ENGLISH NATURE

Essex Estuaries European marine site

English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

Issued 14 June 2000

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English Nature's advice for the Essex Estuaries candidate Special Area of Conservation given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

Preface

This document provides English Nature's advice to other 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 the Essex Estuaries European marine site. This advice is being prepared to fulfill our obligations under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994.

The Essex Estuaries European marine site is part of a candidate Special Area of Conservation. It is Government policy that such sites should be protected as if they were already designated and, where appropriate, it is desirable to establish voluntary management schemes at an early stage, before the formal statutory obligations apply, and to act in the spirit of the Directive in the meantime (DETR & The Welsh Office 1998). In light of this policy, we have worked with many of you to develop this advice in advance of statutory obligations applying. It should be noted, however, that amendments to the Habitats Regulations for England are currently in force which will result in the statutory obligations within the Regulations being applied to candidate SACs earlier in the process than currently.

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 under the Habitats Directive, which support certain natural habitats and species of European importance, and Special Protection Areas under the Birds Directive which support significant numbers of internationally important wild birds. In many instances, as in the case of Essex Estuaries European marine site, these designations may coincide and our advice is being prepared to cover both the SAC and SPA interests.

This 'Regulation 33 package' is designed to help relevant and competent authorities, who have responsibilities to implement the Habitats Directive, to:

- understand the international importance of the site, underlying physical processes and the ecological requirements of the habitats and species involved;
- develop a management scheme to ensure that the ecological requirements of the site's interest features are met; and
- set the standards against which the condition of the site's interest features can be determined and undertake compliance monitoring to establish whether they are in favourable condition.

In addition, the Regulation 33 package will provide a basis to inform the scope and nature of 'appropriate assessment' required in relation to plans and projects (Regulations 48 & 50 and by English Nature under Regulation 20). English Nature 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. In addition, we 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. If during the European Union's moderation process qualifying interest features are added to this European marine site, English Nature will add to this advice, as appropriate.

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1. Introduction

1.1 Natura 2000

The European Union Habitats[1] and Birds[2] Directives are international obligations which 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[3]. The Birds Directive protects all wild birds and their habitats within the European Union, especially migratory birds and those 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 for the Birds Directive, Special Protection Areas (SPAs) which support wild birds of European Union interest. These sites will form a network of conservation areas to be known as "Natura 2000". Where SACs or SPAs consist of 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.

Further guidance on European marine sites is contained in the Department of the Environment Transport and Regions/Welsh Office document: *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*.

1.2 English Nature's role

The Conservation (Natural Habitats &c.) Regulations 1994 translate the Habitats Directive into law in Great Britain. It gives English Nature a statutory responsibility to advise relevant authorities as to the conservation objectives for European marine sites in England and to advise 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 sites have been designated. This information will be a key component of any of the management schemes which may be developed for these sites.

This document is English Nature's advice for the Essex Estuaries European marine site. Following consultation and acceptance by English Nature Council, this document is issued in fulfilment of Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994 (the 'Regulation 33 package'). Copies of key references quoted in this document are held at the English Nature local office.

In addition to providing such advice, the Regulation 33 package will inform the scope and nature of 'appropriate

[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

[3] 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.

assessment' which the Directive requires to be undertaken for plans and projects (Regulations 48 & 50 and by English Nature under Regulation 20). In the future, English Nature may also provide more detailed advice to competent and relevant authorities to assess the implications of any such plans or projects.

1.3 The role of relevant authorities

The Conservation (Natural Habitats &c.) Regulations 1994 require relevant authorities to exercise their functions so as to secure compliance with the Habitats Directive. The management scheme which the relevant authorities acting as the management group are developing under Regulation 34 for the Essex Estuaries European marine site will provide the framework through which this will be done, and it should be based on the advice in this package. In this respect, 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.

Relevant authorities should ensure that all plans for the area integrate with the management scheme for the European marine site. Such plans may include shoreline management plans, local Environment Agency plans, SSSI management plans, local BAP plans and sustainable development strategies for estuaries. This must occur to ensure that there is only a single management scheme through which all relevant authorities exercise their duties under the Conservation (Natural Habitats &c.) Regulations 1994.

Relevant authorities also need to have regard to changing circumstances of the SAC and SPA and may therefore need to modify the management scheme and/or the way in which they exercise their functions so as to maintain the favourable condition of interest features concerned in the long term. There is no requirement for relevant authorities to take any actions outside their statutory functions.

Under certain circumstances, where another relevant authority is unable to act for legal reasons, or where there is no other relevant authority, English Nature is empowered to use its bylaw-making powers for Marine Nature Reserves (MNR) for use in European marine sites.

1.4 Activities outside the control of relevant authorities

Nothing within this Regulation 33 package will require relevant 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[4]. This also applies if the changes, although causing deterioration or disturbance to the interest features, are the result of human or natural events outside their control. Having issued Regulation 33 advice for European marine sites, English Nature will work with relevant authorities and others to agree, within a defined time frame, a protocol for evaluating all observed changes to baselines and to develop an understanding of natural change and provide further guidance as appropriate and possible. On the Essex Estuaries European marine site a forum already exists and should be used to alert English Nature to such issues so that they may be assessed and any appropriate measures taken. This does not however preclude relevant authorities from taking action to prevent other identified deterioration to the interest features, for example by introducing or promoting codes of practice through the Management Group.

1.5 Responsibilities under other conservation designations

In addition to its candidate SAC and SPA status, parts of Essex Estuaries are also designated and subject to

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

agreements under other conservation legislation (e.g. SSSIs notified under the Wildlife and Countryside Act 1981 as amended 1985). The obligations of relevant authorities and other organisations under such designations are not affected by the advice contained in this document.

1.6 Role of conservation objectives

Section 4 of this document sets out the conservation objectives for the Essex Estuaries European marine site. They are the starting point from which management schemes and monitoring programmes are to be developed as they provide the basis for determining what is likely to cause a significant effect, and for informing on the scope of appropriate assessments of plans or projects. The conservation objectives set out what needs to be achieved and thus deliver the aims of the Habitats Directive.

1.7 Role of advice on operations

The advice on operations set out in Section 7 provides the basis for discussion about 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. It is given on the basis of the working assumption that sites have been generally presumed to have been in favourable condition at the time they were identified. This assumption will be tested during the 2000 - 2006 reporting period. The advice should also be used to identify the extent to which existing measures of control, management and use are, or can be made, consistent with the conservation objectives and thereby focus the attention of relevant authorities and surveillance to areas that may need management measures.

This operations advice will need to be supplemented through further detailed discussions with the management and advisory groups in formulating and agreeing a management scheme, where required, to agreed timescales for the European marine site.

2. Identification of features under the EU Habitats and Birds Directives

2.1 Introduction

The Essex Estuaries European marine site is the second largest estuarine site on the east coast of England. It contributes to the essential range and variation of estuaries in the UK as the best example of a coastal plain estuary system on the British North Sea coast. Covering an area of 472 square kilometres, this relatively undeveloped estuary complex contains the major estuaries of the Colne, Blackwater, Crouch and Roach, as well as extensive open coast tidal flats at Foulness, Maplin and the Dengie. The intertidal mudflats and sandflats within the European marine site support a wide range of typical estuarine and marine communities on sediments ranging from the finer estuarine muds and muddy sands to coarser sands and gravels.

On the tide-swept shores of the lower estuarine areas, a number of diverse and unusual marine communities have developed. Here, boulders and cobbles overlie the mud and support a range of sponges, anemones and sea squirts. On the finer sediments, communities of marine worms, shellfish, and marine snails predominate. The sandier sediments of Maplin sands, on the open coast, support extensive beds of eelgrass and cockles. The mudflats and sandflats are a rich food source for over 182,000 waders and wildfowl which overwinter here, with some species represented in internationally important numbers. In the summer the site hosts breeding populations of three species of tern, listed under Annex 1 of the Birds Directive, which mostly nest on sand and gravel beaches. The subtidal areas exhibit a range of estuarine communities which grade into richer marine communities on more variable substrates. Mixed sediments on the sea bed of the open coast areas are populated by the fern-like whiteweed and the sinuous tubes of the reef-building worm. In the sheltered areas within the estuaries, the build up of sediments creates the conditions required for saltmarsh development. Saltmarshes border the upper shores and display a range of vegetation which varies according to tolerance to tidal flooding.

One fifth of the total area of British saltmarshes occurs in East Anglia, with the Essex Estuaries European marine site containing approximately 8% of the UK saltmarsh resource (about 3,500 hectares). Saltmarshes are highly productive biologically, providing nutrients which support other features within the marine ecosystem, such as mudflats, sandflats and subtidal areas, and wildfowl which graze the shoots of saltmarsh flowers and grasses or feed on the seeds of saltmarsh plants. They have an important physical role too acting as a sediment store to the estuary system as a whole and in providing roosting sites for waders and wildfowl at high tide. They also have an important flood defence function, absorbing wave energy and forming a natural buffer between land and sea. This latter function helps to protect the marsh surface itself from erosion.

The combination of historical land claim for agricultural use and erosion has contracted the Essex saltmarshes from 50,000 hectares in the 16th century to 4,500 currently. The effect of 'coastal squeeze', whereby saltmarshes are being 'squeezed out' between artificial sea defences and rising sea levels, causes saltmarsh to erode at the seaward edge and creek edges, as the saltmarsh tries to accommodate increased tidal flows. It does this by widening, flattening and extending its creeks and by forming 'pans'. Though this helps to spread the increased tidal energy over a greater area, the enlarged creek system also allows higher wave energy to penetrate inland. In a natural system, without sea walls, this process moves the saltmarsh landward enabling it to compensate for its seaward losses, provided that land levels and silt supply favour saltmarsh development. Seawalls, however, prevent this landward migration and truncate the upper marsh, favouring the development of pioneer marsh at the expense of Atlantic salt meadows. The upper mudflats and subtidal channels are also eroding which will steepen the subtidal profile and further threaten the integrity of saltmarsh and mudflat. The Coastal Geomorphology Partnership (2000), in a report commissioned by the Environment Agency, have described the erosion of saltmarsh on the Essex coast over a period of 25 years. During this time, the Blackwater estuary has suffered saltmarsh losses of 22%, the River Crouch, 34%, the Colne, 12% and the Dengie peninsular 14%. In order to maintain the extent of these habitats in favourable condition it is likely that

future managed re-alignment schemes will be required to offset losses. This issue will be considered in detail through preparation of a Coastal Habitat Management Plan (CHaMP) as part of the ongoing EU LIFE Nature project: *Living with the Sea*. Such works have already been undertaken in the Blackwater Estuary, both as part of operational sea defence works and on an experimental basis. Coastal squeeze is exacerbated in south-east England by land level adjustments since the last ice age causing the land to sink. Relative sea level rise in the south-east is estimated to be 3 mm per annum with current trends indicating a doubling to 6 mm per annum.

The Essex Estuaries is a candidate Special Area of Conservation (cSAC) and the constituent estuaries and contiguous open coast areas are classified separately as five distinct Special Protection Areas (SPAs), the boundaries of which are illustrated in Appendix 2. The marine components of these sites each qualify as European marine sites but, for simplicity, and for the purposes of this advice, both the SAC and SPA components are treated as a single European marine site - the Essex Estuaries European marine site. Accordingly, the advice in this document covers both the cSAC habitat interests and the SPA bird interests.

2.2 Interest features under the EU Habitats Directive

The Essex Estuaries has been selected as a c SAC for the following six Annex I habitat features under the EU Habitats Directive:

- ***Salicornia* and other annuals colonising mud and sand** (referred to within this document as pioneer saltmarsh)
- ***Spartina* swards (*Spartinion*)** (referred to within this document as Cordgrass swards)
- **Atlantic salt meadows (*Glauco-Puccinellietalia*)**
- **Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fruticosae*)** (referred to within this document as Mediterranean saltmarsh scrubs)
- **Estuaries**
- **Mudflats and sandflats not covered by seawater at low tide** (referred to within this document as intertidal mudflats and sandflats)

Where these habitats occur within the European marine site they are referred to as interest features. Sub-features have also been identified to highlight the ecologically and physiographically important components of each interest feature. The interest features of the Essex Estuaries European marine site are discussed in more detail in Section 3. The boundary of the cSAC and the distribution and extent of these interest features and the more detailed sub-features are mapped in Figure 1.

The landward boundary of the cSAC is the point of Highest Astronomical Tide. The seaward boundary, which is defined by navigation buoys, runs from Shoebury Ness south to the Leigh South cardinal buoy, then heads due east northeast to the Blacktail Spit Buoy. It then tracks due northeast to the Maplin east cardinal buoy, by Shoe Hole, continuing on to the Maplin north-east buoy, going outside the Whitaker Beacon. At 51º 40.00N 1º 07.18E, it travels due north, east of the Priory Spit, to the coastline at Jaywick.

2.3 Interest features under the EU Birds Directive

The Essex Estuaries European marine site encompasses five Special Protection Areas for Wild Birds, as designated under the EU Birds Directive. The sites which were designated between 1992 and 1998, are:

Site	Date Designated
Colne Estuary	28 July 1994
Blackwater Estuary (including Old Hall Marshes)	12 May 1995
Dengie	24 March 1994
Crouch and Roach Estuaries	29 June 1998
Foulness	4 October 1996

Each SPA qualifies for a number of different internationally and nationally important bird species.

The **Blackwater Estuary SPA** qualifies under Article 4.1 of the EU Birds Directive by supporting:

- internationally important breeding populations of the regularly occurring Annex 1 species: little tern (*Sterna albifrons*).

The Blackwater Estuary SPA also qualifies for supporting an internationally important wintering population of the Annex 1 species hen harrier (*Circus cyaneus*). The habitat required for this species to feed - grassland/grazing marsh - does not however, occur within the European marine site, as it occurs above Highest Astronomical Tide. Objectives to maintain this aspect of bird interest in favourable condition are found within English Nature's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities need to have regard to such adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

The Blackwater Estuary SPA also qualifies under Article 4.2 of the EU Birds Directive in that it supports:

- an internationally important assemblage of waterfowl (wildfowl and waders); and
- internationally important populations of regularly occurring migratory species.

The **Colne Estuary SPA** qualifies under Article 4.1 of the EU Birds Directive by supporting:

- internationally important breeding populations of the regularly occurring Annex 1 species: little tern (*Sterna albifrons*).

As with the Blackwater Estuary SPA, the Colne Estuary SPA also qualifies for supporting an internationally important wintering population of the Annex 1 species hen harrier (*Circus cyaneus*). The habitat required for this species to feed - grassland/grazing marsh - does not however, occur within the European marine site, as it occurs above Highest Astronomical Tide. As with the Blackwater Estuary SPA, objectives to maintain this aspect of bird interest in favourable condition are found within English Nature's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities need to have regard to such adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

The Colne Estuary SPA also qualifies under Article 4.2 of the EU Birds Directive in that it supports:

- an internationally important assemblage of waterfowl (wildfowl and waders); and
- internationally important populations of regularly occurring migratory species; and
- nationally important breeding populations of the regularly occurring migratory species: ringed plover (*Charadrius hiaticula*).

An additional qualifying interest feature of the Colne Estuary SPA is a nationally important breeding population of the migratory species pochard (*Aythya ferina*). The freshwater habitat required for this species to breed also does not occur within the European marine site, as it occurs above Highest Astronomical Tide. As with the hen harrier (*Circus cyaneus*), objectives to maintain this aspect of bird interest in favourable condition are found within English Nature's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities also need to have regard to such adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

The **Crouch and Roach Estuaries SPA** qualifies under Article 4.2 of the EU Birds Directive in that it supports:

- an internationally important assemblage of waterfowl (wildfowl and waders); and
- internationally important populations of regularly occurring migratory species.

The **Dengie SPA** qualifies under Article 4.1 of the EU Birds Directive by supporting:

- an internationally important wintering population of the Annex 1 species hen harrier (*Circus cyaneus*). As with the Colne Estuary and Blackwater Estuary SPAs, the habitat required for this species to feed does not occur within the European marine site.

The Dengie SPA qualifies under Article 4.2 of the EU Birds Directive in that it supports:

- an internationally important assemblage of waterfowl (wildfowl and waders); and
- internationally important populations of regularly occurring migratory species.

The **Foulness SPA** qualifies under Article 4.1 of the EU Birds Directive by supporting:

- internationally important breeding populations of regularly occurring Annex 1 species: sandwich tern (*Sterna sandvicensis*), common tern (*Sterna hirundo*), little tern (*Sterna albifrons*) and avocet (*Recurvirostra avosetta*); and

Foulness SPA also qualifies for supporting an internationally important wintering population of the Annex 1 species hen harrier (*Circus cyaneus*). As with the Colne Estuary and Blackwater Estuary SPAs, the habitat required for this species to feed does not occur within the European marine site.

The Foulness SPA also qualifies under Article 4.2 of the EU Birds Directive in that it supports:

- an internationally important assemblage of waterfowl (wildfowl and waders); and
- internationally important populations of regularly occurring migratory species; and

- nationally important breeding populations of a regularly occurring migratory species: ringed plover (*Charadrius hiaticula*).

3. SAC interest features

The Essex Estuaries cSAC comprises a network of qualifying interest features. 'Estuaries' qualify as a separate interest feature and so do its component parts - saltmarshes and intertidal mudflats and sandflats. These features are interdependent and integral to the functioning of this coastal plain estuary system, with changes in the structure of one feature being inextricably linked to changes in the structure of another. This section describes and explains the importance of each of these cSAC interest features together with their component sub-features.

3.1 Pioneer saltmarsh

3.1.1 Definition

There are over 2,300 hectares of pioneer saltmarsh in the UK, widely distributed across the saltmarshes of England and Wales. It comprises a small number of plant species and is dominated by open stands of glasswort (*Salicornia* agg.), annual sea-blite (*Suaeda maritima*) and sea aster (*Aster tripolium*). European marine sites were selected to represent the geographical range of this habitat. Generally, sites supporting the largest areas of pioneer saltmarsh have been chosen and, since it occurs as an integral part of a sequence of habitats ranging from mudflats and sandflats to a more stable saltmarsh vegetation dominated by long-lived perennials, preference has been given to sites where it forms part of a well-developed successional sequence.

Pioneer saltmarsh colonises intertidal mudflats and sandflats in areas protected from strong wave action and is usually an important precursor to the development of more stable vegetation. It develops at the lower reaches of saltmarshes around mean high water neap tides (MHWN) where it is frequently covered by the tide (around 600 times a year); and can also be a secondary coloniser of open creek sides, depressions or pans within a saltmarsh, as well as disturbed areas of higher saltmarshes.

3.1.2 Importance of the feature within the Essex Estuaries

Pioneer saltmarsh forms a key transition community from the extensive intertidal sediments to the upper salt meadows across much of the upper shore of the site. The saltmarshes within this site are eroding and secondary pioneer communities can appear as a precursor to erosion on the seaward edge of the degraded low marsh communities.

3.1.3 Sub-features

Glasswort (*Salicornia* agg.) / annual sea-blite (*Suaeda maritima*) community - Stands of glasswort (*Salicornia* agg.) form an integral part of the transition from the extensive intertidal mudflats and sandflats through to upper salt meadows. 'Pioneer' suggests that glasswort is first in a succession of vegetation (primary coloniser), however, it is also a precursor to erosion where bare mud succeeds it at the seaward boundary of low to mid marsh vegetation. Species of the genus *Salicornia* occupy different niches within the saltmarsh sward. *S. europaea* and *S. obscura* are typically found at the front edge of the saltmarsh and lower level salt pans. *S. dolistachya*, is also present in the low saltmarsh zone at crumbling creek edges. *S. ramosissima* occurs in short turf on top of the marsh and high level pools. *S. fragilis* is confined to mid-marsh salt pans, while *S. pusilla* requires mature, stable saltmarshes. Perennial glasswort (*Athrocnemum perenne*) is associated with local erosion, occurring on raised, bare, firm muds and clays, in mature saltmarsh. Other species are associated with the glasswort sward at slightly higher elevations including: annual sea-blite (*Suaeda maritima*) and sea aster (*Aster tripolium var. discoides*), which is a short-lived perennial.

Sea aster (*Aster tripolium* var. *discoides*) community - This occurs as a distinct, extensive zone in the low marsh, above the glasswort (*Salicornia europaea*), where 350 tidal submergences per year are comfortably tolerated. This community also occurs along the sides of creeks where inundation is relatively frequent (i.e. above 500 submergences annually). (Rodwell *et al*, 2000; Burd, 1989.)
Other species within this species-poor sward are likely to be glasswort (*Salicornia* agg.) and annual sea-blite (*Suaeda maritima*).

3.2 Cordgrass swards

3.2.1 Definition

Only areas of small cordgrass (*Spartina maritima*) and smooth cordgrass (*S. alterniflora*) were considered for site selection. The former species is native to the UK but is nationally scarce and at the limit of its range. The latter is a naturalised species imported into the UK from its native America in the 19th century. Introduction is thought to have been via transatlantic vessels docking at Southampton.

3.2.2 Importance of the feature within the Essex Estuaries

The distribution of small and smooth cordgrass species is limited by climatic factors and neither species occurs outside south-east England. There are only two sites in the UK where either of these species occurs in significant quantities: the Essex Estuaries and the Solent.

Cordgrass is an important saltmarsh precursor species, colonising a wide range of substrates, form very soft muds to shingle, in areas sheltered from strong wave action. The species can therefore occur on the seaward fringes of saltmarshes and creek sides and may also colonise old salt pans in the upper marsh within the European marine site.

3.2.3 Sub-features

Small cordgrass (*Spartina maritima*) community - Covering an area of 0.17 square kilometres (17 hectares), the Essex Estuaries contain the most extensive stand of small cordgrass in the UK, believed to be one of the largest remaining areas of small cordgrass to be found in Europe. This is located at Foulness Point, fringing the upper saltmarsh on the open coastline. However, the natural cockle shell bank fronting the saltmarsh regularly washes onto the saltmarsh, smothering the vegetation. Stands of small cordgrass form a major component of some of the upper marsh areas within the European marine site, notably on the Colne.

Smooth cordgrass (*Spartina alterniflora*) community - Smooth cordgrass was introduced to the Blackwater Estuary and is currently well established at three locations.

3.3 Atlantic salt meadows

3.3.1 Definition

There are more than 29,000 hectares of this habitat type in the UK, found mostly in the large, sheltered estuaries of the south-east, south-west and north-west of England, and south Wales. These large sites provide the best examples of Atlantic salt meadow in the UK, as they support a well-developed zonation of plant communities. It is likely that up to two-thirds of all British saltmarshes are represented by this saltmarsh type. Candidate SACs have been selected in the UK to cover the geographical range and ecological variation of this habitat. The terms low marsh, mid-marsh and upper marsh are commonly used to describe this variation, the upper marsh being formed where tidal inundation occurs with decreasing frequency and duration. Though,

in broad terms, distribution of these saltmarsh types is determined by tidal inundation, many marshes show a mosaic of vegetation types which is also influenced by distance from feeder creeks (as this affects sedimentation rates and drainage) and by local soil characteristics within the marsh. The vegetation also varies depending on the climate.

3.3.2 Importance of the feature within the Essex Estuaries

Atlantic salt meadow is the most frequently encountered saltmarsh habitat in the Essex Estuaries covering 3376 hectares (approximately 33 square kilometres), representing over 10 per cent of the UK resource. There are marked regional variations in the Atlantic salt meadow community composition around the UK. In the Essex Estuaries low to mid-marsh communities predominate, owing to extensive reclamation of the upper marsh due to enclosure by sea walls. Despite the losses due to land claim (and erosion), extensive areas of salt meadows still exist in south-east England, with perennial flowering plants typical of this part of the UK.

The most notable areas of this saltmarsh type occur on the western shore of the Colne Estuary, at Fingringhoe and the Geedon saltings. The majority of the Blackwater saltmarsh is mapped as Atlantic salt meadow (totalling 1033 hectares) with extensive areas on Northey Island, Lawling and Mayland Creeks and Tollesbury Fleet. The 7.5 km stretch of open coast on the Dengie, approximates to 384 hectares of Atlantic salt meadows. The latter is the largest continuous expanse of saltmarsh between Lowestoft and Dungeness.

Managed set-back schemes, undertaken as a form of sustainable coastline management (on the Blackwater Estuary), contiguous with the European marine site, are showing signs of regenerating upper level Atlantic salt meadows with a transition to grassland in places. There are only three areas within the Essex Estuaries European marine site where sea walls do not prevent the natural transition from high marsh to transitional grassland. These are at Woodham Fen and Lion Creek, on the River Crouch, and Ray Island, on the Blackwater Estuary.

3.3.3 Sub-features

Low/mid-marsh communities - comprise a zone of transitional vegetation between the pioneer saltmarsh and the low marsh areas consisting of common saltmarsh grass (*Puccinellia maritima*), glasswort (*Salicornia* spp.), annual sea-blite (*Suaeda maritima*) and sea aster (*Aster tripolium*). This transitional zone grades into a common saltmarsh grass community (*Puccinellia maritima*), in the low marsh, which forms dense tall swards often intermingled with sea aster (*Aster tripolium)*, sea purslane (*Atriplex portulacoides*), sea plantain (*Plantago maritima*) and greater sea spurrey (*Spergularia media*). Within this community, sea lavender (*Limonium vulgare*) and sea arrow-grass (*Triglochin maritima*) can become locally dominant. Sea lavender may form extensive dense swards and sea arrow-grass is possibly a secondary coloniser of bare patches of mud within this marsh. Common cordgrass (*Spartina anglica*) can occur and this is of conservation importance in terms of the potential negative impact it may have on pioneer and low marsh communities. Saltmarsh grass also occurs in a co-dominant association with sea purslane.

The low/mid marsh sea purslane community (*Atriplex portulacoides*) is characteristically a mid-marsh community but also occurs on the edges of rills in the low marsh. Sea purslane often occurs exclusively (total dominance) but can occur as a co-dominant with common saltmarsh grass (*P.maritima*). It contains several species found in the latter community and grades floristically with it.

Upper marsh communities - A sea lavender/sea thrift (*Limonium vulgare/Armeria maritima*) community forms a distinctive community with a varied, short, dense sward dominated by flowering plants, associated with

salt pans. The presence of sea thrift distinguishes this community as upper marsh. Although described as a sub-community of common saltmarsh grass marsh (*Puccinellia maritima*), this species rarely comprises more than 10% of the sward. Sea arrow grass (*Triglochin maritima*), sea plantain (*Plantago maritima*), sea purslane (*Atriplex portulacoides*) and glasswort are all constant within the sward. There may also be algal mat cover and scattered plants of greater sea spurrey (*Spergularia media*) and annual sea-blite (*Suaeda maritima*).

This community is not common in the UK but does cover large areas in East Anglia. In the Essex Estuaries it can be found on the Blackwater, Colne and Roach estuaries. Its other stronghold is the North Norfolk coast.

As tidal inundation becomes less frequent, an upper marsh common saltmarsh grass (*Puccinellia maritima*) with red fescue (*Festuca rubra*) or sea couch grass (*Elytrigia atherica*) community develops. Sea milkwort (*Glaux maritima*) may also be present. This species is usually restricted to this grassland zone where marsh and land vegetation meet, the determinant being freshwater influence (an unusual situation in Essex due to sea walls truncating natural landward transitions). Where red fescue is more abundant in this community, saltmarsh rush (*Juncus gerardii*) and sea rush (*Juncus maritimus*) may occur. An upper marsh sea purslane (*Atriplex portulacoides*) community also occurs forming a dense dwarf shrub layer generally excluding other species (Boorman, 1992).

Upper marsh transitional communities - A variety of upper saltmarsh types occur in discrete patches on the highest area of the upper marsh. Sea walls have artificially foreshortened the saltmarsh in most of the European marine site and these communities generally have a very restricted distribution along a narrow strip either growing at the base of sea walls or on the sea walls. In a natural situation, in the absence of sea defences, they would occur more frequently and more extensively.

The golden samphire (*Inula crithmoides*) community has an affinity with upper sea purslane marsh (*Atriplex portulacoides*), occurring on sandy spits and bars. It also occurs with drift-line vegetation dominated by sea couch grass (*Elytrigia atherica*). In Essex, golden samphire is almost at the northernmost range of its distribution (there are a few plants in Suffolk), its main distribution being in continental Europe.

The sea wormwood (*Artemisia maritima*) community occurs in association with tidal litter and shell fragments. In Essex, it is most commonly found as a fringe of vegetation along the foot of sea walls, above the sea purslane (*Atriplex portulacoides*) upper marsh, prior to a transition into the drift-line community dominated by sea couch grass (*Elytrigia atherica*).

A sea rush (*Juncus maritimus*) community occurs in clumps at or above the high-tide mark of spring tides, but is never abundant in the Essex Estuaries. It is associated with red fescue (*Festuca rubra*), sea milkwort (*Glaux maritima*) and saltmarsh rush (*Juncus gerardii*).

The saltmarsh rush (*Juncus gerardii*) community occupies a position above the upper saltmarsh grass (*Puccinellia maritima*) zone, above mean high tide levels, in association with upper marsh sea purslane (*Atriplex portulacoides*), sea rush (*Juncus maritimus*) and sea plantain (*Plantago maritima*). Notable locations in the Essex Estuaries European marine site include Old Hall marshes, Langenhoe marshes and Brightlingsea. It often forms a discontinuous zone in contact with sea lavender/sea thrift marsh (*Limonium vulgare* agg/*Armeria maritima*).

Drift-line community - The sea couch grass (*Elytrigia atherica*) community is only covered by the highest tides and may be confined to a narrow strip around the tidal limit or form extensive stands in the upper marsh.

As this community is part of the vegetation which terminates the saltmarsh at its upper limit, it forms mosaics with species which are mostly confined to the base of sea walls or growing on the seaward face of the embankment, for example: sea wormwood (*Artemisia maritima*), golden samphire (*Inula crithmoides*), spear-leaved orache (*Atriplex hastata*), grass-leaved orache (*Atriplex littoralis*), lesser sea spurrey (*Spergularia marina*) and common scurvy grass (*Cochlearia officinalis*).

3.4 Mediterranean saltmarsh scrubs

3.4.1 Definition

Only three localities in the UK are known to support extensive examples of this habitat type and they have all been selected as cSACs. This scrubby, salt-tolerant vegetation develops at the uppermost end of saltmarsh zonation. It is formed predominantly of bushes of shrubby sea-blite (*Suaeda vera*), occasionally with sea-purslane (*Atriplex portulacoides*). This most frequently occurs at the upper limit of tidal inundation and is often found in association with transitions to shingle structures.

3.4.2 Importance of the Essex Estuaries

Mediterranean saltmarsh scrub is restricted to the south and south-east of England and reaches the northernmost limit of its distribution in Lincolnshire. It is concentrated around the East Anglian coast, with the major British population occurring in the Essex Estuaries with an approximate extent of around 23 hectares. A transitional type of this saltmarsh occurs at the sand dune/saltmarsh interface and is recorded at only one locality in the Essex Estuaries.

3.4.3 Sub-features

Shrubby sea-blite (*Suaeda vera*) community - This community occurs principally as a strandline community at the base of sea walls. The northern point of the Dengie is characterised by a drift-line community of shrubby sea-blite growing on sand and shingle immediately in front of the sea wall. It also grows on mobile shingle ridges. There are shingle structures on the north Dengie and the Blackwater Estuary, for example, at the mouth of the estuary at West Mersea and at the eastern end of Osea Island, where there are extensive areas of shrubby sea-blite. Recent managed set-back schemes within and adjacent to the boundary of the European marine site (on the Blackwater Estuary) are developing a zone of shrubby sea-blite forming part of a natural transition to high-level freshwater vegetation.

Rock sea lavender (*Limonium binervosum*)/ sea heath (*Frankenia laevis*) community - This vegetation type is known to be present at one location in the Essex Estuaries European marine site forming a more or less continuous belt of vegetation from Lee-over-Sands to Colne Point. The point comprises mobile shingle, sands and saltmarsh. This mobile shingle and sandy/mud saltmarsh transition (sand dune/saltmarsh interface) has reduced evidence of the characteristic saltmarsh scrub (*Suaeda vera*) and a greater abundance of herbaceous species, featuring rock sea-lavender, *Limonium binervosum* (the sub-species, *L.binervosum saxonicum* is endemic to the Tendring District), and sea heath (*Frankenia laevis*). Both species (but particularly rock sea lavender) are dependent on the dynamic process of sand or shell moving over the saltmarsh. However, they are sensitive to smothering; it is suspected that the build up of the shell bank at Sales Point, on the Dengie may account for the loss of sea heath at this location.

3.5 Estuaries

3.5.1 Definition

Estuaries are complex ecosystems interlinking an interdependent mosaic of terrestrial and marine habitats. These habitats include intertidal mudflats and sandflats and four saltmarsh types, all of which independently qualify as Annex I habitats within the Essex Estuaries European marine site. Estuaries can be defined as partially enclosed tidal areas at least partly composed of soft tidal shores, open to saline water from the sea, and receiving freshwater from rivers, land run-off or seepage through embankments (Davidson *et al.*, 1991). There is a gradient of freshwater to increasingly marine conditions. Inputs of sediment from a riverine source, shelter from wave action and low current flows lead to the formation of extensive sediment flats.

More than a quarter of the area of the north-western European estuaries are located in the UK where they cover an area of approximately 529,000 hectares (Davidson *et al*, 1991). The wide range of estuary types occurring in the UK is also unusual in a European context. Sites have been selected to represent the geographical range of estuaries and include examples of the four geomorphological types and a range of substrates and associated plants and animals. Selection has generally favoured larger sites, as they display a wider variety of estuarine habitats. The intertidal and subtidal sediments of estuaries support biological communities that vary depending on their geographic location, sediment type, tidal currents and the salinity gradients within the estuary. For classification purposes, the physical and chemical characteristics which define a particular type of habitat, together with the marine communities associated with it, are termed 'biotopes'. By mapping these biotopes, it is possible to describe the biological nature of the marine environment.

3.5.2 Importance of the feature within the Essex Estuaries

This site is part of a low-lying sedimentary coastline and includes the major estuaries of the Blackwater, Colne, and Crouch/Roach complex, with open coast and offshore elements creating an extensive area of continuous marine habitat. These estuaries have formed from pre-existing valleys which were flooded at the end of the last ice age. Their geological structure and physiographic features classify them as coastal plain estuaries in that they deepen and widen towards the mouth and in outline and cross section they would naturally form a triangular shape. The estuary floors have a large width to depth ratio, are shallow (less than 30 metres deep) and have been infilled with post-glacial sediments sourced by deposits trapped in the southern North Sea. These are of varying thicknesses, with mud in the upper reaches becoming increasingly sandier towards the mouth. Indeed, this estuary system remains of high importance to larger-scale regional sediment circulation of the southern North Sea as a whole, including the East Anglian coastline. The range in tidal heights (average tidal range of 4.8 metres) allows a vast extent of intertidal sediment flats to become exposed (approximately 169 square kilometres). In sheltered areas these may become stabilised by microscopic algae (diatoms) and saltmarsh plants. At lower levels and exposed locations the sediments are resuspended by tidal currents and wave action making the estuarine waters turbid. Coastal plain estuary systems are chiefly restricted to temperate climates where the sediment input from rivers is relatively small. River flow is also limited compared with the volume of tidal water entering the system. As such, there is a strong saline influence.

Estuaries are dynamic systems which are continually adjusting over different geological time scales to changes imposed by climate, location, geology and tides (Davidson *et al.*, 1991). This is an important point to remember, particularly in terms of management. The Essex Estuaries are currently undergoing change due to rising sea levels and land level adjustments following the last ice age, causing the south-east land mass to sink. Comparatively recently, containment of the estuary by sea walls has prohibited the natural landward adjustment of the estuary boundaries in response to this influence, resulting in erosion of the key features and habitats.

Though soft substrates of sands and muds predominate, there are areas of hard substrates mainly comprised of small boulders, cobbles, pebbles or broken shells. On the Blackwater estuary exposed gravel beds, shingle and shell banks are features of the tidal flats. At Bradwell, at the northern end of the Dengie, there is a small sand and shingle spit with a high shell content. Colne Point has formed from two shingle spits which enclose a large area of saltmarsh. The spits are a relict of a system of extensive shingle ridges which, up until the mid 1800s, stretched between Walton-on-the-Naze and St Osyth. Areas of barren shingle occur off Shoebury Ness (TQ932389) and the Dengie, at Sales Point. The major soft substrates are: normal to variable salinity muddy sands and variable to reduced salinity muds. Salinity is the key determinant of plant and animal distribution in estuaries. Marine communities associated with reduced salinity are physiologically 'stressed', and only a few species such as tubifex worms ('sludge-worms') are able to exploit this situation. Where the salinity is highly variable, this suits species such as the shrimp-like *Corophium volutator*, marine snails (*Hydrobia ulvae*) and the bivalve Baltic tellin (*Macoma baltica*). Seaweeds and algae are also able to tolerate these conditions. In fully marine conditions, species composition is more varied, with diversity increasing where mixed sediments occur, enabling marine organisms to colonise both above and below the surface. In the estuary mouth, where the salinity is above 25 parts per thousand, cockles are found on the foreshore; hydroids, anemones, brittle stars and bivalve beds occupy the subtidal zone.

Fish species such as grey mullet, twaite shad, smelt, sprat, eels and flounder inhabit the estuarine waters and an important population of spring spawning Thames-Blackwater herring breed at the mouth of the Blackwater Estuary. Young bass, although spawned offshore, complete their development in the estuaries, remaining there until they reach adulthood after three years. A MAFF (Ministry of Agriculture, Fisheries and Food) designated bass nursery lies off the Bradwell power station, in the Blackwater Estuary part of the European marine site, where the waters are warmed by the power station outfall. Both young herring and bass feed and shelter in the productive waters of the saltmarsh creeks.

3.5.3 Sub-features

Saltmarsh communities - Saltmarsh communities (comprising four separate saltmarsh interest features) are classified in the Habitats Directive as interest features in their own right and are therefore described separately below - **see sections 3.1 to 3.4.**

Intertidal mudflat and sandflat communities - Intertidal mudflat and sandflat communities are classified in the Habitats Directive as an interest feature in their own right and are therefore described separately below **- see section 3.6.**

Rock communities - Within the Essex Estuaries two types of rock community occur: the intertidal boulder and cobble communities and the bed clay communities. In a sedimentary system it is relatively uncommon to find pebbles and cobbles overlying the muddy foreshore. This happens where tidal movements are too fast to favour the deposition of silt, but cobbles and pebbles readily settle on the muddy bed. A species-rich marine community of sedentary plants and animals is able to gain a foothold on the hard surfaces, such as the brown seaweed (serrated wrack - *Fucus serratus*), and red seaweeds (*Ceramium* spp. and *Chondrus crispus*). Sponges, including the breadcrumb sponge (*Halichondria panicea*), hydroids (*Coryne pusilla* and *Tubularia pusilla*), sessile colonial animals, such as hornwrack and sea squirts (star ascidians, *Botryllus schlosseri; Botrylloides leachi*), are also well represented. Patches of sand or mud between the pebbles support sand mason worms (*Lanice conchilega*), peacock worms (*Sabella pavonina*) and anemones (*Sagartia troglodytes*). Clusters of mussels and slipper limpets also occur and mobile species, winkles and shore crabs, are also present. This biotope is considered to be nationally uncommon (Conner *et al.*, 1997). The occurrence

of this biotope in the Essex Estuaries is given in Table A below:

Location	OS Grid	Blackwater	Colne
Westmarsh Point	TM077161	Y	T
Bradwell Creek	TL985070	T	Y
Rolls Farm	TL945082	T	Y
Mill Creek	TL975090	T	Y
Stansgate Abbey Farm	TL929058	T	Y

Table A Occurrence of tideswept low shore mixed substrata (SLR.FserX.T) biotope in the Essex Estuaries European marine site. Source: "Essex Estuaries Candidate Marine Special Area Of Conservation - Littoral And Sublittoral Biotope Mapping and Data Capture Exercise"; EN Research Report 305 (1998)

In similar conditions dense beds of mussels occur associated with the brown seaweed, bladderwrack (*Fucus vesiculosus*), which clings to the mussel shells or pebbles. Within Ray Sands on the Dengie, mussel beds occur on stable muddy sands on the mid to lower shore. Isolated patches of mussel bed occur in two locations around the Colne Bar area (at TM096123 and TM099122) and extensive beds are evident on the west shore of the Colne mouth on the Mersea Flats National Nature Reserve (NNR) at East Mersea. The Blackwater locations are: Goldhanger, east of Gore Saltings; and an 'outcrop' of mussel 'scar' in St Lawrence Bay. The north shores of the Roach, east of Bartonhall Creek, and the Crouch, east of Stow Creek to Cliff Reach, also support mussel beds. Some of these beds are of commercial importance (Wiggins, 1999). Barnacles typically cover the mussels. The brown seaweeds, knotted wrack (*Ascophyllum nodosum*) and bladder wrack form distinctive zones on pebbly areas in the Blackwater. Around Mill Creek, a zone of knotted wrack occurs on the mid shore above the mussel beds.

Freshwater seepage influences the vegetation make-up over the foreshore. The brown seaweed, *Fucus ceranoides*, is typically found along with the opportunistic green algae, *Enteromorpha* spp. and sea lettuce (*Ulva lactuca*). This biotope is present around the Marsh House outfall on the Dengie and at Stansgate Abbey (TL932059) on the Blackwater. Where salinity is less variable, the brown seaweed, bladder wrack, has established over a large area of pebbles covering the foreshore north of Ramsey Island on the Blackwater. Where banks of cobbles and pebbles are too unstable or too small to support seaweeds, they are colonised by barnacles. Small patches of this biotope occur at the northern limit of the European marine site at the mouth of the Colne. In the summer ephemeral red and green algae blanket the mixed foreshore at St Lawrence Bay extending to the low water mark of the Blackwater channel.

In a few places on the intertidal flats, the underlying bed clays are exposed. This could indicate that these are actively eroding sites. An extensive outcrop of intertidal clay occurs on the lower shore of the Blackwater, south of Rolls Farm (TL945082). Small clumps of mussels are attached to the surface while, below the surface, bivalve molluscs, known as piddocks, bore into the clay for protection. This biotope is described as rare in Britain (Connor *et al.*, 1997).

A soft clay substrate has been found in the subtidal zone at the confluence of the Blackwater and Colne estuaries, inhabited by American piddocks (*Petricola pholadiformis*) and the white piddock (*Barnea candida*). This community type is also listed as rare in Britain, recorded mainly in south-east England (Connor, *et al*, 1997).

Subtidal mud communities - These communities are typical of much of the estuary floor. Much of the seabed is characterised by stable shallow mud dominated by the marine bristle worm, *Aphelochaeta marioni.* The majority of the Crouch estuary supports this typically estuarine community which occurs with mixed sediments at various points along the estuary. In the Blackwater this cohesive muddy sediment occurs in the upper reaches (TL880075) and in the Colne it is found in the middle reaches and at the mouth, west of the Colne Bar. In the upper reaches of the Colne, physically unstable low salinity muddy environments allow the development of opportunistic species.

The lower reaches of the Colne and the middle reaches of the Roach estuaries have a substrate of shallow subtidal muds extending from the extreme lower shore. Marine worms and Baltic tellins are the typical species of this sediment type. In the mouth of the Blackwater estuary mud is suspended and deposited on each tide forming a fluid layer. This type of sediment is probably common in Britain. Although it does not contain distinctive species, it supports species washed in from other communities.

At the mouth of the Colne and Blackwater, at the southern end of the Colne Bar, the muddy sediment has a gravelly component attracting large numbers of barnacles (*Elminius modestus* and *Balanus crenatus*). The infauna (animals living within the mud), however, is dominated by marine bristle worms and oligochaete worms (which are related to the terrestrial earthworms). The presence of dense numbers of the marine bristle worm, *Capitella capitata*, suggests an organically enriched or physically disturbed habitat. The presence of barnacles indicate a transition towards estuarine mixed sediments.

In areas of silt deposition at the edges of tidal channels free-living catworms (*Nephtys hombergii*) and the bivalves, Baltic tellin (*Macoma baltica*) and the white furrow shell (*Abra alba*) are numerous. An isolated area of this community is present in the middle reaches of the Crouch and Roach, at the inner mouth of the Blackwater estuary (TM035103), and around Alresford on the Colne.

Subtidal muddy sand communities - Sheltered muddy sands on Maplin Sands support 58 hectares of eelgrass (*Zostera marina*) in shallow waters (Irvine, 1998). Eelgrass beds are relatively rare in Europe and largely confined to the UK, where they are uncommon (Davison & Hughes, 1998). Eelgrass is able to establish where few algal species can grow as its roots are able to penetrate into the soft sediment. Eelgrass beds influence both the physical and chemical environment around them. By reducing current speeds within the beds, a substrate of stable, poorly sorted sediments develops which encourages suspended material to deposit out. They have a high conservation value: the build up of sediments inhibits erosion and provides a habitat for burrowing marine animals in an otherwise hostile environment. The stems and leaves of the eelgrass plants provide refuges for young fish and crustaceans (shrimps, crabs etc). A wasting disease in the 1930s reduced the size of the subtidal eelgrass beds dramatically. Apart from the beds at Maplin, all that remains of this shallow-water species within the SAC boundary can be found at two sites on the Blackwater - a strip extending along the northern shore of Osea Island, and a discrete patch at St Lawrence Bay (English Nature, 1998).

Sheltered muds and sands in fully saline conditions are characterised by a predominance of the bivalve molluscs, Baltic tellin (*Macoma baltica*), the white furrow shell (*Abra alba*), and the nut shell, *Nucula nitidosa*. This community is found at the confluence of the Blackwater and Colne estuary mouths and is particularly stable extending into deeper waters. The substrate is typically organically rich and appears to be common in British waters. At greater depths, in sheltered conditions, the circalittoral (deep water) version of this community is encountered in which nut shells (*Nucula nitidosa*) predominate with white furrow shells (*Abra alba*) represented in smaller numbers. This biotope is also common in Britain. In the Essex Estuaries it occurs in at least two locations: at the Bench Head at the shared estuary mouth of the Colne and

Blackwater, and the Ray Sand channel (between the Dengie flats and the Buxey sands).

Subtidal mixed sediment communities - The Essex Estuaries have a long history of oyster cultivation and many areas of the seabed have had a covering of cockle or slipper limpet shells laid as oyster 'culch'. The culch provides a surface for the oyster spat (larvae) to settle on. This has altered the naturally occurring muddy substrate. In the 1950s, in the Crouch and the Roach, the cultivated oyster grounds were dominated by the slipper limpet (*Crepidula fornicata*), an introduced species. At this time uncultivated oyster beds of the Blackwater demonstrated a more diverse fauna; though slipper limpets represented the dominant species, sea squirts were also present. In the lower Blackwater at the edge of the main channel and the Salcott Channel, a marine community associated with oyster beds is evident. Shell debris and cobbles overlying sand and mud are colonised by a variety of sea squirts, an abundance of slipper limpets, and other species requiring a more stable substrate, such as mussels. In the centre of the main channel, the seabed consists of a coarse, mud-free sediment with clean shell and large stones. Though largely based on slipper limpets, this community is dominated by the sea squirt, *Dendrodoa grossularia*. Other characteristic species include: spider crabs, hydroids and surface-dwelling snails (gastropods) such as the grey top shell (*Gibbula cineraria*). Living within the mud are the marine bristle worms, *Aphelochaeta marioni* and *Caulleriella zetlandica*. A variant of this biotope, dominated by the burrowing shrimp-like amphipod *Corophium volutator*, is found at the mouth of the Blackwater, south-west of the Mersea Flats (Dyer, 1999). The typical form of the biotope is common in southern Britain.

Stable mixed sediments, subjected to moderate tidal streams, are located to the north-east and south-east of Osea Island and favour the establishment of solitary sea squirts (as opposed to colonial species) and bivalves, such as blunt gapers. In the Blackwater, mixed muddy substrates occur at the mouth of the central channel, Lawling Creek and South Channel, and are characterised by marine worms, crustaceans (crabs and shrimps) and sea squirts. Thirslet Creek contains the latter species as well as dahlia anemones, hydroids, sponges, bryozoans and sea spiders (Reid *et al.*, 1998).

Mixed sediments are interspersed with muddy sediments throughout the Crouch. Grab samples of species living in the mud showed an increase from 37 species in 1987, to 63 in 1991 (Hiscock, 1998). This may be related to the ban on the use of tributyltin (TBT) antifouling paint on vessels less than 25 metres, implemented in 1987. The most abundant species are marine worms, ghost shrimps, and the bivalves, Baltic tellin and *Mysella bidentata*. Slipper limpets are abundant on the Crouch and occupy the middle reaches, along with sea squirts which also occupy the upper reaches. Sponges, hydroids, pink shrimps (*Pandalus montagui*), brown shrimps (*Crangon crangon*), shore crabs (*Carcinus maenus*) and the common starfish (*Asterias rubens*) are also widespread throughout the estuary. Twenty fish species have also been recorded within the Crouch estuary. A substantial area of shallow seabed adjacent to the Colne and Blackwater mouths (TM085050 - 2.5 km off the Dengie flats) consists of mixtures of mud, sand and gravel with shells and stones on the surface. A variety of marine animals are present reflecting the diversity of the substrate: tube-dwelling worms, common whelks, mussels, barnacles, native oysters, anemones, common star fish, brittle stars, green sea urchins, hermit crabs and the hydroid, *Obelia longissima*.

Impoverished versions of more distinctive community types frequently occur. An example of this is a sparse community of bivalves which, though containing little fine sediment, resembles the muddy sand bivalve community and is likely to be a transitional with neighbouring mud biotopes.

Calcified tubes of the ross worm *Sabellaria spinulosa* form thin crusts on mixed sediment in the Colne/Blackwater estuary mouths and off the open coast to the south. The worms anchor their tubes to pebbles and shell in areas where strong wave action stirs the sediment. Sand thrown into suspension is captured by the worms for tube-building. In favourable conditions the tubes aggregate forming more stable structures. However, more commonly, the structures are of a transitory nature, breaking up in winter storms and reforming in the spring following new settlement. The exposed surfaces of the crusts support hermit

crabs, sea spiders and amphipod shrimps. Tubes of the marine worm *Polydora* may be present where there is a high level of suspended material in the water. The more stable reef structures formed by *Sabellaria* are not typically estuarine features and are more likely to be found offshore.

The Essex Estuaries supports a whiteweed 'fishery'. These fern-like hydroids (*Sertularia cupressina*) form large branching colonies which can reach up to 45cm high. Despite the name, whiteweed is a colonial animal which has a planktonic juvenile stage in its life cycle. Whiteweed colonises shallow sands with cobbles and pebbles in strong tidal streams. As such, it can withstand periodic submergence and scour by sand. Whiteweed is trawled commercially and is dried for use in ornamental displays. Locations in the European marine site include the Ray Channel, to the south-eastern tip of Swire Hole, and the mouth of the Crouch Estuary, extending north-west into the Whitaker Channel. The southern boundary of the cSAC intercepts the extensive whiteweed bed south of Maplin sands.

The Eagle Bank gravel bank lies at the entrance to the Blackwater and Colne estuaries and because of its position at the mouth of the main outfall channel of these estuaries, it experiences high wave energy which favours the deposition of coarser sediments. It is the principal spawning site for the Thames-Blackwater herring (*Clupea harengus*). A smaller spawning ground is also known at St Lawrence Bay (Midlen, 1999). This is a distinct sub-type of the southern North Sea herring distinguished by its smaller size, having one less vertebra. It migrates annually from the southern North Sea into the Essex estuaries to spawn in spring. The migration inshore starts in early November. Spawning is thought to be triggered by water temperature and takes place over the Eagle Bank in late February. The fertilised eggs develop in the gravelly substrate and larvae hatch out after two to four weeks. In late spring, the young herring begin to move out of the estuary into the deeper waters of the southern North Sea.

3.6 Intertidal mudflats and sandflats

3.6.1 Definition

This habitat is widespread on the North Sea coasts of Atlantic Europe and occurs widely throughout the UK. Sites have been selected to encompass the range of geographical and ecological variation of this habitat type in the UK. Sites demonstrating large areas of intertidal flats as well as presenting a range of sheltered, mobile and diverse subtypes were favoured for selection.

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

Muds: These form in the most sheltered areas in estuaries and on the open coast, where large quantities of silt are deposited. The sediment is stable and marine communities are dominated by marine bristle worms and shellfish (including marine snails and bivalve molluscs). Reduced salinities in the upper parts of estuaries or near freshwater discharges may cause variations in these communities

Muddy sands: these occur where shelter from wave action is sufficient to allow the deposition of fine sediments, but some water movement or the lack of silt supply leads to a more sandy substrate. Such conditions may occur at the mouths of estuaries. A wide range of organisms, such as the tube-dwelling

lugworm (*Arenicola marina*) and bivalve molluscs, can colonise these sediments. Beds of intertidal eelgrass (*Zostera noltii*) may occur on the mid and upper shore. Substantial beds of cockles (*Cerastodermra edule*) may develop on the lower shore.

Clean sands: Sandy beaches occur on the open coast and in bays where wave action or strong tidal streams prevent the deposition of finer silt particles. Clean sands also occur where the supply of silt in suspension is low. In the latter conditions there is a high proportion of heavier grains of sediment. Owing to the mobility of the sediment and abrasion, due to the wave and/or tidal energy acting upon it, the inhabitants of these areas tend to be mobile and robust and include sand hoppers, some marine worms and bivalve molluscs.

3.6.2 Importance of the feature within the Essex Estuaries

The Essex Estuaries represents the range of variation of this habitat type found in south-east England. It includes the extensive intertidal flats of the Colne, Blackwater, Roach and Crouch estuaries, as well as the open coast flats of the Dengie and Maplin Sands, which have an unusually undisturbed nature. The site contains a wide range of sediment flat communities, from estuarine muds, sands and muddy sands to fully saline sandy mudflats with extensive growths of eelgrass *Zostera* spp. on the open coast. Maplin Sands is particularly important for its large, nationally important beds of dwarf eelgrass *Zostera noltii* and associated animal communities. On wave exposed sections of coast the finer sediments are replaced by gravels. In terms of biomass, the soft sediments are generally more productive and these typically estuarine muddy habitats support millions of marine worms, snails and bivalve molluscs. The extent of these sediment flats in the Essex Estuaries is approximately 17,000 hectares (English Nature, 1998).

The Essex Estuaries also holds the most southerly breeding population of common seal in Europe. Counts undertaken in August (1995), the month when the largest aggregation of seals haul out onto Foulness and Buxey sands for the annual moult, observed 11 pups amongst 28 adults (Smith, 1996). Thirty seven were counted in this area in January 1998 (Dobson, 1999). It is estimated that the total population of common seals in the Crouch estuary numbers 55 and the number for the Essex Estuaries as a whole may increase to up to 100 if seals within the Blackwater estuary are included. Common seals have been observed in the Blackwater all year round but are most evident in late summer and mid-winter when they come into the estuary to feed on bass, herring and sprats and haul out on the undisturbed mud flats. Smaller numbers frequent the Pyefleet Channel in the Colne estuary. The Sea Mammal Research Unit survey in 1995, estimated that the total number of seals breeding in the Essex area was 78. This included sites outside the Essex Estuaries European marine site - Hamford Water (north of the site) and East Barrow sands, offshore, to the east of the site. This constitutes 0.3% of the British common seal population. The common seal is listed as an Annex II species in the Habitats Directive.

3.6.3 Sub-features

Mud communities - The estuary systems of the Crouch, Roach, Blackwater and Colne are muddier than the open coast. Fine particulate sediments form extensive mudflats. In the extreme upper reaches of these estuaries, the shores are of soft mud with a silt/clay fraction of over 80 per cent. The salinity levels at these locations are variable to low and marine communities associated with these conditions are species poor.

On the mid to upper shore in variable and reduced salinity conditions, ragworms (*Hediste diversicolor*), and peppery furrow shells (*Scrobicularia plana*) are typically found. The sediment is characteristically wet in appearance and the crow's foot pattern made by the feeding activity of the peppery furrow shell is

conspicuous. Beds of these bivalves are seen in the upper reaches of Mayland Creek on the Blackwater. Examples of this marine community also occur in the upper parts of the Colne - in the Geedon, Brightlingsea and Pyefleet Channels - and in the upper Roach on the inner shores and creeks to the south of the main channel. Where the salinity is lower and the substrate muddier, fewer bivalves are present. As salinity levels decrease further the species make-up becomes more impoverished consisting of opportunistic species of oligochaete worms. Soft fluid mud conditions prevail over much of the River Crouch tidal flats and in the upper reaches of the Colne in the Pyefleet Channel and the Geedon, Flag and Alresford Creeks, which are completely drained of water at low tide.

Sandy mud shores form soft sediment flats with a silt/clay fraction of 60 to 80 per cent; the amount of sandy material yields a substrate that is relatively firm underfoot. Sandy mud sediments in sheltered estuarine locations on the mid to lower shore, in fully saline conditions, give rise to a marine community characterised by free-living marine bristle worms, such as burrowing worms, brown shrimps, burrowing amphipods (shrimp-like animals), and molluscs, such as the Baltic tellin and cockles. The surface of the mud is typically colonised by the mud snail, *Hydrobia ulvae* and green algae. All the above are present in abundant numbers. Burrowing lugworm encroach into sandier areas. This marine community covers the intertidal flats of the Colne to its confluence with Brightlingsea Creek and is also extensive in the Blackwater: vast stretches occur from east of Northey Island, passing north and south of Osea Island and extending for 4 km to the Nass. In the south of the European marine site, the high shore of Foulness and Maplin Sands, plus the River Roach and the southern shore of the Crouch, and the mouths of these estuaries, have a sandy-mud substrate dominated by ragworms and Baltic tellin bivalves.

Muddy sand communities - Muddy sand and its component communities tend to be located nearer the estuary mouths and open coastline which are exposed to higher wave energy and/or faster tidal currents than the more sheltered inner estuaries. Here they cover vast areas - in total over 10,000 hectares within the Essex Estuaries.

Extensive areas of muddy sand are associated with the linear shorelines of Foulness and Maplin Sands, the Dengie flats, the Buxey Sands, and the mouth of the Colne estuary. The mud fraction makes up 10 to 30 per cent of the sediment and the sand fraction is typically fine. Muddy sand forms gently sloping flats that remain water saturated throughout the tidal cycle. On the Dengie from St Peter's to Ray Sand the range of species typically found in this substrate are evident down to the low water mark: lugworm, ragworm, sand mason worms, Baltic tellin and cockles. The Mersea Flats, to the west of Brightlingsea Reach, are also dominated by this marine community, with lugworm being found in the sandier fractions.

Muddy sands on moderately exposed coasts are sufficiently stable to support cockle beds. These conditions are prevalent on Maplin Sands which support a nationally important cockle fishery, the largest in the UK. Muddy sands also provide a substrate for the establishment of dwarf eelgrass beds (*Zostera noltii*), which are nationally scarce in Britain. They form a 240-hectare strip along the mid and upper shore of Foulness and Maplin Sands, probably representing the largest continuous population of this species in Europe. Extensive patches occur around Havengore Head (TQ985993) and at Shelford Head (TQ992890) and Rugwood Head (TR020913). Isolated patches also occur in the Blackwater Estuary on the northern shore of Osea Island (TL906068 to TL925065) and on the foreshore at Goldhanger. The numerous algae that live on the eelgrass shoots attract grazing marine invertebrates. The root network of the plant help bind the sediment and help to reduce erosion.

Sand and gravel communities - High wave energy drives sand and gravel into beaches and ridges in the

outer estuary. Some of these waves may even propagate into the estuary itself and have localised effects. This wave action gives rise to a number of communities. Dense populations of sand mason worms (*Lanice conchilega*) occupy areas of medium to fine sands on the lower shore with moderate exposure to wave action. An example of this biotope occurs at Stone Point, opposite Brightlingsea (on the south shore of Brightlingsea Reach) in the Colne estuary.

On sandy shores where seaweed accumulates on the extreme upper shoreline, the decaying seaweed provides cover and humidity for burrowing sand hoppers (amphipods) and wrack flies. A stretch of this biotope occurs on the Dengie between Bradwell Power Station and Sales Point. Amphipods are also found where local conditions produce a substrate of well-sorted gravel on coarse sand; strand-line algae and the sorting of pebbles due to a localised tidal flow around Decoy Point, on the Blackwater, provide a suitable substrate for these marine animals to thrive.

In exposed conditions on the open coast, the sandy substrate is continually mobile. Few invertebrates tolerate this environment. Mobile sands are a feature of the north-eastern end of Foulness Sand. To the south-east they interface with stable muddy sands supporting the Maplin cockle beds.

Shingle or gravel shores on exposed open coasts are subject to a high degree of mobility and contain virtually no marine animals. This is the situation on the upper shore of Ray Sands on the Dengie, and along a thin bank of chenier ridge extending for 2.5 km, from an area around St Peter's Chapel (TM034084).

4. SPA interest features

4.1 Background and context

A major aim of the Birds Directive is to take special measures to conserve the habitats of Annex 1 and migratory 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 conservation objectives at a site level focus on maintaining the condition of the habitats used by the qualifying species. Habitat condition will be delivered through appropriate site management, including the avoidance of damaging disturbance. In reporting on Favourable Conservation Status, account will need to be taken of both habitat condition and the status of the birds on the SPA.

Accordingly, English Nature will use annual counts, in the context of five-year peak means for qualifying species, together with available information on population and distribution trends, to assess whether an 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 Commission

English Nature's advice focuses on the qualifying species for which an SPA was originally classified despite the fact that numbers and species composition may have changed on a site since that time. Such population and species composition changes are being documented through the UK SPA Network Review, led by JNCC, which will provide advice to Ministers on any changes in SPA citations required. Depending on the review and decisions from DETR, English Nature may reissue this advice on SPAs with updated bird information.

In addition to focusing on avoiding deterioration to the habitats of the qualifying species, the Habitats Directive also requires that actions are taken to avoid significant disturbance to the species for which the site was designated. Such disturbance may include alterations in population trends and/or distribution patterns. Avoiding disturbance to species requirements is mentioned in the favourable condition table underpinning the conservation objectives for the SPA. In this context, five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.

Attention is, however, also directed to the inclusion of disturbance in the advice on operations provided in section 6. Where disturbance is highlighted in such advice, relevant authorities need to avoid damaging disturbance to qualifying species when exercising their functions under the Directive.

In recognition that bird populations may change as a reflection of national or international trends or events, this advice on the bird interests of the European marine site focuses on the condition of the habitats necessary to support the bird populations. As with SAC interest features, sub-features are identified which describe the key habitats within the European marine site necessary to support the birds that qualify within the SPA. Detailed information and targets for habitat condition are listed in the favourable condition table in Section 5. Bird usage of the site varies, with different areas being favoured over others at certain times of the year.

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 the estuaries for feeding and nesting. Changes in the habitat may therefore affect prey availability and nesting areas. The important bird populations therefore require a functional estuary system which is capable of supporting intertidal habitats suitable for feeding, roosting and nesting. The most important factors related to this are:

- Current extent and distribution of suitable feeding, roosting and nesting habitats;
- Sufficient prey availability (e.g. small fish, shellfish, crustaceans and worms);
- Minimal levels of disturbance;
- Water quality, quantity and salinity necessary to maintain plant and animal communities suitable for bird feeding, nesting and roosting

4.2 Reductions in organic inputs

Under the Urban Waste Water Treatment (UWWT) Directive all coastal discharges above a certain size must have 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. The effects of these reductions on coastal birds in Essex Estuaries are difficult to predict. On a local scale cleaner sewage discharges may cause a redistribution of feeding birds or they may have a much greater effect causing a reduction in the overall capacity of a coastal area to support bird populations.

English Nature supports the cleaning up of coastal discharges. The overall ecological benefits of cleaner discharges will, in general, outweigh any subsequent local decline in bird numbers. However, coastal clean ups may have the potential to significantly effect the features of the SPA. Under the Birds and Habitats Directives, the competent authority (in this case Environment Agency) will therefore be required to undertake an appropriate assessment. If adverse effects are anticipated then compensatory measures, such as habitat creation or mitigation in the form of reducing disturbance through the use of refuges at critical times of the year, may be an option.

4.3 General Description

The five Special Protection Areas within the Essex Estuaries support a diverse range of species. These include internationally important populations of breeding birds, as well as internationally important assemblages of wintering waterfowl, present in both nationally and internationally important numbers. This advice refers specifically to those species (and their habitats) that regularly use the parts of the SPAs lying within the boundary of the Essex Estuaries European marine site. A detailed description of the importance of these species together with their sub-features, for the five SPAs, is provided below. A list of these species is given in Table 1.

4.4 Importance of internationally important populations of the regularly occurring Annex 1 species

The bird species listed in Annex 1 of the Birds Directive are in danger of extinction, rare or vulnerable and are the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. The Essex Estuaries European marine site is important for the following breeding populations of internationally important Annex 1 species:

- sandwich tern (*Sterna sandvicensis*);
- common tern (*Sterna hirundo*);
- little tern (*Sterna albifrons*); and
- avocet (*Recurvirostra avosetta*).

4.4.1 Sub-features

Shell, sand and gravel shores - Little tern, sandwich tern and common tern generally favour sand and gravel for nesting, with a mosaic of sparse vegetation as protection for their chicks. Common tern may also nest on bare scrapes in drift-line seaweed. Shell banks are also used. All prefer a shallow, sloping shoreline, giving maximum protection against flooding. The most popular tern nesting site in the Essex Estuaries is the Maplin shell bank off of Shoeburyness (Foulness), which lies within the Ministry of Defence establishment.

The Maplin Bank is an artificial shell bank which owes its existence to the Maplin airport proposal in the 1970s. The Maplin Airport Development Authority constructed an experimental hydrological bank which was colonised initially by little and common tern. The Maplin Bank now supports the largest colony of common terns in Essex - consistently over 100 nests (with over 200 nests in 1992). The Maplin site continues to support over 30 pairs annually[5].

The shell bank at Foulness Point hosted the first successful breeding colony of 40 pairs of sandwich terns in 1973. This increased to 110 pairs in 1978. No further breeding records are known until 1983 when 42 nests were found on the Maplin Bank, in association with common and little tern. In 1992 there was a peak of 548 pairs, with 329 young ringed. Though further good breeding years followed, in 1997 only 34 nests, with eggs, were recorded but no young were fledged. The Maplin Bank is the sole nesting site for sandwich tern in the Essex Estuaries. However, the Maplin Bank is shrinking, and nesting opportunities here are likely to decrease in future. The breeding strategy of this species to nest in a few large colonies, leaves it vulnerable to localised unfavourable events, for example, food shortages or extreme high tides.

In 1983, the stronghold of the little tern breeding colonies in the Essex Estuaries was at Foulness Point and Maplin Bank - that year 78% of the Essex breeding population was based at these sites. By 1993 this proportion had dropped to 26% - indeed the Essex population as a whole had fallen from its peak in 1983 of 458 pairs to 187 pairs. A smaller breeding population is now spread over a larger number of sites which include Colne Point and Langenhoe, on the Colne estuary; Pewet Island at Bradwell, Bradwell shell banks, Packing Shed Island and Cobmarsh Island (Blackwater Estuary). The latter (Cobmarsh) is a saltmarsh island with a large area of gravel. In 1997 it attracted 30 breeding pairs, about a quarter of the Essex population that year. The practice of recycling gravel obtained from channel dredgings (foreshore recharge), as a form of saltmarsh protection, has contributed to breeding success on Cobmarsh and Pewet Islands as the dredgings have raised the land level well above the highest spring tides. In addition to losses due to flooding, this species has suffered from predation and human disturbance on nesting grounds. Little terns in the Essex Estuaries mirror trends shown nationally - stability in terms of their overall distribution, with large variations in the size of individual colonies from year to year.

Intertidal mudflat and sandflats - An internationally important breeding population of avocet (*Recurvirostra avosetta*) breed on the banks and islands of shallow brackish lagoons inside the sea wall at Foulness and, since 1993, at Old Hall Marshes. Although these breeding sites lie outside the boundary of the Essex Estuaries European marine site, these birds are found all year round feeding within the site having slowly re-established

[5] Common tern occasionally nest on bare scrapes on high saltmarsh. They traditionally nest on Great Cob Island, located in the Tollesbury Fleet in the Blackwater Estuary. In 1992, the 58 nests on this saltmarsh island were flooded out. Human pressures and nests being flooded out by higher spring tides, due to sea level rise, are likely to prevent the population from expanding in the Essex Estuaries.

as a breeding population after an absence of half a century. A breeding population was thought to have existed on Northey Island, in the Blackwater, in the 18th century. However, by the 1890s avocets had become rare visitors to England. Their disappearance at this time coincided with extensive land claim reducing the area of high saltmarshes with brackish pools, required for breeding. Single pairs returned to breed within the site in the 1940s and in 1988 birds began colonising Foulness.

The intertidal mud and sandflats provide a feeding area for avocet adults and fledglings during the summer (and winter) months. Avocet feed primarily on small crustaceans (shrimps etc), marine worms and molluscs. They use sweeping movements of the bill to obtain prey from shallow water or surface sediments. They also pick up individual prey items from the surface of the mud.

Saltmarsh - Saltmarsh within the European marine site is an important roost site for avocet adults and fledglings, providing a safe refuge at high tide.

Shallow coastal waters - Common, little and sandwich terns feed in shallow coastal waters mainly on small fish (eg. sandeel)and also crustacea. These species are also likely to feed in marine waters outside the site.

4.5 Importance of the internationally important assemblage of waterfowl

Over 20,000 waders and wildfowl regularly visit the Essex Estuaries in winter - the combined total for the Mid-Essex Coast SPAs is 182,797 (five-year peak means from 87/88 to 91/92). These large populations of waterfowl either use the Essex coast on migration or overwinter here. They travel from breeding grounds in Greenland, Iceland, Scandinavia and Siberia. The site is an important resting point, on a route linking other western European estuaries, for birds passing through on migration to sites as far south as central Africa. For birds such as brent geese, which overwinter here, it is their destination after a 6,000 km flight from Siberia. In severe weather, the site may attain greater international importance as birds arrive from other areas to this more sheltered environment.

4.5.1 Sub-features

Intertidal mudflats and sandflats - Estuarine flats constitute the most biologically productive system in Britain producing a greater tonnage of biomass (weight of all organisms) per unit area than intensive agriculture. Ragworms (*Hediste diversicolor*) can occur at densities of up to 10,000 per square metre and mud snails (*Hydrobia ulvae*) reach densities of up to 50,000 per square metre. Both of these species are important prey items for a variety of waterfowl, including grey plover and redshank; mud snails are the preferred food of shelduck. The location of feeding birds on the intertidal flats is a reflection of the invertebrate species found there which, in turn, are dependent on the sediment type. For instance, bar-tailed godwits feed on large worms - lugworm (*Arenicola marina*) or ragworm - and are generally to be found feeding in the outer estuary. The most important site for these waders in the Essex Estuaries are the sandy muds of Maplin Sands, which in January and February hold up to 10,000 individuals, about 18 per cent of the national total. The coarse-grained sediment flats of Maplin and Dengie also attract large flocks of knot which are specialist feeders on bivalve molluscs - cockles (*Cerastoderma edule*), and Baltic tellin (*Macoma baltica*).

The more sheltered inner reaches on the Crouch, Roach and Blackwater estuaries, where the sediments are finer and muddier, appear to support the highest concentrations of feeding birds (National Rivers Authority, 1992). Dunlin feed on small prey items on or just below the surface. They penetrate right up into the creek heads and the heads of estuaries where worms are abundant in the more enriched, low salinity, fluid muds.

Dunlin feed in flocks mostly on the mid-shore, while redshank, which take similar prey items, are more thinly distributed, mainly on the upper shore. Redshank are cautious feeders as they hunt by sight, whereas dunlin detect their prey tactually by their bills.

The eelgrass beds (*Zostera* spp.) at Foulness, and sites linked to the Mid-Essex Coast SPAs in the Thames estuary, support some 40 to 50 per cent of the UK population of dark-bellied brent geese in November, making south Essex the most important site in the country for brents at this time. This is the first stop for brent geese arriving after their long migratory flight from western Siberia. Weight loss incurred on migration is regained within a matter of days feeding on this easily digestible, high protein food source. Once the beds have been eaten out, birds disperse to other estuaries and open coast sites within the Mid-Essex Coast SPAs where their diet will include algae (*Enteromorpha* spp. and *Ulvae lactuca*), which form mats on the surface of the mud flats. Algae is also eaten by shelduck.

The outer estuary sandy muds and fine sands are the preferred locations for feeding sanderling. A range of invertebrate prey items are taken. They also probe through strand-line vegetation for wrack flies (sea weed flies) - adult, larval and pupal stages - and sandhoppers.

Boulder and cobble shores - The intertidal boulder and cobble communities support mussel beds which are frequented by oystercatcher. Ringed plover feed on the upper shore zones of this community, particularly on amphipods and small worms. Boulder and cobble shores also support knot which feed on small molluscs. Algae (*Enteromorpha* spp) is an important food source for dark-bellied brent geese and is present on the boulder and cobble shores as well as the intertidal sandflats and mudflats.

Saltmarsh - As well as offering a further food source for brent geese and teal - the latter feeding on the seeds of saltmarsh plants - saltmarshes have an important function for feeding waders and waterfowl. They provide a safe haven from the tides which flood the mudflats twice a day. The low-growing, dense vegetation provides a suitable roosting habitat for waders. The main high tide roosts are in areas with little human disturbance, where large aggregations of waders alight from their various feeding areas. Important roost sites on the Blackwater are Cooper's Creek, west of Mundon Stone Point, on the inner estuary, and Highfields at St Lawrence on the south shore. On the Colne the Geedon saltings are a major roosting site. On the highest spring tides, the saltings are completely immersed forcing wading birds to roost on fields behind the sea walls. However, as soon as the tides starts to drop and begins to reveal the merest hint of saltmarsh, birds start to leave the fields to huddle on the these exposed slivers in readiness to recommence feeding at the earliest opportunity - demonstrating the truly estuarine nature of these birds.

Shallow coastal waters - Cormorant and goldeneye are present in nationally important numbers and contribute to the internationally important waterfowl assemblage. Cormorants feed primarily on fish, whilst goldeneye dive for invertebrates, such as mollusc, on the sea bed.

4.6 Importance of internationally important populations of regularly occurring migratory bird species

Several of the species included in the wintering waterfowl assemblage also occur in internationally important numbers, and thus qualify for SPA status in their own right. These species are listed in Table 1 and have been cited under the ' sub-features' above. As all these internationally important populations are included within the wintering waterfowl assemblage, and as they depend on the same marine habitats, they have been included in the conservation objective for the assemblage.

4.6.1 Sub-features

The sub-features for the internationally important populations of regularly occurring migratory waterfowl species are as for the waterfowl assemblage (given above at 4.5), with the exception of the shallow coastal waters sub-feature.

5. Conservation objectives for all interest features

Under Regulation 33(2)(a) of The Conservation (Natural Habitats &c.) Regulations 1994, English Nature has a duty to advise other relevant authorities as to the conservation objectives for the European marine site. The conservation objectives for the Essex Estuaries European marine site are provided below and should be read in the context of other advice given in this package, particularly

- the attached maps showing the extent of the various interest features and sub-features;
- summary information on the interest of each of the features; and
- the favourable condition table, providing information on how to recognise favourable condition for each of the features and which will act as a basis from which the monitoring programme will be developed.

5.1 Conservation objectives for Essex Estuaries SAC interest features

5.1.1 *Salicornia* and other annuals colonising mud and sand

Subject to natural change, maintain ***Salicornia* and other annuals colonising mud and sand** in favourable condition[6], in particular:

- Glasswort/annual sea-blite community
- Sea aster community

5.1.2 Cordgrass swards

Subject to natural change, maintain the ***Spartina* swards (*Spartinion*)** in favourable condition[6], in particular:

- Small cordgrass community
- Smooth cordgrass community

5.1.3 Atlantic salt meadows

Subject to natural change, maintain the **Atlantic salt meadows (*Glauco-Puccinellietalia*)** in favourable condition[6], in particular:

- Low/mid-marsh communities
- Upper marsh communities
- Upper marsh transitional communities
- Drift-line community

[6] For a detailed definition of how to recognise favourable condition see Table 2 (Section 6)

5.1.4 Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fruticosae*)

Subject to natural change, maintain the **Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fruticosae*)** in favourable condition[6], in particular:

- **!** Shrubby sea-blite community
- **!** Rock sea lavender/sea heath community

5.1.5 Estuaries

Subject to natural change, maintain the **estuaries** in favourable condition[6], in particular:

- **!** Saltmarsh communities
- **!** Intertidal mudflat and sandflat communities
- **!** Rock communities
- **!** Subtidal mud communities
- **!** Subtidal muddy sand communities
- **!** Subtidal mixed sediment communities

5.1.6 Mudflats and sandflats not covered by seawater at low tide

Subject to natural change, maintain the **mudflats and sandflats not covered by seawater at low tide** in favourable condition[6], in particular:

- **!** Mud communities
- **!** Muddy sand communities
- **!** Sand and gravel communities

[6]For a detailed definition of how to recognise favourable condition see Table 2 (Section 6)

5.2 Conservation objectives for Blackwater Estuary SPA interest features

5.2.1 The conservation objective for the internationally important populations of the regularly occurring Annex 1 bird species

Subject to natural change, maintain the habitats for the **internationally important populations of the regularly occurring Annex 1 bird species** in favourable condition[6], in particular:

- **!** Sand and gravel shores
- **!** Shallow coastal waters

Numbers of bird species using these habitats are given in Table 1.1

5.2.2 The conservation objective for the internationally important populations of regularly occurring migratory bird species

Subject to natural change, maintain the habitats for the **internationally important populations of regularly occurring migratory bird species** in favourable condition[6], in particular:

- **!** Saltmarsh
- **!** Intertidal mudflats and sandflats
- **!** Boulder and cobble shores

Numbers of bird species using these habitats are given in Table 1.1

5.2.3 The conservation objective for the internationally important assemblage of waterfowl

Subject to natural change, maintain the habitats for the **internationally important assemblage of waterfowl** in favourable condition[6], in particular:

- **!** Saltmarsh
- **!** Intertidal mudflats and sandflats
- **!** Boulder and cobble shores
- **!** Shallow coastal waters

Numbers of bird species using these habitats are given in Table 1.1

[6] For a detailed definition of how to recognise favourable condition see Table 2 (Section 6)

5.3 Conservation objectives for Colne Estuary SPA interest features

5.3.1 The conservation objective for the internationally important populations of the regularly occurring Annex 1 bird species

Subject to natural change, maintain the habitats for the **internationally important populations of the regularly occurring Annex 1 bird species** in favourable condition[6], in particular:

- **!** Sand and gravel shores
- **!** Shallow coastal waters

Numbers of bird species using these habitats are given in Table 1.2

5.3.2 The conservation objective for the internationally important populations of regularly occurring migratory bird species

Subject to natural change, maintain the habitats for the **internationally important populations of regularly occurring migratory bird species*** in favourable condition[6], in particular:

- **!** Saltmarsh
- **!** Intertidal mudflats and sandflats
- **!** Boulder and cobble shores

Numbers of bird species using these habitats are given in Table 1.2

* Including the nationally important breeding populations of regularly occurring migratory species: ringed plover (*Charadrius hiaticula*).

5.3.3 The conservation objective for the internationally important assemblage of waterfowl

Subject to natural change, maintain the habitats for the **internationally important assemblage of waterfowl** in favourable condition[6], in particular:

- **!** Saltmarsh
- **!** Intertidal mudflats and sandflats
- **!** Boulder and cobble shores
- **!** Shallow coastal waters

Numbers of bird species using these habitats are given in Table 1.2

[6] For a detailed definition of how to recognise favourable condition see Table 2 (Section 6)

5.4 Conservation objectives for Crouch and Roach Estuaries SPA interest features

5.4.1 The conservation objective for the internationally important populations of regularly occurring migratory bird species

Subject to natural change, maintain the habitats for the **internationally important populations of regularly occurring migratory bird species** in favourable condition[6], in particular:

- Saltmarsh
- Intertidal mudflats and sandflats
- Boulder and cobble shores

Numbers of bird species using these habitats are given in Table 1.3

5.4.2 The conservation objective for the internationally important assemblage of waterfowl

Subject to natural change, maintain the habitats for the **internationally important assemblage of waterfowl** in favourable condition[6], in particular:

- Saltmarsh
- Intertidal mudflats and sandflats
- Boulder and cobble shores

Numbers of bird species using these habitats are given in Table 1.3

[6]For a detailed definition of how to recognise favourable condition see Table 2 (Section 6)

5.5 Conservation objectives for Dengie SPA interest features

5.5.1 The conservation objective for the internationally important populations of regularly occurring migratory bird species

Subject to natural change, maintain the habitats for the **internationally important populations of regularly occurring migratory bird species** in favourable condition[6], in particular:

- **!** Saltmarsh
- **!** Intertidal mudflats and sandflats
- **!** Boulder and cobble shores

Numbers of bird species using these habitats are given in Table 1.4

5.5.2 The conservation objective for the internationally important assemblage of waterfowl

Subject to natural change, maintain the habitats for the **internationally important assemblage of waterfowl** in favourable condition[6], in particular:

- **!** Saltmarsh
- **!** Intertidal mudflats and sandflats
- **!** Boulder and cobble shores

Numbers of bird species using these habitats are given in Table 1.4

[6]For a detailed definition of how to recognise favourable condition see Table 2 (Section 6)

5.6 Conservation objectives for Foulness SPA interest features

5.6.1 The conservation objective for the internationally important populations of the regularly occurring Annex 1 bird species

Subject to natural change, maintain the habitats for the **internationally important populations of the regularly occurring Annex 1 bird species** in favourable condition[6], in particular:

- **!** Shell, sand and gravel shores
- **!** Intertidal mudflats and sandflats
- **!** Saltmarsh
- **!** Shallow coastal waters

Numbers of bird species using these habitats are given in Table 1.5

5.6.2 The conservation objective for the internationally important populations of regularly occurring migratory bird species

Subject to natural change, maintain the habitats for the **internationally important populations of regularly occurring migratory bird species*** in favourable condition[6], in particular:

- **!** Saltmarsh
- **!** Intertidal mudflats and sandflats
- **!** Boulder and cobble shores

Numbers of bird species using these habitats are given in Table 1.5

* Including the nationally important breeding populations of regularly occurring migratory species: ringed plover (*Charadrius hiaticula*).

5.6.3 The conservation objective for the internationally important assemblage of waterfowl

Subject to natural change, maintain the habitats for the **internationally important assemblage of waterfowl** in favourable condition[6], in particular:

- **!** Saltmarsh
- **!** Intertidal mudflats and sandflats
- **!** Boulder and cobble shores

[6]For a detailed definition of how to recognise favourable condition see Table 2 (Section 6)

Note: These SPA conservation objectives focus on habitat condition in recognition that bird populations may change as a reflection of national or international trends or events. Annual counts for qualifying species will be used by English Nature, in the context of five year peak means, together with available information on UK population and distribution trends, to assess whether this SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species across Europe.

Numbers of bird species using these habitats are given in Table 1.5

Tables 1.1 to 1.5 Information on populations of species of birds qualifying under the Birds Directive regularly using the parts the SPAs lying within the Essex Estuaries European marine site at the time the component SPAs were classified.

Table 1.1 BLACKWATER ESTUARY SPA

Species	Qualifying Status	Population*
Little tern *Sterna albifrons*	Internationally important populations of regularly occurring Annex 1 species.	73 pairs
Dark-bellied brent geese *Branta bernicla bernicla*	Internationally important populations of regularly occurring migratory bird species[1].	8,761 birds
Grey plover *Pluvialis squatarola*	Internationally important populations of regularly occurring migratory bird species[1].	2,172 birds
Dunlin *Calidris alpina*	Internationally important populations of regularly occurring migratory bird species[1].	17,743 birds
Black-tailed godwit *Limosa limosa*	Internationally important populations of regularly occurring migratory bird species[1].	755 birds
All internationally and nationally important wintering species.	Internationally important waterfowl assemblage.	46,552 birds**
Cormorant *Phalacrocorax carbo*	Nationally important populations of regularly occurring migratory bird species[2].	243 birds
Shelduck *Tadorna tadorna*	Nationally important populations of regularly occurring migratory bird species[2].	2,425 birds
Teal *Anas crecca*	Nationally important populations of regularly occurring migratory bird species[2].	2,190 birds
Goldeneye *Bucephala clangula*	Nationally important populations of regularly occurring migratory bird species[2].	315 birds
Ringed plover *Charadrius hiaticula*	Nationally important populations of regularly occurring migratory bird species[2].	338 birds
Curlew *Numenius arquata*	Nationally important populations of regularly occurring migratory bird species[2].	1,847 birds
Redshank *Tringa totanus*	Nationally important populations of regularly occurring migratory bird species[2].	1,079 birds

* 5-year average peak count (1987/8 to 1991/2). See SPA citation held on Register of European Sites for GB

** this figure includes the internationally important populations of regularly occurring migratory bird species listed above, as well

as the nationally important populations of regularly occurring migratory bird species listed in the table below.

[1]Internationally important populations of regularly occurring migratory species are a qualifying feature as well as contributing to the internationally important waterfowl assemblage.

[2]Nationally important populations of regularly occurring migratory species contribute to the international waterfowl assemblage.

Table 1.2 COLNE ESTUARY SPA

Species	Qualifying Status	Population*
Little tern *Sterna albifrons*	Internationally important populations of regularly occurring Annex 1 species.	73 pairs
Ringed plover *Charadrius hiaticula*	Nationally important breeding populations of regularly occurring migratory bird species.	135 pairs
Dark-bellied brent geese *Branta bernicla bernicla*	Internationally important populations of regularly occurring migratory bird species[1].	5,315 birds
Redshank *Tringa totanus*	Internationally important populations of regularly occurring migratory bird species[1].	1,252 birds
All internationally and nationally important wintering species.	Internationally important waterfowl assemblage.	30,687 birds**
Cormorant *Phalacrocorax carbo*	Nationally important populations of regularly occurring migratory bird species[2].	243 birds
Mute swan *Cygnus olor*	Nationally important populations of regularly occurring migratory bird species[2].	354 birds
Shelduck *Tadorna tadorna*	Nationally important populations of regularly occurring migratory bird species[2].	1,237 birds
Goldeneye *Bucephala clangula*	Nationally important populations of regularly occurring migratory bird species[2].	262 birds
Ringed plover *Charadrius hiaticula*	Nationally important populations of regularly occurring migratory bird species[2].	355 birds
Grey plover *Pluvialis squatarola*	Nationally important populations of regularly occurring migratory bird species[2].	1,168 birds
Sanderling *Calidris alba*	Nationally important populations of regularly occurring migratory bird species[2].	219 birds
Dunlin *Calidris alpina*	Nationally important populations of regularly occurring migratory bird species[2].	11,272 birds
Black-tailed godwit *Limosa limosa*	Nationally important populations of regularly occurring migratory bird species[2].	606 birds
Curlew *Numenius arquata*	Nationally important populations of regularly occurring migratory bird species[2].	938 birds

* 5-year average peak count (1987/8 to 1991/2). See SPA citation held on Register of European Sites for GB

** this figure includes the internationally important populations of regularly occurring migratory bird species listed above, as well as the nationally important populations of regularly occurring migratory bird species listed in the table below.

[1]Internationally important populations of regularly occurring migratory species are a qualifying feature as well as contributing to the internationally important waterfowl assemblage.

[2]Nationally important populations of regularly occurring migratory species contribute to the international waterfowl assemblage.

Table 1.3 CROUCH AND ROACH ESTUARIES SPA

Species	Qualifying Status	Population*
Dark-bellied brent geese *Branta bernicla bernicla*	Internationally important populations of regularly occurring migratory bird species[1].	5,509 birds
All internationally and nationally important wintering species.	Internationally important waterfowl assemblage.	27,021 birds**

* 5-year average peak count (1989/90 to 1993/4). See SPA citation held on Register of European Sites for GB

[1]Internationally important populations of regularly occurring migratory species are a qualifying feature as well as contributing to the internationally important waterfowl assemblage.

Table 1.4 DENGIE SPA

Species	Qualifying Status	Population*
Dark-bellied brent geese *Branta bernicla bernicla*	Internationally important populations of regularly occurring migratory bird species[1].	2,250 birds
Grey plover *Pluvialis squatarola*	Internationally important populations of regularly occurring migratory bird species[1].	1,752 birds
Knot *Calidris canutus*	Internationally important populations of regularly occurring migratory bird species[1].	7,763 birds
All internationally and nationally important wintering species.	Internationally important waterfowl assemblage.	27,947 birds**
Dunlin *Calidris alpina*	Nationally important populations of regularly occurring migratory bird species[2].	8,470 birds
Black-tailed godwit *Limosa limosa*	Nationally important populations of regularly occurring migratory bird species[2].	63 birds
Bar-tailed godwit *Limosa lapponica*	Nationally important populations of regularly occurring migratory bird species[2].	835 birds

* 5-year average peak count (1987/8 to 1991/2). See SPA citation held on Register of European Sites for GB
** this figure includes the internationally important populations of regularly occurring migratory bird species listed above, as well as the nationally important populations of regularly occurring migratory bird species listed in the table below.

[1]Internationally important populations of regularly occurring migratory species are a qualifying feature as well as contributing to the internationally important waterfowl assemblage.

[2]Nationally important populations of regularly occurring migratory species contribute to the international waterfowl assemblage.

Table 1.5 FOULNESS SPA

Species	Qualifying Status	Population*
Sandwich tern *Sterna sandvicensis*	Internationally important populations of regularly occurring Annex 1 species.	267 pairs
Common tern *Sterna hirundo*	Internationally important populations of regularly occurring Annex 1 species.	186 pairs
Little tern *Sterna albifrons*	Internationally important populations of regularly occurring Annex 1 species.	73 pairs
Avocet *Recurvirostra avosetta*	Internationally important populations of regularly occurring Annex 1 species.	26 pairs
Ringed plover *Charadrius hiaticula*	Nationally important breeding populations of regularly occurring migratory bird species.	135 pairs
Dark-bellied brent geese *Branta bernicla bernicla*	Internationally important populations of regularly occurring migratory bird species[1].	13,276 birds
Oystercatcher *Haematopus ostralagus*	Internationally important populations of regularly occurring migratory bird species[1].	9,805 birds
Grey plover *Pluvialis squatarola*	Internationally important populations of regularly occurring migratory bird species[1].	2,229 birds
Knot *Calidris canutus*	Internationally important populations of regularly occurring migratory bird species[1].	22,151 birds
Bar-tailed godwit *Limosa lapponica*	Internationally important populations of regularly occurring migratory bird species[1].	5,213 birds
Redshank *Tringa totanus*	Internationally important populations of regularly occurring migratory bird species[1].	1,540 birds
All internationally and nationally important wintering species.	Internationally important waterfowl assemblage.	74,791 birds**
Shelduck *Tadorna tadorna*	Nationally important populations of regularly occurring migratory bird species[2].	826 birds
Dunlin *Calidris alpina*	Nationally important populations of regularly occurring migratory bird species[2].	9,420 birds
Curlew *Numenius arquata*	Nationally important populations of regularly occurring migratory bird species[2].	2,132 birds

* 5-year average peak count (1987/8 to 1991/2). See SPA citation held on Register of European Sites for GB

** this figure includes the internationally important populations of regularly occurring migratory bird species listed above, as well as the nationally important populations of regularly occurring migratory bird species listed in the table below.

[1]Internationally important populations of regularly occurring migratory species are a qualifying feature as well as contributing to the internationally important waterfowl assemblage.

[2]Nationally important populations of regularly occurring migratory species contribute to the international waterfowl assemblage.

6. Favourable condition table

The favourable condition table is supplied as an integral part of English Nature's Regulation 33 advice package. It 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 site and its features. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under Regulations 20 and 48-50, but 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, by contrast, a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects. English Nature 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 is the principle source of information that English Nature will use to assess the condition of an interest feature and as such comprises indicators of condition. On many terrestrial European sites, we know sufficient about the preferred or target condition of qualifying habitats to be able to define measures and associated targets for all attributes to be assessed in condition monitoring. Assessments as to whether individual interest features are in favourable condition will be made against these targets. In European marine sites we know far less about habitat condition and find it difficult to predict what favourable condition may look like. Individual sites within a single marine habitat category are also all very different, further hampering the identification of generic indicators of condition. Accordingly, in the absence of such information, condition of interest features in European marine sites will be assessed against targets based on the existing conditions, which may need to be established through baseline surveys in many cases.
The assumption that existing interest features on European marine sites are in favourable condition will be tested in the 2000 - 2006 reporting period and the results subsequently fed back into our advice and site management. Where there is more than one year's observations on the condition of marine habitats, all available information will need to be used to set the site within long-term trends in order to form a view on favourable condition. Where it may become clear that certain attributes are a cause for concern, and if detailed studies prove this correct, restorative management actions will need to be taken to return the interest feature from unfavourable to favourable condition. It is the intention of English Nature to provide quantification of targets in the favourable condition table during the 2000 - 2006 reporting period.

This advice also provides the basis for discussions with management and advisory groups, and as such the attributes and associated measures and targets may be modified over time. 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. Monitoring of the attributes may be of fairly coarse methodology, underpinned by more rigorous methods on specific areas within the site. To meet UK agreed common standards, English Nature will be committed to reporting on each of the attributes subsequently listed in the final version of the table, although the information to be used may be collected by other organisations through agreements.

The 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. 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 will be responsible for collating the information required to assess condition and will form a judgement on the condition of each feature within the site, taking into account all available information and using the favourable condition table as a guide.

Box 1 Glossary of terms used in the favourable condition table

Feature	The habitat or species for which the site has been selected.
Sub-feature	An ecologically important sub-division of the feature.
Attribute	Selected characteristic of an interest feature/sub-feature which provides an indication of the condition of the feature to which it applies.
Measure	What will be measured in terms of the units of measurement, arithmetic nature and frequency at which the measurement is taken. This measure will be attained using a range of methods from broad scale to more specific across the site.
Target	This defines the desired condition of an attribute, taking into account fluctuations due to natural change. Changes that are significantly different from the target will serve as a trigger mechanism through which some further investigation or remedial action is taken.
Comments	The rationale for selection of the attribute.

Table 2 Favourable Condition Table for Essex Estuaries 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. Note: Saltmarshes are dynamic systems and are continually adjusting to natural changes. The dynamism of the system is essential for the viability of saltmarsh plants. Baseline data from which to measure change has yet to be established. National Vegetation Classification codes (NVCs) and marine biotope codes are given, where relevant. Appendix II and Sections 3.1.1 to 3.1.4 on saltmarsh types (p. 13 to 18) describes these communities in full.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Annex 1 saltmarsh features as a whole: ***Salicornia* and other annuals colonising mud and sand.** **Cordgrass swards.** **Atlantic salt meadows.** **Mediterranean saltmarsh scrub.**		Extent.	Area (hectares) measured at low spring tides, once during the reporting cycle.	No decrease in extent of saltmarsh communities from an established baseline, subject to natural change.	Monitoring will need to take account of the dynamic nature of these habitats and seasonal and periodic random variations in annual vegetation types. Sea level rise is effecting changes: as sea level rises and submerges existing vegetation zones, they should be able to re-establish at higher levels, but artificial sea walls prevent this. Monitoring the rate of change is therefore important. Site integrity will be dependent on maintaining the range of community types from low to high marsh by allowing natural roll back of the saltmarsh to occur.
		Creek density and creek morphology	Pattern of creek systems (creek 'orders') and creek bed levels, widths and bank angle measured once during the reporting cycle.	No change in creek bathymetry or width/length/bank angle of creeks from an established baseline, subject to natural change.	Meanders in creeks help to absorb tidal energy. (Creek of 4th and 5th order are complex. 1st and 2nd order creeks are found on mud flats.) Creeks transport sediment to and from the saltmarsh and act as drainage channels. Widening, flattening and lengthening of creeks are an indication of sea level rise/increase in tidal energy. Though this dissipates the increased tidal energy over a larger area, this allows higher energy to spread further inland.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Topography	Surface elevation of saltmarsh and foreshore relative to sea level rise measured periodically (frequency to be determined).	No change in surface level of saltmarsh and foreshore relative to sea level rise from an established baseline, subject to natural change.	The presence of sea walls may prevent saltmarsh from keeping pace with sea level rise and maintaining its position in the tidal frame (the landward migration of saltmarsh to compensate for sea level rise is prevented).
Annex 1 saltmarsh features as a whole: ***Salicornia* and other annuals colonising mud and sand.** **Cordgrass swards.** **Atlantic salt meadows.** **Mediterranean saltmarsh scrub.**		Vegetation structure	Range and distribution of varying vegetation heights, measured periodically (frequency to be determined).	Vegetation structure should not deviate significantly from an established baseline subject to natural change.	Grazing can result in changes to plant community composition. Limited grazing of saltmarshes can increase species diversity, but on an eroding marsh the combination of grazing and trampling is likely to exacerbate erosion. Also, it may lower the level of the saltmarsh thus changing species composition.
***Salicornia* and other annuals colonising mud and sand**	Glasswort/annual sea-blite community ie: SM7, SM8; SM9; SM11. Sea aster community ie: SM11.	Algal mat cover.	Area (and thickness of algal mat) measured periodically (frequency to be determined).	No increase in algal mat cover from an established baseline.	Algal mats are often associated with pioneer and low marsh communities, and are important primary producers, but can be affected by changes to water quality - eutrophication may lead to expansion and smothering of vegetation, or pollution can cause a decline which can lead to destabilisation of sediment surfaces and initiate erosion. An increase in algal cover can also indicate a decline in grazing invertebrates. NB a reduction in algal mat cover can indicate active erosion.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		English cord grass (*Spartina anglica*) community (SM6).	Distribution and extent of English cord grass, measured once during the reporting cycle.	No increase in extent from an established baseline, subject to natural change.	Not of conservation importance in the UK but an invasive pioneer species. Could impact on intertidal, pioneer saltmarsh and low-mid saltmarsh, but may be a precursor to the development of other saltmarsh communities in some circumstances.
***Salicornia* and other annuals colonising mud and sand**	Glasswort/annual sea-blite community ie: SM7, SM8; SM9; SM11.	Distribution and extent of pioneer saltmarsh community.	Distribution and extent of pioneer saltmarsh community, measured once during the reporting cycle.	No change in distribution and extent of pioneer saltmarsh community from an established baseline, subject to natural change.	Pioneer saltmarsh must be carefully defined for the purposes of monitoring. Species within the *Salicornia* (glasswort) genus have different niches and are not necessarily spatially connected.
	Sea aster community ie: SM11.	Distribution and extent of pioneer saltmarsh community.	Distribution and extent of pioneer saltmarsh community, measured once during the reporting cycle.	No change in distribution and extent of pioneer saltmarsh community from an established baseline, subject to natural change.	
Spartina swards	Small cordgrass (SM4).	Distribution and extent of small cordgrass community.	Distribution and extent of small cordgrass community, measured once during the reporting cycle.	No change in distribution and extent of small cordgrass community from an established baseline, subject to natural change.	
	Smooth cordgrass (SM5).	Distribution and extent of smooth cordgrass community.	Distribution and extent of smooth cordgrass community, measured once during the reporting cycle.	No change in distribution and extent smooth cordgrass community from an established baseline, subject to natural change.	

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Atlantic salt meadows	Low/mid marsh communities ie: SM10; SM 13; SM14.	Distribution and extent of low/mid marsh communities.	Distribution and extent of low/mid marsh communities, measured once during the reporting cycle.	No change in distribution and extent of low/mid marsh communities from an established baseline, subject to natural change.	Vegetation cover of the low marsh community can be quite variable and may have up to 50 per cent algal mat cover.
Atlantic salt meadows	Upper marsh communities ie: SM13; SM13 sub-communities; SM14; SM16; SM28.	Distribution and extent of upper saltmarsh communities.	Distribution and extent of upper saltmarsh communities, measured once during the reporting cycle.	No change in distribution and extent of upper saltmarsh communities from an established baseline, subject to natural change.	
	Upper marsh transitional communities ie: SM16; SM17; SM18; SM26.	Distribution and extent of upper marsh transitional communities.	Distribution and extent upper marsh transitional communities, measured once during the reporting cycle.	No change in distribution and extent of upper marsh transitional communities from an established baseline, subject to natural change.	
	Drift-line community ie: SM28.	Distribution and extent of drift-line community.	Distribution and extent of drift-line community measured once during the reporting cycle.	No changes in distribution and extent of drift-line community from an established baseline, subject to natural change.	Often occurs within other saltmarsh vegetation types, forming mosaics with other saltmarsh species.
		Absence of landward constraints.	Distribution and extent of upper marsh natural landward transitional communities, measured once during the reporting cycle.	No change in distribution and extent of natural landward transitional communities from an established baseline, subject to natural change.	Only 3 locations within SAC where this occurs. Elsewhere upper marsh transitional vegetation is truncated by sea walls. Sea level rise may squeeze the habitat against sea walls. The extent of this habitat which can migrate inland as sea levels rise is likely to be especially valuable in redressing losses incurred to the feature.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Mediterranean saltmarsh scrub	Shrubby sea-blite community ie: SM25.	Distribution and extent of shrubby sea-blite community.	Distribution and extent of shrubby sea-blite community, measured once during the reporting cycle.	No changes in distribution and extent of shrubby sea-blite community from an established baseline, subject to natural change.	
Mediterranean saltmarsh scrub	Rock sea lavender/sea heath community.	Distribution and extent of rock sea lavender/sea heath community.	Distribution and extent of rock sea lavender/sea heath community measured once during the reporting cycle.	No changes in distribution and extent of rock sea lavender/sea heath community from an established baseline, subject to natural change.	
Estuaries		Morphological equilibrium.	Intra and inter-estuarine Tidal Prism/Cross Section ratio (TP/CS ratio) measured every second reporting cycle.	The intra- and inter- estuarine TP/CS relationship should not deviate significantly from an established baseline subject to natural change.	TP = Tidal Prism = total volume of water crossing a given cross section during the flood tide (m^3). CS = Area of a given cross section at high water springs (m^2). 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 the indicate the influence of anthropogenic factors and this would trigger more detailed evaluation of potential problems.
			Long term trends in the horizontal boundary of the saltmarsh/mudflat interface, measured periodically during the reporting cycle.	The horizontal boundary of the saltmarsh/mudflat interface should not deviate significantly from an established baseline, subject to natural change.	Monitoring the saltmarsh boundary is a practical means of securing data which 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 (determined on a regional basis). In the absence of saltmarsh, vertical change in mudflat position can act as a surrogate for, or in addition to, the saltmarsh boundary.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Estuaries		Temperature. Salinity.	Water temperature and salinity measured periodically throughout the reporting cycle (frequency to be determined).	Average temperature/ salinity should not deviate significantly from an established baseline, subject to natural change.	Temperature and salinity are characteristic of the overall hydrography of the area. Changes in temperature and salinity influences 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.
	Saltmarsh	See separate table, page 43.			
	Intertidal mud flats and sand flats.	See separate table, page 50.			
	Rock; subtidal mud; subtidal muddy sand; subtidal mixed sediment communities.	Relative distribution of sub-features.	Relative distribution of sub-features, measured once during the reporting cycle.	No change in relative distribution of sub-features from an established baseline, subject to natural change.	The relative distribution is an important structural aspect of the sub-features. Changes in extent and/or distribution relative to the other sub-features may indicate long term changes in the physical conditions at the site.
	Subtidal mud; subtidal muddy sands; subtidal mixed sediment communities.	Sediment character.	Particle size analysis (to produce grain size survey map). Parameters include %sand/silt, mean and median grain size, and sorting coefficient, used to characterise sediment type.	Average PSA parameters should not deviate significantly from an established baseline, subject to natural change.	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. Redistribution of sediment would indicate estuary adjustment to morphological change.
	Subtidal mud communities	Range and distribution of subtidal mud communities. (IMU biotopes)	Variety (range) and distribution (approximate location) of biotopes measured during late summer/early autumn, once during the reporting cycle.	Range and distribution should not deviate significantly from an established baseline, subject to natural change.	The variety and location of biotopes is an important structural and functional aspect of the feature. Look out for changes in the biotope where a biotope loses its distinctive quality and becomes a variant of another widely occurring biotope - though the number of biotopes on site is the same there will have been a loss in diversity.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Estuaries	Subtidal muddy sand communities.	Range and distribution of subtidal muddy sand communities. (IMS & CMS biotopes)	Variety (range) and distribution (approximate location) of biotopes measured during late summer/early autumn, once during reporting cycle.	Range and distribution should not deviate significantly from an established baseline, subject to natural change.	The variety and location of biotopes is an important structural and functional aspect of the feature. Look out for changes in the biotope where a biotope loses its distinctive quality and becomes a variant of another widely occurring biotope - though the number of biotopes on site is the same there will have been a loss in diversity.
	Subtidal muddy sand communities.	Extent of IMS.Zmar *(Zostera marina* community)	Area of eelgrass beds measured during late summer, once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	The extent and distribution of eelgrass beds provides a long-term integrated measure of environmental conditions.
	Subtidal muddy sand communities.	Abundance of characteristic species: eelgrass - *Zostera marina*.	Average density, measured during peak growth period, once during the reporting cycle.	Average abundance should not deviate significantly from an baseline, subject to natural change.	An early indicator of seagrass under stress is a reduction in biomass, ie the number and length of leaves. Density is preferred as a surrogate for biomass, being less destructive, based on baseline survey to establish the relationship between density and biomass at a site.
	Subtidal mixed sediment communities.	Range and distribution of subtidal mixed sediment communities (IMX, CMX & IGS biotopes)	Variety (range) and distribution (approximate location) of biotopes measured during late summer/early autumn, once during the reporting cycle.	Range and distribution should not deviate significantly from an established baseline, subject to natural change.	The variety and location of biotopes is an important structural and functional aspect of the feature. Look out for changes in the biotope where a biotope loses its distinctive quality and becomes a variant of another widely occurring biotope - though the number of biotopes on site is the same there will have been a loss in diversity.
		Extent. In particular: CMX.SspiMx (*Sabellaria spinulosa*) IGS.ScupHyd (whiteweed)	Area measured during late summer, once during reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	*S. spinulosa* forms thin crusts which may support a rich fauna. White weed form large colonies likely to support other marine plants and animals. The Eagle Bank constitutes mixed sediments and is the principal spawning site of the Thames-Blackwater herring - a distinct sub-species of the North Sea herring.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Estuaries	Rock communities	Range and distribution of rock communities (SLR, MLR, MCR biotopes)	Variety (range) and distribution (approximate location) of biotopes measured during late summer/early autumn, once during reporting cycle.	Range and distribution should not deviate significantly from an established baseline, subject to natural change.	The variety and location of biotopes is an important structural and functional aspect of the feature. Look out for changes in the biotope where a biotope loses its distinctive quality and becomes a variant of another widely occurring biotope - though the number of biotopes on site is the same there will have been a loss in diversity.
		Extent of specific rock communities: SLR.MytX (mussel beds); SLR.FserX.T (rich tide-swept communities) MLR.MytPid; MCR.Pid (bed clay communities).	Area of biotopes measured during late summer, once during reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Mussel beds and tide-swept communities are rich marine communities more commonly found on rocky shores; mussel beds bind the sediment. Increase in intertidal and subtidal bed clays may be indicative of increased erosion of soft sediments.
Intertidal mudflats and sandflats		Extent	Area of intertidal mudflats and sandflats measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Extent is an attribute on which reporting is required by the Habitats Directive. Loss of intertidal mud and sandflat communities is likely to be detrimental to the structure of the feature, eg associated with a change in sediment budget or geomorphological regime, and may indicate long-term changes in the physical condition of the feature. It will be important to assess impact of coastal squeeze on coastal processes.
		Topography	Tidal elevation (relative to sea level rise) and shore slope, measured periodically (frequency to be determined).	Shore profile measured on low-water spring tide in the summer months, should not deviate significantly from the baseline, subject to natural change.	In the intertidal, topography reflects the energy conditions and stability of the sediment, which is key to the structure of the feature. Topography is a major influence on the distribution of communities throughout the feature. Measuring topography may also indicate the position of channels through the feature, which is another important indicator of the processes influencing the site.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
	Mud; muddy sand communities	Sediment character.	1.Particle size analysis. Parameters include %sand/silt/gravel, mean and median size, and sorting co-efficient used to characterise sediment type.	1.Average PSA parameters should not deviate significantly from the baseline, subject to natural change.	1. 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.
Intertidal mudflats and sandflats	Mud; muddy sand communities.	Sediment character.	2. Sediment penetrability - degree of sinking.	2. Average measure should not deviate significantly from the baseline, subject to natural change.	2. Penetrability is an indicator of sediment stability, degree of compaction 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.
			3. Organic carbon/content % organic carbon from sediment sample.	3. Average organic carbon content should not increase in relation to the baseline, subject to natural change.	3. Organic content critically influences the infaunal community and can cause deoxygenation of the feature which can be detrimental to the biota. The quantity of organic matter is particularly important in determining the food availability for benthic communities and increased organic enrichment can lead to a deterioration in the health of the benthic population.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
			4. Oxidation - reduction potential (a) Depth of black layer (b) In situ measurement (Eh) of redox potential) Sediment character to be measured during summer month once (may be more frequent depending on operations within site) during reporting cycle.	Average black layer depth/ Eh should not increase in relation to the baseline, subject to natural change.	4. 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. Close examination of the sediment reveals an oxygenated brown layer which changes to a grey layer immediately above a black sulphide layer (muddy sediments). The grey layer marks the transition between oxygenated and reduced conditions. The degree of oxygenation/reduction is measured by the redox potential of the sediment.
		Nutrient enrichment - macroalgal mats.	Abundance of macroalgae on the feature during summer, annually.	Average abundance of macroalgae should not increase in relation to the baseline, subject to natural change.	Nutrient status is a key functional factor that influences biota associated with sediments, including infauna as well as plants/algae at the surface. Indicator macroalgae indicate elevated nutrient levels which reduce the quality of the sediments and their communities, primarily through smothering and deoxygenation.
Intertidal mudflats and sandflats	Mud communities	Range and distribution of mud communities, in particular: LMU.HedOl; LMU.HedScr; LMU.HedStr.	Variety (range) and distribution (approximate location) of biotopes measured during late summer/early autumn, once during reporting cycle.	Range and distribution should not deviate significantly from an established baseline, subject to natural change.	The variety and location of biotopes is an important structural and functional aspect of the feature.
	Muddy sand communities.	Range and distribution of muddy sand communities, in particular: LMS.MacAre; LMS.PCer; LMS.Znol.	Variety (range) and distribution (approximate location) of biotopes measured during late summer/early autumn, once during reporting cycle.	Range and distribution should not deviate significantly from an established baseline, subject to natural change.	The variety and location of biotopes is an important structural and functional aspect of the feature.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Extent of specific biotopes ie: Cockle beds (LMS.PCer); Eelgrass beds LMS.Znol.	Extent (hectares) of these characteristic biotope, measured during late summer, annually.	No net loss in extent from an established baseline, subject to natural change.	Cockle beds in the Essex Estuaries are nationally important, supporting over half the UK commercial fishery (Wiggins, 1992). Also shellfish beds reduce tidal flow and encourage sedimentation in their lee, so they are also important in indicating changes in coastal processes. Eelgrass beds contribute to sediment structure ie stabilise foreshore sediments by reducing wave energy.
		Characteristic species: abundance of *Zostera* ***noltii***	Average density, measured during peak growth period once during the reporting cycle.	Average abundance should not deviate significantly from the baseline, subject to natural change.	An early indicator of seagrass under stress is a reduction in biomass, ie the number and length of leaves. Density is preferred as a surrogate for biomass, being less destructive, based on baseline survey to establish the relationship between density and biomass at a site.
		Cockle (*Cerasto-derma edule*) (LMS.PCer).	Abundance and age/size class profile of cockles, measured periodically (frequency to be determined).	Abundance and age/size class profile of cockles should not fall below an established baseline, subject to natural change.	Cockles are a key structural component of the intertidal muddy sand communities and they play an important role in the functioning of the intertidal mudflats and sandflats. The range of age classes is an important indicator of cockle recruitment and growth.
Intertidal mudflats and sandflats	Sand and gravel communities	Sediment character.	Particle size analysis. Parameters include %sand/silt/gravel, mean and median size, and sorting co-efficient used to characterise sediment type.	Average PSA parameters should not deviate significantly from the baseline, subject to natural change.	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.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Range and distribution of sand and gravel communities, in particular: LGS.Lan; LGS.Tal; LGS.Pec; LGS.BarSnd; LGS.BarSh.	Variety (range) and distribution (approximate location) of biotopes measured during late summer/early autumn, once during the reporting cycle.	Range and distribution location should not deviate significantly from an established baseline, subject to natural change.	The variety and location of biotopes is an important structural and functional aspect of the feature.

Favourable Condition Table for Essex Estuaries European marine site - Blackwater Estuary SPA. 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.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important Annex 1 bird population - **Little tern (*Sterna albifrons*)**.		Impact of human disturbance.	Displacement of breeding birds from known nesting sites.	No significant displacement of birds, due to human disturbance, from baseline ie numbers arriving at site to breed in that year.	If human disturbance is an issue this would need to be addressed through the management scheme.
	Sand and gravel shores	Extent of potential nesting sites.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	If the supporting feature is unable to keep pace with sea level rise (and coastal squeeze could be implicated in this) inundation of this feature becomes more frequent and nests are at increased risk of flooding. With scrapes formed close to the high-tide mark, this is a common cause of nest failure.
		Vegetation cover/density.	Ratio of open ground with sparse vegetation and bare areas, measured periodically (frequency to be determined).	Ratio of open ground with sparse vegetation and bare areas should not deviate significantly from an established baseline, subject to natural change.	Important nesting habitat. Open, largely bare areas of sand and gravel comprise unrestricted views >200m, with vegetation cover <10% and the remainder bare during the breeding period (April-August).
	Shallow coastal waters	Abundance of prey species.	Abundance of sprats, sandeels, crustacea and worms, measured periodically (frequency to be determined).	Abundance of prey species should not deviate significantly from an established baseline, subject to natural change.	Availability of prey species is important during the breeding period

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).		Impact of human disturbance	Reduction in numbers measured using 5-year peak mean information on populations.	No significant reduction in numbers from established baseline, subject to natural change.	Extreme events such as storms and extreme cold weather will need to be recorded as this will affect numbers. Use WeBS (Wetland Bird Survey) high-tide and low-tide counts as baseline.
	Intertidal mudflats and sandflats; boulder and cobble shores	Extent.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	The features are important for supporting feeding birds.
		Abundance of invertebrate prey species.	Abundance of: oligochaetes, polychaetes, gastropods, bivalves crustacea - amphipoda, decapoda - measured periodically (frequency to be determined).	Abundance of prey species should not deviate from established baseline, subject to natural change.	These species are an important food supply for birds. This food source is also important for a nationally important breeding population of ringed plover. For specialist feeders it may be necessary to record to species level for important prey items. Food availability will be affected by freezing conditions.
		Abundance of marine algae (*Enteromorpha* spp. and *Ulva lactuca*).	Abundance of marine algae measured periodically, in late summer (frequency to be determined).	Average abundance of marine algae should not deviate from established baseline, subject to natural change.	Marine algae is an important food source for brent geese. Macroalgal mats are also an indicator of nutrient enrichment (see favourable condition table for 'intertidal mudflats and sandflats' - also specifies quantitative measure).
	Intertidal mudflats and sandflats	Abundance of eelgrass. (*Zostera marina* and *Zostera noltii*).	Abundance of eelgrass measured periodically, in late summer (frequency to be determined).	Average abundance should not deviate from an established baseline, subject to natural change.	Eelgrass is an important food source for brent geese. (The 'intertidal mudflats and sandflats' favourable condition table also contains a quantitative attribute for eelgrass).

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).	Shallow coastal waters	Abundance of prey species.	Abundance of small fish, crustaceans and molluscs measured periodically (frequency to be determined).	Abundance of prey species should not deviate significantly from established baseline.	A nationally important population of cormorants feed on fish species in shallow coastal waters. A nationally important population of goldeneye feed on bottom-dwelling invertebrates - mostly molluscs and crustaceans
	Saltmarsh: Atlantic salt meadows	Extent.	Area (ha) measured once during reporting cycle.	No decrease in extent of Atlantic salt meadows from an established baseline, subject to natural change.	Important roosting area. Roosting birds require good all round vision to watch for predators - they favour areas with open, short vegetation (<10cm) and unrestricted views (>200m).
		Presence and abundance of food species.	Presence and abundance of soft-leaved grasses & herbs and seed bearing plants. Measured periodically (frequency to be determined).	Presence and abundance of characteristic food species should not deviate significantly from an established baseline, subject to natural change.	Brent geese feed on sea aster (*Aster trifoliu*m); saltmarsh grass (*Puccinellia maritima*) and species within this sward such as: sea plantain (*Plantago maritima*) and sea arrow grass (*Triglochin maritima*); red fescue (*Festuca rubra*) and lesser sea-spurrey (*Spergularia marina*). Teal feed on the seeds of saltmarsh plants.

Favourable Condition Table for Essex Estuaries European marine site - Colne Estuary SPA. 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.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important Annex 1 bird population - **Little tern (*Sterna albifrons*)**.		Impact of human disturbance.	Displacement of breeding birds from known nesting sites.	No significant displacement of birds, due to human disturbance, from baseline ie numbers arriving at site to breed in that year.	If human disturbance is an issue this would need to be addressed through the management scheme.
	Sand and gravel shores	Extent of potential nesting sites.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	If the supporting feature is unable to keep pace with sea level rise (and coastal squeeze could be implicated in this), inundation of this feature becomes more frequent and nests are at increased risk of flooding. With scrapes formed close to the high-tide mark, this is a common cause of nest failure.
		Vegetation cover/density.	Ratio of open ground with sparse vegetation and bare areas, measured periodically (frequency to be determined).	Ratio of open ground with sparse vegetation and bare areas should not deviate significantly from and established baseline, subject to natural change.	Important nesting habitat. Open, largely bare areas of sand and gravel comprise unrestricted views >200m, with vegetation cover <10% and the remainder bare during the breeding period (April-August).
	Shallow coastal waters	Abundance of prey species.	Abundance of sprats, sandeels, crustacea and worms measured periodically (frequency to be determined).	Abundance of prey species should not deviate significantly from an established baseline, subject to natural change.	Availability of prey species is important during the breeding period.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).		Impact of human disturbance.	Reduction in numbers measured using 5-year peak mean information on populations.	No significant reduction in numbers from established baseline, subject to natural change.	Extreme events such as storms and extreme cold weather will need to be recorded as this will affect numbers. Use WeBS (Wetland Bird Survey) high-tide and low-tide counts as baseline.
	Intertidal mudflats and sandflats; boulder and cobble shores	Extent.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	The features are important for supporting feeding birds.
		Abundance of invertebrate prey species.	Abundance of: oligochaetes, polychaetes, gastropods, bivalves crustacea - amphipoda, decapoda, diptera (wrack flies) - measured periodically (frequency to be determined).	Abundance of prey species should not deviate from an established baseline, subject to natural change.	These species are an important food supply for birds. This food source is also important for a nationally important breeding population of ringed plover. For specialist feeders it may be necessary to record to species level for important prey items. Food availability will be affected by freezing conditions.
		Abundance of marine algae (*Enteromorpha* spp. and *Ulva lactuca*).	Abundance of marine algae measured periodically, in late summer (frequency to be determined).	Average abundance of marine algae should not deviate from an established baseline, subject to natural change.	Marine algae is an important food source for brent geese. Macroalgal mats are also an indicator of nutrient enrichment (see favourable condition table for 'intertidal mudflats and sandflats' - also specifies quantitative measure).
	Shallow coastal waters	Abundance of prey species.	Abundance of small fish, crustaceans and molluscs, measured periodically (frequency to be determined).	Abundance of prey species should not deviate significantly from an established baseline.	A nationally important population of cormorants feed on fish species in shallow coastal waters. A nationally important population of goldeneye feed on bottom-dwelling invertebrates - mostly molluscs and crustaceans.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species) .	Saltmarsh: Atlantic salt meadows	Extent.	Area (ha) measured once during reporting cycle.	No decrease in extent of Atlantic salt meadows from an established baseline, subject to natural change.	Important roosting area. Roosting birds require good all round vision to watch for predators - they favour areas with open, short vegetation (<10cm) and unrestricted views (>200m).
		Presence and abundance of food species.	Presence and abundance of soft-leaved grasses & herbs and seed bearing plants, measured periodically (frequency to be determined).	Presence and abundance of characteristic food species should not deviate significantly from an established baseline, subject to natural change.	Brent geese feed on sea aster (*Aster trifoliu*m); saltmarsh grass (*Puccinellia maritima*) and species within this sward such as: sea plantain (*Plantago maritima*) and sea arrow grass (*Triglochin maritima*); red fescue (*Festuca rubra*) and lesser sea-spurrey (*Spergularia marina*).

Favourable Condition Table for Essex Estuaries European marine site - Crouch and Roach Estuaries SPA. 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.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).		Impact of human disturbance.	Reduction in numbers measured using 5-year peak mean information on populations.	No significant reduction in numbers from an established baseline, subject to natural change.	Extreme events such as storms and extreme cold weather will need to be recorded as this will affect numbers. Use WeBS (Wetland Bird Survey) high-tide and low-tide counts as baseline.
	Intertidal mudflats and sandflats; boulder and cobble shores	Extent.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	The features are important for supporting feeding birds.
		Abundance of invertebrate prey species.	Abundance of: oligochaetes, polychaetes, gastropods, bivalves crustacea - amphipoda, decapoda - measured periodically (frequency to be determined).	Abundance of prey species should not deviate from established baseline, subject to natural change.	These species are an important food supply for birds. For specialist feeders it may be necessary to record to species level for important prey items. Food availability will be affected by freezing conditions.
		Abundance of marine algae (*Enteromorpha* spp. and *Ulva lactuca*).	Abundance of marine algae measured periodically, in late summer (frequency to be determined).	Average abundance of marine algae should not deviate from established baseline, subject to natural change.	Marine algae is an important food source for brent geese. Macroalgal mats are also an indicator of nutrient enrichment (see favourable condition table for 'intertidal mudflats and sandflats' - also specifies quantitative measure).

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).	Saltmarsh: Atlantic salt meadows	Extent.	Area (ha) measured once during reporting cycle.	No decrease in extent of Atlantic salt meadows from an established baseline, subject to natural change.	Important roosting area. Roosting birds require good all round vision to watch for predators - they favour areas with open, short vegetation (<10cm) and unrestricted views (>200m).
		Presence and abundance of food species.	Presence and abundance of soft-leaved grasses & herbs and seed bearing plants. Measured periodically (frequency to be determined).	Presence and abundance of characteristic food species should not deviate significantly from an established baseline, subject to natural change.	Brent geese feed on sea aster (*Aster trifoliu*m); saltmarsh grass (*Puccinellia maritima*) and species within this sward such as: sea plantain (*Plantago maritima*) and sea arrow grass (*Triglochin maritima*); red fescue (*Festuca rubra*) and lesser sea-spurrey (*Spergularia marina*).

Favourable Condition Table for Essex Estuaries European marine site - Dengie SPA. 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.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).		Impact of human disturbance.	Reduction in numbers measured using 5-year peak mean information on populations.	No significant reduction in numbers from established baseline, subject to natural change.	Extreme events such as storms and extreme cold weather will need to be recorded as this will affect numbers. Use WeBS (Wetland Bird Survey) high-tide and low-tide counts as baseline.
	Intertidal mudflats and sandflats; boulder and cobble shores	Extent.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	The features are important for supporting feeding birds.
		Abundance of invertebrate prey species.	Abundance of: oligochaetes, polychaetes, gastropods, bivalves crustacea - amphipoda, decapoda - measured periodically (frequency to be determined).	Abundance of prey species should not deviate from an established baseline, subject to natural change.	These species are an important food supply for birds. For specialist feeders it may be necessary to record to species level for important prey items. Food availability will be affected by freezing conditions.
		Abundance of marine algae (*Enteromorpha* spp. and *Ulva lactuca*).	Abundance of marine algae measured periodically, in late summer (frequency to be determined).	Average abundance of marine algae should not deviate from established baseline, subject to natural change.	Marine algae is an important food source for brent geese. Macroalgal mats are also an indicator of nutrient enrichment (see favourable condition table for 'intertidal mudflats and sandflats' - also specifies quantitative measure).

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).	Saltmarsh: Atlantic salt meadows	Extent.	Area (ha) measured once during reporting cycle.	No decrease in extent of Atlantic salt meadows from an established baseline, subject to natural change.	Important roosting area. Roosting birds require good all round vision to watch for predators - they favour areas with open, short vegetation (<10cm) and unrestricted views (>200m).
		Presence and abundance of food species.	Presence and abundance of soft-leaved grasses & herbs and seed bearing plants, measured periodically (frequency to be determined).	Presence and abundance of characteristic food species should not deviate significantly from an established baseline, subject to natural change.	Brent geese feed on sea aster (*Aster trifoliu*m); saltmarsh grass (*Puccinellia maritima*) and species within this sward such as: sea plantain (*Plantago maritima*) and sea arrow grass (*Triglochin maritima*); red fescue (*Festuca rubra*) and lesser sea-spurrey (*Spergularia marina*).

Favourable Condition Table for Essex Estuaries European marine site - Foulness SPA. 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.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important Annex 1 bird populations - **Little tern (*Sterna albifrons*)**. **Common tern (*Sterna hirundo*)** **Sandwich tern (*Sterna sandvicensis*)**		Impact of human disturbance.	Displacement of breeding birds from known nesting sites.	No significant displacement of birds, due to human disturbance, from baseline ie numbers arriving at site to breed in that year.	If human disturbance is an issue this would need to be addressed through the management scheme.
	Shell, sand and gravel shores	Extent of potential nesting sites.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	If the supporting feature is unable to keep pace with sea level rise (and coastal squeeze could be implicated in this), inundation of feature becomes more frequent and nests are at increased risk of flooding.
		Vegetation cover/density.	Ratio of open ground with sparse vegetation and bare areas, measured periodically (frequency to be determined).	Ratio of open ground with sparse vegetation and bare areas should not deviate significantly from and established baseline, subject to natural change.	Important nesting habitat. Open, largely bare areas of sand and gravel comprise unrestricted views >200m, with vegetation cover <10% and the remainder bare during the breeding period (April-August).
	Shallow coastal waters	Abundance of prey species.	Abundance of small fish - including sand eels, sprats, herrings - worms and crustacea, measured periodically (frequency to be determined).	Abundance of prey species should not deviate significantly from an established baseline, subject to natural change.	Availability of prey species is important during the breeding period. Sandwich terns feed on sand eel, sprat and herring in the size range 5 -13 cm. Common terns take sand eel and sprat in the size range 5 - 8 cm.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important Annex 1 bird population - **Avocet** *(Recurvirostra avosetta*)		Impact of human disturbance.	Displacement of birds from feeding and roosting sites.	No significant displacement of birds, due to human disturbance, from baseline.	Birds feed on the intertidal mudflats and sandflats feature and roost on the saltmarsh.
Internationally important Annex 1 bird population - **Avocet** *(Recurvirostra avosetta*)	Intertidal mudflats and sandflats.	Extent.	Area (ha) measured once during reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Important feeding area. Avocet use sweeping movements of the bill to obtain prey from shallow water or surface mud. They also pick up individual prey items.
	Intertidal mudflats and sandflats.	Abundance of prey species.	Abundance of crustaceans, molluscs, small fish and worms, measured periodically (frequency to be determined).	Abundance of prey species should not deviate significantly from an established baseline, subject to natural change.	Important food source. Prey species include: *Gammarus*, *Corophium*, *Nereis*, *Hydrobia*, *Cerastoderma*, gobies.
	Saltmarsh	Extent.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Important roosting areas. Roosting birds require good all round vision to watch for predators - they favour areas with open, short vegetation (<10cm) and unrestricted views (>200m).
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).		Impact of human disturbance.	Reduction in numbers measured using 5-year peak mean information on populations.	No significant reduction in numbers from an established baseline, subject to natural change.	Extreme events such as storms and extreme cold weather will need to be recorded as this will affect numbers. Use WeBS (Wetland Bird Survey) high-tide and low-tide counts as baseline.
	Intertidal mudflats and sandflats	Extent.	Area (ha) measured once during the reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	The features are important for supporting feeding birds.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).	Intertidal mudflats and sandflats	Abundance of invertebrate prey species.	Abundance of: oligochaetes, polychaetes, gastropods, bivalves crustacea - amphipoda, decapoda - measured periodically (frequency to be determined).	Abundance of prey species should not deviate from an established baseline, subject to natural change.	These species are an important food supply for birds. This food source is also important for a nationally important breeding population of ringed plover. For specialist feeders it may be necessary to record to species level for important prey items. Food availability will be affected by freezing conditions.
		Abundance of marine algae (*Enteromorpha* spp. and *Ulva lactuca*).	Abundance of marine algae measured periodically, in late summer (frequency to be determined).	Average abundance of marine algae should not deviate from an established baseline, subject to natural change.	Marine algae is an important food source for brent geese. Macroalgal mats are also an indicator of nutrient enrichment (see favourable condition table for 'intertidal mudflats and sandflats' - also specifies quantitative measure).
		Abundance of eelgrass (*Zostera marina* and *Zostera noltii*).	Abundance of eelgrass measured periodically (frequency to be determined).	Average abundance of eelgrass should not deviate from an established baseline, subject to natural change.	Eelgrass is an important food source for brent geese. (The 'intertidal mudflats and sandflats' and 'estuaries' favourable condition table also contains a quantitative attribute for eelgrass).
	Saltmarsh: Atlantic salt meadows.	Extent.	Area (ha) measured once during reporting cycle.	No decrease in extent of Atlantic salt meadows from an established baseline, subject to natural change.	Important roosting areas. Roosting birds require good all round vision to watch for predators - they favour areas with open, short vegetation (<10cm) and unrestricted views (>200m).

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Presence and abundance of food species.	Presence and abundance of soft-leaved grasses & herbs and seed bearing plants. Measured periodically (frequency to be determined).	Presence and abundance of characteristic food species should not deviate significantly from an established baseline, subject to natural change.	Brent geese feed on sea aster (*Aster trifoliu*m*)*; saltmarsh grass (*Puccinellia maritima*) and species within this sward such as: sea plantain (*Plantago maritima*) and sea arrow grass (*Triglochin maritima*); red fescue (*Festuca rubra*) and lesser sea-spurrey (*Spergularia marina*).

7. Advice on operations

English Nature has 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 has developed this advice is given in section 7.2, and on how it may be reviewed and updated in the future, in Section 7.4.

The advice is provided in summary form in Table 3 and Section 7.5 and with more detail in Table 4 and Table 5 and Section 6.6, including advice in relation to specific interest features and their sub-features.

7.1 Purpose of advice

The aim of this advice is to enable 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 Essex Estuaries European marine site. The advice is linked to the conservation objectives for interest features and, once issued, will help provide the basis for detailed discussions within the management group to formulate and agree a management scheme to agreed timescales for the site. The advice given here will inform on, but is without prejudice to, any advice to be given subsequently under Regulation 48 or Regulation 50 on operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

7.2 Methods for assessment

To develop this advice on operations English Nature has 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 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.

All the scores of relative sensitivity, exposure and vulnerability are 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.

7.2.1 Sensitivity assessment

The sensitivity assessment used is an assessment of the relative sensitivity of the interest features or the

component sub-features of the Essex Estuaries 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). As an example, seagrass beds are highly sensitive to increases in turbidity of the surrounding water. This reduces the light penetration which in turn, prevents adequate photosynthesis.

The sensitivity assessments of the interest features or their component sub-features of the Essex Estuaries European marine site are based upon a series of scientific review documents. These include reports produced for the UK Marine SAC LIFE project (Davison *et al* 1998; Elliott *et al* 1998), the Countryside Council for Wales Science Report (Holt *et al,* 1995) and the Marine Habitats Reviews (Jones *et al,* in prep.).

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, over the next three years, and available to all over the World Wide Web (www.marlin.ac.uk).

7.2.2 Exposure assessment

This has been undertaken for the Essex Estuaries European marine site by assessing the relative exposure of the interest features or their component sub-features on the site to the effects of broad categories of human activities currently occurring on the site. For example, the exposure of interest features within the site to changes in the thermal regime as a result of human activities is negligible but exposure of some of the interest features to nutrient enrichment is high.

7.2.3 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 provided in Appendix I.

7.3 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.

These broad categories provide a clear framework against which relevant authorities can assess activities under their responsibility. The more detailed information in Table 4 provides relevant authorities with a context against which to consider an assessment of 'significant effect' of any plans or projects which 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 formally over individual plans and projects where required to do so under the Regulations.

7.4 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 knows about current activities and patterns of usage at the Essex Estuaries European marine site. English Nature expects that the information on current activities and patterns of usage (which was used to derive Table 4) will be refined as part of the process of developing the management scheme through further discussion with the relevant authorities. The option of zoning this information may be appropriate 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 (Table 5) 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 discussions 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.

7.5 Summary of advice on operations

7.5.1 Pioneer saltmarsh

In pursuit of the conservation objective for pioneer saltmarsh (Section 5.1.1), the relevant and competent authorities for Essex Estuaries European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following:

- Removal of pioneer saltmarsh habitats.
- Physical damage resulting from abrasion.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment.
- Biological disturbance through the selective extraction of species.

7.5.2 Cordgrass swards

In pursuit of the conservation objective for cordgrass swards (Section 5.1.2), the relevant and competent authorities for Essex Estuaries European marine site are advised to manage human activities within their remit

such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following:

- Removal of cordgrass swards habitats.
- Physical damage resulting from abrasion.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment.

7.5.3 Atlantic salt meadows

In pursuit of the conservation objective for Atlantic salt meadows (Section 5.1.3), the relevant and competent authorities for Essex Estuaries European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following:

- Removal of Atlantic salt meadow habitats.
- Physical damage resulting from abrasion.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment.

7.5.4 Mediterranean saltmarsh scrub

In pursuit of the conservation objective for Mediterranean saltmarsh scrub (Section 5.1.4), the relevant and competent authorities for Essex Estuaries European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following:

- Removal of Mediterranean saltmarsh scrub habitats.
- Increased synthetic and/or non-synthetic toxic contamination.
- Organic enrichment.

7.5.5 Estuaries

In pursuit of the conservation objective for estuaries (Section 5.1.5), the relevant and competent authorities for Essex Estuaries European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following:

- Removal and/or smothering of estuary habitats.
- Physical damage resulting from siltation and/or abrasion.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment.
- Biological disturbance resulting from the introduction of microbial pathogens, introduction of non-native species/translocation, and/or selective extraction of species.

7.5.6 Intertidal mudflats and sandflats

In pursuit of the conservation objective for intertidal mudflats and sandflats (Section 5.1.6), the relevant and

competent authorities for Essex Estuaries European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following:

- Removal and/or smothering.
- Physical damage resulting from siltation and/or abrasion and/or selective extraction.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment, and/or changes in turbidity.

7.5.7 SPA interest features

In pursuit of the conservation objective for "habitats supporting internationally important populations of regularly occurring Annex 1 species" (Sections 5.2 to 5.6), the relevant and competent authorities for Essex Estuaries European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following*:*

- Removal and/or smothering.
- Physical damage resulting from siltation and/or abrasion.
- Disturbance from noise and/or visual activities.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment, and/or changes in turbidity.
- Biological disturbance through selective extraction of species.

In pursuit of the conservation objective for "habitats supporting internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species)" (Sections 5.2 to 5.6), the relevant and competent authorities for Essex Estuaries European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following*:*

- Removal and/or smothering of habitats.
- Physical damage from siltation and/or abrasion.
- Disturbance from noise and/or visual activities.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient and/or organic enrichment and/or changes in turbidity.
- Biological disturbance through selective extraction of species.

Table 3 showing operations which may cause deterioration or disturbance to the Essex Estuaries European marine site interest features at current levels of use

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 **U** indicate those features (or some component of them) that are considered to be highly or moderately vulnerable to the effects of the operations[6].

Standard list of categories of operation which may cause deterioration or disturbance	SAC interest features						SPA interest features	
	Pioneer saltmarsh	Cordgrass swards	Atlantic salt meadows	Mediterranean saltmarsh scrub	Estuaries	Intertidal mudflats and sandflats	Internationally important Annex 1 Bird Populations	Internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species
Physical loss								
Removal (e.g. harvesting, coastal development)	**U**	**U**	**U**	**U**	**U**	**U**	**U**	**U**
Smothering (e.g. by artificial structures, disposal of dredge spoil)					**U**	**U**	**U**	**U**
Physical damage								
Siltation (e.g. run-off, channel dredging, outfalls)					**U**	**U**	**U**	**U**
Abrasion (e.g. boating, anchoring, trampling)	**U**	**U**	**U**		**U**	**U**	**U**	**U**
Selective extraction (e.g. aggregate dredging, entanglement)								
Non-physical disturbance								
Noise (e.g. boat activity)							**U**	**U**
Visual (e.g. recreational activity)							**U**	**U**

Standard list of categories of operation which may cause deterioration or disturbance	SAC interest features						SPA interest features	
	Pioneer saltmarsh	Cordgrass swards	Atlantic salt meadows	Mediterranean saltmarsh scrub	Estuaries	Intertidal mudflats and sandflats	Internationally important Annex 1 Bird Populations	Internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species
Toxic contamination								
Introduction of synthetic compounds (e.g. pesticides, TBT, PCBs)	U	U	U	U	U	U	U	U
Introduction of non-synthetic compounds (e.g. heavy metals, hydrocarbons)	U	U	U	U	U	U	U	U
Introduction of radionuclides								
Non-toxic contamination								
Nutrient enrichment (e.g. agricultural run-off, outfalls)	U	U	U		U	U	U	U
Organic enrichment (e.g. mariculture, outfalls)	U	U	U	U	U	U	U	U
Changes in thermal regime (e.g. power stations)								
Changes in turbidity (e.g. run-off, dredging)						U	U	U
Changes in salinity (e.g. water abstraction, outfalls)								
Biological disturbance								
Introduction of microbial pathogens					U			
Introduction of non-native species & translocation					U			
Selective extraction of species (e.g. bait digging, wildfowling, commercial & recreational fishing)	U				U		U	U

[6]This advice has been developed using best available scientific information and informed scientific interpretation and judgement (as at October 1999). 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. This is shown in the sensitivity and vulnerability matrices at Table 5. 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 dependent upon the nature, scale, location and timing of events. More detailed advice is available from English Nature to assist relevant authorities in assessing actual impacts and cumulative effects. Assessment of this information should be undertaken in the development of the management scheme by the management group and 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 October 1999. 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.

7.6 Interest feature and sub-feature specific advice on operations

This section provides information to help relate general advice to each of the specific interest features of the Essex Estuaries European marine site.

This advice relates to the vulnerability of the interest features and sub-features of the Essex Estuaries European marine site as summarised in Table 3 and detailed in Table 5. An explanation of the sensitivity of the interest features or sub-features follows, together 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 3.

7.6.1 Saltmarsh

The advice on operations for all four of the saltmarsh interest features that occur on the Essex Estuaries European marine site is provided together within this section. This is because many of the operations have similar potential effects on the different saltmarsh types. Where the sensitivity, exposure and vulnerability is different between saltmarsh interest features, this is described below.

i) Physical loss

- Sea walls, in combination with sea level rise, pose the greatest potential threat to saltmarsh interest features in the Essex Estuaries European marine site. Continued development of land behind the sea wall, below the 5 metre contour, is also a problem as this reduces the availability of suitable land for saltmarsh creation. In the Essex Estuaries, two per cent of the total area of saltmarsh is being lost each year and within the estuaries, there has been a switch, in the last 100 years, from an accreting environment to an eroding one. In natural circumstances, the saltmarsh will respond by migrating inland. However, sea walls prevent this from happening and saltmarsh in the Essex Estuaries is undergoing coastal squeeze. A high sensitivity and a high vulnerability to removal rating are therefore given for all four saltmarsh interest features.

ii) Physical damage

- Pioneer saltmarsh, cordgrass swards and Atlantic salt meadows are moderately vulnerable to physical damage by abrasion. Abrasion caused by boat wash can change the wave conditions in estuaries and their creek systems. This action may erode the front edge of the saltmarsh community. Placement of groynes on the foreshore may also cause saltmarsh erosion by changing local hydrodynamic conditions. Wave reflection from sea walls may also have an abrasive impact.

- Land drainage outfalls introduce freshwater into the estuaries. The impact of high velocity freshwater inputs may destabilise saltmarsh sediments and result in large unvegetated areas around such discharge points.

- Saltmarsh plants, especially common saltmarsh grass (*Puccinellia maritima*) are also sensitive to abrasion which may result from recreational activities such as walking (through trampling) and from water sport activities such as jet skiing (through direct contact with shallow saltmarsh areas covered during high spring tides).

iii) Toxic contamination

- All the four saltmarsh interest features that occur on the Essex Estuaries European marine site are considered to have a high sensitivity and a high vulnerability to toxic contamination by synthetic compounds and a moderate sensitivity and moderate vulnerability to non-synthetic compounds. Although saltmarsh plants may be reasonably tolerant of certain synthetic substances, they can bioaccumulate toxic compounds and act as sinks for them (Holt *et al.*, 1995). This could have implications for wildfowl which feed on saltmarsh plants.

- Freshwater outfalls accepting run-off from agricultural land can introduce herbicides into the estuary. MCPP (Mecoprop) has been demonstrated as being harmful to saltmarsh plants and can cause die-back of certain species. With the loss of the vegetation, the mudflat sediments can become unstable and susceptible to erosion.

- Saltmarsh plants are also sensitive to oil, even at relatively low levels (Holt *et al.*, 1995). This is mainly by virtue of their ability to trap sediments. Acute events such as oil spills can be particularly damaging to saltmarsh plants. Dispersants used to treat oil spills can also have an adverse effect on saltmarsh plants, sometimes to a greater degree than the spilled oil itself. Saltmarshes have been reported to recover from chronic oil pollution, where denuded of vegetation, within 10 years, although recovery depends largely on the degree to which oil is retained in the sediment. With erosion of saltmarsh in the Essex Estuaries occurring at a rate of two per cent annually however, considerable amounts of sediment may be lost during vegetation die-back.

- Saltmarsh sediments have been shown to contain some metals at elevated concentrations. Heavy metal concentrations (including copper, lead, cadmium and manganese) have been investigated in the Essex Estuaries by Imperial College (on behalf of the Environment Agency). Metals in the sediments are unlikely to be contributing to plant stress, although their accumulation in estuarine sediments may, in time, affect other parts of the saltmarsh ecosystem with the potential for release of high concentrations of metals as the sediments erode (National Rivers Authority, 1993).

- Although concentrations of organic micropollutants have been found to be low in the Essex Estuaries, these may be adding additional stresses to saltmarsh plants particularly if shock loadings are discharged directly onto the saltmarsh at the time of seedling germination. So the timing of the release of substances into the environment is likely to be important (National Rivers Authority, 1993).

iv) Non-toxic contamination

- Studies in North America suggest that saltmarshes are unlikely to be particularly sensitive to changes in water quality due to nutrient enrichment (Holt *et al.*, 1995). However, increased growth of algal plants, as a result of eutrophication, may cause local smothering and has been known to cause almost complete failure of glasswort (*Salicornia* spp.) in the pioneer marsh, as well as killing off areas of higher marsh (Boorman, 2000). A moderate sensitivity rating has been given for pioneer saltmarsh, Atlantic salt meadows and cordgrass swards and a moderate vulnerability is accorded, due to the significant area

of agricultural catchment likely to be a major source of nutrients to the Essex Estuaries.

- The exposure of saltmarsh features to organic enrichment is considered to be moderate, in view of the large number of outfalls around the Essex Estuaries. Although the sensitivity of saltmarsh sub-features to organic enrichment is low, the moderate exposure score leads to a moderate vulnerability rating.

v) Biological disturbance

- Gathering of samphire (glasswort) takes place commercially. The plants are picked before flowering, so the seedbank for recolonisation of sediments will be reduced. Although the impact of this is not fully known at present, the moderate vulnerability score for pioneer saltmarsh reflects a precautionary approach to the potential effects of this activity.

- The saltmarsh interest features on the Essex Estuaries are all considered to be moderately sensitive to selective extraction of species. Limited grazing of saltmarshes can increase species diversity but on an eroding marsh, the combination of grazing and trampling is likely to increase the problem of erosion. Also, grazing may lower the level of the saltmarsh thus changing species composition.

- The establishment of English cord grass (*Spartina anglica*) does not appear to have altered the general ecology of saltmarshes in the Essex Estuaries.

7.6.2 Estuaries

Saltmarsh and intertidal mudflat and sandflat communities are sub-features of estuaries, but are also features of the Essex Estuaries SAC in their own right. Therefore operations which may cause deterioration or disturbance to these sub-features within estuaries are presented in Sections 7.6.1 and 7.6.3 for saltmarsh and intertidal mudflats and sandflat features respectively, and not repeated here.

i) Physical loss

- All of the estuary sub-features are highly sensitive to physical loss by removal. In a coastal plain estuary system such as the Essex Estuaries, which is largely constrained by sea walls and unable to adjust to change, all sub-features are highly vulnerable to physical loss. This is a dynamic system dependent on the circulation and deposition of sediments. Coarse-grained sediment removed from the system would not be replenished naturally. Very little sand and gravel enters the system as these are derived from post-glacial outwash sands and gravels and from glacial debris washed landward from the central North Sea at the end of the last ice age. A very limited source may come from outside the area but this does not represent a significant input to the Essex Estuaries. Fine silts, held in suspension in the water column, do appear to be entering the European marine site from several sources: marine sources adjoining the North Sea, from sea bed erosion in the southern North Sea, and cliff erosion to the north of the Essex coast. However, in order for deposition and stabilisation of fine sediment to occur, tidal and wave energy must be sufficiently low. In the Essex Estuaries, increased wave heights and increased storminess in the North Sea, due to sea level rise, have disturbed the dynamic equilibrium of the system, and resulted in erosion in some areas.

- The estuary system is further stressed by sea walls which constrain the upper shore boundary preventing 'roll back' of the estuary interest features: sub-tidal erosion is occurring, steepening the sub-tidal profile which may ultimately affect the intertidal mudflat and sandflat features. All of the marine communities are important in helping to stabilise the sediments, either because of their physical presence (presenting an uneven surface which reduces wave energy) or because of the way they impact on the physical properties of the sediment through their feeding behaviour.

- Coastal defences, such as groynes constructed on the foreshore, may cause a direct loss of intertidal sub-features and this may have knock-on effects elsewhere within the site.

- Under natural circumstances estuary sub-features are subjected to some degree of smothering by sediments moved during storm events. Most of the estuary communities are widespread and many are likely to be able to repopulate smothered areas.Some shellfish (and other types of marine organisms) have the ability to excavate themselves but only if they are lightly buried (eg white furrow shell - *Abra alba*). Recovery times for shellfish communities would be longer than for mud communities which predominantly support worm populations.

- In sedimentary systems where erosion is occurring to the sub-features, any losses of sediment from the system are critical and practices have developed, on a relatively small scale, of re-using clean (non-toxic) dredged silts to 'recharge' eroded areas. In some cases, sediments have been introduced into the estuary from other areas outside the European marine site, but within the coastal cell (as defined by the Shoreline Management Plan, 1996). Rock communities and herring spawning grounds (within the subtidal mixed sediment community) have received a moderate vulnerability rating.

- It is important that the substrate of herring spawning grounds is suitable for receiving spawn and for egg development (from February to April). Recharging these grounds may be necessary to maintain the favourable condition of the substrate. But clearly these areas would be vulnerable to smothering during the spawning season. Rock communities comprise boulder and cobble communities on the foreshore which support a variety of marine plants and animals. Recovery timescales would be an important consideration when considering the impact of dredge disposal operations adjacent to or within such areas. Sub-tidal muddy sand communities, by virtue of the high sensitivity of eel grass (*Zostera marina*) to smothering,, receive a moderate vulnerability score.

ii) Physical damage

- *Zostera marina* (eelgrass) - a community found on subtidal muddy sand - is moderately vulnerable to siltation due to the possible impact of sea defence structures. It requires an equilibrium between sediment deposition and erosion. Any disruption to this process, which either increases erosion or accretion, such as coastal defence structures (sea walls or groynes) and channel dredging, may alter sediment flow and destabilise the eelgrass beds. The turbidity caused by silt plumes from dredging or alteration of current flow reduces light availability to the plants, which is essential for photosynthesis.

- Mussel beds are often found in areas of high natural turbidity, but greatly increased sediment levels, as a result of dredging activities, for example, have

been shown to result in loss of condition and increased predation by crabs. Rock communities therefore, have a high vulnerability score because of their proximity to dredging activities.

- With the exception of subtidal mud communities, all estuary sub-features are moderately vulnerable to physical damage through abrasion. *Zostera marina* (eelgrass) is particularly sensitive to any direct scouring or abrasion. Eelgrass root systems are easily damaged as they do not extend more than 20 cm below the surface. Activities associated with military operations on the foreshore at Foulness could potentially have an abrasive impact on the eelgrass beds. Rock communities and subtidal mixed sediment communities are relatively species rich with predominantly surface-dwelling invertebrates. They are potentially vulnerable to abrasion from moorings and oyster dredging.

iii) Toxic contamination

- All the estuary sub-features are vulnerable to toxic contamination by both synthetic and non-synthetic compounds. This is mainly because they all contain reasonably high populations of shellfish which are particularly sensitive to a range of toxic compounds.

- Industrial and domestic effluent discharges contain contaminants which build up in the food chain and can have toxic effects on organisms. Examples of such contaminants include heavy metals (copper, zinc, mercury, cadmium), radionuclides, and synthetic organic compounds (e.g. dieldrin, TBT, PCBs - polychlorinated biphenyls). These may have lethal or sub-lethal effects on marine organisms. This may allow pollution-tolerant species to dominate, reducing the species richness. Sub-lethal effects reduce the fitness of individuals by affecting reproduction, genetics, physiology and their general health. In combination, toxic contaminants can have different effects, sometimes more damaging. Sheltered low energy areas where muddy sediments are found act as a pollution 'sink', pollutants bind to fine sediments and become trapped in the system because dispersal by water currents is slow. Toxic compounds trapped in these 'sinks' can be released, if the sediment is disturbed, making them bio-available and potential pollutants.

- Some shellfish species inhabiting the estuaries, such as oysters, are particularly sensitive to synthetic compounds such as TBTs. This is believed to have contributed to the decline of shellfish stocks within the Essex Estuaries. It has been demonstrated that the TBT compound have affected the reproductive capacity of oysters and are suspected of stunting their growth. Mortalities have occurred in mussels as a result of exposure to TBTs. Eelgrass is also known to accumulate this compound. Since the ban on TBTs in 1987, on vessels of less than 25 metres, shellfish populations have shown signs of recovery. However, application of this antifoulant to larger vessels continues. The moderate vulnerability ratings given to particular sub-features reflects their proximity to boat moorings where disturbance of the sediment could lead to TBT compounds being mobilised.

- There is also evidence to suggest that PCB concentrations are much higher in the tissues of aquatic organisms than in the surrounding water on the site. Where mussels have accumulated PCBs there has been a detectable decline in populations at the time of spawning.

- A moderate vulnerability rating has been given to muddy sand communities because of the high sensitivity and potential for exposure of eelgrass to herbicide run-off. Terrestrial herbicides entering estuaries through land run-off may damage eelgrass as there is some evidence that they can inhibit growth. Eelgrass is also sensitive to dispersants used in oil spill clean-up operations. Dispersing oil into the water column promotes the penetration of oil into the sediment.

- Large oil spills can cause large-scale deterioration of communities in intertidal and shallow subtidal sedimentary systems and can persist in the environment for a long time, due to the low degradation rate of hydrocarbons that become incorporated in sediments or the lipid tissues of organisms. Eelgrass growth may be reduced or halted by oil coverage. Natural degradation/weathering of oil tends to be slow in low wave and tidal energy environments such as estuarine shores. Losses are likely to be greater if dispersants are used to assist this process, due to the oil being dispersed into the water column rather than remaining on the surface.

- Heavy metal concentrations tend to be greater and more variable in the top 10 cm of sediment. A study by CEFAS (1997) has shown that in the Essex Estuaries, levels of copper and zinc in the water appear to exceed 'safe' levels for marine life, particularly in certain invertebrates. Potentially, copper concentrations are high enough to cause sublethal and even lethal effects in some species and/or life stages, while zinc concentrations may only be sufficient to cause sublethal changes. Both metals have the potential to cause significant changes to estuarine ecosystems. The real test is 'bioavailability' (i.e. how much is actually available to marine organisms to harm them). It could be that these metals are forming chemical complexes with dissolved organic materials which could be buffering their impact. Nevertheless, the study concludes that it seems unlikely that no organisms avoid being adversely affected. MAFF studies in east coast estuaries have found that residuals of chromium, lead and zinc are highest nearer the coast than offshore. The greatest effects of these inputs are limited to areas close to and within estuaries and this is partly due to reduced currents in estuary systems preventing dispersal of contaminated sediment. Mercury concentrations have shown an increase with size of the organism while cadmium and zinc have been shown to be higher in younger animals. Wright and Mason (1999) consider that lead, and possibly mercury, pose potential threats to the ecology of estuaries. Eelgrass is also known to accumulate heavy metals which have been demonstrated to impact upon nitrogen fixation and this may affect the viability of the plant.

iv) Non-toxic contamination

- Certain contaminants can have non-toxic but nevertheless harmful effects on estuarine sub-features, mainly because they can be discharged in large quantities, such as organic material. Sewage effluents, for example, contain oxygen-depleting substances and nutrients. They also often contain toxic substances.

- Nutrients from fertiliser and feed used in agriculture and husbandry, and from treated sewage and other effluents enter the estuary system. The amounts of nitrogen and phosphorous reaching the estuary has consequently increased in the last few decades. There is a direct correlation between phosphorous concentration and algal growth. Elevated nutrient levels can cause phytoplankton blooms in the water column, which after dying off can result in the depletion of oxygen and may lead to death of marine

invertebrates. Bivalves, such as the white furrow shell, *Abra alba*, are sensitive to lowered oxygen concentrations arising from eutrophication. Algal mats deplete oxygen levels by reducing water exchange between the substrate and the water column. This could reduce species richness in intertidal rock communities and shallow water mixed sediment communities, resulting in a moderate vulnerability score.

- Eelgrass beds (in subtidal muddy sand) may increase production at low levels of nutrient enrichment. However, high nitrate concentrations are considered to cause the decline of mature plants. Phytoplankton blooms reduce the biomass of eelgrass and its ability to penetrate deeper into the shallow subtidal zone. Algae which grow on eelgrass leaves and blanketing algal species, such as *Enteromorpha* spp., may increase in nutrient enriched waters and cover the plant, reducing light availability and inhibiting photosynthesis. This accounts for a high vulnerability rating.

- Organic pollution occurs when the rate of input of organic matter is greater than the capacity of the estuary to process it. Some species will respond well to moderately enriched environments and high abundances will result, for example mussels and marine annelid worms. The subtidal benthic invertebrate community of the Colne estuary is generally regarded as being of poorer quality than that of the Blackwater. This is attributed to a higher organic content. The Colne benthic community is dominated only by oligochaetes (notably *Tubifex costatus* - sludge worms). Because organic enrichment is likely to lead to impoverished marine communities, species-rich communities are more vulnerable to organic enrichment than species-poor communities.

v) Biological disturbance

- Estuaries present a hostile environment to microbial pathogens which tend to die off rapidly, particularly in the presence of sunlight. However, they can adhere to suspended particles and accumulate in sediments which can extend their survival time to weeks. The causative agent of the wasting disease infecting subtidal eelgrass beds (*Zostera marina*) in the 1930s was able to survive in the marine environment and effect epidemic losses to this species. It has been suggested that plants only succumb when they are stressed by other factors. The route of introduction of the disease is not known but it does serve to indicate that once introduced into the population, the impacts can be very severe, not only on the target species but on other species dependent on it as a food source. Massive losses of a single species change the nature of the community and may destabilise sediments (as in this case) making the substrate more prone to erosion. For this reason the subtidal muddy sand community (which contains *Z.marina*) has received both a high sensitivity and high vulnerability score.

- Non-native species predate on or compete with native species and, in the absence of naturally evolved predators or disease, there are no natural checks on the alien species population which can rapidly reach pest status. As well as having a direct effect in depleting the prey population, this may lead to changes in the species dominance and characteristic species of the marine community. Uncultivated oyster beds would possibly have a more diverse fauna but the combination of cultivation and introduced species has had an impact on the native oyster's habitat. Shallow mixed sediment communities have therefore been given a high sensitivity and high vulnerability rating. Translocation of oyster stocks from France introduced the parasitic protozoan, *Bonamia ostreae*, to the UK which has decimated native oyster populations. A further protozoan parasite,

Marteilia refringens, has been discovered in French stocks but, so far, has not affected UK oysters. The slipper limpet (*Crepidula fornicata*) was accidentally introduced from America and has become a pest species on oyster beds. It can also have an impact on the physical environment. In the process of filter feeding, slipper limpets deposit, 'mussel mud'. This may degrade oyster grounds and hinder recruitment. Ironically, though, slipper limpet shells provide good culch for oyster larvae settlement. The American oyster drill was introduced from North America in the 1900s and predates oysters along with a list of indigenous species - crabs, starfish, dog whelks, shell-boring worms and sponges.

- Selective extraction of species such as oysters and whiteweed could, if overexploited, lead to damage to the sub-tidal mixed sediment community. The whiteweed fishery (in the subtidal mixed sediment community) is fished commercially and is unregulated. Though the whiteweed population is fairly tolerant to selective extraction, the lack of regulation may render it vulnerable. Its high vulnerability score accounts for this.

7.6.3 Intertidal mudflats and sandflats

i) Physical loss

- All the intertidal sediment sub-features are highly sensitive and highly vulnerable to removal. The containment of the estuary by sea walls is preventing saltmarsh and intertidal habitats from responding to sea level rise. This may eventually lead to steepening of the sub-tidal profile and disappearance of mud and sandflat sediments and their associated marine communities into the estuary channels. Dredging within estuary channels is likely to exacerbate this situation. Extending the built environment and coastal defences (in the form of groynes) onto the intertidal mudflats and sandflats, as well as constituting a direct loss of sediment flat communities, can alter tidal flow and sediment deposition in the immediate vicinity or elsewhere within the feature.

- All sub-features are potentially sensitive to smothering. However, a degree of smothering by storm-washed sediment is a natural occurrence in this dynamic system. Most of the intertidal mud and sand communities are widespread and are able to repopulate smothered areas. Some communities will recover more quickly than others. Eelgrass beds (*Zostera noltii)* would take considerably longer to re-establish. Muddy sand communities therefore score the highest sensitivity rating and receive a moderate vulnerability score.

- Foreshore recharge takes place within the Essex Estuaries. This involves placing sediment arising from channel dredgings in front of eroding saltmarsh in an effort to reduce tidal energy and slow down saltmarsh and foreshore erosion. This has meant that sediment within the coastal cell is retained within the system, as removal encourages further erosion. The recharge material smothers intertidal communities and may alter the sediment composition at the placement site (although often the intertidal sediments have been eroded to expose the underlying geology). Relatively small areas of these features are involved. On areas with well-represented features that are likely to be undergoing erosion themselves, such as mud communities, this may be less of an issue as migration of newly colonising species will be relatively fast. However, eelgrass beds (*Zostera noltii)* would take considerably longer to re-establish. Muddy sand communities therefore, by virtue of the high sensitivity of eel grass to smothering, have a moderate vulnerability score.

ii) Physical damage

- Silt deposition is a natural characteristic of the mud and sand flats - except where strong tidal movements favour the deposition of coarse sands and gravels. Eelgrass (*Zostera noltii*) requires an equilibrium between sediment deposition and erosion. Any disruption to this process, such as coastal defence structures (sea walls or groynes) and channel dredging, alters sediment flow and destabilises the eelgrass beds. The turbidity caused by silt plumes from dredging or alteration of current flow reduces light availability which is essential for photosynthesis. The muddy sand sub-feature consequently receives a moderate vulnerability rating due to the possible impact of sea defence structures. Though mud communities are considered to have a low sensitivity to siltation they have a moderate vulnerability score due to navigation dredging of the sea bed.

- *Zostera noltii* (eelgrass) is highly vulnerable to any direct scouring or abrasion which, potentially, could arise from military access to the foreshore at Foulness. Eelgrass is fairly shallow rooting and these can be easily damaged. Bivalve communities are also vulnerable to abrasion which may result from activities such as benthic fishing. The delicate shells of shellfish may be damaged by benthic fishing gear. Vulnerability scores are accorded to the mud, muddy sand, and sand and gravel communities

iii) Toxic contamination

- Industrial and domestic effluent discharges contain contaminants which build up in the food chain and have toxic effects. These contaminants may be non-synthetic, such as heavy metals: copper, zinc, mercury, cadmium, radionuclides; or synthetic organic compounds such as dieldrin, TBT, PCBs (polychlorinated biphenyls). These may have lethal or sub-lethal effects on marine organisms. This may allow pollution-tolerant species to dominate, reducing the species richness. Sub-lethal effects can reduce the fitness of individuals by affecting reproduction, genetics, physiology and general health. The combined effects of several pollutants may be responsible for causing the loss of communities. Sheltered low energy areas where muddy sediments are found act as a pollution 'sink' - pollutants bind to the fine sediment and become trapped in the system because dispersal by water currents is slow. All marine communities score highly in terms of sensitivity to synthetic and non-synthetic compounds. They also rated as vulnerable due to their proximity to industrial areas or concentrations of boat moorings.

- The use of TBTs on small vessels was banned in 1987; marine organisms (including eelgrass) have suffered the toxic effects of this compound but are showing signs of recovery. PCBs (polychorinated byphenyls) are thought to be the most ubiquitous and resistant pollutants affecting the ecosystem. They have been used widely in industrial applications. The marine environment is a major 'sink' for these chemicals. PCB concentrations are much higher in the tissues of aquatic organisms than in the water and they have been associated with population declines in shellfish.

- Agriculture is the major industry around the estuary and pesticides run off the land finding an outlet through the many sluices which drain the catchment. Terrestrial herbicides entering estuaries through land run-off may damage eelgrass (*Zostera noltii*) as there is some evidence that they can inhibit growth.

- Eelgrass is sensitive to the use of dispersants, and in sediment areas chemical dispersion

can promote the penetration of oil into fine sediments.

- Concentrations of some heavy metals have been shown to be unacceptably high in some species in the Essex Estuaries and potentially could have adverse impacts on the estuarine ecosystems. For this reason sub-features with muddy sediments have been rated as having a high sensitivity and high vulnerability to non-synthetic compounds. Sands and gravels contain less fine matter than muddy sediments, so tend to accumulate less contaminants and are therefore less sensitive.

- Large oil spills can cause large-scale deterioration of communities in intertidal sedimentary systems. Oil covering intertidal muds prevents oxygen transport to the sediment resulting in the death of invertebrates living within the sediment. All intertidal biotope complexes would be affected, favouring the development of opportunistic communities. On intertidal sands, tidal pulsing pushes oil into the sediment. Where oxygen is available, the oil will be broken down, but little degradation will take place at depths where aeration does not occur.

- Intertidal eelgrass (*Z.noltii*) is not considered to have suffered long-term effects attributable to chronic exposure to oil refinery effluent. It is unlikely to be as sensitive as other communities to a major oil spill, but that might depend on the type of oil. There is evidence that eelgrass growth may be reduced or halted by oil coverage. The distribution of *Z.noltii* in the intertidal area means that it will be more vulnerable to oil coverage than *Zostera marina*, which is protected by sea water. As eelgrass occurs in fairly low energy sites, natural degradation/weathering of oil will be slow. However, losses are likely to be greater if dispersants are used to treat the contamination, due to the dispersion of oil into the water column.

- Eelgrass is known to accumulate heavy metals which have been demonstrated to impact upon nitrogen fixation; this may affect the viability of the plant.

iv) Non-toxic contamination

- Eutrophication (the excessive growth of planktonic or benthic algae) is caused by increased nutrient inputs, originating from sewage or agricultural run-off. Finer sediment communities score as moderately vulnerable. Blanketing algae (*Enteromorpha* spp.) on eelgrass beds (*Zostera noltii*) cause severe shading inhibiting photosynthesis. Nutrient enrichment can break down the eelgrass immune system making it more susceptible to disease. Sediments covered in algal mats will experience depleted oxygen levels as water exchange between the sediment and the water column is reduced. This may result in the death of many species. Phytoplankton blooms may coat the gills of shellfish and prevent them from being able to feed or respire effectively.

- Mudflats are particularly rich in organic material resulting from the breakdown of plant material. These natural sources are supplemented by sewage effluent inputs. Organic pollution occurs when the rate of input of organic matter is greater than the capacity of the estuary to process it. Localised organic pollution may occur on the surface of sediments. This can smother the invertebrates that live there and depletes the oxygen levels in the sediment. This results in a reduction in species variety leading to dominance by a few species of pollution tolerant oligochaetes (annelid worms). Organic pollutants may affect nitrogen fixation in eelgrass (*Z.noltii*) which may reduce its viability. The finer

sediment communities are moderately sensitive to organic enrichment, and have a high vulnerability score based on the moderate number of outfalls around the estuary. The open coast communities with their coarser sediments have a more oxygenated environment.

- Most communities in estuaries are naturally tolerant of turbid conditions and minor increases from man-induced sources are also likely to be tolerated. There are exceptions however. Filter-feeding organisms, such as cockles, may lose condition if turbidity levels increase above background levels clogging feeding or respiratory structures. Eelgrass (*Zostera noltii*), may be affected by increased turbidity of water, reducing light availability for photosynthesis. However, as this species is uncovered at low tide, it is likely to be less sensitive than its shallow water counterpart (*Zostera marina*). A moderate vulnerability score has been given (reflecting the high sensitivity rating) to the muddy sand sub-feature because it supports the above communities.

v) Biological disturbance

- Overexploitation of cockle stocks could lead to reduced populations of this species, characteristic of muddy sand in the outer estuary. Losses of cockle stock may also destabilise these sedimentary areas and result in them being more prone to erosion. The sub-feature contaning this community, therefore, has a moderate vulnerability rating.

7.6.4 SPA interest features

Interest feature and sub-feature specific advice on operations for the five SPAs which this advice package covers (Colne Estuary, Blackwater Estuary, Dengie, Crouch and Roach Estuaries, and Foulness) is provided together within this section. This is because many of the operations have similar potential effects on the various bird species for which the sites qualify, or the habitats which support the birds. Where the sensitivity, exposure and vulnerability is different between sites or qualifying categories, this is described below.

i) Physical loss

- All features supporting the important bird assemblages and Annex 1 species are vulnerable to physical loss by removal. Sea level rise, exacerbated by coastal squeeze, is the main threat to loss of intertidal (and shallow subtidal) feeding habitats. Mud and muddy sand communities cover extensive areas and support an abundance of invertebrate communities including cockle beds and eelgrass (*Zostera* spp.) communities. Mussel beds are found on mixed sediment foreshores (described as 'rock' communities). Sea level is rising at 6mm annually and a sea level rise of 0.8 metres would lead to a permanent loss of up to 20 per cent of intertidal flats in the Essex Estuaries. Saltmarshes are important roosting habitats for internationally important assemblages of regularly occurring migratory species, and drift-line communities may be favoured as nesting sites by common tern, an Annex 1 species. This habitat is also subjected to coastal squeeze. If current rates of saltmarsh loss continue in the Essex Estuaries, the majority of the saltmarsh resource will be lost by the middle of this century. Sand and shingle habitats are potential nesting sites for the Annex 1 species: sandwich, common and little tern. These habitats are also impacted upon by coastal squeeze. Higher spring tides, due to sea level rise, increase the risk of flooding at nesting sites.

- All sub-features are naturally prone to smothering by sediments driven by storm tides. Re-use of clean dredged silts over saltmarsh, to raise the level and try and combat erosion has not been undertaken in Essex. Should this be considered, as the leaves and seeds of saltmarsh plants are a food source for certain wildfowl, the impact on saltmarsh as a food source would have to be taken into account A moderate sensitivity rating has been assigned to the saltmarsh feature for this reason. Raising the saltmarsh level would reduce the risk of nest flooding, as would raising the height of sand and gravel nesting sites. Raising saltmarshes would also benefit roosting birds, reducing their reliance on non-estuarine habitats for roosting. Disposal of channel dredgings (foreshore recharge) at tern nesting sites (on sand and gravel) in the Blackwater have raised the land level well above the high spring tide line increasing the chances of breeding success. (Recharge material is also used to reduce erosion rates of saltmarsh). Smothering of intertidal habitats by silts would be likely to temporarily reduce the extent and suitability of feeding areas. Recolonisation by mud dwelling invertebrates could however, be fairly rapid. Sand and gravel recharge over mudflats alters the species composition representing a loss of finer-sediment intertidal feeding habitat. This may be sustainable if small areas are involved. However, smothering of cockle beds and eelgrass beds (on the intertidal flats and in the shallow subtidal) could lead to the overall loss of these communities which are an important food source for birds. Though the intertidal feature has a low exposure to smothering, the potential for damage to cockle beds and eelgrass communities is high and this results in a moderate vulnerability score. Dredge disposal over boulder and cobble shores could represent a medium-term loss of feeding habitat for oystercatcher.

Recovery time would depend on the sediment type. This community also receives a moderate vulnerability score based on the potential for recharge placement adjacent to it.

ii) Physical damage

- Prey items of birds feeding on intertidal mudflats live on the surface of the mud or within the sediment. Siltation is unlikely to affect availability of prey species as burrowing worms and shellfish would tend migrate upwards through deposited silts. Filter-feeding shellfish may be stressed by increased siltation and this may affect prey availability to waterfowl. Similarly, eelgrass (*Zostera* spp.), which occurs on muddy sands, is an important food source for internationally important numbers of brent geese. This is also sensitive to siltation, requiring an equilibrium between sediment deposition and erosion. Any disruption to this process, such as coastal defence structures (sea walls or groynes) and channel dredging, may alter the sediment flow and destabilise the eelgrass beds. The turbidity caused by silt plumes from dredging or alteration of current flow may also reduce light availability which is essential for photosynthesis, though intertidal eelgrass may not be as susceptible to the latter as its subtidal counterpart. Due to the possible impacts of sea defence structures on eel grass beds and channel dredging, the intertidal mud and sandflats have been assigned a moderate vulnerability rating

- Eelgrass beds (*Zostera* spp.) are also highly vulnerable to damage by abrasion, due to the potential for military operations on the foreshore at Foulness. Shellfish can be damaged by benthic trawls. Repeated trawling has the potential to impact on prey populations. Boulder and cobble shore communities contain mussel beds. This community can be abraded by the action of moored boats. Marine communities comprising shellfish have received moderate vulnerability ratings as they may be impinged upon by moorings. A combination of human influences can cause abrasion of saltmarshes: use of personal water craft, boat wash, groynes, scour due to land drainage outfalls. These activities and operations occur within the European marine site and the feature is considered moderately vulnerable. Roosting, feeding and nesting birds rely on saltmarsh habitat.

iii) Non-physical disturbance

- All bird species using the site are sensitive to disturbance. Much of the site is accessible to the public. In most areas the sea wall is a public right of way and there are zones of high public activity particularly during the spring and summer. The site is also easily accessible from the water. For this reason a moderate to high vulnerability rating to non-physical disturbance has been given. Birds are particularly sensitive to disturbance during severe weather when energy reserves are at a premium. Disturbance causes birds to expend energy at a time when feeding rates are likely to be reduced by lack of food availability; foraging is impossible on frozen mudflats and on near freezing intertidal flats, burrowing animals are more deeply embedded in the sediment, thus requiring birds to use more energy to obtain food, reducing the frequency of feeding in the process. Evidence suggests that little terns nesting in the Essex Estuaries have been forced to abandon nests due to non-physical disturbance. Consequently, the sand and gravel feature has a high vulnerability mark.

- There are reports of birds being disturbed by low-flying military aircraft, on the Blackwater (Smith, 1999). Noise from boats engines appears to disturb feeding birds, depending on distance from the mudflat margins. Wildfowling is practised within the

Essex Estuaries marine site. As well as potentially having an impact on species numbers, the firing of guns may disturb roosting birds. With few exceptions, wildfowling areas are leased by wildfowling clubs affiliated to the British Association of Shooting and Conservation. All wildfowling within the site requires the consent of English Nature. Refuge areas are usually outside the site on grazing marshes, landward of the sea wall.

- There is public access to virtually all the sea walls around the Essex Estuaries. Where these are adjacent to urban conurbations disturbance to feeding birds is likely. However, the low-tide bird counts carried out in the Essex Estuaries reported high concentrations of birds in the inner estuaries despite the proximity of urban development at the head of the estuaries (National Rivers Authority, 1993). Acclimatisation may be a factor here but possibly the fact that sea walls tend to be higher and steeper may make the foreshore, in places, less accessible to recreation. In addition, saltmarshes are narrower (or absent) and the muddy foreshore may be less appealing to recreational users. Less saltmarsh means a greater area for feeding and there may be some enrichment of the sediment from increased land run-off, leading to an abundance of worm populations, reflecting opportunistic feeding by birds. Also the sediments are softer and easier to probe. Another factor may be that there is a sufficient buffer of sediment flats between the feeding birds and the shoreline. A study on the Crouch (Moroney, 1998) reported that numbers of feeding shelduck and redshank tended to be higher away from urban areas. These birds were particularly sensitive to disturbance from dog walkers and car movement (Moroney, 1998). Dog walkers on the sea wall on the Blackwater have also been reported to be the greatest cause of disturbance to feeding birds and roosting birds (Beecroft, 1997). Annex 1 species nesting on islands are disturbed by visitors alighting from boats.

iv) Toxic contamination

- Industrial and domestic effluent discharges contain contaminants which build up in the food chain and may have toxic effects on birds and their prey. These contaminants include heavy metals such as copper, zinc, mercury, cadmium, radionuclides, and synthetic organic compounds (e.g. dieldrin, TBT, PCBs - polychlorinated biphenyls). These may have lethal and sub-lethal effects on marine invertebrates predated by birds. Specialist feeders could be affected by the loss of a prey species, while generalist feeders could benefit from an abundance of opportunistic prey species. This may however, result in a reduced diversity of species in the bird assemblage and may affect internationally important populations. Sub-lethal effects on food sources reduce the fitness of individual prey species by affecting reproduction, genetics, physiology and general health, though, initially this may result in an abundance of food as invertebrate prey behaviour may be altered making them more available to feeding populations. Ultimately the prey populations would start to reduce in number. Birds feeding on contaminated food sources are directly at risk from those containing substances with the potential to accumulate in the food chain. All sub-features have moderate to high vulnerability ratings for toxic contamination by synthetic and non-synthetic compounds due to their proximity to industrial areas or boat moorings.

- Large oil spills over intertidal mud and sandflats can cause large scale deterioration of invertebrate communities and this would have a significant impact on an important food source. Eel grass growth may be reduced or halted by oil coverage. Acute oil spills over

saltmarsh would render this food source unpalatable and birds alighting to roost or feed would become oiled and contaminated. Oil over the water column would present a threat to diving and dabbling wildfowl. Detergents used to disperse the oil are also harmful to the saltmarsh and mudflat features.

- Although concentrations of organic micropollutants have been found to be low in the Essex Estuaries, saltmarsh seedlings could be affected adversely by shock loadings discharged directly onto the saltmarsh, via sluices and stormwater outfalls, at the time of seedling germination. This could have the potential to affect birds that feed on the saltmarsh plants.

v) Non-toxic contamination

- Agricultural run-off is likely to be a major source of nutrient input to the Essex Estuaries. This may lead to a proliferation of blanketing algae (*Enteromorpha* spp.) on eelgrass beds (*Zostera* spp.) which can cause shading of eelgrass inhibiting photosynthesis. Nutrient enrichment may also break down the eelgrass immune system making it more susceptible to disease. Brent geese rely on this as a food source on arrival in early November after their migratory flight. Conversely, brent geese and wigeon may benefit from an increase in opportunist macroalgae such as *Enteromorpha* spp. and *Ulvae* spp. However other waders and wildfowl which feed on mud-dwelling invertebrates will experience a reduction in feeding areas. Furthermore, the covering of algae over the surface can reduce the water exchange between the sediment and the water column, resulting in deoxygenation of the sediment. This may alter the composition of the sediment fauna and may lead to death of prey species in severe cases. Increased algal growth may cause smothering of saltmarsh plants and prevent germination of glasswort (*Salicornia* spp.) seedlings (Boorman, 2000). A moderate vulnerability rating is assigned to the intertidal, boulder and cobble shores, saltmarsh and shallow coastal water features.

- Sewage effluent discharges into the estuary may organically enrich the sediments benefitting invertebrate prey species that can tolerate low oxygen levels. Though there may be an abundance of marine worms (oligochaetes), which thrive in these conditions, there are usually few other species present. While it may appear that birds benefit under these circumstances because large numbers visit such areas to feed, it could indicate opportunism by a limited number of bird species. In the absence of such organically enriched areas, birds may be more widely dispersed within the site. Intertidal mud and sandflats, boulder and cobble communities and shallow coastal waters are rated as vulnerable to organic enrichment because of the potential to cause a reduction in species richness. Saltmarshes have been assigned a moderate vulnerability score due to the medium exposure of the feature to enrichment through sewage outfalls. However, saltmarshes have a low sensitivity to organic enrichment.

- Most prey communities are used to turbid conditions and increases from man-induced sources are likely to be tolerated. The exceptions are however: filter-feeding shellfish inhabiting the foreshore and shallow waters, which may lose condition if turbidity levels increase above background levels clogging feeding or respiratory structures; and eelgrass (*Zostera* spp.) which may be affected as increased turbidity of tidal waters may reduce light penetration and consequently inhibit photosynthesis. The moderate vulnerability score reflects the high sensitivity of eelgrass to turbid conditions.

vi) Biological disturbance

- As pathogens are species specific, specialist feeders, such as brent geese on eelgrass or knot on shellfish, could be affected if an epidemic disease severely depleted these important food sources. Brent geese were able to slowly recover their populations by switching to alternative food sources when eelgrass was depleted by a wasting disease in the 1930s, but this took several decades. There is the potential for microbial pathogens to infect Annex 1 species and internationally important assemblages of feeding birds via food sources.

- Bird populations may be affected if they are in competition with humans in exploiting a food species. Over exploitation of shellfish stocks could have a serious impact on birds such as knot and oystercatcher. Likewise, Annex 1 tern species could be affected by overfishing of sand eels, sprats and herring. Gathering of samphire plants (glasswort) in pioneer saltmarsh takes place commercially. The plants are picked before flowering so the seedbank for recolonisation of sediments will be reduced. The impact of this is not fully known. Potentially, this could deplete a food source for seed-eating birds. For the reasons described above, the shallow coastal water, intertidal mudflats and sandflats and saltmarsh features are considered vulnerable to selective extraction.

7.6.5 Plans and Projects

Under Regulation 48(1), an appropriate assessment needs to be undertaken in respect of any plan or project which:

a. either alone or in combination with other plans or projects would be likely to have a ***significant effect*** on a European Site; and
b. is not directly connected with the management of the site for nature conservation.

An appropriate assessment is required by law for all European Sites (Regulation 48). A European Site is any classified SPA and any SAC from the point where the Union and the Government agree the site as a Site of Community Importance. Appropriate assessment is also required, currently as a matter of Government policy, for potential SPAs, candidate SACs and listed Ramsar Sites for the purpose of considering development proposals affecting them. (PPG 9 paras 13 and C7). It should be noted, however, that amendments to the Habitats Regulations for England are currently before Parliament which will result in a statutory requirement for Appropriate Assessments to be conducted for candidate SACs before they become Sites of Community Importance.

Tables 3 and 4 provide relevant 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 relevant authorities to formally consult English Nature over individual plans and projects where required under the Regulations.

7.6.6 Review of consents

Regulation 50 of The Conservation (Natural Habitats, &c.) Regulations 1994 requires competent authorities to undertake a review of all existing consents and permissions affecting SAC and SPAs, as soon as possible after the site officially becomes a Site of Community Importance. This will have implications for discharge and other consents, which will need to be reviewed in light of these objectives and may mean that lower targets for background levels of contaminants etc. will need to be set.

Table 4. Assessment of the relative exposure of interest features and sub-features of Essex Estuaries European Marine site to different categories of operations based on current level of activities (November 1999)

Key High= High exposure (3) Med =Medium exposure (2) Low= Low exposure (1)

Categories of operations which may cause deterioration or disturbance	Saltmarsh			
	Pioneer saltmarsh	*Spartina swards*	*Atlantic salt meadows*	*Mediterranean and thermo-Atlantic halophilous scrubs*
Physical loss				
Removal (eg. harvesting, land claim, coastal development)	High	High	High	High
Smothering (eg. disposal of dredgings)	Low	Low	Low	Low
Physical damage				
Siltation (eg. dredging, outfall)	Low	Low	Low	Low
Abrasion (eg. mobile benthic fishing, anchoring)	Low	Low	Low	Low
Selective extraction (eg. aggregate extraction, entanglement)	Low	Low	Low	Low
Non-physical disturbance				
Noise (eg. boat activity)	Low	Low	Low	Low
Visual presence (eg. recreational activity)	Low	Low	Low	Low
Toxic contamination				
Introduction of synthetic compounds (eg, TBTs, PCBs)	Medium	Medium	Medium	Medium

Categories of operations which may cause deterioration or disturbance	**Saltmarsh**			
	Pioneer saltmarsh	*Spartina swards*	*Atlantic salt meadows*	*Mediterranean and thermo-Atlantic halophilous scrubs*
Introduction of non-synthetic compounds (eg. heavy metals, hydrocarbons)	Low	Low	Low	Low
Introduction of radionuclides	Low	Low	Low	Low
Non-toxic contamination				
Nutrient enrichment (eg. agricultural run-off, outfalls)	Medium	Medium	Medium	Medium
Organic enrichment (eg. mariculture, outfalls)	Medium	Medium	Medium	Medium
Changes in thermal regime (eg. power stations)	Low	Low	Low	Low
Changes in turbidity (eg. dredging)	Low	Low	Low	Low
Changes in salinity	Low	Low	Low	Low
Biological disturbance				
Introduction of microbial pathogens	Low	Low	Low	Low
Introduction of non-native species and translocation	Low	Low	Low	Low
Selective extraction of species (eg. commercial and recreational fishing)	Low	Low	Low	Low

Categories of operations which may cause deterioration or disturbance	**Estuaries**			
	Rock communities	*Subtidal mud communities*	*Subtidal muddy sand communities*	*Subtidal mixed sediment communities*
Physical loss				
Removal (eg. harvesting, land claim, coastal development)	High	Low	Medium	Low
Smothering (eg. disposal of dredgings)	High	Low	Low	Low
Physical damage				
Siltation (eg. dredging, outfall)	High	Low	Low	Low
Abrasion (eg. mobile benthic fishing, anchoring)	High	Medium	Low	Medium
Selective extraction (eg. aggregate extraction, entanglement)	Low	Low	Low	Low
Non-physical disturbance				
Noise (eg. boat activity)	Low	Low	Low	Low
Visual presence (eg. recreational activity)	Low	Low	Low	Low
Toxic contamination				
Introduction of synthetic compounds (eg, TBTs, PCBs)	Low	Medium	Medium	Low
Introduction of non-synthetic compounds (eg. heavy metals, hydrocarbons)	Medium	Medium	Medium	Low
Introduction of radionuclides	Low	Low	Medium	Low

Categories of operations which may cause deterioration or disturbance	**Estuaries**			
	Rock communities	*Subtidal mud communities*	*Subtidal muddy sand communities*	*Subtidal mixed sediment communities*
Non-toxic contamination				
Nutrient enrichment (eg. agricultural run-off, outfalls)	Low	Low	Medium	Low
Organic enrichment (eg. mariculture, outfalls)	Medium	Low	Medium	Low
Changes in thermal regime (eg. power stations)	Low	Low	Medium	Low
Changes in turbidity (eg. dredging)	Low	Low	Medium	Low
Changes in salinity	Low	Low	Low	Low
Biological disturbance				
Introduction of microbial pathogens	Low	Low	Low	Low
Introduction of non-native species and translocation	Low	Low	Low	Low
Selective extraction of species (eg. commercial and recreational fishing)	Low	Low	Low	Medium

Categories of operations which may cause deterioration or disturbance	Intertidal mudflats and sand flats		
	Mud communities	*Muddy sand communities*	*Sand and gravel communities*
Physical loss			
Removal (eg. harvesting, land claim, coastal development)	High	High	High
Smothering (eg. disposal of dredgings)	Low	Low	Low
Physical damage			
Siltation (eg. dredging, outfall)	Medium	Low	Medium
Abrasion (eg. mobile benthic fishing, anchoring)	Medium	Medium	High
Selective extraction (eg. aggregate extraction, entanglement)	Low	Low	Low
Non-physical disturbance			
Noise (eg. boat activity)	Low	Low	Low
Visual presence (eg. recreational activity)	Low	Low	Low
Toxic contamination			
Introduction of synthetic compounds (eg, TBTs, PCBs)	Low	Medium	Medium
Introduction of non-synthetic compounds (eg. heavy metals, hydrocarbons)	Medium	Medium	Medium
Introduction of radionuclides	Low	Low	Low
Non-toxic contamination			
Nutrient enrichment (eg. agricultural run-off, outfalls)	Low	Low	Low
Organic enrichment (eg. mariculture, outfalls)	Medium	Medium	Low
Changes in thermal regime (eg. power stations)	Low	Low	Low
Changes in turbidity (eg. dredging)	Low	Low	Low
Changes in salinity	Low	Low	Low
Biological disturbance			
Introduction of microbial pathogens	Low	Low	Low
Introduction of non-native species and translocation	Low	Low	Low
Selective extraction of species (eg. commercial and recreational fishing)	Low	Medium	Low

Categories of operations which may cause deterioration or disturbance	**Nationally important Annex 1 Bird Populations**				**Internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).**			
	Saltmarsh	*Intertidal mudflats and sandflats*	*Sand and gravel*	*Shallow coastal waters*	*Saltmarsh*	*Intertidal mudflats and sandflats*	*Boulder and cobble shores*	*Shallow coastal waters*
Physical loss								
Removal (eg. harvesting, land claim, coastal development)	High	High	High	Low	High	High	High	Low
Smothering (eg. disposal of dredgings)	Low	Low	Low	Low	Low	Low	High	Low
Physical damage								
Siltation (eg. dredging, outfall)	Low	Medium	Medium	Medium	Low	Medium	High	Medium
Abrasion (eg. mobile benthic fishing, anchoring)	Low	Medium	High	Low	Low	Medium	High	Low
Selective extraction (eg. aggregate extraction, entanglement)	Low	Low	Low	Low	Low	Low	Low	Low
Non-physical disturbance								
Noise (eg. boat activity)	Medium	High	High	Medium	Medium	High	High	Medium
Visual presence (eg. recreational activity)	Medium	High	High	Medium	Medium	High	High	Medium
Toxic contamination								
Introduction of synthetic compounds (eg, TBTs, PCBs)	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium
Introduction of non-synthetic compounds (eg. heavy metals, hydrocarbons)	Low	Medium	Medium	Low	Low	Medium	Medium	Low
Introduction of radionuclides	Low	Low	Low	Low	Low	Low	Low	Low

Categories of operations which may cause deterioration or disturbance	**Nationally important Annex 1 Bird Populations**				**Internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).**			
	Saltmarsh	*Intertidal mudflats and sandflats*	*Sand and gravel*	*Shallow coastal waters*	*Saltmarsh*	*Intertidal mudflats and sandflats*	*Boulder and cobble shores*	*Shallow coastal waters*
Non-toxic contamination								
Nutrient enrichment (eg. agricultural run-off, outfalls)	Medium	Low	Low	Medium	Medium	Low	Low	Medium
Organic enrichment (eg. mariculture, outfalls)	Medium	Medium	Low	High	Medium	Medium	Medium	High
Changes in thermal regime (eg. power stations)	Low	Low	Low	Low	Low	Low	Low	Low
Changes in turbidity (eg. dredging)	Low	Low	Low	Low	Low	Low	Low	Low
Changes in salinity	Low	Low	Low	Low	Low	Low	Low	Low
Biological disturbance								
Introduction of microbial pathogens	Low	Low	Low	Low	Low	Low	Low	Low
Introduction of non-native species and translocation	Low	Low	Low	Low	Low	Low	Low	Low
Selective extraction of species (eg. commercial and recreational fishing)	Low	Low	Low	Medium	Low	Low	Low	Medium

Table 5. **Assessment of the relative vulnerability of interest features and sub-features of Essex Estuaries European Marine site to different categories of operations. Categories of operations to which the features or sub-features of the site are highly or moderately vulnerable are indicated by shading. Table also incorporates relative sensitivity scores used in part to derive vulnerability.[8]**

Key

	High vulnerability	ž ž ž ž	High sensitivity
	Moderate vulnerability	ž ž ž	Moderate sensitivity
		ž ž	Low sensitivity
		ž	No detectable sensitivity

Categories of operations which may cause deterioration or disturbance	**Saltmarsh interest features**			
	Pioneer saltmarsh	Cordgrass swards	Atlantic salt meadows	Mediterranean saltmarsh scrubs
Physical loss				
Removal (eg. harvesting, land claim, coastal development)	ž ž ž ž	ž ž ž ž	ž ž ž ž	ž ž ž ž
Smothering (eg. disposal of dredgings)	ž ž ž	ž ž ž	ž ž ž	ž ž ž ž
Physical damage				
Siltation (eg. dredging, outfall)	ž ž	ž ž	ž ž	ž ž
Abrasion (eg. mobile benthic fishing, anchoring)	ž ž ž	ž ž ž	ž ž ž	ž ž ž
Selective extraction (eg. aggregate extraction, entanglement)	ž ž ž	ž ž ž	ž ž ž	ž ž ž

Categories of operations which may cause deterioration or disturbance	**Saltmarsh interest features**			
	Pioneer saltmarsh	Cordgrass swards	Atlantic salt meadows	Mediterranean saltmarsh scrubs
Non-physical disturbance				
Noise (eg. boat activity)	Ž	Ž	Ž	Ž
Visual presence (eg. recreational activity)	Ž	Ž	Ž	Ž
Toxic contamination				
Introduction of synthetic compounds (eg, TBTs, PCBs)	ŽŽŽŽ	ŽŽŽŽ	ŽŽŽŽ	ŽŽŽŽ
Introduction of non-synthetic compounds (eg. heavy metals, hydrocarbons)	ŽŽŽ	ŽŽŽ	ŽŽŽ	ŽŽŽ
Introduction of radionuclides	ŽŽ	ŽŽ	ŽŽ	ŽŽ
Non-toxic contamination				
Nutrient enrichment (eg. agricultural run-off, outfalls)	ŽŽŽ	ŽŽŽ	ŽŽŽ	ŽŽ
Organic enrichment (eg. mariculture, outfalls)	ŽŽ	ŽŽ	ŽŽ	ŽŽ
Changes in thermal regime (eg. power stations)	ŽŽ	ŽŽ	ŽŽ	Ž
Changes in turbidity (eg. dredging)	ŽŽ	ŽŽ	ŽŽ	ŽŽ
Changes in salinity	ŽŽ	ŽŽ	ŽŽ	ŽŽ
Biological disturbance				
Introduction of microbial pathogens	Ž	Ž	Ž	Ž
Introduction of non-native species and translocation	ŽŽ	ŽŽ	ŽŽ	ŽŽ

Categories of operations which may cause deterioration or disturbance	**Saltmarsh interest features**			
	Pioneer saltmarsh	Cordgrass swards	Atlantic salt meadows	Mediterranean saltmarsh scrubs
Selective extraction of species (eg. commercial and recreational fishing)	žžž	žžž	žžž	žžž

Categories of operations which may cause deterioration or disturbance	Estuaries					
	Rock communities	Subtidal mud communities	Subtidal muddy sand communities	Subtidal mixed sediment communities	Saltmarsh communities	Intertidal mudflats and sandflats
Physical loss					For information of the sensitivity and vulnerability of these sub-features see the individual assessments made elsewhere in this table.	
Removal (e.g. harvesting, land claim, coastal development)	žžžž	žžžž	žžžž	žžžž		
Smothering (e.g. disposal of dredgings)	žžž	žžž	žžžž	žžž		
Physical damage						
Siltation (e.g.dredging, outfall)	žžž	žž	žžžž	žžž		
Abrasion (e.g. mobile benthic fishing, anchoring)	žžž	žžž	žžžž	žžžž		
Selective extraction (e.g. aggregate extraction, entanglement)	žžž	žžž	žžž	žžž		
Non-physical disturbance						
Noise (e.g. boat activity)	ž	ž	ž	ž		
Visual presence (e.g. recreational activity)	ž	ž	ž	ž		
Toxic contamination						
Introduction of synthetic compounds (eg, TBTs, PCBs)	žžžž	žžžž	žžžž	žžžž		
Introduction of non-synthetic compounds (e.g. heavy metals, hydrocarbons)	žžžž	žžžž	žžžž	žžžž		
Introduction of radionuclides	žž	žž	žž	žž		

Categories of operations which may cause deterioration or disturbance	**Estuaries**					
	Rock communities	Subtidal mud communities	Subtidal muddy sand communities	Subtidal mixed sediment communities	Saltmarsh communities	Intertidal mudflats and sandflats
Non-toxic contamination						
Nutrient enrichment (e.g. agricultural run-off, outfalls)	žžž	žž	žžžž	žžž	For information of the sensitivity and vulnerability of these sub-features see the individual assessments made elsewhere in this table.	
Organic enrichment (e.g. mariculture, outfalls)	žž	žž	žžž	žž		
Changes in thermal regime (e.g. power stations)	žžž	žž	žžž	žžž		
Changes in turbidity (e.g. dredging)	žžž	žž	žžžž	žžž		
Changes in salinity	žžž	žžž	žžž	žžž		
Biological disturbance						
Introduction of microbial pathogens	žž	žž	žžžž	žž		
Introduction of non-native species and translocation	žžž	žž	žžž	žžžž		
Selective extraction of species (e.g. commercial and recreational fishing)	žžž	žžž	žžž	žžžž		

Categories of operations which may cause deterioration or disturbance	Intertidal mudflats and sandflats		
	Mud communities	Muddy sand communities	Sand and gravel communities
Physical loss			
Removal (eg. harvesting, land claim, coastal development)	ŽŽŽŽ	ŽŽŽŽ	ŽŽŽŽ
Smothering (eg. disposal of dredgings)	ŽŽŽ	ŽŽŽŽ	ŽŽ
Physical damage			
Siltation (eg.dredging, outfall)	ŽŽ	ŽŽŽŽ	ŽŽ
Abrasion (eg. mobile benthic fishing, anchoring)	ŽŽ	ŽŽŽŽ	ŽŽ
Selective extraction (eg. aggregate extraction, entanglement)	ŽŽŽ	ŽŽŽ	ŽŽŽ
Non-physical disturbance			
Noise (eg. boat activity)	Ž	Ž	Ž
Visual presence (eg. recreational activity)	Ž	Ž	Ž
Toxic contamination			
Introduction of synthetic compounds (eg, TBTs, PCBs)	ŽŽŽŽ	ŽŽŽŽ	ŽŽŽŽ
Introduction of non-synthetic compounds (eg. heavy metals, hydrocarbons)	ŽŽŽŽ	ŽŽŽŽ	ŽŽŽ
Introduction of radionuclides	ŽŽ	ŽŽ	ŽŽ

Categories of operations which may cause deterioration or disturbance	Intertidal mudflats and sandflats		
	Mud communities	Muddy sand communities	Sand and gravel communities
Non-toxic contamination			
Nutrient enrichment (eg. agricultural run-off, outfalls)	žžž	žžžž	žž
Organic enrichment (eg. mariculture, outfalls)	žžž	žžž	žž
Changes in thermal regime (eg. power stations)	žž	žž	žž
Changes in turbidity (eg. dredging)	žž	žžžž	žž
Changes in salinity	žžž	žžž	žž
Biological disturbance			
Introduction of microbial pathogens	žž	žžž	žž
Introduction of non-native species and translocation	žžž	žžž	žžž
Selective extraction of species (eg. commercial and recreational fishing)	žžž	žžž	žžž

Categories of operations which may cause deterioration or disturbance	**Internationally important Annex 1 Bird Populations**				**Internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).**		
	Saltmarsh	Shallow coastal waters	Intertidal mudflats and sandflats	Sand and gravel	Saltmarsh	Intertidal mudflats and sandflats	Boulder and cobble shores
Physical loss							
Removal (eg. harvesting, land claim, coastal development)	žžžž	žžžž	žžžž	žžžž	žžžž	žžžž	žžžž
Smothering (eg. disposal of dredgings)	žžž	žž	žžžž	žž	žžž	žžžž	žžž
Physical damage							
Siltation (eg.dredging, outfall)	žž	žž	žžžž	žž	žž	žžžž	žžž
Abrasion (eg. mobile benthic fishing, anchoring)	žžž	žž	žžžž	žž	žžž	žžžž	žžž
Selective extraction (eg. aggregate extraction, entanglement)	žžž	žž	žžž	žžž	žžž	žžž	žžž
Non-physical disturbance							
Noise (eg. boat activity)	žžžž	žžž	žžžž	žžžž	žžžž	žžžž	žžžž
Visual presence (eg. recreational activity)	žžžž	žžž	žžžž	žžžž	žžžž	žžžž	žžžž
Toxic contamination							
Introduction of synthetic compounds (eg, TBTs, PCBs)	žžžž	žžž	žžžž	žžžž	žžžž	žžžž	žžžž
Introduction of non-synthetic compounds (eg. heavy metals, hydrocarbons)	žžž	žžž	žžžž	žžž	žžž	žžžž	žžžž
Introduction of radionuclides	žž	žž	žž	žž	žž	žž	žž

Categories of operations which may cause deterioration or disturbance	**Internationally important Annex 1 Bird Populations**				**Internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).**		
	Saltmarsh	Shallow coastal waters	Intertidal mudflats and sandflats	Sand and gravel	Saltmarsh	Intertidal mudflats and sandflats	Boulder and cobble shores
Non-toxic contamination							
Nutrient enrichment (eg. agricultural run-off, outfalls)	žžž	žžž	žžžž	žž	žžž	žžžž	žžž
Organic enrichment (eg. mariculture, outfalls)	žž	žž	žžž	žž	žž	žžž	žž
Changes in thermal regime (eg. power stations)	žž	žž	žž	žž	žž	žž	žžž
Changes in turbidity (eg. dredging)	žž	žžž	žžžž	žž	žž	žžžž	žžž
Changes in salinity	žž	žžž	žžž	žž	žž	žžž	žžž
Biological disturbance							
Introduction of microbial pathogens	ž	žž	žžž	žž	ž	žžž	žž
Introduction of non-native species and translocation	žžž	žž	žžž	žžž	žžž	žžž	žžž
Selective extraction of species (eg. commercial and recreational fishing)	žžž	žžž	žžž	žžž	žžž	žžž	žžž

Categories of operations which may cause deterioration or disturbance	**Internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).** Shallow coastal waters
Physical loss	
Removal (eg. harvesting, land claim, coastal development)	ŽŽŽŽ
Smothering (eg. disposal of dredgings)	ŽŽŽ
Physical damage	
Siltation (eg.dredging, outfall)	ŽŽ
Abrasion (eg. mobile benthic fishing, anchoring)	ŽŽ
Selective extraction (eg. aggregate extraction, entanglement)	ŽŽ
Non-physical disturbance	
Noise (eg. boat activity)	ŽŽŽ
Visual presence (eg. recreational activity)	ŽŽŽ
Toxic contamination	
Introduction of synthetic compounds (eg, TBTs, PCBs)	ŽŽŽ
Introduction of non-synthetic compounds (eg. heavy metals, hydrocarbons)	ŽŽŽ
Introduction of radionuclides	ŽŽ

Categories of operations which may cause deterioration or disturbance	**Internationally important assemblages of waterfowl (including internationally and nationally important populations of regularly occurring migratory species).** Shallow coastal waters
Non-toxic contamination	
Nutrient enrichment (eg. agricultural run-off, outfalls)	ŽŽŽ
Organic enrichment (eg. mariculture, outfalls)	ŽŽŽ
Changes in thermal regime (eg. power stations)	ŽŽ
Changes in turbidity (eg. dredging)	ŽŽŽ
Changes in salinity	ŽŽŽ
Biological disturbance	
Introduction of microbial pathogens	ŽŽ
Introduction of non-native species and translocation	ŽŽ
Selective extraction of species (eg. commercial and recreational fishing)	ŽŽŽ

[8]English Nature's 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 October 1999), 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 contrast, 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.

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9. Glossary

Annex I habitat(s) A natural habitat(s) listed in Annex I of the Habitats Directive for which Special Areas of Conservation can be selected.

Attribute A measurable indicator of the condition of a feature which tend to be either indicators of the quantity or quality of the interest feature.

Benthos Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by the tides.

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.

Biodiversity The total variety of life on earth. This includes diversity within species, between species and of ecosystems.

Characteristic Special to or especially abundant in a particular situation or biotope. Characteristic species should be immediately conspicuous and easily identified.

Chenier A long, sinuous ridge of sand.

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.

European marine site A European site (SAC or SPA) which consists of, or so far as it consists of, marine areas.

Favourable conservation status A range of conditions for a natural habitat or species at which the sum of the influences acting upon the habitat or species are not

	adversely affecting its distribution, abundance, structure or function throughout the EU in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis.
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 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
Geomorphology	The description and interpretation of the structure, origin and development of land forms.
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.
Infauna	Benthic animals which live within the sediment.
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 specific component of their fauna and flora, or any Annex II species and any population of a bird species for which a SPA has been designated under the Birds Directive. Any habitat of a species for which the site has been selected, or typical species of an Annex I habitat are also considered to be interest features.
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.
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
Neap tide	Tides that occur during the first or last quarter of the moon when the tide shows the smallest rise and fall in tidal level.
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.
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.
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.
Spring tide	Tides that occur at or just after a new moon and full moon when the greatest rise and fall in tidal level occurs.
Subfeature	An ecologically important sub-division of an interest feature.
Typical Species	A species and its habitat that is considered to be a typical component of an interest 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 waterfowl based on counts undertaken once per month outside of the breeding season

Appendix I Matrix of relative vulnerability

The relative vulnerability of an interest feature or sub-feature is determined by multiplying the scores for relative sensitivity and exposure, and classifying that total into categories of relative vulnerability.

Relative sensitivity of the interest feature

Relative exposure of the interest feature

	High (3)	Medium (2)	Low (1)	None detectable (0)
High (3)	9	6	3	0
Medium (2)	6	4	2	0
Low (1)	3	2	1	0
None (0)	0	0	0	0

Categories of relative vulnerability

High	6 - 9
Medium	3 - 5
Low	1 - 2
None detectable	0

Appendix II Key biotopes and saltmarsh communities occurring within the Essex Estuaries European marine site

Estuaries

Saltmarsh communities

See below.

Intertidal mudflat and sandflat communities

See below.

Rock communities

Biotopes: SLR.Fves; SLR.FserX.T; SLR.MytX; SLR.EphX; SLR.FcerX; SLR.BLlit; SLR.Asc; MLR.MytPid; MCR.Pid

! ***Intertidal boulder and cobble communities***

SLR.Fves; SLR.FserX.T; SLR.MytX; SLR.EphX; SLR.FcerX; SLR.BLlit; SLR.Asc

! ***Bed clay communities***

MLR.MytPid; MCR.Pid (sub-tidal)

Subtidal mud communities

Biotopes: IMU.AphTub; IMU.Tub; IMU.EstMu; IMU.MobMud; IMU.NhomTub

Subtidal muddy sand communities

Biotopes: IMS.Zmar; IMS.MacAbr; CMS.AbrNuCor

! ***Zostera communities***

IMS.Zmar

! ***Bivalve communities***

IMS.MacAbr; CMS.AbrNuCor

Subtidal mixed sediment communities

Biotopes: IMX.CreAph; IMX.PolMtru; IMX; CMX.SspiMx (includes herring spawning ground); IGS.Mob; IGS.ScupHyd

! ***Shallow (estuarine) mixed sediment communities***

IMX.CreAph; IMX.PolMtru; IMX; IGS.Mob

! ***Sabellaria spinulosa***

CMX.SspiMx

! ***Whiteweed***

IGS.ScupHyd

! ***Herring spawning ground*** - Eagle Bank (gravel beds)

Intertidal mudflats and sandflats

Mud communities

Biotopes: LMU.HedOl; LMU.HedScr; LMU.HedStr; LMU.HedMac; LMU.HedMac.Are

! ***Soft mud communities***

LMU.HedOl; LMU.HedScr; LMU.HedStr

! ***Sandy mud communities***

LMU.HedMac; LMU.HedMac.Are

Muddy sand communities

Biotopes: LMS.MacAre; LMS.PCer; LMS.Znol

! ***Muddy sand with lugworm and Baltic tellin***

LMS.MacAre

! ***Muddy sand with cockle beds***

LMS.PCer

! ***Muddy sand with eelgrass beds***

LMS.Znol

Sand and gravel communities

Biotopes: LGS.Lan; LGS.Tal; LGS.Pec; LGS.BarSnd; LGS.BarSh

! ***Fine sands with sand mason worms***

LGS.Lan

! ***Sandy shores with strand-line seaweed***

LGS.Tal; LGS.Pec

! ***Barren sands***

LGS.BarSnd

! ***Barren shingle***

LGS.BarSh

Saltmarsh

Glasswort and other annuals colonising mud and sand - pioneer saltmarsh communities
SM7 - Perennial glasswort (*Athrocnemum perenne*)
SM8 - Glasswort (*Salicornia* agg)
SM9 - Annual sea blite (*Suaeda maritima*)

Cordgrass swards
SM4 - Small cordgrass (*Spartina maritima*)
SM5 - Smooth cordgrass (*Spartina alterniflora)*

Atlantic salt meadows
Low/mid marsh communities

SM10 - Transitional pioneer to low/mid marsh
SM13 - Lower marsh common saltmarsh grass (*Puccinellia maritima*)
SM14 - Lower marsh sea purslane (*Atriplex portulacoides*)

Upper marsh communities

SM13 (part) - Sea lavender/sea thrift (*Limonium vulgare* agg */Armeria maritima*)
SM13 (part); SM16/SM28 - Upper marsh common saltmarsh grass (*Puccinellia maritima*) with red fescue (*Festuca rubra*) and/or sea couch grass (*Elytrigia atherica)*
SM14 - Upper marsh sea purslane (*Atriplex portulacoides*)

Upper marsh transitional communities

SM16 - Saltmarsh rush (*Juncus gerardii*)
SM17 - Sea wormwood (*Artemisia maritima*)
SM18 - Sea rush (*Juncus maritimus*)
SM26 - Golden samphire (*Inula crithmoides*)

Drift-line community

SM28 - Sea couch grass (*Elytrigia atherica*)

Mediterranean saltmarsh scrubs
SM25 - Shrubby sea-blite (*Suaeda vera*)

Rock sea lavender (*Limonium binervosum*)/sea heath (*Frankenia laevis*)

Appendix III Relevant authorities list

Relevant authority	Address
Mr J Partridge, Brightlingsea Harbour Commissioners	Clerk to the Commissioners, Brightlingsea Harbour Commissioners, Harbour Office, 4 Copperas Road, Brightlingsea, Essex CO7 0AP
Mr P MacBride, Chelmsford Borough Council	Environmental Planning Services, Chelmsford Borough Council, Civic Centre, Duke Street, Chelmsford CM1 1JE
Mr D Cookson, Colchester Borough Council	Planning Manager, Planning Department, Colchester Borough Council, Lexden Grange, 127 Lexden Road, Colchester, Essex CO3 3RJ
Captain Ian Bell, Crouch Harbour Authority	Harbour Master/General Manager, Crouch Harbour Authority, The Quay, BURNHAM-ON-CROUCH, Essex CM0 8AS
Mrs Hilary Aldridge, Environment Agency	Area Manager (Eastern Region), Environment Agency, Anglian Region, Cobham Road, Ipswich, Suffolk IP3 9JE
Mrs J Noble, Essex County Council	Principal Policy Planner, Environment Policy Group, Planning Services, Essex County Council, County Hall, Chelmsford, Essex CM1 1LF
Mr M F Powis, Kent and Essex Sea Fisheries Committee	Clerk of the Committee, Kent and Essex Sea Fisheries Committee, The Ice House, Military Road, Ramsgate, Kent CT11 9LG
Mr Peter Markwell, London Port Health Authority	Upper River Base, Riverside, Charlton, London, SE7 7SU
Linda Weeks, Maldon District Council	Planning Services Department, Maldon District Council, Princes Road, Maldon, Essex CM9 5DL
Mr T Wycherley, Ministry of Defence	Ministry of Defence, Defence Estates Organisation - Estates (East), Stirling House, Denny End Road, Waterbeach CB5 9QE
Mr James Trimmer, Port of London Authority	Planning and Environment Division, Port of London Authority, Devon House, 58-60 St Katherine's Way, London E1 9LB
Mr S Scrutton, Rochford District Council	Planning Department, Rochford District Council, Council Offices, South Street, Rochford, Essex SS4 1BW
Mr M Brady, Southend on Sea Borough Council	Southend on Sea Borough Council, PO Box 6, Civic Centre, Victoria Avenue, Southend-on-Sea, Essex SS2 6ER

Appendix IV SAC and SPA location maps

Figure 1. Maps showing interest features in Essex Estuaries European marine site