis from WeBS counts | No less than 120,726 individual waterbirds in the assemblage [i.e. the 5 year peak mean between 1994/5 and 1998/9]<br><br>Target number of Annex II bird species:<br><br>passage redshank: 8,795 individuals;<br>wintering shelduck: 7,725 individuals;<br>wintering teal: 5,251 individuals;<br>wintering pintail: 5,407 individuals;<br>wintering oystercatcher: 22,677 individuals;<br>wintering grey plover: 1,643 individuals;<br>wintering knot: 12,394 individuals;<br>wintering dunlin: 27,769 individuals;<br>wintering black tailed godwit: 1,747 individuals;<br>wintering curlew: 3,899 individuals;<br>wintering redshank: 5,293 individuals.<br><br>[i.e. the 5 year peak mean between 1994/5 and 1998/9]. | Monthly WeBS counts carried out once a month on a high spring tide will provide this information. The counts are undertaken by volunteers on behalf of the WeBS partners, which include English Nature and the Countryside Council for Wales.<br><br>Population size is a key attribute of the feature. Use of the five year peak mean as a measure of population size means that short-term fluctuations in population size are 'averaged out' and a measure of population over a five year is used. |

| Feature | Sub-feature | Attribute | Measure | Target | Comments |
|---|---|---|---|---|---|
| **Internationally important populations of regularly occurring migratory species**<br><br>**and**<br><br>**Internationally important assemblage of waterbirds** | Across all sub-features | Proportion of biogeographic population | Rolling five year mean proportion of relevant international biogeographic population using annual peak WeBS counts | Target percentage of biogeographic populations for Annex II bird species:<br><br>passage redshank: 5.9%<br>wintering shelduck: 2.6%<br>wintering teal: 1.3%<br>wintering pintail: 9.0%<br>wintering oystercatcher: 2.5%<br>wintering grey plover: 1.1%<br>wintering knot: 3.5%<br>wintering dunlin: 2.0%<br>wintering black tailed godwit: 2.5%<br>wintering curlew: 1.1%<br>wintering redshank: 3.5% | WeBS counts provide this information.<br><br>Changes in the proportion of the biogeographic population can be used in conjunction to determine whether changes in the number of birds using the site may be attributable to 'external factors' affecting the size of the wider biogeographic population. |
| | | Distribution of individuals within the site | Number and location of WeBS sectors occupied at low tide measured using low water WeBS counts | No decrease in the number of sectors used by each species in significant numbers (5% of the five year mean peak) from an established baseline. | WeBS low tide counts in 2001/2 provide a baseline. Birds tend to use certain sectors to a greater or lesser degree from year to year however the failure of a particular species to use a sector previously favoured by a significant portion of the population could indicate a reduction in habitat quality. |
| | | Disturbance to feeding, roosting and loafing areas | Reduction in bird numbers using the site or displacement of birds within the site measured using both low and high water WeBS counts | No significant reduction in numbers or displacement of birds attributable to disturbance from an established baseline. | Significant disturbance attributable to human activities can result in reduced food intake and/or increased energy expenditure. Five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.<br><br>Key roosting and loafing sites used by wader and wildfowl species are shown in Appendices VI and VIII. They include areas of estuary channels (used by pintail for loafing), intertidal flats, shingle banks, saltmarsh and rocky shore. |
| | | Unimpeded sightlines at feeding and roosting sites | Openness of terrain unrestricted by obstructions | No increase in obstructions to existing bird sightlines.<br><br>Areas of habitat with an effective field size of at least 10 ha. | Most waders require unrestricted views >200m and an effective field size of 10 ha to allow early detection of predators when feeding and roosting. |

**NB**. Extreme events (such as storms reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Dee Estuary and may well be missed by routine monitoring.

# 12. Detailed operations advice for the Dee Estuary SPA interest features

## 12.1 Background

This section provides information to help relate general advice to each of the specific interest features of the Special Protection Area.

This advice relates to the vulnerability of the SPA interest features to impacts upon their supporting habitats within the Dee Estuary European marine site as summarised in Table 1 and set out in more detail in Table 7. An explanation of the sensitivity of the interest features to impacts upon these habitats follows with an explanation of their exposure and therefore their vulnerability to damage or disturbance from the listed categories of operations. This enables links to be made between the categories of operation and the ecological requirements of the European marine site's interest features, as set out in Section 9.

The categories of operation may cause damage or disturbance to the interest features and sub-features of the Dee Estuary European marine site, either alone or in combination.

The Dee Estuary European marine site covers a large geographical area and this operations advice refers to the interest features across the estuary. Therefore, activities have been allocated an 'average' exposure score based on their occurrence within the estuary. The following text will reflect where activities only occur in a small area of the site but may be undertaken intensively or frequently. Also, there may often be a difference in the intensity of activities occurring in different parts of the site, especially on either shore of the estuary.

In order to simplify the assessment process the qualifying features are discussed using the three qualifying criteria: internationally important populations of regularly occurring Annex 1 species, internationally important populations of regularly occurring migratory species, and internationally important assemblage of waterbirds. Furthermore since the species comprising the internationally important populations of regularly occurring migratory species make up such a large proportion of the internationally important assemblage of waterbirds these two categories are also grouped together in the assessment.

## 12.2 Physical loss

The Dee Estuary SPA / pSPA provides important nesting, feeding and roosting habitats for **Annex 1 species**, and feeding and roosting habitat for **important migratory species** and species comprising the **waterbird assemblage**. The loss by removal or smothering of any of the supporting habitats, on which they depend, is likely to result in the loss of nesting and roosting sites and/or the reduction of food resources. It could also result in increased competition for food and space in areas that are already occupied, and ultimately reduce bird numbers on the estuary.

### 12.2.1 Physical loss by removal

Physical loss by removal may be caused directly by developments such as infrastructure construction and modification, coastal protection works, and land claim (See also section 8.2.1). In addition coastal developments and other anthropogenic activities may also cause

the indirect loss of estuarine habitats through the interruption of coastal processes such as sediment transport.

The **Annex I species**, **important migratory species** and species of the **waterbird assemblage** are all considered to be **highly sensitive** to removal of **any** of their **supporting habitats** due to the severity and often long term nature of such impacts.

Exposure to physical loss varies across the European site. The **Estuary channels** 'sub-feature' comprises the estuaries subtidal sediment communities as well as the water column that lies above. These channels are important as feeding areas for terns and other species comprising the waterbird assemblage, in addition they provide loafing areas for pintail. As described in section 8.2.1 the recent scale of dredging operations within estuary channels results in the subtidal sediment communities being highly exposed to removal. However with regard to the SPA features the **exposure** of the 'channels' including the water column is only considered to be **low** as even though the subtidal sediments will provide habitat for some fish and invertebrates most of the prey species which the terns and other waterbird feed on are likely to be carried into the estuary with the flooding tide.

The intertidal **mudflats and sandflats** of the estuary constitute the major feeding resource for virtually all of the wading birds present on the estuary including the Annex 1 species bar-tailed godwit. Taken as a whole the intertidal mudflat and sandflat communities are considered to have **medium exposure** to removal. This assessment is based upon the development pressures that still exist within the estuary together with the ongoing accretion of saltmarsh within the estuary, which will be reducing the area of intertidal mud communities (See also section 8.2.1).

**Saltmarsh communities** provide important high tide roosting sites for waders and key feeding areas for wildfowl species. Across the estuary the **exposure** of these roosting and feeding areas to removal is considered to be **low**, although the rapid erosion of saltmarsh along much of the Welsh shore may be having localised effects.

The **unvegetated shingle ridge** at Gronant provides nesting habitat for the Annex 1 species, little tern. The shingle ridge which forms the spit at the Point of Ayr is one of the key roost sites for wading birds within the estuary, in particular oystercatcher. The spit at Point of Ayr is a dynamic feature that depends upon a supply of shingle to prevent its erosion. The shingle ridge at Gronant is one of a series of such features that are evident at the site. Over time the ridges become vegetated and unsuitable for nesting, thus the long-term future of the colony at the site is likely to be dependant upon the continued creation of new shingle features. While neither area of shingle is considered to be exposed to physical loss through direct land take both are considered to have **medium exposure** due to the potential for removal resulting from interruption of their sediment supply. This interruption may stem from a combination of the presence of coastal defences to the west of Prestatyn along the North Wales coastline, which starve the beaches of sediment supply; the presence of groynes to trap sediment along particular stretches of coastal frontage preventing the prevailing long shore drift; and changes to the hydrodynamic regime associated with dredging of the main channel that lies off Point of Ayr and Gronant.

The **rocky shore communities** around the Hilbre Islands, which are used as roosting sites by migratory wading birds, are considered to have only **low exposure** to removal. This

exposure derives primarily from the ongoing erosion, in particular of Little Eye rather than any anthropogenic impact.

Thus the **Annex 1 species, important migratory species** and those belonging to the **waterbird assemblage** are considered **highly vulnerable** to removal of **intertidal mudflats and sandflats** and **shingle ridges**, whereas they are **moderately vulnerable** to removal of **estuary channels** and **saltmarsh communities**. The **migratory species** and **waterbird assemblage** are **moderately vulnerable** to the removal **of rocky shore**.

### 12.2.2 Physical loss by smothering

Physical loss by smothering occurs where accretion occurs so rapidly that the nature of the surface substrate is changed. Alternatively the nature of the 'smothering material' may be the same as the existing substrate yet the rate of deposition is such that the existing community is unable to maintain a presence at the surface. Smothering may be caused either directly, e.g. by deposition of dredged spoil or indirectly by the modification of coastal processes (see also section 8.2.2).

**Annex I species** are considered **highly sensitive** to the **smothering of the shingle ridge** at Gronant as this could result in the loss of eggs or chicks if it occurred during the breeding season. **Annex I species, important migratory species and species of the waterbird assemblage** are all considered to be **moderately sensitive** to smothering of **all other supporting habitats.** Sensitivity to smothering is less than for removal due to the generally greater potential for eventual recovery (See also section 8.2.2).

The exposure of subtidal sediment communities within the estuary is considered to be high due to disposal of dredged sediment within Mostyn Deep, yet the **exposure** to the **estuary channels** sub-feature is considered to be **low** due to the limited impact of smothering upon the aspects of the sub-feature which support the bird features, in particular the presence of small fish in the water column.

The **intertidal mudflats and sandflats**, **saltmarsh communities, shingle ridges and rockyshore communities** are all considered to have a **low exposure** to smothering.

Thus the **Annex 1 species** are considered to be **moderately vulnerable** to the **smothering** of the **shingle ridge** at **Gronant** due to their high sensitivity; while they and the **important migratory species** and species of the **waterbird assemblage** are all considered to have **low vulnerability** to the smothering of **all other sub-features**.

## 12.3 Physical damage

Physical damage can alter habitat structure and lead to a change in species composition. It may result from a range of activities causing either siltation, abrasion or selective extraction. These categories of impact are likely to affect the bird species of the European marine site through the loss of the habitat, or through the loss of prey species. Physical damage to intertidal habitats may ultimately lead to sediment destabilisation and increased erosion, and reduce the suitability of the area as feeding, roosting or breeding habitat.

### 12.3.1 Physical damage by siltation

Silt in the water column can smother or block the feeding and respiratory organs of marine invertebrates living within the substrate. It can also affect recruitment processes and reduce light penetration in the water column. Thus siltation may have the capacity to reduce prey availability or alter community composition in estuarine communities. Despite these potential problems, estuarine communities are highly adapted to siltation, rocky shore communities are the main exception to this rule. Siltation may also have an adverse effect on some birds through increased turbidity levels (see also section 12.6.4)

**Both** Annex 1 species**,** important migratory species **and species of the** waterbird assemblage **are considered to have only** low sensitivity **to siltation of** estuary channels**,** intertidal mudflats and sandflats **and** saltmarsh communities **due to their adaptations to siltation. These species are also considered to have** no sensitivity **to siltation of the** unvegetated shingle ridges**, which do not support significant invertebrate food resources. However the** important migratory species **and species of the** waterbird assemblage **are considered** moderately sensitive **to siltation of the** rockyshore communities **around Hilbre Island which provide limited food resources for species such as oystercatcher, turnstone and purple sandpiper.**

Exposure to siltation varies across the site with the main factor being proximity to any dredging operations in the estuary channels. Thus the **estuary channels** are considered to have a **high exposure to siltation,** the **intertidal mudflats and sandflats** which lie adjacent to the dredged channel have **medium exposure** while the **saltmarsh, rockyshore communities and shingle ridges** have **low exposure.**

**Thus the** Annex 1 species, important migratory species **and species of the** waterbird assemblage **are only considered** moderately vulnerable **to siltation relating to their use of the** estuary channels**, their** vulnerability **to siltation in respect of** other habitats **being** low or none

### 12.3.2 Physical damage by abrasion

Activities that cause direct scouring or abrasion to estuarine habitats may kill or harm particular species of animals and plants, altering community structure particularly within rockyshore or sediment communities. Abrasion may also cause indirect effects on communities by altering the nature of the substrate, e.g. by causing erosion of a finer sediments.

Both Annex 1 species, important migratory species and species of the waterbird assemblage are considered to have low sensitivity to abrasion of the estuary channels since the terns and other waterbirds feeding in the channels are believed to depend mainly on fish species carried in by the tide rather that those associated with the subtidal sediment communities.

All three groups of species (Annex 1 species, important migratory species and species of the waterbird assemblage) **are considered to be** moderately sensitive **to abrasion of** intertidal mudflats and sandflats **and** saltmarsh**,** migratory species **and those of the** waterbird assemblage **are also** moderately sensitive **to abrasion of the** rockyshore**.**

Abrasion of the intertidal flats may harm invertebrate communities which waders and wildfowl feed on, animals living close to the surface such as cockles are especially vulnerable. Similarly abrasion of saltmarshes could harm the food plants of wildfowl species including teal and pintail, rocky shore communities are also susceptible, simply trampling can create gaps in communities allowing new species to settle, possible at the expense of prey species such as mussels.

The Annex 1 species, in particular little terns differ in their sensitivity to abrasion of the shingle ridges from the migratory species and those of the waterbird assemblage since the little terns use the shingle ridge at Gronant as a nesting area while wading species use the shingle ridges simply as a high water roost site. Clearly ground nesting birds should be regarded as highly sensitive to abrasion of the substrate.

Although the subtidal sediment communities experience medium exposure to abrasion arising from both dredging and fishing activities, the exposure of the wider estuary channels feature is considered to be low (see also section 8.3.2). The intertidal mudflats and sandflats are considered to have a high exposure to abrasion primarily due to the current scale of the cockle fishery, which employs very large numbers of people using hand rakes. As well as the gathering of mature cockles the abrasion caused by raking may damage smaller immature cockles and other invertebrates as well as displacing them from the beds (See also section 8.3.2). Bait digging for lugworms also occurs within the area although this tends to concentrate outside of the pSPA along North Wirral Foreshore. Abrasion of upper shore sediment communities may also result from recreational activities including walking and horse riding as well as sand yachting and motorcycling.

The overall exposure of saltmarsh communities within the estuary is considered to be low, although significant abrasion does occur at localised points where motorcycle scrambling occurs on the upper marsh, this activity is most prevalent along the Welsh shore at Walwen and Bagillt.

The area of the shingle ridge used by the little tern colony at Gronant is fenced off and wardening takes place during the breeding season thus while the potential for abrasion from recreational activity in the area is high the measures in place ensure that actual exposure is low. In contrast the shingle spit at Point of Ayr experiences a high level of abrasion arising from recreational activity. The spit is very close to the main access point at Talacre and is a favoured site for walking and beach recreation. Quad biking is also known to occur along this spit.

The rockyshore communities around Hilbre Island are considered to experience only low exposure to abrasion due to visitors on foot.

**Thus** Annex 1 species, important migratory species **and species of the** waterbird assemblage **are all considered** highly vulnerable **to abrasion of the** intertidal mudflats and sandflats**. Similarly** all groups **are considered** moderately vulnerable **to the abrasion of** shingle ridges**, though as a result of different combinations of sensitivity and exposure. Vulnerability to abrasion of** all other habitats **is** low **for all species**

### 12.3.3 Physical damage by selective extraction

Selective extraction is the removal of a particular type of substrate from within a habitat or community, for example the removal of large pebbles from the shingle ridges. More indiscriminate removal of habitat falls under physical loss by removal. Selective extraction has the potential to cause similar affects to abrasion, causing direct harm to prey species or changing substrate composition thereby reducing its capacity to support such species.

Sensitivity of the **all** the **SPA species** is **moderate** with respect to **all habitats** with two **exceptions** with **high** sensitivity: **Annex 1 species**, in particular breeding little terns, to selective extraction of **shingle ridges**; and the sensitivity of **migratory species** especially oystercatcher and of species comprising the **waterbird assemblage** including turnstone to selective extraction affecting **rocky shore communities**. The little terns are considered highly sensitive to changes is the composition of their shingle ridge as this may reduce its suitability as nesting habitat, e.g. by affecting nest camouflage. Prey species of rocky shore are considered highly sensitive due to their dependence upon a fixed substrate.

**Exposure** to selective extraction is considered to be **low** for **all habitats** within the site. As a consequence **Annex 1 species** are only considered **moderately vulnerable** to the selective extraction of **shingle,** while **important migratory species** and **species of the waterbird assemblage** are **moderately vulnerable** to selective extraction of **rocky shore communities,** both due to their elevated sensitivity.

### 12.4 Non-physical disturbance

Birds may be disturbed by both noise and visual cues. Industry, transport and recreational activities may all result in both forms of disturbance. Disturbance may have the effect of displacing birds from feeding, roosting or breeding areas. The most disturbing human activities are those that cause fast or unpredictable movements, or loud and unexpected noises. Species will vary in their susceptibility to different types of disturbance and responses will vary according to the time of year and the intensity of the activity.

Nesting birds are highly sensitive to noise and visual disturbance as this will cause them to expend energy at a time when they require more energy to breed and forage for food.

Feeding birds will tend to concentrate where food is plentiful. Disturbance in these areas can prevent birds from feeding and effectively cause a loss of available habitat. In response to disturbance, birds either decrease their energy intake at their present (disturbed) feeding site through displacement activity, or they will move to an alternative, less favoured site, or one which is already occupied. This increases competition, with a larger number of birds dependent on one particular area. Such a response affects energy budgets and thus survival, and will be of particular concern during prolonged periods of cold weather, when energy requirements are increased and during severe conditions when intertidal flats can freeze. In addition, waders find it difficult to obtain sufficient food in mid to late winter as energy reserves and food resources are at their lowest and foraging for food can be difficult. The response of birds to disturbing events depends on a wide range of factors. These include the level of disturbance, reactions of other birds nearby, flock size and knowledge from earlier experiences (e.g. habituation). Additional factors determine either their willingness to remain in the same place (scarcity of food, adverse weather, physiological condition of individual

birds) or their motivation to leave for another place (daily and annual patterns of movement, related to time of year and tidal level, or the presence of alternative sites).

### 12.4.1 Non-physical disturbance caused by noise

Due to the serious nature of the potential effects of disturbance at feeding, roosting, loafing or breeding sites **all SPA species** are considered to be **highly sensitive** to noise occurring on all of their supporting habitats.

**Exposure** to noise is considered to be generally **low** in the vicinity of the **estuary channels** with the noise that does occur primarily resulting from boat traffic, including traffic associated with Port of Mostyn, leisure craft and to a lesser degree fishing boats.

Noise levels across the **intertidal mud and sand flats** are also predominantly low, though they may be high near favoured sites for beach recreation at the top of the shore, particularly at Gronant, Talacre, West Kirby and Thurstaston. At present high levels of noise disturbance are also associated with the cockle fishery, however the overall **exposure** is still considered to be **low**.

Birds utilising areas of **saltmarsh** within the estuary are considered to have a **medium exposure** to disturbance. As with the intertidal mud and sand flats much disturbance is associated with recreational activities occurring towards the top of the marsh, including dog walking, fishing, motorcycle scrambling and the flying of model aircraft. These forms of recreational disturbance are most frequent along the Welsh shore especially at Point of Ayr and Bagillt. Disturbance on the upper marsh can often occur in close proximity to important high tide roost sites. The main Crew to Holyhead railway line passes very close to the upper marsh along much of the Welsh shore and is a cause of quite frequent disturbance.

Wildfowling also occurs within the estuary, though the area affected is much restricted compared to its former extent, with much of the saltmarsh effectively forming a shooting sanctuary area. Shooting currently occurs predominantly over areas of marsh at the head of the estuary, as well as off Heswall, and to a lesser degree along the Welsh shoreline at Oakenholt, Flint and Mostyn. Wildfowling causes disturbance to both quarry species and non-target waterbirds over the areas shot.

The breeding colony of **Annex 1 species** little terns experience **medium exposure** to noise disturbance at the shingle ridge at Gronant, this results mainly from recreation in the nearby dunes and along the beach. The **internationally important migratory species** utilising the roost site on the shingle spit at Point of Ayr also experience **medium** noise **exposure** again resulting from recreational activities.

Birds using **rocky shore** of the Hilbre Islands generally experience **low exposure** to noise disturbance, this generally results from recreational usage when people visit the islands over low tide.

Thus **all bird species** are considered to be **highly vulnerable** to noise disturbance on the estuary's **saltmarsh** and **shingle ridges** and **moderately vulnerable** in other habitats.

### 12.4.2 Non-physical disturbance caused by visual cues

As for noise disturbance due to the serious nature of the potential effects of disturbance at feeding, roosting, loafing or breeding sites **all SPA species** are considered to be **highly sensitive** to visual disturbance affecting **all** of their **supporting habitats.**

**Exposure** to disturbance due to visual presence is considered to be **medium** for the **estuary channels**, this disturbance results from similar causes as the noise disturbance experienced, however the sheer size of some of the boats using the channel, particularly those related to wind farm construction, means that the level of exposure is considered to be greater than for noise disturbance.

Visual disturbance is considered to be generally **low** across the **intertidal flats**. Yet significant disturbance does occur in some areas as a result of recreational usage, especially of the upper shore. Water sports at West Kirby are a particular cause for concern for migratory species including redshank roosting on the upper shore (Smith, 2003). Other disturbance to the intertidal flats may result from boat traffic along the estuary channels and also planes and other aircraft passing over the site.

Visual disturbance to the **Annex 1 little terns** is considered to be **medium** at their breeding site on the **shingle ridge** at Gronant caused by the same recreational activity as the noise disturbance. However for the **migratory species** using the roosting site on the **shingle spit** at Point of Ayr exposure to visual disturbance is considered to be **high**. At weekends it is not unusual to see several people in succession, often with dogs, disturbing high tide roosts of oystercatcher and dunlin.

There is evidence to suggest that the relatively recent introduction of kite surfing at West Kirby, together with ongoing windsurfing, may be causing significant disturbance to oystercatcher utilising Little Eye as a high water roost site (Smith, 2003). As a result the **migratory species** utilising the **rocky shore** of the Hilbre Islands are considered to have a **high exposure** to visual disturbance.

Thus **all SPA features** are considered to be **highly vulnerable** to visual disturbance affecting the **estuary channels** and **unvegetated shingle ridges**; they are **moderately vulnerable** to visual disturbance affecting the **intertidal flats** and **saltmarsh**. The **important migratory species** and species comprising the **waterbird assemblage** are considered to be **highly vulnerable** to visual disturbance affecting the **rocky shore** of the Hilbre Islands.

### 12.5 Toxic contamination

Toxic contamination may reach the European marine site from both marine and terrestrial sources, and by a variety of pathways including tidal currents, river flow, terrestrial run-off and atmospheric deposition (see section 8.5). Toxic contaminants can be categorised as synthetic compounds, non-synthetic compounds or radionuclides. Their potential effects vary according to the state and availability of the compound and the characteristics of the receiving environment.

Birds are subject to the accumulation of toxic contaminants through the food chain, or through direct contact while feeding. Bird populations may also be affected due to contaminants affecting the abundance of their prey items. Pollution-tolerant prey species

may become dominant within contaminated communities, reducing species richness. Birds that are specialist feeders may be affected by the loss of a particular prey species, whilst generalist species may benefit from an abundance of opportunistic prey species. In addition contamination can affect the palatability of prey items, thus affecting the birds opportunity to feed normally.

Thus the two most likely ways in which the SPA bird species are likely to be affected by toxic contamination are ingesting contaminates with their food or indirectly due to reductions in food availability. As a result of this the sensitivity of the SPA features to the toxic contamination of their supporting habitats will be dependant upon their mode of usage by the birds. In general birds are likely to have higher sensitivity to toxic contamination of their feeding habitats than their roosting habitats.

### 12.5.1 Toxic contamination by synthetic toxic compounds

Many synthetic compounds, such as PCBs are known to have toxic effects even in low concentrations, and are capable of high levels of bioaccumulation within many benthic organisms. Such compounds may then biomagnify as they are transmitted up the food chain, potentially having an adverse effect on bird species. Marine invertebrate groups such as molluscs and polychaete worms, which include the preferred prey species of many of the wintering waterbirds, are known to bioaccumulate toxic substances such as heavy metals within their bodies (Cole *et al.*, 1999). Habitats such as saltmarshes can bioaccumulate toxic compounds and acting as sinks areas (Holt *et al.*, 1995). This could have implications for the wildfowl, such as teal and pintail that feed on the saltmarsh plants and seeds.

Bird's sensitivity to synthetic toxic contamination is considered to be high with regard to their feeding habitats due to the serious effects of many synthetic toxic compounds and their tendency to bioaccumulate. Thus both the **Annex 1 species**, **important migratory species** and species of the **waterbird assemblage** are considered **highly sensitive** to synthetic toxins affecting the **estuary channels** and the **intertidal mudflats and sand flats**. The **migratory species** and **waterbird assemblage** are also highly sensitive to such contamination of **saltmarsh communities** and **rocky shore communities**.

As discussed in section 8.5.1 due to the dynamic nature of the Dee's estuarine environment with tidal mixing and resuspension of sediment pollutants are readily circulated once entering the estuary. Thus the levels of exposure of all intertidal habitats will be reasonably similar; with the possible exception of those habitats located in higher energy environment of the outer estuary, and those in the upper reaches of the intertidal zone, which experience less frequent periods of inundation and consequently less exposure to contaminants carried in the water column. Based on this view of the estuary, the wide geographical distribution of potential sources of contaminants and the absence of more precise information, it was determined that there should be an assessment of **medium exposure** to **synthetic toxic contamination** for **all the supporting habitats** with the exception of the rarely inundated **shingle ridges**.

The **Annex 1 species**, **important migratory species** and species of the **waterbird assemblage** are all considered **highly vulnerable** to the affects of synthetic contaminants on the **estuary channels**, and **intertidel mudflats and sandflats**, and the migratory species and those of the waterbird assemblage are also considered highly vulnerable to affects on **saltmarsh communities** and **rocky shore communities**.

### 12.5.2 Toxic contamination by non-synthetic toxic compounds

Non-synthetic compounds may naturally be present at very low levels in the environment, but many become toxic at elevated concentrations. They include many hydrocarbons, as well as heavy metals.

Large oil spills affecting marine habitats can have a detrimental effect on bird populations. Different oils vary in their toxicities, and their effects are dependent upon exact conditions and duration of exposure. Oil spills within the estuary would render food sources unpalatable and birds alighting could become oiled and contaminated. Oil can cause physical damage to plumage and be ingested by the bird as it tries to preen. Oil affects the waterproofing of the bird's feathers by causing them to stick together. This results in waterlogging and the bird may die from hypothermia. Oil on the surface of the water column would present a threat to diving and feeding seabirds. Oil covering the intertidal area will prevent oxygen transport to the sediments, leading to anoxia and the death of infaunal species. The most vulnerable habitats are those that are sheltered mudflats and saltmarshes that may trap the oil. The use of dispersants to remove the oil may also be harmful to both the intertidal habitats and their associated communities, and to the birds themselves.

Birds are generally considered to be moderately sensitive to the contamination of their supporting habitats by non-synthetic toxic compounds; again their sensitivity may be greater to contamination of feeding areas than for example roosting habitat. The **Annex 1 species**, **important migratory species** and species of the **waterbird assemblage** are all considered **moderately sensitive** to non-synthetic toxic contamination affecting the **estuary channels** and the **intertidal mudflats and sand flats**. The **migratory species** and **waterbird assemblage** are also moderately sensitive to such contamination of **saltmarsh communities** and **rocky shore communities**. The **Annex 1 little terns** are considered to be **moderately sensitive** with respect to the **shingle ridge at Gronant** due to the possibility of oil contamination**.**

The existing and potential sources of non-synthetic contamination within the estuary are described in detail in section 8.5.2. Again the dynamic nature of the estuary is likely to result in similar levels of exposure for all intertidal habitats with the exception of those experiencing less infrequent tidal inundation. The exposure of **all** the SPA **supporting habitats** to the effects of non-synthetic toxic contamination is considered to be **medium** with the exception of the **unvegetated shingle ridges**, which have **low** exposure.

Thus the **Annex 1 species** are considered **moderately vulnerable** to the introduction of non-synthetic compounds to estuary channels and **intertidal mudflats** and **sandflats**; **the internationally important migratory species** and those of the **waterbird assemblage** are **moderately vulnerable** with respect to the **estuary channels, intertidal mudflats and sandflats, saltmarsh** and **rocky shore**.

### 12.5.3 Toxic contamination by radioactive compounds

The effects of radionuclides have been demonstrated in a number of marine organisms, such as invertebrates and fish (Cole *et al.*, 1999). Depending on the radioactive dosage, lethal, genetic or reproductive effects may result. There is also evidence to show that radionuclides accumulate in biota, particularly benthic crustaceans, molluscs and saltmarsh grasses (Cole *et*

*al*., 1999). However **sensitivity** to radionuclides is generally considered to be **low for all communities**.

There are currently no major sources of radioactive contamination within the Dee Estuary itself, although there are several discharging installations around Liverpool Bay and the eastern Irish Sea. These include the Sellafield nuclear reprocessing plant, which is the dominant source of radioactive waste discharge to the coastal waters of the UK (Hutchinson, 1994). Airborne gamma spectrometry surveys have revealed elevated levels of $^{137}$Caesium in the saltmarshes and tidal flats of major estuaries in the eastern Irish Sea environments including the Dee Estuary (Narayana *et al*., 2001). Doses received by man from exposure to such artificial radionuclides have been the subject of most scientific investigation. In the Dee Estuary the largest dose of radioactivity received by the most exposed group, people working on the marshes, is estimated to be only 6% of the recommended annual dose limit (Rose *et al*., 1996). In the absence of more specific data relating to particular habitats or species the **exposure** to radioactivity for **all features** within the site is considered to be **low**.

Since **all the bird species** of the estuary are considered to exhibit only **low sensitivity** and **low exposure** to the **introduction of radionuclides**, their **vulnerability** to **radionuclides** is also **low.**

### 12.6 Non-toxic contamination

Certain contaminants can have non-toxic, but nevertheless harmful effects on the bird species of the estuary. Water quality may be affected by contaminants altering factors such as nutrient levels, organic loading, heat, turbidity and salinity. Such contaminants may either harm the birds directly, damage their supporting habitats, or adversely affect their prey species.

Non-toxic contaminants are generally present in much higher concentrations than the toxic contaminants discussed above. They can enter the estuarine environment in large quantities from sewage outfalls and industrial discharges, riverine inputs and agricultural run-off.

#### 12.6.1 Non-toxic contamination by changes in inorganic nutrient loading

Nutrient enrichment can have indirect effects on bird populations, with the potential to both increase or decrease food availability. Nutrient pollution can lead to an increase in benthic populations such as opportunistic marine worms and some birds may benefit from this augmentation; however at the same time the diversity of prey species may be reduced, eliminating the favoured prey items of more specialised feeders.

An excessive supply of nutrients can result in deoxygenation of the sediments and water column and lead to the establishment of anoxic conditions, increasing oxygen demand and stimulating the release of ammonia and hydrogen sulphide which can be toxic to aquatic life. Severe eutrophication can also lead to the death of many benthic invertebrate species (Cole *et al*., 1999), many of which may be key prey species. An increased growth of algal mats on the intertidal area can cause smothering, resulting in deoxygenation of the sediments again leading to the death of invertebrate prey species. Species such as wigeon may benefit from an increase in opportunist algae such as *Enteromorpha,* but other waders and wildfowl that feed on mud-dwelling invertebrates, will experience a reduction in prey and feeding areas.

Eutrophication of shallow coastal waters including estuary channels can have a detrimental effect on the prey species of terns and other waterbirds, which include small fish and invertebrates within the water column. Algal blooms can also cause a reduction in water clarity, which will affect the visibility of prey items. This will impact on sight feeders such as redshank.

Studies in North America have suggested that saltmarshes are unlikely to be highly sensitive to changes in water quality due to nutrient enrichment (Holt *et al.*, 1995).

Invertebrate communities in general are considered moderately sensitive to nutrient enrichment, and therefore the bird species that depend on these communities for food are also moderately sensitive. Thus the **Annex 1 species** are **moderately sensitive** to inorganic enrichment; the **internationally important migratory species** and those of the **waterbird assemblage** are moderately sensitive to enrichments of the **estuary channels**, **intertidal flats**, and **rocky shore communities.**

As described in section 8.6.2 there are five main sources of nutrient enrichment within the Dee Estuary. These are: river input, tidal mixing, direct discharge, atmospheric deposition, and organic production (organic nutrients only). The relative importance of these input categories is not well understood, although the relative contributions from Liverpool Bay are considered highly significant (Howarth *et al.*, 2001). In addition freshwater inputs to the estuary both from the River Dee and freshwater discharges are considered to contribute significantly to the estuary's nitrogen loading (Howarth *et al.*, 2001). Among wastewater treatment works Chester and Queensferry are mainly responsible for the highest nutrient loadings being discharged to the estuary, they contribute the most oxidised nitrogen, phosphate and orthophosphate (Potter, 2003).

In 2001, the Dee Estuary from Chester Weir to its mouth was proposed by Environment Agency Wales as a Sensitive Area to Eutrophication under the Waste Water Treatment Directive, as the estuary exceeded chemical and biological criteria indicative of eutrophic conditions (Howarth *et al.*, 2001). Evidence for eutrophication includes chemical data, reduced dissolved oxygen concentration in summer and elevated nitrogen concentrations in winter, Chlorophyll-*a* measurements, and evidence of algal scum. Two algal blooms were reported within the estuary between 1999 and 2001 (Howarth *et al.*, 2001).

On the basis of evidence described above it was determined that all the supporting habitats that are subject to frequent tidal inundation are **highly exposed** to changes and inorganic nutrient loading. These habitats are: the **estuary channels**, **intertidal mudflats and sandflats**, **saltmarsh**, and **rocky shore communities**.

Thus the **Annex 1 species** are considered **highly vulnerable** to inorganic enrichment of the **estuary channels** and **intertidal flats** and **moderately vulnerable** with respect to **saltmarsh**. The **migratory species** and species of the **waterbird assemblage** are also considered **highly vulnerable** to enrichment of the **estuary channels**, **intertidal flats and rocky shore communities** and **moderately vulnerable** with respect to **saltmarsh.**

### 12.6.2 Non-toxic contamination by changes in organic nutrient loading

As described above enrichment of inorganic nutrients can have indirect effects on bird populations, both through increasing and decreasing food availability, and the same applies for organic nutrients. An excessive supply of organic carbon can result in similar consequences to inorganic nutrients, including deoxygenation of the sediments and water column, and growth of algal mats. **Sensitivity** of the SPA features to the organic enrichment of their supporting habitats is therefore the **same as for inorganic enrichment** in section 12.6.1 above.

The five main sources of organic nutrients present within the Dee Estuary are also the same as described above for inorganic nutrients. Again the relative importance of each is not well understood. However, the requirements for wastewater treatment works (WwTW) to be 'secondary treated' in recent years has led to reduction in the amount of organic matter (BOD) discharged into the estuary and adjacent coastal waters. Recent investigations of faunal communities in the vicinity of the wastewater treatment works around the estuary found that the composition of these communities was generally classified as unbalanced and slightly polluted (Potter, 2003).

Again on the basis of evidence described above that the estuary may be sensitive to eutrophication, all the supporting habitats subject to frequent tidal inundation are considered to be **highly exposed** to changes in organic nutrient loading. These habitats are the **same as** listed **for inorganic enrichment.**

Thus the **Annex 1 species** are considered **highly vulnerable** to organic enrichment of the **estuary channels** and **intertidal flats** and **moderately vulnerable** with respect to **saltmarsh.** The **migratory species** and species of the **waterbird assemblage** are also considered **highly vulnerable** to enrichment of the **estuary channels, intertidal flats and rocky shore communities** and **moderately vulnerable** with respect to **saltmarsh.**

### 12.6.3 Non-toxic contamination by changes in the thermal regime

Changes to the thermal regime of the estuarine water column may lead to changes in the distribution and composition of marine organisms, resulting in changes to bird distribution. Ultimately a long-term thermal discharge is likely to lead to a change in community composition, and colonisation by species adapted to warm water temperatures. Changes in species productivity may also occur as some species may thrive in warmer temperatures, whilst others may decline. The impact of heated water discharges are likely to depend on the location of the discharge point, the temperature of the discharge and the nature of tidal currents in the area. In spite of these potential impacts **all the SPA features** are generally considered to have **low sensitivity to changes in the thermal regime** affecting their supporting habitat.

Although there are several warm water discharges around the estuary, including cooling water outfalls from two power stations in the upper estuary channel, their effects upon the temperature regime of the estuary are believed to be localised. Heat energy is a dissipating 'pollutant' and the impact of these outfalls is thought to be concentrated around the point of

discharge. **The supporting habitats** are therefore determined to have at most a **low exposure** to **changes in thermal regime.**

The **vulnerability** of **all** the **SPA features** to changes in the thermal regime affecting all their supporting habitats is therefore considered to be **low**.

### 12.6.4 Non-toxic contamination by changes in turbidity

The Dee Estuary is a naturally turbid system; therefore any localised increases in turbidity from anthropogenic actions are likely to fall within the normal range experienced by estuarine communities. Most estuarine communities can tolerate turbid conditions, however excessive turbidity may have adverse effects on filter-feeding organisms, clogging feeding and respiratory structures that in turn may reduce food availability for the birds. The **Annex 1 tern species** and other species of the **waterbird assemblage** are considered **moderately sensitive** to increases in turbidity affecting the estuary's water column including the **estuary channels**. These species rely on sight to catch small fish and invertebrates, which may themselves by discouraged by poor water clarity. Clearly increases in turbidity may have adverse impacts on the ability of these species to feed.

Primarily due to ongoing possibility of dredging works and disposal of dredged materials within the estuary the **exposure** to changes in turbidity was determined to be **high** for the **estuary channels** and **medium** for other **habitats experiencing frequent tidal inundation**.

The **Annex 1 species** and species of the waterbird assemblage are therefore moderately vulnerable to increases in turbidity within the estuary.

### 12.6.5 Non-toxic contamination by changes in salinity

Estuaries naturally exhibit a large degree of variability in salinity associated with the interaction between the ebb and flow of the tide and river flow. As a consequence most of the estuarine communities are able to tolerate a wide range of salinities. Despite the adaptation of estuarine communities to variable salinity, significant changes in salinity due to discharge of hyper-saline or fresh water can have effects on community composition. Benthic invertebrate communities vary in response to salinity, with diversity decreasing with a decrease in salinity (Cole *et al.* 1999). Thus the principle potential effect on the birds of the SPA to changes in the salinity regime is a change in their food availability (Cole *et al.* 1999). In addition changes in salinity can cause indirect effects on communities as salinity can affect the chemical availability of various contaminants.

Studies carried out in Suffolk and Essex have indicated that freshwater flows over intertidal habitats may be important for waders and wildfowl (Ravenscroft, 2003). The number and density of some wildfowl such as shelduck, wigeon, grey plover and redshank all showed statistically greater densities close to freshwater flows when compared with similar areas of mudflats lacking such flows.

Despite the potential effects of salinity changes mentioned above the **SPA features** are generally considered to have **low sensitivity** to the salinity changes affecting all their supporting habitats**.** Although hyper-saline discharges may be harmful to most estuarine communities, these effects will generally be localised. Estuarine communities will generally be unaffected by short-term changes in salinity within the limits of their normal exposure.

Within the estuary only the power stations are thought to discharge hyper-saline water. The main influences on the salinity of the estuary are tidal inundation and rainfall. Thus **exposure** to anthropogenic changes in salinity is determined to be **low throughout the estuary** and bird's **vulnerability** to changes in salinity is therefore **low** for **all species** and their supporting habitats.

### 12.7 Biological disturbance

Biological disturbance includes the introduction of microbial pathogens, introduction and translocation of non-native species, and the selective extraction of species.

#### 12.7.1 Biological disturbance by introduction of microbial pathogens

The marine environment provides a generally hostile environment for microbial pathogens, where they tend to die off rapidly, particularly in the presence of sunlight (Cole *et al.* 1999). Yet these pathogens can become associated with suspended particles and accumulate in sediments, surviving for days or weeks (Cole *et al.* 1999). They can also accumulate in filter-feeding organisms to levels that can be harmful to birds (Cole *et al.* 1999). Despite this fact the **sensitivity** of the SPA features to the introduction of microbial pathogens is considered to be either **low** for **all supporting habitats**.

Mainly as a result in recent improvements to waste water treatment **exposure** to microbial pathogens within the estuary is **generally** perceived to be **low**, although elevated levels may occur in the upper estuary and canalised lower river due to reduced dilution of sewage discharges.

Thus the **vulnerability** of the **SPA features** to introduction of microbial pathogens is considered to be **low for all supporting habitats**.

#### 12.7.2 Biological disturbance by introduction of non-native species

The introduction of non-native species, both flora and fauna, could have an impact on the estuarine ecosystem including indirect effects on the bird species. Introduced species may thrive at the expense of native species, resulting in a change in the composition of estuarine communities. Invasive plants including algae may also cause harmful effects changing the structure of habitats.

Birds are generally considered most likely to be affected by the introduction of non-native species to areas of feeding habitat. Thus **all the SPA species** are considered **moderately sensitive** to the introduction of non-native species affecting the **estuary channels** and **intertidal flats**, and the **internationally important migratory species** and those of the **waterbird assemblage** are also **moderately sensitive** with respect to the **saltmarsh** and **rocky shore communities**.

As discussed in section 8.7.2 new introductions of non-native marine species are perhaps most likely to occur through the discharge of ballast water within the estuary by ships embarking from foreign ports. Further work would be needed to establish which non-native marine species may already be present in the waters of the Dee Estuary and to investigate the likelihood of current shipping activities resulting in further introductions

Common cordgrass *Spartina anglica,* was first planted on the Dee in 1920s to assist in coastal defence and land claim (see also section 8.2.1). It demonstrates vigorous growth and is able to grow low down on the shore where the sediments are mobile, being a particularly aggressive coloniser of bare mud. Over the last two decades there has been an increase of about 35% in the extent of saltmarsh habitat, mainly on the north side of the main channel, especially in the mid and upper estuary (Dargie, 2001). This expansion is of particular concern with respect to the loss of muddy sediment communities and the potential for loss of feeding areas used by internationally important migratory species including dunlin, redshank and shelduck.

Primarily due to the possibility of further encroachment of common cordgrass the **intertidal mudflats and sandflats** are considered to have a **medium exposure** to the introduction and translocation of non-native species. The exposure of other habitats is considered to be low.

The **Annex I species, migratory species** and those of the **waterbird assemblage** are all considered to be **moderately vulnerable** to the **introduction of non-native species** to the **intertidal mudflats and sand flats**, their vulnerability with regard to other habitats is low.

### 12.7.3 Biological disturbance by selective extraction of species

Selective extraction of species includes various forms of exploitation of the living resources comprising estuarine communities, such as commercial shellfish and finfish fisheries, sport fishing (both sea angling and coarse fishing). It also covers the exploitation of the birds themselves in the form of wildfowling.

The unsustainable removal of particular species from estuarine habitats may affect the ecological balance of the marine communities reducing the availability of bird's prey species and food plants. In general **the SPA features** are considered to be **moderately sensitive** to selective extraction of potential prey species in their **feeding habitats** and to their own selective extraction due to wildfowling on the saltmarsh.

The Dee supports fisheries for both shellfish and finfish. There is a cockle (*Cerastoderma edule*) fishery of high economic importance, and smaller mussel *Mytilus edulis* fishery; in addition there is small-scale collection of razor fish *Ensis* spp. and bait digging for lugworms *Arenicola marina*. The Dee also has a notable fishery for species such as flounder *Pleuronectes flesus*, mullet species *Chelon labrosus* and *Liza ramada,* cod *Gadus morhua*, and shrimps *Crangon crangon*, as well as a salmon *Salmo salar* net fishery controlled by a Net Limitation Order (NRA, 1993; Potts & Swaby, 1993).

Cockles are an important prey species for several of the Dee's internationally important migratory species including oystercatcher, knot and black-tailed godwit. Exploitation of cockles has the potential to both reduce the availability of this important prey species as well as to damage undersize cockles and other invertebrates due to effects or raking, trampling and riddling (see also section 12.3.2.).

As discussed in section 8.7.3 the existing powers available to the Environment Agency to manage the cockle fishery are limited in scope and resources with no control available upon the numbers of fishermen that may take part. However shellfishery management within the estuary is currently under review and in the future existing problems may be resolved. In the

future any deleterious effects of the cockle fishery could be offset by the potential benefits that arise from sustainable management of the stock according to traditional principles. These include the prevention of widespread 'shelling up' of beds, creation of space to allow improved spat fall, reduced volatility of cockle population dynamics, and the maintenance of a better managed stock within the estuary.

Mussels are another exploited species that are also an important prey species for oystercatcher and knot. Mussel harvesting within the Dee is less regulated that the cockle fishery but occurs with less intensity. Within the estuary mussels occur on hard substrates, especially the 'artificial' rocky shores around Port of Mostyn, and the rocky shore of the Hilbre Islands as well as on the intertidal mudflats and sandflats off West Kirby and Thurstaston. Mussel settlement may also take place on very dense cockle beds, which have undergone or are in the process of 'shelling up'. Excessive exploitation of mussels resulting in the removal of long established areas of mussel beds, or the total removal of mussels over extensive stretches of rocky shore, is considered highly undesirable as it is likely to result in changes in the availability of this important prey species.

Bait digging and razor shell collection are practised within the site at lower intensity, in particular within the sand communities of the North Wirral Foreshore. As with cockling such activities disturb the sediment through digging and to a lesser extent trampling potentially causing changes to sediment community composition**.**

Wildfowling results in the selective extraction of quarry species including both teal and pintail, which are internationally important migratory species as well as mallard and wigeon, which form part of the internationally important waterbird assemblage. Wildfowling within the Dee is considered to be well managed and now confined to relatively small areas with the much of the saltmarsh being a refuge area. Percival and Percival (1998) report that between 1993 and 1997 the average annual wildfowling bag was 2,580 birds with wigeon forming over half of this total. Their investigation found no evidence that wildfowling as practised on the Dee Estuary in 1998 was not sustainable (Percival & Percival, 1998).

Wildfowling also occurs within the estuary, though the area affected is much restricted compared to its former extent, with much of the saltmarsh effectively forming a shooting sanctuary area. Shooting currently occurs predominantly over areas of marsh at the head of the estuary, as well as off Heswall, and to a lesser degree along the Welsh shoreline at Oakenholt, Flint and Mostyn. Wildfowling causes disturbance to both quarry species and non-target waterbirds over the areas shot.

Considering the variety of potential exposure mechanisms described above **exposure** to selective extraction is considered to be **low** for the **estuary channels** and **unvegetated shingle ridges**, **medium** for the rocky shore communities and **high** for the intertidal flats, due to the potential scale of shell fish gathering.

Selective extraction for the saltmarsh relates primarily to the direct abstraction of SPA species in the form of wildfowling. Here exposure is considered to be **low** for the **Annex 1 species** including no quarry species. Yet, exposure is high for the important migratory species, especially pintail, and species of the waterbird assemblage, in particular wigeon.

Integrating the assessments of sensitivity and exposure, the **Annex 1 species** are considered to have **low vulnerability** to selective extraction affecting the **estuary channels**, **saltmarsh**

and **shingle ridges** and **high vulnerability** with respect to the **intertidal mudflats and sandflats**. The **migratory species** and those of the **waterbird assemblage** also have **low vulnerability** to selective extraction affecting the **estuary channels** and **shingle ridges**; they are **highly vulnerable** with respect to the **intertidal flats** and the **saltmarsh**, and **moderately** vulnerable with respect to the **rocky shore communities**.

**Table 7. Assessment of the relative exposure of interest features and sub-features of the Dee Estuary European marine site to different categories of operations (as at February 2003).**

Categories of operations to which the features or sub-features of the site are highly or moderately vulnerable are indicated by shading, light grey for moderate vulnerability and dark grey for high vulnerability. Table also incorporates the relative sensitivity scores, used in part to derive vulnerability.

**Key:** Matrix used to determine relative vulnerability (i.e. Sensitivity x Exposure = Vulnerability)

| | | | | | |
|---|---|---|---|---|---|
| **High sensitivity** | O O O O | **High Exposure** | × × × × | **High vulnerability** | ⊗⊗⊗⊗<br>⊗⊗⊗O<br>⊗⊗⊗× |
| **Moderate sensitivity** | O O O | **Medium Exposure** | × × × | **Moderate vulnerability** | ⊗⊗OO<br>⊗⊗× ×<br>⊗⊗⊗ |
| **Low sensitivity** | O O | **Low Exposure** | × × | **Low vulnerability** | ⊗⊗O<br>⊗⊗×<br>⊗⊗ |
| **No detectable sensitivity** | O | **No exposure** | × | **No vulnerability** | ⊗O<br>⊗×<br>⊗ |

| Categories of operations which may cause deterioration or disturbance | SPA Interest Features | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Internationally important populations of regularly occurring Annex I species | | | | Internationally important migratory species and waterbird assemblage | | | | |
| | Estuary channels | Intertidal mudflats and sandflats | Saltmarsh communities | Unvegetated shingle ridges | Estuary channels | Intertidal mudflats and sandflats | Saltmarsh communities | Rocky shore | Unvegetated shingle ridges |
| **Physical Loss** | | | | | | | | | |
| Removal (e.g. land claim, dredging) | ⊗⊗○○ | ⊗⊗⊗○ | ⊗⊗○○ | ⊗⊗⊗○ | ⊗⊗○○ | ⊗⊗⊗○ | ⊗⊗○○ | ⊗⊗○○ | ⊗⊗⊗○ |
| Smothering (e.g. depositing dredge spoil, beach feeding) | ⊗⊗○ | ⊗⊗○ | ⊗⊗○ | ⊗⊗○○ | ⊗⊗○ | ⊗⊗○ | ⊗⊗○ | ⊗⊗○ | ⊗⊗○ |
| **Physical Damage** | | | | | | | | | |
| Siltation (e.g. dredging, outfalls) | ⊗⊗×× | ⊗⊗× | ⊗⊗ | ⊗× | ⊗⊗×× | ⊗⊗× | ⊗⊗ | ⊗⊗○ | ⊗× |
| Abrasion (e.g. recreational activity, vehicles) | ⊗⊗ | ⊗⊗⊗× | ⊗⊗○ | ⊗⊗○○ | ⊗⊗ | ⊗⊗⊗× | ⊗⊗○ | ⊗⊗○ | ⊗⊗×× |
| Selective extraction (e.g. aggregate extraction) | ⊗⊗○ | ⊗⊗○ | ⊗⊗○ | ⊗⊗○○ | ⊗⊗○ | ⊗⊗○ | ⊗⊗○ | ⊗⊗○○ | ⊗⊗○ |
| **Non-physical disturbance** | | | | | | | | | |
| Noise (e.g. land/water-based recreation, marine traffic) | ⊗⊗○○ | ⊗⊗○○ | ⊗⊗⊗○ | ⊗⊗⊗○ | ⊗⊗○○ | ⊗⊗○○ | ⊗⊗⊗○ | ⊗⊗○○ | ⊗⊗⊗○ |
| Visual presence (e.g. land/water-based recreation, marine traffic) | ⊗⊗⊗○ | ⊗⊗○○ | ⊗⊗○○ | ⊗⊗⊗○ | ⊗⊗⊗○ | ⊗⊗○○ | ⊗⊗○○ | ⊗⊗⊗○ | ⊗⊗⊗⊗ |
| **Toxic contamination** | | | | | | | | | |
| Introduction of synthetic compounds (e.g. TBT, PCBs) | ⊗⊗⊗○ | ⊗⊗⊗○ | ⊗⊗ | ⊗⊗○ | ⊗⊗⊗○ | ⊗⊗⊗○ | ⊗⊗⊗○ | ⊗⊗⊗○ | ⊗⊗ |
| Introduction of non-synthetic compounds (e.g. effluent outfalls, crude oil) | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗× | ⊗⊗○ | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗⊗ | ⊗⊗ |
| Introduction of radionuclides | ⊗⊗× | ⊗⊗× | ⊗⊗× | ⊗⊗× | ⊗⊗× | ⊗⊗× | ⊗⊗× | ⊗⊗× | ⊗⊗× |
| **Non-toxic contamination** | | | | | | | | | |
| Changes in nutrient loading (e.g. agricultural run-off, effluent outfalls) | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗×× | ⊗⊗ | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗×× | ⊗⊗⊗× | ⊗⊗ |
| Changes in organic loading (e.g. effluent outfalls, aquaculture) | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗×× | ⊗⊗ | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗×× | ⊗⊗⊗× | ⊗⊗ |
| Changes in thermal regime (e.g. power station discharges) | ⊗⊗ | ⊗⊗ | ⊗× | ⊗ | ⊗⊗ | ⊗⊗ | ⊗× | ⊗× | ⊗ |
| Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil) | ⊗⊗⊗× | ⊗⊗× | ⊗×× | ⊗× | ⊗⊗⊗× | ⊗⊗× | ⊗⊗× | ⊗⊗ | ⊗× |

| Categories of operations which may cause deterioration or disturbance | SPA Interest Features | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Internationally important populations of regularly occurring Annex I species | | | | Internationally important migratory species and waterbird assemblage | | | | |
| | Estuary channels | Intertidal mudflats and sandflats | Saltmarsh communities | Unvegetated shingle ridges | Estuary channels | Intertidal mudflats and sandflats | Saltmarsh communities | Rocky shore | Unvegetated shingle ridges |
| Changes in salinity (e.g. water abstraction, effluent outfalls) | ⊗⊗ | ⊗⊗ | ⊗× | ⊗× | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗× |
| **Biological disturbance** | | | | | | | | | |
| Introduction of microbial pathogens (e.g. effluent outfalls) | ⊗⊗ | ⊗⊗ | ⊗× | ⊗× | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗× |
| Introduction of non-native species and translocation | ⊗⊗O | ⊗⊗⊗ | ⊗⊗ | ⊗⊗ | ⊗⊗O | ⊗⊗⊗ | ⊗⊗O | ⊗⊗O | ⊗⊗ |
| Selective extraction of species (e.g. samphire picking, bait collection) | ⊗⊗O | ⊗⊗⊗× | ⊗⊗O | ⊗⊗O | ⊗⊗O | ⊗⊗⊗× | ⊗⊗⊗× | ⊗⊗⊗ | ⊗⊗O |

# Ramsar

# 13. Dee Estuary Ramsar site interest features

The Dee Estuary European marine site also includes a Ramsar site qualifying under the Ramsar Convention. An extension to the Ramsar site has also been proposed, but this has not yet been listed and is therefore known as a proposed Ramsar site. The features of the proposed Ramsar site mirror very closely those of the potential SPA. This section will indicate which Ramsar figures can be considered directly analogous to which SPA features. To save unnecessary duplication, wherever possible the reader will be referred to the text provided for the SPA features.

The Dee Estuary Ramsar and pRamsar site includes both marine areas (i.e. land covered continuously or intermittently by tidal waters) and land that is not subject to tidal influence. In accordance with previous DETR and NAW policy statements, "*Ramsar Sites in England* (November 2000) and *Ramsar Sites in Wales* (February 2001), Ramsar sites must be given the same consideration as European sites. Therefore, the areas of the Ramsar and pRamsar below highest astronomical tide will be considered as part of the Dee Estuary European marine site. The seaward boundary of the European marine site is concurrent with that of the Ramsar or pRamsar. The landward boundary of the European marine site is the upper boundary of the Ramsar or pRamsar, or where that extends above land covered continuously or intermittently by tidal waters, it is at the limit of the marine habitats.

Where the Ramsar or pRamsar qualifying species occur within the European marine site, they are referred to as interest features. Supporting habitat sub-features have also been identified to highlight the ecologically important components of the European marine site for each interest feature. A flow chart showing how the interest features and supporting habitat sub features are related can be seen in Figure 3.

This section on the Dee Estuary Ramsar site, applies to both the listed site and to the proposed Ramsar site. It describes and explains the importance of each of these interest features together with their component sub-features.

## 13.1 Background and context

The Convention on Wetlands of International Importance especially as Waterbirds Habitats was signed in Ramsar, Iran in 1971. The broad objectives are to stem the loss and progressive encroachment on wetlands now and in the future through the designation of Ramsar sites. In addition, signatories to the Convention are required to promote the conservation of wetland habitats and wise use of wetlands within their territories.

A habitat can qualify as a Ramsar site for its representation of a wetland, for supporting wetland plant or animal species or for its role in supporting internationally important waterbirds. Interest features are identified within certain criteria.

The Dee Estuary Ramsar site is currently considered to qualify under the following San José criteria:

**Criterion 2:** A wetland should be considered internationally important if it supports vulnerable, endangered or critically endangered species or threatened ecological communities

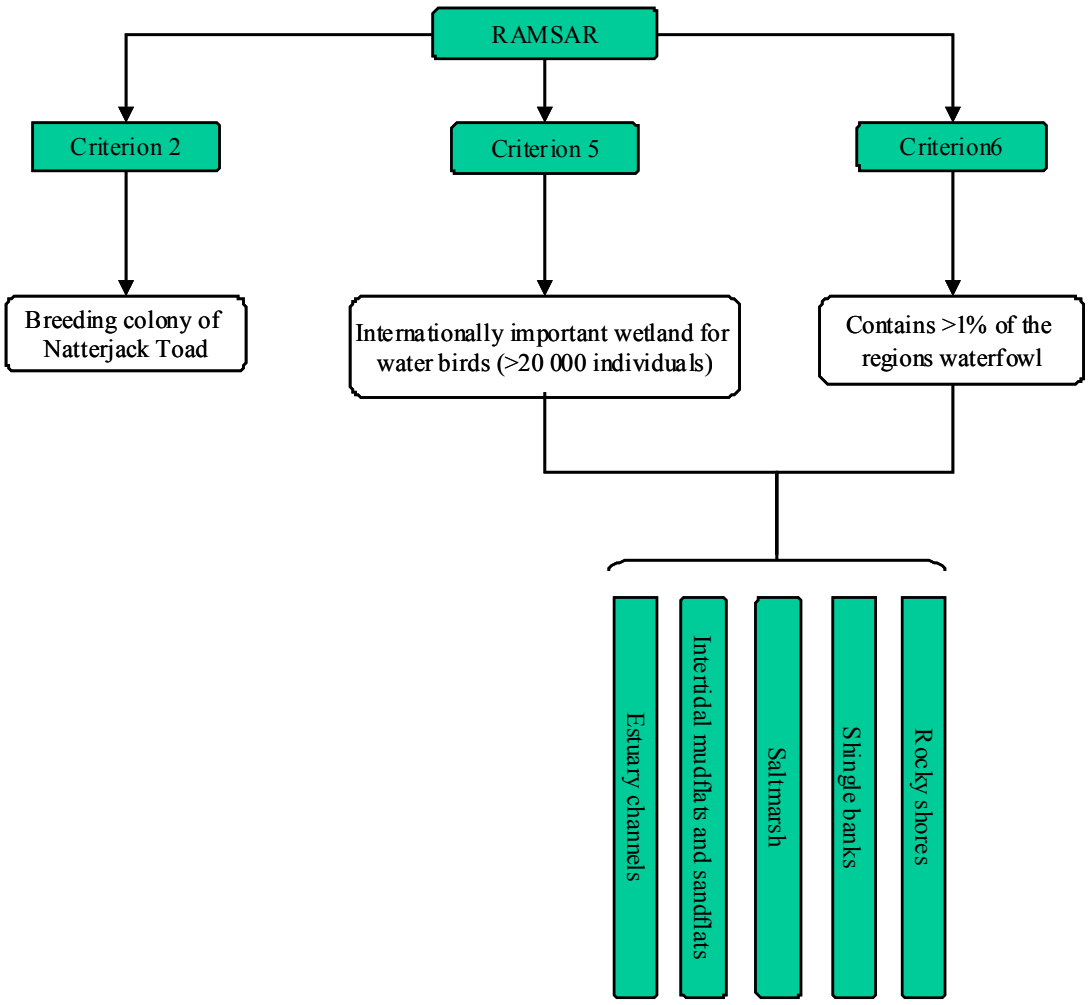


Figure 3. Flow chart showing the relationship between qualifying interest features and supporting habitat sub features of The Dee Estuary Ramsar / pRamsar site. Qualifying interest features are in 'open' horizontal boxes with supporting habitat sub features in shaded vertical boxes.

**Criterion 5:** A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds

**Criterion 6:** A wetland should be considered internationally important if it regularly supports 1% or more of the individuals in a population of one species or sub-species of waterbird.

As with SPAs, English Nature and the Countryside Council for Wales' conservation objectives provide information on maintaining the favourable condition of the habitats listed on the citation and/or the habitats used by the qualifying species. Also, the UK Ramsar Committee, led by JNCC, is scoping a review of listed Ramsar sites, which will provide advice to ministers on any changes required. Depending on the conclusions of the review, English Nature and the Countryside Council for Wales may review this advice.

The Ramsar site boundary within the Dee Estuary European marine site is generally concurrent with the corresponding SPA boundary, the major difference being that Red Rocks SSSI is included within the pRamsar site but not the SPA. As explained in section 2.4.3 there are a number of habitats within the SPA, which support the qualifying bird species, but which do not, occur within the European marine site as they occur above highest astronomical tide. These habitats include coastal grazing marsh used by waterbirds for feeding and roosting, and the nesting areas of common terns. Conservation objectives covering the use of such coastal habitats by the qualifying bird species are appended to the SPA conservation objectives. They are provided for information only and do not constitute advice under Regulation 33(2) of the Conservation (Natural Habitats & c.) Regulations 1994. Some species also use areas of land and coastal waters outside the boundaries of the Ramsar site. Relevant authorities need to have regard to such adjacent interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

### 13.2 Internationally important wetland supports a breeding colony of the vulnerable natterjack toad *Bufo calamita*

The Dee Estuary qualifies as a Ramsar site under Criterion 2 because it supports breeding colony of the vulnerable natterjack toad *Bufo calamita.*

The breeding colony of vulnerable Natterjack Toad *Bufo calamita* at Red Rocks SSSI is dependant on coastal habitats occurring above Highest Astronomical Tide. They are therefore not considered to be a feature of the European marine site. Objectives to maintain the toad's supporting habitats in favourable condition are found within English Nature's conservation objectives for the relevant SSSI within the Ramsar site boundary and will be dealt with through relevant procedures outlined in the Conservation (Natural Habitats & c.) Regulations 1994.

### 13.3 Internationally important wetland, regularly supporting an assemblage of waterbird

The Dee Estuary qualifies as a Ramsar site under **Criterion 5** because it regularly supports 20,000 or more waterbirds (see Table 5).

### 13.3.1 Key sub-features

The key sub-features for the 20,000 or more waterbirds are as for the **SPA section 9.5.3**:

- Estuary Channels (subtidal sediment communities and the water column)
- Intertidal mudflats and sandflats
- Saltmarsh communities
- Shingle banks
- Rocky shore communities

## 13.4 Internationally important wetland, regularly supporting populations of waterbird species

The Dee Estuary qualifies as a Ramsar site under **Criterion 6** because it regularly supports 1% or more of the biogeographic populations of waterbirds species

### 13.4.1 Key sub-features

The key sub-features for the populations of waterbird species are as for the **SPA section 9.5.1**:

- Estuary Channels (subtidal sediment communities and the water column)
- Intertidal mudflats and sandflats.
- Saltmarsh communities.
- Shingle banks.
- Rocky shore communities.

# 14 The Dee Estuary Ramsar site conservation objectives

Under Regulation 33(2)(a) of the Conservation (Natural Habitats &c.) Regulations 1994, English Nature and the Countryside Council for Wales have a duty to advise other relevant authorities as to the conservation objectives for the European marine site.

The conservation objectives for the Dee Estuary Ramsar interest features are provided below and should be read in the context of other advice given in this package, particularly:

- the maps showing the extent of the supporting habitats provided in Appendix V;
- summary information on the interest of each of the features; and
- the favourable condition table sets out the types of information and assessment measures that may be used to support judgements on whether or not the conservation objectives are being met, and which will act as a basis for the development of a monitoring programme.

All the conservation objectives are subject to review by English Nature and the Countryside Council of Wales.

### 14.1 Interest feature 1, Criterion 5: Conservation objective for the internationally important wetland regularly supporting 20,000 or more waterbirds

**The conservation objective for the "internationally important wetland regularly supporting 20,000 or more waterbirds" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**internationally important wetland regularly supporting 20,000 or more waterbirds** will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering waterbird assemblage is no less than 120,726 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii the relative proportions[2] of waders and wildfowl comprising the wintering waterbird assemblage is maintained;

iii. the extent of intertidal flats[3] and the spatial distribution[4] of their constituent sediment community types[5] is maintained;

iv. the extent of saltmarsh[6] and the spatial distribution[4] of its constituent vegetation community types[7] is maintained;

v. the extent and spatial distribution[4] of saltmarsh vegetation less than 10 cm in height is maintained;

vi. the extent of rocky shore[8] at Hilbre Island, Middle Eye Little Eye and Tanskey rocks is maintained;

vii. the extent and height of the shingle spit[9] at Point of Ayr is maintained;

viii. The abundance of waterbird prey species[10] are maintained at levels sufficient to support the population size in (i);

ix. Greater than 25% cover of both seed bearing plants[11] and soft leaved herbs and grasses[12] is maintained during winter across the saltmarsh;

x. existing unrestricted bird sightlines of at least 200m are maintained in every direction around roosting sites[13], loafing[14]and feeding areas[15];

xi. aggregations of roosting[13], loafing[14] or feeding[15] waterbirds are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-15] above is provided in **Box 1.**

**NB**. Additional conservation objectives are provided relating to the use by waterbirds of areas of the Dee Estuary Ramsar / pRamsar above highest astronomical tide, which are outside the

Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI, and at Inner Marsh Farm SSSI, used by waterbirds for feeding, roosting and loafing. Thus the Dee Estuary Ramsar internationally important assemblage of regularly occurring waterbirds feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of waterbird prey species including earthworms, leatherjackets and chironomids is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of waterbirds roosting, loafing or feeding on the coastal fields are not subject to significant disturbance.

**Box 1: Explanatory information for the "internationally important assemblage of regularly occurring waterbirds" conservation objective**

**[1] Natural processes**:

Each interest feature is subject to both natural processes and human influences. Human influence on the interest features is acceptable provided that it is compatible with the achievement of the conditions set out under the definition of favourable condition for each interest feature. A failure to meet these conditions which is entirely a result of natural processes will not constitute unfavourable condition, but will trigger a review of the definition of favourable condition. This qualification is necessary because:

(a) the bird populations themselves are subject to natural factors, many of which arise outside the SPA, such as breeding success and winter temperatures;

(b) the supporting habitats of the birds are influenced by the evolution of the estuary. Natural adjustments within estuaries can take many forms. One important example is the tendency of estuaries to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by subtidal and intertidal sediment banks or features. This, with other natural processes, will therefore cause the width and depth of the estuary to change over time, moving towards a state of dynamic equilibrium or 'most probable state'. As part of this process, the location and extent of saltmarshes and mudflats may change, provided there is capacity to accommodate readjustment. However, where this process is constrained, the capacity of habitats to accommodate readjustment may be affected.

**[2] Relative proportions of waders wildfowl and other waterbirds**

Waders currently make up about 70% of the of the wintering waterbird assemblage, wildfowl comprise about 22% and other waterfowl the remaining 8%.

**[3] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[5] is shown in Appendices V and IV respectively.

**[4] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[5] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[6] Saltmarsh extent and spatial distribution:**

Saltmarsh extent and spatial distribution of community types is shown in Appendices V and IV respectively.

**[7] Saltmarsh vegetation community types:**

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

**Box 1 (continued): Explanatory information for the "internationally important assemblage of regularly occurring waterbirds" conservation objective**

**[8] Rocky shore extent**:

Rocky shore extent and distribution is shown in Appendix V.

**[9] Shingle ridge extent and height:**

The location of the shingle ridge at Point of Ayr is shown in Appendix V.

**[10] Waterbirds prey species:**

Prey species favoured by the waterbirds of the Dee Estuary include the following:

Polychaete worms: rag worm *Hediste diversicolor*, lug worm *Arenicola marina*,
Molluscs: Mud snails *Hydrobia* spp., mussels *Mytilus edulis*, cockles *Cerastoderma edule*, Baltic tellins *Macoma balthica*;
Crustaceans: amphipods *Corophium spp*., shore crab *Carcinus maenas*, brown shrimp *Crangon crangon*;

**[11] Seed bearing plants**:

Wildfowl feed on seed-bearing saltmarsh plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. (Kirby *et al*., 2000).

**[12] Soft leaved herbs and grasses**:

Wildfowl feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccenellia maritima* and glasswort *Salicornia* spp. (Kirby *et al*., 2000).

**[13] Waterbird roosting areas:**

Roosting sites regularly used by waders, and other waterbirds are shown in Appendices VI and VIII.

**[14] Waterbird loafing areas:**

Loafing areas regularly used by wildfowl are shown in Appendices VIII

**[15] Waterbird feeding areas:**

Feeding areas regularly used by waders, wildfowl and other waterbirds are shown in Appendices VI and VIII.

### 14.2 Interest feature 2, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more redshank of the eastern Atlantic population on passage

**The conservation objective for the "passage redshank" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**passage redshank**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met**:**

i. the 5 year peak mean population size for the passage redshank population is no less than 8,795 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the abundance and dispersion[5] of redshank prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] redshank are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 2**.

NB. Additional conservation objectives are provided relating to the use by redshank of areas of the Dee Estuary Ramsar / pRamsar above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by redshank for feeding. Thus the Dee Estuary Ramsar passage redshank feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland with standing water including, pools, ditches and channels is maintained;
d) the abundance of redshank prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of redshank roosting or feeding on the coastal fields are not subject to significant disturbance.

Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by redshank because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts the Dee Estuary Ramsar and forms part of the area of the Dee Estuary pSAC. North Wirral Foreshore includes some of the key feeding areas for the Dee Estuary redshank population and therefore the Dee Estuary passage redshank feature can only be in favourable condition if the conservation objectives pertaining the Mersey Narrows and North Wirral Foreshore pSPA wintering redshank feature are also met in full.

**Box 2: Explanatory information for the "passage redshank" conservation objective**

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices VI and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

[6] **Redshank prey species**:

Redshank prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp., tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Redshank roosting areas**:

Roosting sites regularly used by redshank are shown in Appendix VI.

[8] **Redshank feeding areas**:

Feeding areas regularly used by redshank are shown in Appendix VI.

### 14.3 Interest feature 3, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering shelduck of the North-western European population

**The conservation objective for the "wintering shelduck" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering shelduck**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering shelduck population is no less than 7,725 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the abundance and dispersion[5] of shelduck prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

v. aggregations of loafing[7] or feeding[8] shelduck are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 3**.

**Box 3: Explanatory information for the "wintering shelduck" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices VI and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6] Shelduck prey species**:

Shelduck prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp. tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

**[7]. Shelduck loafing areas**:

Loafing areas regularly used by shelduck are shown in Appendix VIII.

**[8] Shelduck feeding areas**:

Feeding areas regularly used by shelduck are shown in Appendix VIII.

### 14.4 Interest feature 4, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering teal of the North-western European population

**The conservation objective for the "wintering teal" feature of the Dee Estuary pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering teal**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering teal population is no less than 5,251 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the extent of saltmarsh[5] and the spatial distribution[3] of its constituent vegetation community types[6] is maintained;

iv. greater than 25% cover of seed bearing plants[7] is maintained during winter across the saltmarsh;

v. the extent of standing water pools or 'flashes' in the saltmarsh is maintained;

vi. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[8] and feeding areas[9];

vii. aggregations of loafing[8] or feeding[9] teal are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-9] above is provided in **Box 4.**

**NB**. Additional conservation objectives are provided relating to the use by teal of areas of the Dee Estuary Ramsar / pRamsar above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields and pools along the Welsh shore within the Dee Estuary SSSI and at Inner Marsh Farm SSSI, which are used for loafing and feeding. Thus the Dee Estuary Ramsar wintering teal feature can only be in favourable condition if the conservation objectives pertaining to their use of these habitats are also met. These objectives (*a-d*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) aggregations of teal loafing or feeding on pools and coastal fields are not subject to significant disturbance.

**Box 4: Explanatory information for the "wintering teal" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Saltmarsh extent and spatial distribution:**

Saltmarsh extent and distribution is shown in Appendix V.

**[6] Saltmarsh community types**:

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

**[7] Seed bearing plants:**

Teal feed on seed-bearing saltmarsh plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. (Kirby *et al*., 2000).

**[8] Teal loafing areas:**

Loafing areas regularly used by teal are shown in Appendix VIII.

**[9] Teal feeding areas**:

Feeding areas regularly used by teal are shown in Appendix VIII.

## 14.5 Interest feature 5, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering pintail of the North-western Europe population

**The conservation objective for the "wintering pintail" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering pintail**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering pintail population is no less than 5,407 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the extent of saltmarsh[5] and the spatial distribution[3] of its constituent vegetation community types[6] is maintained;

iv. the abundance and dispersion[7] of pintail prey species[8] is maintained at levels required to support the population size in (i);

v. greater than 25% cover of soft leaved herbs and grasses[9] is maintained during winter across the saltmarsh;

vi. existing unrestricted bird sightlines of at least 200m are maintained in every direction around loafing areas[10], and feeding areas[11];

vii. aggregations of loafing[10] or feeding[11] pintail are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-11] above is provided in **Box 5.**

**NB**. Additional conservation objectives are provided relating to the use by pintail of areas of the Dee Estuary Ramsar / pRamsar above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields and pools at Inner Marsh Farm SSSI, which are used for loafing and feeding. Thus the Dee Estuary Ramsar wintering pintail feature can only be in favourable condition if the conservation objectives pertaining to their use of these habitats are also met. These objectives (*a-d*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) aggregations of pintail loafing or feeding on pools and coastal fields are not subject to significant disturbance.

**Box 5: Explanatory information for the "wintering pintail" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Saltmarsh extent and spatial distribution**:

Saltmarsh extent and distribution is shown in Appendix V.

**[6] Saltmarsh community types**:

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

**[7] Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

**[8] Pintail prey species**:

Pintail feed on surface and near surface invertebrates including mudsnails *Hydrobia* spp. (Kirby *et al.*, 2000).

**[9] Soft leaved herbs and grasses**:

Pintail feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccenellia maritima* and glasswort *Salicornia* spp. (Kirby *et al.*, 2000).

**[10] Pintail loafing areas:**

Low water loafing areas regularly used by pintail are shown in Appendix VIII

**[11] Pintail feeding areas:**

Feeding areas regularly used by pintail are shown in Appendix VIII.

### 14.6 Interest feature 6, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering oystercatcher of the Europe and North-western Africa population

**The conservation objective for the "wintering oystercatcher" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering oystercatcher**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering oystercatcher population is no less than 22,677 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of oystercatcher prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. the extent of rocky shore[7] at Hilbre Island, Middle Eye Little Eye and Tanskey rocks is maintained;

vi. the extent and height of the shingle spit[8] at Point of Ayr is maintained;

vii. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[9] and feeding areas[10];

viii. aggregations of roosting[9] or feeding[10] oystercatcher are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-10] above is provided in **Box 6.**

**NB**. Additional conservation objectives are provided relating to the use by oystercatcher of areas of the Dee Estuary Ramsar / pRamsar above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by oystercatcher for feeding. Thus the Dee Estuary SPA wintering oystercatcher feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;

d) the abundance of oystercatcher prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of oystercatcher roosting or feeding on the coastal fields are not subject to significant disturbance.

Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by oystercatcher because they are a feature of this SSSI, which directly abuts the Dee Estuary Ramsar and forms part of the area of both the Dee Estuary pSAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary oystercatcher population and therefore the Dee Estuary passage oystercatcher feature can only be in favourable condition if the conservation objectives pertaining to the North Wirral Foreshore SSSI oystercatcher feature are also met in full.

**Box 6: Explanatory information for the "wintering oystercatcher" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6] Oystercatcher prey species:**

Oystercatcher prey species include cockles *Cerastoderma edule* and mussels *Mytilis edulis* between 15 and 35 mm in length as well as lugworms *Arenicola marina* (Kirby *et al*, 2000).

**[7] Rocky shore extent:**

Rocky shore extent at Hilbre Island, Middle Eye Little Eye and Tanskey Rocks is shown in Appendix V.

**[8] Shingle ridge extent and height:**

The location of the shingle ridge at Point of Ayr is shown in Appendix V.

**[9] Oystercatcher roosting areas:**

Roosting sites regularly used by oystercatcher are shown in Appendix VI.

**[10] Oystercatcher feeding areas:**

Feeding areas regularly used by oystercatcher are shown in Appendix VI.

## 14.7 Interest feature 7, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering grey plover of the Eastern Atlantic population

**The conservation objective for the "wintering grey plover" feature of the Dee Estuary pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering grey plover**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering grey plover population is no less than 1,643 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of grey plover prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution of saltmarsh vegetation less than 10 cm in height is maintained

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] grey plover are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 7.**

**NB.** Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by grey plover because they are a feature of this SSSI, which directly abuts the Dee Estuary Ramsar and forms part of the area of both the Dee Estuary pSAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary grey plover population and therefore the Dee Estuary wintering grey plover feature can only be in favourable condition if the conservation objectives pertaining to the North Wirral Foreshore SSSI grey plover feature are also met in full.

**Box 7: Explanatory information for the "wintering grey plover" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

**[6] Grey plover prey species**:

Grey plover prey species include polychaete worms, small molluscs and crustaceans (Kirby *et al.*, 2000)

**[7] Grey plover roosting areas:**

Roosting sites regularly used by grey plover are shown in Appendix VI.

**[8] Grey plover feeding areas:**

Feeding areas regularly used by grey plover are shown in Appendix VI.

## 14.8 Interest feature 8, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering knot of the North-western Canada to North-western Europe population

**The conservation objective for the "wintering knot" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering knot**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering knot population is no less than 12,394 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of knot prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] knot are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 8.**

**NB.** Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by knot because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts the Dee Estuary Ramsar and forms part of the area of the Dee Estuary pSAC. North Wirral Foreshore includes the key feeding areas for the Dee Estuary knot population and therefore the Dee Estuary wintering knot feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA wintering knot feature are also met in full.

**Box 8: Explanatory information for the "wintering knot" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

**[6] Knot prey species:**

Knot prey species include the small molluscs, Baltic tellin *Macoma balthica*, mussel spat *Mytilus edulis* and cockle spat *Cerastoderma edule*, and mud snails *Hydrobia* spp. (Kirby *et al.*, 2000).

**[7] Knot roosting areas:**

Roosting sites regularly used by knot are shown in Appendix VI.

**[8] Knot feeding areas:**

Feeding areas regularly used by knot are shown in Appendix VI.

## 14.9 Interest feature 9, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering dunlin of the Northern Siberia, Europe and Northern Africa population

**The conservation objective for the "wintering dunlin" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering dunlin**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering dunlin population is no less than 27,769 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. The abundance and dispersion[5] of dunlin prey species[6] are maintained at levels sufficient to support the population size in (i);

iv the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] dunlin are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 9**.

**NB**. Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by dunlin because they are a feature of this SSSI, which directly abuts the Dee Estuary Ramsar and forms part of both the area of the Dee Estuary pSAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary dunlin population and therefore the Dee Estuary wintering dunlin feature can only be in favourable condition if the conservation objectives pertaining to the North Wirral Foreshore SSSI dunlin feature are also met in full.

**Box 9: Explanatory information for the "wintering dunlin" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al.*, 2001).

**[6] Dunlin prey species:**

Dunlin prey species include ragworms *Hediste diversicolor*, Baltic tellin *Macoma balthica*, mud snails *Hydrobia* spp., brown shrimp *Crangon crangon*, and small shore crabs *Carcinus maenas* (Kirby *et al.*, 2000).

**[7] Dunlin roosting areas**:

Roosting sites regularly used by dunlin are shown in Appendix VI

**[8] Dunlin feeding areas:**

Feeding areas regularly used by dunlin are shown in Appendix VI.

### 14.10 Interest feature 10, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering black-tailed godwit of the Icelandic population

**The conservation objective for the "wintering black-tailed godwit" feature of the Dee Estuary pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering black-tailed godwit**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering black-tailed godwit population is no less than 1,747 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. The abundance and dispersion[5] of black-tailed godwit prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] and feeding[8] black-tailed godwit are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 10.**

**NB**. Additional conservation objectives are provided relating to the use by black-tailed godwit of areas of the Dee Estuary Ramsar / pRamsar above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI, and at Inner Marsh Farm SSSI, used by black-tailed godwit for feeding and roosting. Thus the Dee Estuary Ramsar wintering black-tailed godwit feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of black-tailed godwit prey species including earthworms, leatherjackets and chironomids is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of black-tailed godwit feeding or roosting on the coastal fields are not subject to significant disturbance.

**Box 10: Explanatory information for the "wintering black-tailed godwit" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6] Black-tailed godwit prey species:**

Black-tailed godwit prey species include Baltic tellins *Macoma balthica*, cockles *Cerastoderma edule* and polychaete worms including ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

**[7] Black-tailed godwit roosting areas:**

Roosting sites regularly used by black-tailed godwit are shown in Appendix VI.

**[8] Black-tailed godwit feeding areas:**

Feeding areas regularly used by black-tailed godwit are shown in Appendix VI.

### 14.11 Interest feature 11, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering bar-tailed godwit of the Western Paleartic population

**The conservation objective for the "wintering bar-tailed godwit" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering bar-tailed godwit**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering bar-tailed godwit population is no less than 1,150 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the extent and spatial distribution[3] of vegetation less than 10cm in height across the saltmarsh[5] is maintained;

iv. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[6] and feeding areas;

v. aggregations of bar-tailed godwit roosting[6] or feeding or on the intertidal flats or saltmarsh[4] saltmarsh are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-6] above is provided in **Box 11**.

**NB.** Other conservation objectives are to be produced relating to the use of North Wirral Foreshore SSSI by bar-tailed godwits because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts the Dee Estuary Ramsar and forms part of the area of the Dee Estuary pSAC. North Wirral Foreshore includes the key feeding areas for the Dee Estuary bar-tailed godwit population and therefore the Dee Estuary bar-tailed godwit feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA bar-tailed godwit feature are also met in full.

**Box 11: Explanatory information for the "wintering bar-tailed godwit" conservation objective**

**[1] Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Saltmarsh extent and spatial distribution**:

Saltmarsh extent and distribution is shown in Appendix V

**[6] Bar-tail godwit roosting areas**:

Roosting sites regularly used by bar-tailed godwit are shown in Appendix VI

## 14.12 Interest feature 12, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering curlew of the European population

**The conservation objective for the "wintering curlew" feature of the Dee Estuary pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering curlew**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering curlew population is no less than 3,899 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of curlew prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] curlew are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 12.**

**NB**. Additional conservation objectives are provided relating to the use by curlew of areas of the Dee Estuary Ramsar / pRamsar above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI for feeding and roosting. Thus the Dee Estuary Ramsar wintering curlew feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of curlew prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of curlew feeding or roosting on the coastal fields are not subject to significant disturbance.

**Box 12: Explanatory information for the "wintering curlew" conservation objective**

**[1]. Natural processes:**

The meaning of 'natural processes' is explained in **Box 1.**

**[2]. Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4]. Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5]. Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6]. Curlew prey species:**

Curlew prey species include shore crab *Carcinus maenas* and polychaete worms including ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

**[7]. Curlew roosting areas:**

Roosting sites regularly used by curlew are shown in Appendix VI.

**[8]. Curlew feeding areas:**

Feeding areas regularly used by curlew are shown in Appendix VI.

### 14.13 Interest feature 13, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering redshank of the Eastern Atlantic population

**The conservation objective for the "wintering redshank" feature of the Dee Estuary Ramsar / pRamsar is to maintain the feature in a favourable condition, as defined below:**

The interest feature "**wintering redshank**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering redshank population is no less than 5,293 individuals [*i.e. the 5 year mean peak betweem1994/95-1998/99*];
ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained
iii. The abundance and dispersion[5] of redshank prey species[6] are maintained at levels sufficient to support the population size in (i);
iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10 cm is maintained;
v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] redshank are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 13.**

**NB**. Additional conservation objectives are provided relating to the use by redshank of areas of the Dee Estuary Ramsar / pRamsar above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by redshank for feeding. Thus the Dee Estuary Ramsar wintering redshank feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland with standing water including, pools, ditches and channels is maintained;
d) the abundance of redshank prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of redshank feeding or roosting on the coastal fields are not subject to significant disturbance.

Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by redshank because they are a feature of the Mersey Narrows and North Wirral

Foreshore pSPA, which directly abuts the Dee Estuary Ramsar and forms part of the area of the Dee Estuary pSAC. North Wirral Foreshore includes some of the key feeding areas for the Dee Estuary redshank population and therefore the Dee Estuary wintering redshank feature can only be in favourable condition if the conservation objectives pertaining the Mersey Narrows and North Wirral Foreshore pSPA wintering redshank feature are also met in full.

**Box 13: Explanatory information for the "wintering redshank" conservation objective**

**[1] Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

**[2] Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

**[3] Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the donation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

**[4] Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

**[5] Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

**[6] Redshank prey species:**

Redshank prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp. tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

**[7] Redshank roosting areas:**

Roosting sites regularly used by redshank are shown in Appendix VI.

**[8] Redshank feeding areas:**

Feeding sites regularly used by redshank are shown in Appendix VI.

# 15. Favourable Condition Table for Dee Estuary Ramsar site interest features of the Dee Estuary European marine site

**For further information on the information that English Nature and the Countryside Council for Wales will use to assess the condition of Ramsar interest features within the Dee Estuary European marine site please see the Favourable Condition Table provided for the SPA features in Section 11 of this advice package.**

When making use of the SPA favourable condition table the information provided for the SPA features should be considered applicable for the Ramsar features as detailed below:

The SPA features, 'internationally important populations of regularly occurring migratory species' are analogous to the Ramsar feature waterbird populations qualifying under Ramsar Criterion 6.

The SPA feature 'internationally important assemblage of waterbirds' is analogous to the Ramsar feature 'assemblage of waterbirds' under Ramsar Criterion 5.

N.B. The SPA feature 'internationally important populations of regularly occurring Annex 1 species' includes bar-tailed godwit, which under the Ramsar designation is a waterbird population qualifying under Ramsar Criterion 6.

# 16 Operations advice for the Dee Estuary Ramsar site interest features

The detailed operations advice for the SPA interest features provided in Chapter 12 of this advice package and summarised in Table 7 can be considered applicable to the Ramsar features of the European marine site as detailed below and therefore this information will not be repeated here.

The SPA features, 'internationally important populations of regularly occurring migratory species' are analogous to the Ramsar feature waterbird populations qualifying under Ramsar Criterion 6.

The SPA feature 'internationally important assemblage of waterbirds' is analogous to the Ramsar feature 'assemblage of waterbirds' under Ramsar Criterion 5.

# 17. Bibliography

ABP RESEARCH & CONSULTANCY LTD. 1999. Natura 2000: *Good practice guidelines for ports and harbours operating within or near UK European marine sites*. UK Marine SACs Project.

ARMITAGE, M. J. S., BURTON, N. H. K., ATKINSON, P. W., AUSTIN, G. E., CLARK, N. A., MELLAN, H. J., & REHFISCH, M. M. 2002. *Reviewing the Impact of Agency Permissions and Activities on Bird Populations in Special Protection Areas: Level 1 Interpretation*. BTO Research Report No. 296. Thetford: British Trust for Ornithology.

ASHALL, J., DUCKWORTH, J., HOLDER, C. & SMART, S. 1991. *Sand dune survey of Great Britain, Site report No. 131, Gronant to Talacre, Delyn, Wales 1991*. JNCC Report No. 46. Peterborough: Joint Nature Conservation Committee.

BALMER, D. E., HOLLOWAY, S. J., BURTON, N. H. K. & CLARK, N. A. 2002. *A study of the risk of collision with power lines by common terns and waterbirds of Shotton steel works, North Wales*. British Trust for Ornithology Science Report, Thetford.

BOLAS, M. & DAY, P. 1998. *SSSI Management Plan: Gronant Dunes and Talacre Warren SSSI*. Countryside Council for Wales, internal document, unpublished.

BRIGGS MARINE ENVIRONMENTAL SERVICES LTD. 2003. *Environment Agency, Corus and Port of Mostyn Dee Estuary Oil Spill Contingency Plan*. Aberdeen: Briggs Marine Environmental Services Ltd.

BROWN, A.E., BURN, A.J., HOPKINS, J.J. & WRAY, S.F. 1997. *The Habitats Directive: Selection of Special Areas of Conservation in the UK*. JNCC Report No. 270.

BURD, F. 1989. *The Saltmarsh survey of Great Britain: an inventory of British saltmarshes*. Research and Survey in Nature Conservation Report No. 17. Peterborough: Joint Nature Conservation Committee.

BURTON, N.H.K., PAIPAI, E., ARMITAGE, M J.S., MASKELL, J.M., JONES, E.T., STRUVE, J., HUTCHINGS, C.J. & REHFISCH, M.M.. 2002. *Effects of Reductions in Organic and Nutrient Loading on Bird Populations in Estuaries and Coastal Waters of England and Wales Phase 1 Report March 2002*. BTO Research Report No. 267. Thetford: BTO.

CCW. 1993. *Welsh estuaries review*. Bangor: Countryside Council for Wales.

CCW. 2002. *Basis for selection of Aber Afon Dyfrdwy / Dee Estuary possible Special Area of Conservation*. Draft CCW internal report. Bangor: Countryside Council for Wales.

CRANSWICK, P., POLLITT, M., MUSGROVE, A., & HUGHES, B. 1999. *The Wetland Bird Survey 1997-98 Wildlife and Wader Counts*. British Trust for Ornithology, WWT, RSPB & JNCC.

COLE, S., CODLING, I.D., PARR, W. & ZABEL, T. 1999. Natura 2000: *Guidelines for managing water quality impacts within UK European marine sites*. UK Marine SACs Project.

DARGIE, T. 2001. *NVC survey of the saltmarsh and other habitats in the Dee & Clwyd Estuaries 2000*. CCW Science Report No. 450. Bangor: Countryside Council for Wales.

DETR & THE WELSH OFFICE. 1998. *European marine sites in England and Wales. A guide to the Conservation (Natural Habitats & c.) Regulations 1994 and to the preparation and application of management schemes*. London.

ELLIOTT, M., NEDWELL, S., JONES, N .V, READ S.J, CUTTS, N.D. & HEMINGWAY, K. L. 1998. *Intertidal sand and mud flats and subtidal mobile sandbanks (volume II). An overview of dynamics and sensitivity characteristics for conservation management of marine SACs*. Scottish Association for Marine Science (UK Marine SACs Project).

ENVIRONMENT AGENCY, 1998. *Dee local environment agency plan.* Bangor: Environment Agency.

GARWOOD, P. & FOSTER-SMITH, R. 1991. *Marine Nature Conservation Review: Intertidal survey from Rhos Point to New Brighton.* Peterborough: Nature Conservancy Council.

GOSS-CUSTARD, J. D., WEST, A. D., STILLMAN, R. A., DURRELL, S. E. A. L. D., CALDOW, R. W. G., MCGORTY, S., & NAGARAJAN, R. 2001. Density-dependant starvation in a vertebrate without significant depletion. *Journal of Animal Ecology*, **70**, 955-965.

GOULDSTONE, A. 1994. *Wintering Bird Surveys in Gronant Dunes, Foreshore and the Warren, Talacre*. Newtown: RSPB.

HAZLEWOOD, M. 2002. *An assessment of the current status of the Dee Estuary Cockle Stocks (May / June 2002).* Internal Report. Buckley: Environment Agency Wales.

HENDERSON, P. 2003. *Background information on species of shad and lamprey.* London: Pisces Conservation Ltd.

HILL, M. 1986. *Population studies of Spartina anglica (J C E Hubbard) in the Dee Estuary.* Unpublished PhD thesis. University of Liverpool.

HILL, M. I. 1987. *Vegetation change in the communities of* Spartina anglica *(C. E. Hubbard) in saltmarshes of north-west England.* Peterborough, Nature Conservancy Council. (Contract Surveys No. 9)

HISCOCK, K., ed. 1996. *Marine Nature Conservation Review: rationale and methods*. Peterborough: Joint Nature Conservation Committee.

HOLT, T.J., JONES, D.R., HAWKINS, S.J. & HARTNOLL, R.G. 1995. *The sensitivity of marine communities to man-induced change - a scoping report*. Contract Science Report no.65. Bangor: CCW.

HOWARTH, G., WESTERBERG-LIPTROT, K. & EVANS, J. 2001. *Urban Waste Water Treatment Directive: Dee Estuary Sensitive Area (Eutrophic) Designation*. Buckley: Environment Agency.

HUBBARD, J. C. E. & STEBBINGS, R. E. 1967. Distribution, dates of origin and acreages of *Spartina townsendii* (S.I) marshes in G.B. *Proceedings of the Botanical Society of the British Isles*, Vol. 7, pp.1-7.

HUTCHINSON, S. M. 1994. Distribution of super (137)Cs in saltmarsh sediments in the Dee Estuary, NW England. *Marine Pollution Bulletin*, Vol. 28 (4), pp.262-265.

JEMMETT, A. 1993. *The Dee Estuary Review*. Unpublished report. Birkenhead: The Dee Estuary Strategy.

JNCC. 1996. *Guidelines for the selection of biological SSSI's: intertidal marine habitats and saline lagoons*. Peterborough: Joint Nature Conservation Committee.

JNCC. 2003. *Handbook on the UK status of EC Habitats Directive interest features: provisional data on the UK distribution and extent of Annex I habitats and the UK distribution and population size of Annex II species*. JNCC Report 312. Joint Nature Conservation Committee. www.jncc.gov.uk/Publications/JNCC312/default.htm

JONES, L.A., HISCOCK, K. & CONNOR, D.W. 2000. Marine Habitat Reviews. *A summary of ecological requirements and sensitivity characteristics for the conservation and management of marine SACs*. Peterborough: Joint Nature Conservation Committee.

JONES, M., LOUGH N., BAUKHAM, K., BUNKER, A., LINDENBAUM, C., BRUNSTROM, A., BRAZIER, P. 2002. *Dee Estuary Conservation Assessment*. Internal Report. Bangor: Countryside Council for Wales.

KAISER, M. J., BROAD, G. & HALL, S.J. 2001. Disturbance of intertidal soft-sediment benthic communities by cockle hand raking. *Journal of Sea Research*, Vol.45, pp.119-130.

KIRBY, M. F., BLACKBURN, M. A., THAIN, J. E, & WALDOCK, M. J. 1998. Assessment of water quality in estuarine and coastal waters of England and Wales using a contaminant concentration technique. *Marine Pollution Bulletin*, Vol. 36 (8), pp. 631-642.

KIRBY, J., DREWITT, A., CHIVERS, L., & SAUNDERS, R. 2000. Key habitat attributes for birds and bird assemblages in England. Peterborough: *English Nature Research Reports*, No. 359.

LIFE IN UK RIVERS PROJECT. 2003. *Handbook of the Ecological requirements of species and habitats of European Importance: Ecological requirements of the river, brook and sea lampreys*. Life in UK Rivers Project. www.english-nature.org/lifeinukrivers/index.html

LIVERPOOL MUSEUM. 1994. *Liverpool Museum 1993 Upper Dee Estuary Terrestrial and Aquatic Invertebrate Survey*. A survey for the North Wales Wildlife Trust supported by National Power. Liverpool: Liverpool Museum (National Museums and Galleries on Merseyside).

LIVERPOOL MUSEUM. 2003. *Invertebrate Biodiversity and Conservation Management at Talacre Dunes and The Warren SSSI, Point of Ayr, Flintshire*. A survey for BHP Petroleum Ltd, Draft Report. Liverpool: Liverpool Museum (National Museums Liverpool).

MARLIN. *The Marine Life Information Network for Britain and Ireland*. An initiative of the Marine Biological Association of the UK. www.marlin.ac.uk.

MAITLAND, P. S. 1997. *Species action plans for lampreys in England*. Fish Conservation Centre Report to JNCC, Peterborough.

MUSGROVE, A., POLLITT, M., HALL, C., HEARN, R., HOLLOWAY, S., MARSHALL, P., ROBINSON, J., CRANSWICK, P. 2001. *The Wetland Bird Survey 1999-2000 Wildfowl and Wader Counts*. British Trust for Ornithology, WWT, RSPB & JNCC.

MUSGROVE, A. (in press). *WeBS Low Tide Counts – Dee Estuary 2001-2002.*

NARAYANA, Y., JONES D. G., STRUTT, M. H. & RAINEY, M. P. 2001. *Distribution and enrichment of $^{137}$Cs in Dee Estuary saltmarsh*. NERC Co-ordinating group on environmental radioactivity (COGER). Abstracts from the twentieth open meeting at Imperial College, 12-14 September 2001. http://www.erconsult.co.uk/coger/2001/2001_abstracts.htm

NATURE CONSERVANCY COUNCIL, 1978. *Dee Estuary Research Review*. Nature Conservancy Council North Wales Region.

NATIONAL RIVERS AUTHORITY, 1993. *The Dee Estuary Uses, Objectives and Standards*. Cardiff: National Rivers Authority.

NICHOLAS PEARSON ASSOCIATES LTD. 1993. *Baseline Ecological Studies Winter and Autumn Passage Bird Populations at Point of Ayr, Clwyd*. A report on behalf of Hamilton Oil Company Ltd.

PARR, S. J. 1988. *The Dee Estuary Site of Special Scientific Interest: An ecological appraisal.* A report for the Nature Conservancy Council. Newtown: RSPB.

PERCIVAL, S. & PERCIVAL, T. 1998. *Dee Estuary Wildfowling Strategy Project.* A report to Dee Wildfowlers Club.

POTTER, L. 2003. *Interim report on the Dee Estuary AMP3 investigation.* Bangor: Environment Agency Wales.

POTTER, M. & HATTON-ELLIS, T. 2003. *Conservation Fish Surveys of Riverine proposed Special Areas of Conservation in Wales: Phase II.* Bangor: Countryside Council for Wales and Environment Agency Wales.

POTTS, G. W., & SWABY, S. E. 1993. Review of the status of estuarine fishes. Peterborough: *English Nature Research Reports*, No. 34. English Nature and the Marine Biological Association. Peterborough and Plymouth.

PRATER, A. J. 1981. *Estuary Birds of Britain and Ireland.* A Report of the Birds of Estuaries Enquiry. Calton: T. & A. D. Poyser Ltd.

RAVENSCROFT, N. O. M. & BEARDALL, C. H. 2003. The importance of freshwater flows over estuarine mudflats for wintering waders and wildfowl. *Biological Conservation.* Vol. 113, pp. 89-97.

REISE, K., GOLLASCH, S. & WOLFF, W. J. 1999. Introduced marine species of North Sea coasts. *Helgolaender Meeresuntersuchungen*, Vol. 52 (3-4), pp.219-234.

RODWELL, J. S. 2000. *British Plant Communities Volume 5, Maritime communities and vegetation of open habitats*. Cambridge University Press, Cambridge.

ROSE, C. L., MCKAY, W. A., LEONARD, D. R. P., BARR, H. M., TOOLE, J. & HALLIWELL, C.M. 1996. Radioactivity in two tide-washed marsh areas in the eastern Irish Sea: A radiological assessment. *Science of the Total Environment*, Vol.191 (1-2), pp.1-13.

SHORELINE MANAGEMENT PARTNERSHIP 2002. *Wing Transportation Facility: River Dee Transit, Addendum to Appropriate Assessment Baseline Report of December 2001*. A report by Shoreline Management Partnership on behalf of Airbus UK.

SMITH, R. 2003. *The effect of kite surfing on wader roosts at West Kirby, Dee Estuary*. Unpublished Report on behalf of the West Kirby Voluntary Wardens.

SIMMONDS, M.P., JOHNSTON, P.A. & FRENCH, M.C. 1993. Organochlorine and mercury contamination in United Kingdom seals. *The Veterinary Record*. Vol. 132 (12) pp.291-295

TYLER, A. O., MILLWARD, G. E., JONES, G. E, & TURNER, A. 1994. Polychlorinated dibenzo-para-dioxins and polychlorinated dibenzofurans in sediments from U.K. estuaries. *Estuarine, Coastal and Shelf Science*. Vol. 39 (1) pp.1-13.

WASSON, K., ZABIN, C. J., BEDINGER, L., DIAZ, M. C. & PEARSE, J. S. 2001. Biological invasions of estuaries without international shipping: the importance of intra-regional transport. *Biological Conservation*, Vol.102 (2), pp.143-153.

WATERS R., J., CRANSWICK, P. A., MUSGROVE, A. J., & POLLITT, M. S. 1998. *The Wetland Bird Survey 1996-97: Wildfowl and Wader Counts*. Slimbridge: BTO/WWT/RSPB/JNCC.

WELLS, C. E., FRISWELL, N. 2000. *Dee Estuary WeBS Annual Report – Winter 1999/2000*. RSPB, Burton Point Farm.

WELLS, C. E., FRISWELL, N. 2001. *Dee Estuary WeBS Annual Report – Winter 2000/2001* . RSPB, Burton Point Farm.

WELLS, C. E., FRISWELL, N. 2002. *Dee Estuary WeBS Annual Report – Winter 2001/2002* . RSPB, Burton Point Farm.

WELLS, C. E., FRISWELL, N. 2003. *Dee Estuary WeBS Annual Report – Winter 2002/2003* . RSPB, Burton Point Farm.

WELLS, C. E. & GOULDSTONE, A. 1999. *Dee Estuary Reserve Management Plan 1999-2004*. RSPB, Burton Point Farm.

# 18. Glossary

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| **Abrasion** | The process of scraping or wearing down by friction |
| **Advisory Group** | A body of representatives from local interests, user groups and conservation groups, formed to advise a management group |
| **Algal bloom** | A massive reproduction and growth of algae, often free-floating, in response to the presence of higher than normal levels of nutrients. |
| **Annex 1 birds** | The species listed in Annex 1 of the Birds Directive are the subject of special conservation measures concerning their habitat. These measures ensure the survival and reproduction of the birds in their area of distribution. Species listed on Annex 1 are in danger of extinction, rare or vulnerable |
| **Annex I habitat type(s)** | A natural habitat(s) listed in Annex I of the Habitats Directive for which Special Areas of Conservation can be selected. |
| **Annex II species** | A species listed in Annex II of the Habitats Directive for which Special Areas of Conservation can be selected. |
| **Anthropogenic** | Produced by human activity. |
| **Assemblage** | A collection of plants and/or animals characteristically associated with a particular environment but not necessarily interdependent. |
| **Attribute** | Characteristic of an interest feature/sub-feature or supporting habitat, which provides an indication of the condition of the feature/sub-feature or supporting habitat to which it applies. |
| **BAP** | Biodiversity Action Plan. |
| **Baseline** | A standard or value from which it is possible to determine any deviation in the integrity of the interest features for which the site has been designated. |
| **Benthos** | Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides. |
| **Bioaccumulation** | The ability of organisms to retain and concentrate substances from their environment. The gradual build-up of substances in living tissue, usually used in referring to toxic substances, may result from direct absorption from the environment or through the food chain. |
| **Biodegradation** | Breakdown or decomposition by bacteria or other biological means. |
| **Biodiversity** | The total variety of life on earth. This includes diversity within species, between species and ecosystems. |
| **Biogeographic region** | A region which is separated from adjacent regions by barriers or a change in environmental conditions which limits the movement of species or prevents their establishment outside their natural geographical range. |
| **Biomagnification** | Increasing concentrations of a substance in successive trophic levels of a food chain. |
| **Biomass** | The total quantity of living organisms in a given area. |
| **Biotope** | The physical habitat with its biological community; a term, which refers to the combination of physical environment and its distinctive assemblage of conspicuous species. |
| **Characteristic** | Special to, or especially abundant in, a particular situation or biotope. Characteristic species should be immediately conspicuous and easily identified. |
| **Chart datum** | Approximately the lowest tidal level due to astronomical effects, and excluding meteorological effects. |

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| **Circalittoral** | The rocky subtidal zone dominated by animals and below the zone that is dominated by algae (Animal dominated subtidal zone). |
| **Community** | A group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and identifiable by means of ecological survey from other groups. |
| **Competent authority** | Any Minister, government department, public or statutory undertaker, public body or person holding a public office that exercises legislative powers. |
| **Conservation objective** | A statement of the nature conservation aspirations for a site, expressed in terms of the favourable condition that we wish to see the species and/or habitats for which the site has been selected to attain. Conservation objectives for European marine sites relate to the aims of the Habitats Directive. |
| **Crustaceans** | A class of invertebrates that include crabs, shrimps and barnacles. |
| **Diversity** | The richness of different types in a location, including the number of different biotopes and numbers of species. |
| **Epifauna** | Benthic animals living on the seabed of sediments or hard substrates. |
| **Eulittoral** | The main part of the intertidal zone characterised by limpets, barnacles, mussels, fucoid algae and red algae often abundant on the lower part. |
| **European marine site** | A European site that consists of, or in so far as it consists of, areas covered intermittently or continuously by seawater. |
| **European Site** | A classified SPA, designated SAC, site of Community importance (a site selected as a candidate SAC, adopted by the European Commission but not yet designated), a candidate SAC (in England only) or a site hosting a priority species in respect of which Article 5 of the Habitats directive applies. |
| **Eutrophication** | The over-enrichment of an aquatic environment with inorganic nutrients, especially nitrates and phosphates, often anthropogenic (e.g. sewage, fertiliser run-off), which may result in stimulation of growth of algae and bacteria, and can reduce the oxygen content of water. |
| **Exposure** | The relative extent and intensity of the effects of broad categories of human activities currently occurring on the site to which the interest features or their component sub-features on the site are subject. |
| **Fauna** | Animal life in an area. |
| **Favourable condition** | A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function within an individual *Natura 2000* site in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis. |
| **Favourable conservation status** | A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function throughout the biogeographic region in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis. |
| **Habitat** | The place in which a plant or animal lives. |
| **Habitats Directive** | The abbreviated term for *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora*. It is the aim of this Directive to promote the conservation of certain habitats and species within the European Union. |
| **Halophytic** | Plants that thrive in, or tolerate the presence of saline conditions. |

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| **Highest Astronomical Tide** | The highest tidal level that can be predicted to occur under average meteorological conditions and in any combination of astronomical conditions. |
| **Hydrodynamic regime** | The particular conditions of water movement at one particular site, including wave action, tidal streams and residual currents. |
| **Infauna** | Benthic animals that live within the seabed. |
| **Infralittoral** | The subtidal zone in which upward facing rocks are dominated by erect algae, typically kelps. |
| **Interest feature** | A natural or semi-natural feature for which a European site has been selected. This includes any Habitats Directive Annex I habitat, or any Annex II species and any population of a bird species for which an SPA has been designated under the Birds Directive. |
| **Littoral** | The area of the shore that is occupied by marine organisms which are adapted to or need alternating exposure to air and wetting by submersion, splash or spray. Also called intertidal. |
| **Maintain** | The action required for an interest feature when it is considered to be in favourable condition. |
| **Management group** | The body of relevant authorities formed to manage the European marine site. |
| **Management scheme** | The framework established by the relevant authorities at a European marine site under which their functions are exercised to secure, in relation to that site, compliance with the requirements of the Habitats Directive. |
| **Molluscs** | Soft-bodied, unsegmented, invertebrate animals usually with shells and includes cockles, whelks, limpets, oysters and snails. |
| **Nationally scarce/rare** | For marine purposes, these are regarded as species of limited national occurrence |
| ***Natura 2000*** | The European network of protected sites established under the Birds Directive and the Habitats Directive |
| **Non-synthetic contamination** | Non-synthetic compounds are those materials that occur naturally. They may have to be refined before they are useful to man and could occur in many slightly different forms. Examples of non-synthetic materials are; heavy metals and hydrocarbons (oil and petrol). |
| **Notable species** | A species that is considered to be notable due to its importance as an indicator, and may also be of nature conservation importance, and which is unlikely to be a 'characteristic species'. |
| **Operations which may cause deterioration or disturbance** | Any activity or operation taking place within, adjacent to, or remote from a European marine site that has the potential to cause deterioration to the natural habitats for which the site was designated, or disturbance to the species and its habitats for which the site was designated. |
| **Opportunistic species** | A species that is able to rapidly exploit changes in habitat conditions or circumstances to its own advantage. |
| **Plan or project** | Any proposed development that is within a relevant authority's function to control, or over which a competent authority has a statutory function to decide on applications for consents, authorisations, licences or permissions. ACK to update |
| **Ramsar site** | A site listed under the Convention on Wetlands of International Importance especially as Waterbirds Habitat, which was agreed at Ramsar, Iran. |
| **Relevant authority** | The specific competent authority which has powers or functions which have, or could have, an impact on the marine environment, or adjacent to, a European marine site. |

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| **Reporting period** | The cycle within which a definitive report on the condition of features protected within the site series will be produced, set as once in every 6 years. |
| **Restore** | The action required for an interest feature when it is not considered to be in a favourable condition. |
| **Sensitivity** | The intolerance of a habitat, community or individual species to damage from an external force. |
| **Sub-feature** | An ecologically important sub-division of an interest feature. |
| **Sublittoral** | The zone of the shore below low water exposed to air only at its upper limit by the lowest spring tides. |
| **Supporting Habitats** | The key habitats within the European marine site necessary to support the qualifying species interest features. |
| **Synthetic contamination** | Synthetic compounds are those materials that have been manufactured artificially by chemical reaction. Examples of some synthetic compounds are; antifouling paints, detergents, pesticides (Polychloronatedbiphenyls or PCBs) and biocides (tributyltin or TBT). |
| **Turbidity** | This is a measure of the attenuation of light in the water column and can be caused by the light adsorption properties of the water, plankton, suspended particulate organic and inorganic matter and dissolved colour. |
| **Typical species** | A species that is considered to be a typical component of a feature or sub-feature. |
| **Vulnerability** | The exposure of a habitat, community or individual of a species to an external factor to which it is sensitive. |
| **WeBS** | Wetland Bird Survey a collaborative national surveillance scheme of the UK's waterbirds based on counts undertaken once per month outside of the breeding season. |