SOLWAY

EUROPEAN MARINE SITE

English Nature's and Scottish Natural Heritage's advice given in compliance with Regulation 33 (2) and in support of the implementation of The Conservation (Natural Habitats &c.) Regulations 1994

29 February 2000

English Nature's and Scottish Natural Heritage's advice for the Solway European marine site given in compliance with Regulation 33(2) and in support of the implementation of the Conservation (Natural Habitats &c.) Regulations 1994

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Preface

This document provides English Nature's and Scottish Natural Heritage's joint advice to other relevant authorities as to, and in support of, (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 Solway European marine site. This advice is being prepared to both comply with, and support, our obligations under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994. Sections of the document that comply directly with the requirements of Regulation 33 are identified separately (on coloured paper) from those which are included to support this advice.

The Solway European marine site is part of a 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.

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 the Solway 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 which will 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 and Scottish Natural Heritage under Regulation 20). English Nature and Scottish Natural Heritage will keep this advice under review and may update it every six years or sooner, depending on the changing circumstances on the European marine site. In addition we will be providing 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 and Scottish Natural Heritage will add to this advice as appropriate.

Katherine Hayward
English Nature/Scottish Natural Heritage
29 February 2000

1. Introduction

This section is included to provide relevant contextual information in support of the advice required under Regulation 33.

1.1 Natura 2000

The European Union Habitats[1] and Birds[2] Directives are international agreements 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 a 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 areas are Special Areas of Conservation (SACs) which support certain natural habitats or species, and in the Birds Directive, Special Protection Areas (SPAs) which support wild birds of European Union interest. 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.* Guidance and advice relevant in Scotland can be found in Scottish Office Circular No. 6/1995, *Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna, and the Conservation of Wild Birds: The Conservation (Natural Habitats & c.) Regulations 1994.*

1.2 The role of English Nature and Scottish Natural Heritage

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

This document is advice required under Regulation 33 issued by both English Nature and Scottish Natural Heritage in fulfilment and in support 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 English Nature or Scottish Natural Heritage's local offices.

In addition to providing such advice, the Regulation 33 advice, plus supporting information will help to inform on the scope and nature of "appropriate assessments" which the Directive requires to be undertaken for plans and projects (Regulations 48 & 50 and by English Nature and Scottish Natural Heritage under Regulation 20). In the future English Nature and Scottish Natural Heritage may also provide more detailed advice to competent and relevant authorities to assess the implications of any such plans or projects.

[1] Council Directive 92/43/EEC on the conservation of natural habitats 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.

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 are drawing up under Regulation 34 for the Solway 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, amongst others, 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 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 or Scottish Natural Heritage are empowered to use their bylaw-making powers for Marine Nature Reserves (MNR) for use in European marine sites.

1.4 Activity outside the control of relevant authorities

Nothing within this package will require relevant authorities to undertake any actions or ameliorate changes in the condition of interest features if it is shown that 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 and Scottish Natural Heritage 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 Solway European marine site a management group has already been established and should be used to alert either English Nature or Scottish Natural Heritage 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 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 classified SPA status, parts of the Solway are also designated and subject to 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.

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

1.6 Role of conservation objectives

Section 5 of this document sets out the conservation objectives for the Solway European marine site as required under Regulation 33 (2)(a). 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 Directive.

1.7 Role of advice on operations

The advice on operations set out in Sections 7 and 8 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 a 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 areas that may need management measures.

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

2 Identification of interest features under the Habitats and Birds Directives

This section is included to provide relevant contextual information in support of the advice required under Regulation 33 (2).

2.1 Introduction

The Solway is a large shallow complex estuary formed by a variety of physical influences including glaciation, river erosion, sea level change and geological barriers from hard rock outcrops. Of the few examples of these estuaries within Great Britain the Solway is the largest of this type. It is also one of the least industrialised and most natural estuary systems in Europe (Brown *et al.*, 1997). Located on the west coast of Britain, it straddles the border between England and Scotland (Figure 1), forming an extensive system draining into the Irish sea. The inner firth drains several rivers including, Lochar Water, Kirtle Water, the Nith, Sark, Annan, Esk, Eden, Wampool and Waver. The estuary system supports extensive areas of saltmarsh, both pioneer and Atlantic salt meadow, as well as large areas of intertidal mudflats and sandflats, and subtidal sandbanks each of which are of international importance in their own right.

The Solway is a candidate Special Area of Conservation (SAC) and the Upper Solway Flats and Marshes (including Rockcliffe Marsh) is a Special Protection Area (SPA), the boundaries of which are illustrated in Figure 2. The marine components of these sites 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. Accordingly, the advice contained within this document covers both the SAC habitat interests and the SPA bird interests of the European marine site.

The features for which the SAC and SPA have been selected, known as interest features, are listed below. These interest features and ecologically important components, termed sub-features, are described in more detail in Section 3 and mapped in Figure 2 to show their location, distribution and extent.

2.2 Interest features under the EU Habitats Directive

The Solway qualifies as a SAC for the following Annex I habitats as listed in the EU Habitats Directive:

- **Estuaries**;
- ***Salicornia* and other annuals colonising mud and sand** (referred to within this document as pioneer saltmarsh);
- **Atlantic salt meadows *Glauco-Puccinellietalia*** (also commonly referred to as saltmarsh);
- **Mudflats and sandflats not covered by sea water at low tide** (referred to within this document as intertidal mudflats and sandflats); and
- **Sandbanks which are slightly covered by sea water at all times** (referred to within this document as subtidal sandbanks).

2.3 Interest features under the EU Birds Directive

2.3 Interest features under the EU Birds DirectiveThe Upper Solway Flats and Marshes (including Rockcliffe Marsh) qualifies as a SPA under the EU Birds Directive in that it supports:

- **internationally important populations of regularly occurring Annex 1 species;**
- **internationally important populations of regularly occurring migratory species;** and
- **an internationally important assemblage of waterfowl.**

The Upper Solway Flats and Marshes SPA was classified in 1986 and it is that citation on which this advice is based. The Inner Solway Firth is also listed as a Ramsar site, under the Ramsar Convention, and is a wetland of international importance.

3 SAC interest features

This section describes and explains the importance of the SAC interest features of the Solway European marine site and is provided in support of the advice required under Regulation 33 (2).

3.1 Estuaries

3.1.1 General description

Estuaries are complex and highly productive systems supporting a wide range of habitat types. They form the interface between freshwater and the marine environments and extend from the upper limit of tidal influences to the open sea. Unlike large shallow inlets and bays, there is generally a substantial freshwater influence within estuaries. The mixing of freshwater and seawater and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal sandflats and mudflats which, at higher elevations within the tidal range, are exposed for sufficiently long periods to become vegetated with salt tolerant plants and form saltmarshes (or merse). Typical animals associated with intertidal mudflats include the gastropod mollusc *Hydrobia* spp., sandhoppers *Corophium* spp. and a variety of polychaete worms; all of which are food for migratory waterfowl and which make many of Britain's estuaries of international importance for over-wintering waterfowl and waders. Where rock occurs, there are restricted communities characteristic of brackish flowing water, consisting of sparse fucoid algae and species of barnacle and hydroids. Towards the mouth of the estuary, the water gradually becomes more saline and the silt content of the sediment tends to decline. Here the animal communities of the sediments are dominated by invertebrates such as polychaete worms and bivalve molluscs.

3.1.2 Importance of the Solway

The Solway Firth estuary complex is one of the largest, least industrialised and most natural warm sandy estuaries in Europe (Brown *et al.* 1997). The Solway Firth candidate SAC, with a total area of around 44,000 ha.., supports extensive areas of Atlantic salt meadows, pioneer saltmarsh, intertidal mudflats and sandflats, and subtidal sandbanks. Each of these are of international importance, qualifying under the Habitats Directive as Annex I Habitats in their own right. At low water the area of the inner Solway almost completely dries out exposing extensive fringing mudflats and sandflats, which together with the extensive subtidal sandbanks, form the third largest continuous areas of sedimentary habitats in the country. Tidal currents are moderately strong and levels of wave energy can be high, with considerable seasonal fluctuations in water temperature due to the shallow nature of the estuary. The combination of environmental and ecological characteristics is most unusual for British estuaries.

The estuary is also important for migrating fish, particularly sea trout *Salmo trutta* and salmon *Salmo salar* as they pass into the rivers Nith, Annan, Sark, Kirtle Water, Border Esk, Eden and Wampool. The mudflats and sandflats of the inner estuary provide nursery and feeding grounds for commercially and recreationally important fish species, as well as providing a significant food source for birds (Solway Firth Partnership 1996). The estuary supports a range of fish including a number of Annex II[5] Species such as allis shad *Alosa alosa* and twaite shad *Alosa fallax*, which migrate through the Solway Firth to freshwater breeding grounds. Populations of sea lamprey *Petromyzon marinus* and river lamprey *Lampetra fluviatillis* are also present. The site also supports typical estuarine fish populations, such as flounder and other flat fish including plaice, sole and dab.

[5] A species listed in Annex II of the Habitats Directive and for which Special Areas of Conservation can be selected.

3.1.3 Key sub-features

Rocky scar communities - Intertidal and subtidal scar ground (exposed boulders and rocks) is a characteristic feature of the Solway Firth with extensive areas of scar ground present on the English side (Solway Firth Partnership 1996). These scar areas which remain clear of sand, support a rich and well developed epifauna typical of rocky areas, such as the brown seaweed (fucoids) and the edible mussel *Mytilus edulis*. The habitat is also important for crabs, various species of fish and supports the reef building polychaete worm *Sabellaria alveolata* in the intertidal and *Sabellaria spinulosa* in the subtidal. These are specialist communities that can tolerate scour and are considered to be nationally scarce. The extent of exposed scar varies as it is scoured and buried by the constantly shifting intertidal flats. However, an estimated 400 ha.. of scar is thought to be currently uncovered by sediment.

Rocky scars, such as those at Southerness, mostly have communities similar to those of rocky shores. The scar grounds generally lack the littoral fringe and supralittoral communities of bedrock, but are characterised by spiral wrack *Fucus spiralis* above a band of bladder wrack *Fucus vesiculosus* or knotted wrack *Ascophyllum nodosum* depending on the prevalent wave exposure at the site. Many rocky scar sites also have edible mussel *Mytilus edulis* beds. Invertebrates, including common limpets *Patella vulgata*, the barnacles *Semibalanus balanoides* and *Elminius modestus* and dog whelk *Nucella lapillus* are common to these areas. On areas where these rocky shore scars are subject to reduced salinity, they support the brown seaweed horned wrack *Fucus ceranoides*. The *Fucus ceranoides* biotope (SLR.F.Fcer) is scarce in the UK.

Areas of scar subject to more frequent scouring by sand, such as Hogus Point and Powfoot scars support species such as the periwinkle *Littorina littorea* and barnacles *Semibalanus balanoides* and *Elminius modestus*. There is very little fuciod growth as a result of the frequent scour. Mussel *Mytilus edulis* beds are also commonly associated with these areas.

Pioneer saltmarsh – pioneer saltmarsh is part of a complete sequence of saltmarsh types which occur within the estuary. It is also classified in the Habitats Directive as an interest feature in its own right and is therefore described separately below. See Section 3.2.

Saltmarsh – the Atlantic salt meadows which occur within the Solway comprise one of the largest areas of saltmarsh in Britain. They are classified in the Habitats Directive as an interest feature in their own right and are therefore described separately below. See Section 3.3.

Intertidal mudflats and sandflats – intertidal sediments contribute significantly to the habitat diversity of the site and to its international importance. They are classified in the Habitats Directive as an interest feature in their own right and are therefore described separately below. See Section 3.4.

Subtidal sandbanks – subtidal sandbanks within the Solway are the best example of muddy sandbanks influenced by reduced salinity in the UK. These too are classified in the Habitats Directive as an interest feature in their own right and are therefore described separately below. See section 3.5.

3.2 *Salicornia* and other annuals colonising mud and sand (Pioneer saltmarsh)

3.2.1 Definition

Pioneer saltmarsh occurs at the lowest levels of the saltmarsh zone, where immersion occurs at nearly every tide. It colonises intertidal mudflats and sandflats in areas protected from strong wave action and is an important precursor to the development of more stable vegetation. Pioneer saltmarsh develops at the lower reaches of saltmarshes where vegetation is frequently flooded by the tide and can also colonise open creek sides, depressions or pans within saltmarsh, as well as disturbed areas of upper saltmarshes.

3.2.2 Importance of the feature

Pioneer saltmarsh on the Solway Firth has been selected to represent the habitat type in north-west England and south-west Scotland. It is part of a complete sequence of saltmarsh types which occur on the Solway Firth from pioneer communities through to mid and high saltmarsh and tidal grazing marsh (Brown *et al.* 1997). The distribution of pioneer saltmarsh varies in response to changing river channels and erosion of existing marsh and forms part of a dynamic suite of maritime habitat types for which the site has been separately selected. The communities present in the Solway Firth are dominated by glasswort *Salicornia* spp. Glasswort, which is largely absent from other Scottish firths (Burd 1987), forms a distinct zone in the lower marshes of the Solway Firth, but is also characteristic of other bare mud and sand habitats such as the sides of creeks, borrow pits, eroded marsh and at lower elevations in tidal range.

3.2.2 Key sub-features

Annual *Salicornia* spp. communities - this plant community is limited to those annual species that can withstand the tidal regime, and will exhibit considerable seasonal variation. The density of plants will vary according to local conditions, such as sediment composition and exposure to tides.

3.3 Atlantic salt meadows (*Glauco-puccinellietalia*)

3.3.1 Definition

Atlantic salt meadows *Glauco-puccinellietalia* occur on North Sea, English Channel and Atlantic shores. They develop when halophytic vegetation colonises soft intertidal sediments of mud and sand protected from strong wave action. This vegetation forms the middle and upper reaches of saltmarshes where tidal inundation occurs, but with decreasing frequency and duration. Saltmarshes play a fundamental role within estuaries bringing stability to coastal margins and operating as a source of primary productivity (Davison *et al.* 1991).

Atlantic salt meadows comprise a wide range of vegetation types which are zoned according to frequency and duration of tidal inundation; this can often be blurred by other factors such as climate which will affect periods of inundation. Those Atlantic salt meadows which are grazed differ significantly from those which are ungrazed, in terms of both structure and species composition. Areas that are overgrazed are generally more species-poor and dominated by grasses such as *Puccinellia* spp. This in turn affects related invertebrate communities and breeding and feeding birds. The upper saltmarsh of the Solway is regarded as particularly important because it has been lost in many other estuaries as a result of land claim and overgrazing.

3.3.2 Importance of the feature

The Solway Firth has been selected for its Atlantic salt meadows for their size and the extent of uninterrupted transitions. The overall area of this saltmarsh type in the UK is some 29,000 ha.., of which around 3,800 ha.. or 13% occurs on the Solway Firth where they have been little affected by land claim, enclosures and agricultural intensification, with the result that they demonstrate unusually large transitions to freshwater grassland communities. Unlike more southerly saltmarshes, those of the Solway Firth develop on sediments with a higher sand content. Furthermore, some of the plants that they support, such as sea purslane *Atriplex portulacoides*, common sea lavender *Limonium vulgare* and lax-flowered sea lavender *Limonium humile* are at the northern limits of their range in the UK (Solway Firth Partnership 1996). As the Atlantic salt meadows of the Solway Firth are important for a variety of wintering waterfowl which graze them, it is also important to maintain their structure to ensure continued use by waterfowl considered as typical or characteristic of these marshes.

The saltmarsh of the inner Solway is notable for its structure. Terraces are evident within the marshes which have developed as a result of saltmarsh forming as the land moves in relation to the sea (a phenomenon referred to as isostatic adjustment) (Marshall 1962). These marshes provide breeding pools and food sources

for natterjack toads (*Bufo calamita*) which, although not an interest feature for this site, are an Annex IV[6] species of the Habitats Directive. The natterjack toad population within the inner Solway saltmarshes is thought to amount to over 10% of the breeding population in the UK. Otters *Lutra lutra* make extensive use of the inner Solway intertidal habitats for shelter and food; this population is considered to be an important resource for the recolonisation of northern England (Solway Firth Partnership 1996). Otters are listed as Annex II and Annex IV species in the Habitats Directive but are not an interest feature for this site. The marshes also support all four types of salt pan, primary, secondary, channel and residual pans (Marshall 1962).

3.3.3 Key sub-features

Low marsh communities – lying immediately above the pioneer saltmarsh zone, the saltmarshes experience a greater number of tidal inundations than the mid- or upper- marsh. As a result of this, the vegetation communities of the low marsh and mid-low marsh are often relatively species poor, composed of halophytes that can withstand such conditions. Communities of common saltmarsh grass *Puccinellia maritima* (NVC community SM13) and the annual glasswort *Salicornia* spp. (NVC community SM8) typify low marsh.

Mid marsh communities - the mid upper marsh is dominated by the saltmarsh rush *Juncus gerardii* with smaller areas of saltmarsh grass/fescue communities *Puccinellia/Festuca* (NVC community SM16). In the mid marsh zone, as the number of tidal inundations becomes less frequent, the vegetation becomes more diverse, with a more complex structure and a greater proportion of herbs.

Upper marsh communities - at the upper levels of the marsh, tidal inundation only occurs at the highest spring tides. The vegetation communities here reflect this with some species being restricted to this zone. The upper marsh communities will grade into the transitional communities at around extreme high water spring tide mark, these may be freshwater habitats, woodlands or grassland. Where the upper marshes have been truncated by sea walls, these transitions are lost. Such truncations can also affect the succession of saltmarshes and their ability to respond to changes in sea levels.

3.4 Intertidal mudflats and sandflats

3.4.1 Definition

Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide. They form a major component of estuaries and embayments in the UK but also occur along the open coast. The physical structure of the intertidal flats can range from the mobile coarse sand beaches of wave exposed coasts to the fine stable sediment mudflats of estuaries. This habitat type can often be divided into three broad categories, clean sands, muddy sands and muds, 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.

3.4.2 Importance of the feature

The mudflats and sandflats of the Solway Firth comprise the third largest continuous area of intertidal mud and sand in the UK, after the Wash and Morecambe Bay (Solway Firth Partnership, 1996). They contribute significantly to the habitat diversity of the site and to its international importance. The flats are highly mobile and consist predominantly of fine sands and silt. Fine sandy sediments occur in the inner estuary with coarser sediments in the outer reaches. The presence of fine sands rather than muds, due to the lack of mud being imported into the system from rivers (Marshall, 1962), is unusual in conditions of estuarine salinity. A typical estuarine fauna is supported by the flats with variation in the dominant infauna dependent on variation in sediment composition and position on the shore. The flats provide a valuable food source for feeding birds and fish as well as acting as a refuge for roosting birds. A range of factors including, salinity,

[6] Animal and plant species identified in Annex IV of the Habitats Directive as being in need of strict protection.

sediment grain size, organic content and wave exposure influence the sediment communities within the Solway Firth.

3.4.3 Key sub-features

Muddy sand communities - muddy sand communities are found towards the head of the Solway Firth sediments, typically silty muds, with varying degrees of sand (Covey and Emblow, 1992; Cutts and Hemingway, 1996). Communities here are dominated by polychaetes such as the lugworm *Arenicola marina* and bivalves such as the common cockle *Cerastoderma edule* and the Baltic tellin *Macoma balthica*. The cockle beds of the Inner Solway are a characteristic feature of the estuarine complex. They play a crucial role in the functioning and health of the estuary itself, acting as filter feeders and primary consumers which take phytoplankton out of the system and provide pathways for nutrient recycling and making organic matter available to other consumers.

Sandy mud communities - this community occurs in sandy mud in sheltered or extremely sheltered conditions often in variable or low salinities. It is widespread on the mid and lower shores of much of the inner Solway as well as the sheltered estuaries of the outer Solway (Solway Firth Partnership 1996). The most abundant species include the ragworm *Hediste diversicolor* and the Baltic tellin *Macoma balthica.* The burrowing sandhopper *Corophium volutator* and the laver spire shell *Hydrobia ulvae* are also often common within this community.

Gravel and sand communities - in areas of relatively high wave exposure, where the sediments are characteristically coarse, the faunal community is dominated by burrowing amphipods, mainly *Bathyporeia* spp. (Cutts and Hemingway 1996). Medium clean sands to fine sand in moderately exposed reaches of the Solway Firth are dominated by bristleworms such as *Nephtys cirrosa* and *Nephtys hombergii*, and bivalve shellfish such as *Angulus tenuis* and *Donax vittatus*. Transitional communities occur with changes in grain size. In areas of fine or very fine sand typical species include bristleworms *Nephtys* spp., *Scoloplos armiger*, the lugworm *Arenicola marina*, and the amphipod *Bathyporeia pelagica* (Covey and Emblow 1992). These communities tolerant of variable or low salinities. Areas greatly influenced by freshwater run-off are typically dominated by oligochaete worms.

3.5 Subtidal sandbanks

3.5.1 Definition

This habitat primarily consists of soft sediment seabeds that are permanently covered by shallow seawater, typically at depths of less than 20m. The diversity and types of community associated with this habitat type are determined by sediment type and a variety of physical factors. These include geographical location, the relative exposure of the coast and differences in the depth, turbidity and salinity of the surrounding water. Typical species associated with subtidal sandbanks include a burrowing fauna of worms, crustaceans, bivalve molluscs and echinoderms. The mobile fauna at the surface of the sandbank often includes shrimps, crabs and fish.

3.5.2 Importance of the feature

The subtidal sandbanks of the Solway Firth are the best example of muddy sandbanks influenced by reduced salinity in the UK. The subtidal sediment banks are separated by six main river channels which are continually changing their patterns of erosion and accretion. They play an important role in maintaining a sediment balance within the estuary, acting as both a source and sink for sediments. The sublittoral sediment communities of the inner estuary is typically sparse but becomes richer towards the outer estuary due to the less extreme environmental conditions and a more varied substrate including patches of mud, silt, stone and outcrops of underlying hard bed rock amongst sand. These sediments provide spawning grounds and nursery grounds for fish, invertebrates and shrimps.

3.5.3 Key sub-features

Infralittoral gravel and sand communities - to the west and the head of the Solway Firth, the sandbanks are predominantly fine to medium sands, supporting rich and diverse communities dominated by the polychaete worm *Nephtys cirrosa* and the amphipod *Bathyporeia elegans* (Cutts and Hemingway 1996). Other species present include the polychaete *Magelona mirabilis,* the bivalves *Fabulina fabula*, *Spisula subtruncata* and *Angulus tenuis*, and juvenile horse mussels *Modiolus modiolus.* Towards the middle channel and the east, the banks are mainly gravely clean sands with low species diversity, the key species being *Nephtys cirrosa* in clean sand and *Microphthalmus similis* in the areas of gravel and pebbles (Cutts and Hemingway 1996).

4 SPA interest features

This section describes and explains the importance of the SPA interest features of the Solway European marine site and is provided in support of the advice required under Regulation 33 (2).

4.1 Background and context

A major aim of the Birds Directive is to take special measures to conserve the habitats of qualifying wild 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 and Scottish Natural Heritage'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 both of habitat condition and the status of the birds on the SPA.

Accordingly, English Nature and Scottish Natural Heritage 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 and Scottish Natural Heritage's advice focuses on the qualifying species for which the SPA was originally classified despite the fact that numbers and species composition may have changed on this 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 or the Scottish Executive, English Nature and Scottish Natural Heritage 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 sections 7 and 8. Where disturbance is highlighted in such advice, relevant authorities need to avoid damaging disturbance to qualifying species when exercising their functions under the Directive.

4.2 Definition

The Upper Solway Flats and Marshes (including Rockcliffe Marsh) SPA, the boundary of which is shown in figure 2, qualifies under Article 4.1 of the EU Birds Directive by supporting:

- internationally important populations of the following regularly occurring Annex 1 species: barnacle goose *Branta leucopsis*, whooper swan *Cygnus cygnus* and golden plover *Pluvialis apricaria*.

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

- internationally important populations of regularly occurring migratory species; and
- an internationally important assemblage of waterfowl.

Details on the population size and thresholds of the qualifying species for which the SPA was originally classified and on which this advice focuses, are a given in Table 1. The most recent WeBS count data (97-98) relating to birds currently using the Solway Firth is provided in Appendix 4.

4.3 Importance of the Annex 1 species

The entire Svalbard population of the barnacle goose *Branta leucopsis* overwinters on the Solway Firth, arriving from their arctic breeding grounds in late September. Their distribution on the site mirrors that of the Atlantic salt meadows, as these and adjacent farmland, are their principle feeding grounds. Important roosting areas for the barnacle goose *Branta leucopsis*, which vary according to the tide, include Mersehead, Caerlaverock, Blackshaw Bank and the extensive sandflats fronting Rockcliffe saltmarsh. The population of this species of barnacle goose has been steadily increasing since 1986 when the SPA was classified. The current population is estimated at 24,360 (peak WeBS count 1996-97).

The Solway Firth hosts an internationally important population of the Annex 1 species golden plover *Pluvialis apricaria* and the intertidal mudflat areas on the site comprise important roosting grounds for this species (Solway Firth Partnership 1996). On the north shore there is a strong autumn passage, whilst on the south shore numbers rise steeply around October, remaining high until mid February. Usage of the site by this species varies although their principle feeding areas include Caerlaverock and Rockcliffe marsh.

The Solway Firth is also internationally important for whooper swans *Cygnus cygnus*, which regularly overwinter on the site, mainly at Caerlaverock and Moricambe Bay, and usually arriving from Iceland in early-mid October (currently 200 individuals). Whooper swans feed on saltmarsh vegetation, as well as on adjacent farmland and roost on the estuary. Bewick swan *Cygnus columbianus* is also identified on the SPA citation as a qualifying species. However, this species is no longer present on the site in qualifying numbers. Since the SPA was originally classified a further Annex 1 species: bar-tailed godwit *Limosa lapponica*, has been identified at qualifying levels.

4.3.1 Key sub-features

Saltmarsh - saltmarsh grass is grazed by barnacle geese *Branta leucopsis*, requiring a relatively short sward height. The preferred sward height for grazing is considered to be between 2-4 cm. Whooper swans *Cygnus cygnus* and golden plover *Pluvialis apricaria* also feed on the saltmarsh whilst overwintering on the Solway Firth.

Intertidal mudflats and sandflats - the mudflats and sandflats of the Solway Firth provide a valuable food source and roosting area for birds. The flats are a particularly important roosting area for golden plover *Pluvialis apricaria,* barnacle geese *Branta leucopsis* and whooper swans *Cygnus cygnus*.

4.4 Importance of the internationally important populations of regularly occurring migratory species

The Upper Solway Flats and Marshes (including Rockcliffe Marsh) qualify as an SPA for supporting eight internationally important populations of regularly occurring migratory waterfowl, in addition to those listed under annex 1. These are: pink-footed goose *Anser brachyrhynchus*, redshank *Tringa totanus*, curlew *Numenius arquata,* oystercatcher *Haematopus ostralegus*, knot *Calidris canutus*, shelduck *Tadorna tadorna,* sanderling *Calidris alba* and turnstone *Arenaria interpres.*

With the third largest continuous area of intertidal habitat in the UK, covering some 220 km^2, the inner Solway is a vital resting and wintering area for birds migrating along the eastern Atlantic seaboard. Being on the west coast, the Solway can increase in importance for birds during periods of severe cold weather to the east in Britain or Europe.

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 an intertidal area and different prey species. Changes in the habitat may therefore affect their prey availability. The important bird populations therefore require a functional estuarine regime which is capable of supporting intertidal habitat for feeding and areas above high tide for roosting. Factors important to this functioning include:

- the current extent and distribution of suitable feeding & roosting habitat (e.g. saltmarsh and mudflats);
- sufficient food availability (e.g. small fish, crustaceans, bivalve molluscs and worms);
- minimal levels of disturbance; and
- water quality (including salinity and minimal pollution) necessary to maintain intertidal plant and animal communities and to maintain saltmarsh conditions suitable for bird feeding and roosting.

4.4.1 Key sub-features

Saltmarsh - many species of wildfowl graze on grasses and seeds on intertidal saltmarsh areas and in creeks. Although the site does not qualify for breeding waders it is worth noting that the saltmarsh is also an important breeding area for migratory species such as redshank *Tringa totanus*, which breed at Rockcliffe Marsh. Oystercatchers *Haematopus ostralegus* also breed on many of the saltmarshes within the Firth.

Intertidal mudflats and sandflats - the abundance of invertebrates in the mudflats and sandflats provide food for many species of wader including curlews *Numenius arquata*, oystercatcher *Haematopus ostralegus* and redshank *Tringa totanus*. The Solway is the second most important site in the UK for oystercatcher. Moricambe Bay, on the Inner Solway, is of particular importance for curlew *Numenius arquata*. Knot *Calidris canutus*, which arrive on the Solway from their breeding grounds in Greenland and Canada in late Autumn are specialist waders, feeding on various species of bivalve mollusc. Although there are favoured areas of the site, all of the Solway Firth intertidal mudflats and sandflats are potentially suitable habitats for migratory waterfowl.

Intertidal rocky scar ground - scar ground is an important habitat for breeding and wintering wading birds. Their rich and varied fauna provide a valuable source of food for a number of birds such as the oystercatcher *Haematopus ostralegus*, which feeds on a variety of marine invertebrates on the foreshore.

4.5 Importance of the internationally important assemblage of waterfowl

The site also qualifies by supporting over 20,000 overwintering waterfowl. Currently, during the winter months over 120,000 birds feed and roost on the site. This assemblage comprises those species listed in Sections 4.3 and 4.4 as well as the following waterfowl species: pintails *Anas acuta*, goldeneye *Bucephala clangula*, grey plover *Pluvialis squatarola*, dunlin *Calidris alpina*, bar-tailed godwit *Limosa lapponica*, scaup *Athya marila* ringed plover *Charadrius haiticula* and wigeon *Anas penelope.*

4.5.1 Key sub-features

Saltmarsh communities - as with the Annex 1 and migratory birds mentioned in Sections 4.2 and 4.3, saltmarsh provides a roosting and feeding habitat to a range of waterfowl. Goldeneye use the edges of the merse for roosting and feeding, with the largest populations currently being within Kirkconnell and Rockcliffe marshes (Quinn *et al.* 1993).

Intertidal mudflats and sandflats - the Solway Firth flats provide food for an internationally important assemblage of waterfowl. Shelduck *Tadorna tadorna* for example, feed mainly on laver spire shell *Hydrobia*

ulvae which live on and within muddy sediments. They also support dunlin *Calidris alpina* which feed on a wide range of worms and bivalves living in the mud.

Intertidal rocky scar ground - scar ground is an important feeding habitat for a range of wading birds within the Solway European marine site, such as the grey plover *Pluvialis squatarola,* which overwinter in the Firth.

Subtidal sandbanks - the soft sediment seabeds that are permanently covered by shallow seawater, typically at depths of less than 20m support a burrowing fauna of worms, crustaceans, bivalve molluscs, echinoderms and mobile fauna at the surface of the sandbank such as shrimps, crabs and fish. These are an important source of food for diving birds such as the Scaup *Athya marila*.

5 Conservation objectives

This section is provided in compliance with Regulation 33 (2)(a) of The Conservation (Natural Habitats, &c.) Regulations 1994.

Under Regulation 33 (2)(a), English Nature and Scottish Natural Heritage have a duty to advise other relevant authorities as to the conservation objectives for the European marine site. The conservation objectives for the Solway European marine site are provided below and should be read in the context of other advice given in support of these objectives, particularly

- the attached maps showing the extent of the various interest features and sub-features (Figures 1 and 2);
- summary information on the interest of each of the features (Sections 3 and 4); 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 (Section 6).

5.1 The conservation objective for the estuaries

Subject to natural change, maintain in favourable condition[7] the **estuaries**, in particular:

- The extent and diversity of Atlantic salt meadows communities
- The extent and diversity of *Salicornia* spp. communities.
- The extent and diversity of intertidal mudflats and sandflats communities.
- The extent and diversity of subtidal sandbank communities.
- The extent and diversity of rocky scar communities.

5.2 The conservation objective for *Salicornia* and other annuals colonising mud and sand

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

- The extent of *Salicornia* spp. communities.

5.3 The conservation objective for Atlantic salt meadows

Subject to natural change, maintain in favourable condition the **Atlantic salt meadows**, in particular:

- The extent and diversity of *Puccinellia maritima* communities.
- The extent and diversity of *Festuca rubra* communities.

[7] A detailed definition of favourable condition is given in the glossary. For a detailed definition of how to recognise favourable condition see attached table (section 6).

5.4 The conservation objective for mudflats and sandflats not covered by sea water at low tide

Subject to natural change, maintain in favourable condition the **mudflats and sandflats not covered by sea water at low tide**, in particular:

- The diversity of infaunal communities.
- The extent of littoral muddy sand communities, especially polychaetes and *Cerastoderma edule* in fine sand and muddy sand shores, and *Macoma balthica* and *Arenicola marina* in muddy sand shores.
- The extent of sandy mud shore communities, especially *Hediste diversicolor* and *Macoma balthica* in sandy mud shore communities.

5.5 The conservation objective for sandbanks which are slightly covered by sea water at all times

Subject to natural change, maintain in favourable condition the **sandbanks which are slightly covered by sea water at all times**, in particular:

- The diversity of infralittoral gravel and sand communities.

5.6 The conservation objectives for the SPA features

Subject to natural change, maintain in favourable condition the habitats of the **nationally important populations of the regularly occurring Annex 1 species,** in particular:

- Extent and sward height of saltmarsh communities.
- Intertidal mudflats and sandflats as roosting and feeding grounds.

Subject to natural change, maintain in favourable condition the habitats of the **internationally important migratory waterfowl** present during the winter, in particular:

- Extent and sward height of saltmarsh communities.
- Extent and species diversity of intertidal mudflat and sandflat communities.
- Extent and species diversity of intertidal rocky scar communities.

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

- Extent and sward height of saltmarsh communities.
- Extent and species diversity of intertidal mudflat and sandflat communities.
- Extent of pioneer saltmarsh communities.
- Extent and species diversity of intertidal rocky scar communities.
- Subtidal sandbank communities.

Note: The 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 and Scottish Natural Heritage, 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.

Table 1 Information on the populations of internationally important species of birds under the EU Birds Directive using the Solway European marine site at the time the SPA was classified

Species	Qualifying Status	Population on SPA citation*
barnacle goose	Annex 1 species	9,000
whooper swan	Annex 1 species	160
bewick's swan	Annex 1 species	60
golden plover	Annex 1 species	7,300
pink-footed goose	Internationally important migratory waterfowl population	13,000
shelduck	Internationally important migratory waterfowl population	1,400
oystercatcher	Internationally important migratory waterfowl population	37,000
sanderling	Internationally important migratory waterfowl population	260
knot	Internationally important migratory waterfowl population	700
curlew	Internationally important migratory waterfowl population	5,600
redshank	Internationally important migratory waterfowl population	2,300
turnstone	Internationally important migratory waterfowl population	570

Qualifying status	Species (in addition to Annex 1 and internationally important migratory species)	Population on SPA citation*
Internationally important assemblage of waterfowl	pintail, wigeon, goldeneye, scaup, ringed plover, grey plover, bar-tailed godwit and dunlin.	114,000

* SPA citation held on Register of European Sites for GB.

6 Favourable condition table

The favourable condition table is supplied as part of English Nature's and Scottish Natural Heritage's Regulation 33 advice package in support of the conservation objectives for the Solway European marine site (Section 5).

This table is intended to supplement the conservation objectives only in relation to management of established and ongoing activities and future reporting requirements on monitoring the condition of the site and its features. The table **does not by itself** provide a comprehensive basis on which to assess plans & 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. English Nature and Scottish Natural Heritage will provide more detailed advice to competent and relevant authorities in England and Scotland respectively, 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 in England and as such comprises indicators of condition. Scottish Natural Heritage are currently developing the details of their monitoring programme for Scotland and may issue supplementary advice in due course. 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. These observed values will need to be used to assess whether interest features on sites continue to make an appropriate contribution to the Favourable Conservation Status of the habitat or species concerned.

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. The English Nature and Scottish Natural Heritage 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 or sub-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

NB - Many of the attributes will be able to be monitored at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Estuaries		Extent	Area (ha..) of the estuaries measured periodically (frequency to be determined).	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. The extent of the estuaries will not change significantly over time unless due to some human activity but nevertheless needs to be measured periodically.
		Morphological equilibrium	Intra and inter-estuarine Tidal Prism/Cross-Section ratio (frequency to be determined).	Intra- and inter-estuarine TP/CS ratio 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 indicate the influence of anthropogenic factors and this would trigger more detailed evaluation of potential problems.
			Long-term trend in the horizontal boundary of the saltmarsh/mudflat interface.	The horizontal boundary of the saltmarsh/mudflat interface should not deviate significantly form the long term trend, 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.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Estuaries		Water density – water temperature, salinity	Average water temperature and salinity (encompassing the salinity gradient) measured periodically throughout the reporting cycle (frequency to be determined).	Average temperature & salinity gradient throughout the estuary 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 influence the presence and distribution of species (along with recruitment processes and spawning behaviour) including those at the edge of their geographic ranges and non-natives.
	Scar ground	Characteristic biotope – extent of ephemeral red and green seaweeds on variable salinity or disturbed eulittoral mixed substrata (identified in appendix 3).	Distribution and frequency of ephemeral red and green seaweeds on variable salinity or disturbed eulittoral mixed substrata, measured during summer, twice during reporting cycle.	Distribution and frequency should not increase significantly from baseline data (Cutts *et al.* 1998) subject to natural change.	Distribution and occurrence of ephemeral green and red seaweeds on variable salinity or disturbed eulittoral mixed substrata is an indicator to changes in supporting processes such as nutrient enrichment, physical disturbance and freshwater run-off.
		Characteristic biotope - extent of *Sabellaria alveolata* reefs (identified in appendix 3).	Area (ha..) of *Sabellaria alveolata* reefs on littoral sand-abraded rocks. Measured during September, twice during reporting cycle.	No decrease in extent from an established baseline value, subject to natural change.	The extent of *Sabellaria alveolata* reefs on sand abraded rocks is a key structural component of the scar ground. It is a fragile biotope and thus a good indicator of physical disturbance. The Solway is the northernmost limit for *Sabellaria alveolata* and loss may indicate change in water patterns, thus the functioning of the system.
		Characteristic biotope - extent of horned wrack on reduced salinity littoral rock (identified in appendix 3).	Area (ha..), occurrence and frequency of horned wrack on reduced salinity eulittoral rock, measured twice per reporting cycle.	No decrease in extent from an established baseline subject to natural change. Average occurrence and frequency should not deviate from an established baseline subject to natural change.	Horned wrack *Fucus ceranoides* is a scarce biotope, restricted to estuarine conditions. Changes in distribution and abundance of horned wrack can be used as an indicator of changes in the salinity gradient thus the functioning of the estuary.
Estuaries	Scar ground	Characteristic biotope –	Area (ha..), measured in	No decrease in extent from	The extent of mussel beds is a key structural

Feature	Sub-feature	Attribute	Measure	Target	Comments
		extent of mussel beds (identified in appendix 3).	the summer months, once during reporting cycle.	an established baseline, (CSFC survey 1998 (English data) IECS 1998 (Scottish)), subject to natural change.	component of the estuary and, depending on the size and distribution of the beds, they may play an important functional role within the feature, e.g. stabilisation of scar grounds, energy flow. In many cases beds tend to remain in the same place in the long-term whilst patchiness within them is much more dynamic.(Holt *et al.* 1998).
		Characteristic biotope – extent of *Sabellaria spinulosa* reefs (identified in appendix 3).	Area (ha..) of *Sabellaria spinulosa* reefs on sublittoral scar ground, measured during September, twice during reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	The extent of *Sabellaria spinulosa* reefs on sublittoral scar ground is a key structural component of the subtidal hard substrata present in the estuary. It is a fragile biotope thus a good indicator of physical disturbance.
	Salicornia and other annuals colonising mud and sand	Attributes and targets for this sub-feature are listed under the '*Salicornia* and other annuals colonising mud and sand' interest feature covered in other sections of this table.			
	Atlantic salt meadows	Attributes and targets for this sub-feature are listed under the 'Atlantic salt meadows' interest feature covered in other sections of this table.			
	Mudflats and sandflats not covered by seawater at low tides	Attributes and targets for this sub-feature are listed under the 'Mudflats and sandflats not covered by seawater at low tides' interest feature covered in other sections of this table.			
	Sandbanks which are slightly covered by seawater at all times	Attributes and targets for this sub-feature are listed under the 'Sandbanks which are slightly covered by seawater at all time' interest feature covered in other sections of this table.			
Atlantic salt meadows		Extent	Total area (ha..) measured once per reporting cycle.	No decrease in extent from an established baseline,	Solway Atlantic Salt Meadow includes more than 10% of the UK natural resource due to the lack of

Feature	Sub-feature	Attribute	Measure	Target	Comments
				subject to natural change.	enclosure and reclamation for agricultural use. Coastal squeeze may result in replacement of Atlantic Salt Meadows by pioneer saltmarsh
		Range and distribution of characteristic communities, sub-communities and transitional communities. (identified in appendix 2).	Presence and abundance of characteristic communities, sub-communities and transitional communities, measured once per reporting cycle. Surveys should be of sufficient frequency to identify long-term changes to these.	Presence and abundance of characteristic communities, sub-communities and transitional communities should not deviate significantly form an established baseline, subject to natural change.	Atlantic salt meadows can be described according to the corresponding National Vegetation Classification (NVC). The more complete sequences of transition from salt meadows to semi-natural landward communities are most valuable for nature conservation. Range of NVC communities present reflects past and current grazing management of saltmarshes.
		Vegetation structure	Range and distribution of varying heights of vegetation, measured periodically (frequency to be determined).	Range and distribution of varying heights of vegetation should not deviate significantly from an established baseline, subject to natural change.	Vegetation structure is largely affected by the impact of grazing interacting with different vegetation communities. On grazed saltmarshes, where this has been an established practice, the stocking levels need to be appropriate to the interest of the site. Overgrazing can lead to loss of rare plant species and affect bird feeding and breeding habitats and may affect the stability of the saltmarsh. It is therefore important to maintain the site-specific mosaic of structural diversity associated with plant species composition at baseline ratio of tall:short vegetation.
Atlantic salt meadows	Mid and mid-upper marsh	Species composition of characteristic saltmarsh	Frequency and abundance characteristic species:	Frequency and abundance of characteristic species	Covers extensive areas of saltmarsh. Usually present on grazed marshes. Can be variable

Feature	Sub-feature	Attribute	Measure	Target	Comments
meadows	communities	communities: - *Festuca rubra* saltmarsh SM16 (identified in Appendix 2).	*Festuca rubra* and *Juncus gerardii*, measured once per reporting cycle.	should not deviate significantly from an established baseline, subject to natural change	according to local conditions. There are 6 sub-communities of SM16 within Solway.
	Low marsh and low-mid marsh communities	Species composition of characteristic saltmarsh communities: 1. Transitional low marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Suaeda maritima* SM10. 2. *Puccinellia maritima* saltmarsh (SM13). There are 3 sub-communities of SM13 within the Solway (identified in Appendix 2).	Frequency and abundance characteristic species, measured once per reporting cycle: 1. *Puccinellia maritima*, annual *Salicornia* species and *Suaeda maritima*. 2. *P. maritima* with *Triglochin maritima, Plantago maritima, Armeria maritima*.	Frequency and abundance of characteristic species should not deviate significantly from an established baseline (Chapelcross 1993 survey), subject to natural change	1. Tends to be species -poor, with the three main species often co-dominant. Cover of vegetation can be quite variable and may have up to 50% cover of an algal mat. Grazing can affect stands by selective removal of some species and causing reduction in structural diversity. 2. Most widespread type of saltmarsh vegetation. Grazing determines species composition and type of sub-community and structural variation. Can often develop after damage, turf-cutting etc. Community type leads into mid-upper marsh.
***Salicornia* and other annuals colonising mud and sand**		Extent	Total area (ha..), measured once per reporting period.	No decrease in extent from an established baseline (1997 aerial photo baseline), subject to natural change.	*Salicornia* is largely absent from Scottish estuaries, is at its northern limit of distribution.
***Salicornia* and other annuals colonising mud**		Creek morphology	Density and morphology measured periodically during reporting cycle	No significant alteration of creek patterns from an established baseline,	Creeks absorb tidal energy and assist with the delivery of sediment into saltmarshes. The efficiency of this process depends on creek pattern.

Feature	Sub-feature	Attribute	Measure	Target	Comments
and sand			(frequency to be determined).	subject to natural change.	Density is controlled by vegetation cover, suspended sediment load and tidal influence. Creeks allow pioneer vegetation to be established along their banks higher into the saltmarsh system.
		Sediment character	Sediment grain size	Sediment character should not deviate significantly from an established baseline (Cutts and Hemingway 1996), subject to natural change.	Currently the site is thought to be in equilibrium, with sediment flow from the mudflats and sandflats to pioneer marsh to saltmarsh. Alterations in these processes may result in changes to sedimentation rates and saltmarsh vegetation.
	Annual Glasswort (*Salicornia* saltmarsh SM8)	Species composition of characteristic saltmarsh communities. .	Frequency and abundance characteristic species, measured (Frequency to be determined).	Frequency and abundance characteristic species should not deviate significantly form an established baseline, subject to natural change.	These communities are important precursors to more stable vegetation of low to mid marsh.
		Extent of algal mats	Area and thickness of algal mat, measured during the summer, periodically (frequency to be determined).	No increase in extent of algal mats from an established baseline, subject to natural change.	Algal mats are often associated with the pioneer saltmarsh 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. A long-term presence of a dense mat may impact on other vegetation.
Mudflats and sandflats not covered by seawater at low		Extent	Area (ha..), measured periodically (frequency to be determined).	No decrease in extent from an established baseline (aerial photos 1997), subject to natural change.	Extent is an attribute on which reporting is required by the Habitats Directive. For dynamic coastlines fluctuations may be great, but are attributable to natural coastal processes. An equilibrium should

Feature	Sub-feature	Attribute	Measure	Target	Comments
tide					be maintained between mudflat, pioneer saltmarsh and saltmarsh habitats, as these are considered to be transitional communities.
		Sediment character	1. Sediment grain size. Particle size analysis. Parameters include % sand/silt/gravel, mean and median grain size and sorting co-efficient, used to characterise sediment type. 2. Sediment penetrability, degree of sinking	Average sediment parameters should not deviate significantly an established baseline the baseline (IECS 1996) 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. 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. % organic carbon from sediment sample	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.
Mudflats and sandflats not covered by seawater at low tide		Sediment character	4. Redox potential	Average black layer depth/ Eh should not increase in relation to 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.
		Topography	Tidal elevation and shore slope measured in the summer months	Tidal elevation and shore slope should not deviate significantly from an	The intertidal topography reflects the energy conditions and stability of the sediment, which is key to the structure of the feature. Topography is a

Feature	Sub-feature	Attribute	Measure	Target	Comments
			(frequency to be determined).	established baseline, subject to natural change.	major influence on the distribution of communities throughout the feature.
		Nutrient status – green algal mats	Area (ha..), measured annually.	No increase in extent from an established baseline, subject to natural change.	Nutrient status is a key functional factor that influences biota associated with sediments. Ephemeral green macroalgae indicate elevated nutrient levels which reduce the quality of the sediments and their communities, mainly through smothering and deoxygenation.
	Gravel and sand communities	Range of gravel and sand communities (identified in appendix 3).	Range of littoral gravel and sand biotopes, measured once during reporting cycle.	Range of littoral gravel and sand biotopes should not deviate significantly from an established baseline (Cutts & Hemingway 1996; Covey & Emblow 1992), subject to natural change.	The relative distribution of littoral gravel and sand communities is an important structural aspect of the feature. Changes in extent and distribution may indicate long term changes in the physical conditions at the site.
Mudflats and sandflats not covered by seawater at low tide	Sandy mud communities	Range of biotopes (identified in appendix 3).	Distribution of littoral sandy mud communities, measured once during reporting cycle.	Range of biotopes should not deviate significantly from an established baseline (Cutts & Hemingway 1996; Covey & Emblow 1992), subject to natural change.	The relative distribution of littoral sandy mud communities is an important structural aspect of the feature. Changes in extent and distribution may indicate long term changes in the physical conditions at the site.
		characteristic biotope – extent of lugworms, Baltic tellins and soft-shelled clams in muddy sand	Area (ha..), measured in the summer months, once during reporting cycle.	No decrease in extent from an established baseline (Covey and Emblow 1992) subject to natural change.	The extent of the biotope, lugworms, Baltic tellins and soft-shelled clams in muddy sand is a key structural component of the sediments, and is particularly important due to it being sensitive to disturbance.

Feature	Sub-feature	Attribute	Measure	Target	Comments
		Characteristic species – cockles *Cerastoderma edule*	Population size measure – age class/size structure, measured periodically (frequency to be determined).	Age class/size structure should not deviate significantly from an established baseline, subject to natural change.	The measure of cockles is of interest in its own right and is indicative of the structure of the following biotopes:- Polychaetes and *Cerastoderma edule* in fine sand and muddy sand shores, *Macoma balthica* and *Arenicola marina* in muddy sand shores and *Hediste diversicolor, Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores. Change in the species may indicate cyclic change/trend in the host biotope and sediment communities as a whole
Sandbanks which are slightly covered by seawater all the time		Extent	Area (ha..), measured periodically (frequency to be determined).	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. The extent of the estuaries will not change significantly over time unless due to some human activity but nevertheless needs to be measured periodically.
Sandbanks which are slightly covered by seawater all the time		Sediment character	Particle size analysis Parameters include %sand/silt/gravel, mean and median grain size and sorting coefficient used to characterise sediment type, measured during summer, once during reporting cycle.	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.
		Topography	Depth and distribution of sandbanks	Depth and distribution should not deviate significantly from the baseline, subject to natural change.	Depth and distribution of the sandbanks reflects the energy conditions and stability of the sediment, which is key to the structure of the feature. Depth of the feature is a major influence on the distribution of communities throughout.

Feature	Sub-feature	Attribute	Measure	Target	Comments
	Infralittoral gravel and sand communities	Range of biotopes (identified in appendix 3).	Distribution of infralittoral gravel and sand biotopes, measured once every reporting cycle.	No decrease in distribution of biotopes from an established baseline (Cutts and Hemingway 1996), subject to natural change.	The distribution of the infralittoral gravel and sand communities is an important structural aspect of the feature. Changes in extent and distribution may indicate long term changes in the physical conditions at the site. The presence and relative abundance of characterising species gives an indication of the quality of the biotopes and change in composition may indicate cyclic change/trend in subtidal sandbank communities.
Internationally important Annex 1 bird populations		Disturbance in roosting and feeding areas	Reduction or displacement of birds measured using 5 year peak mean information on populations.	No significant reduction in numbers or displacement of birds from an established baseline, subject to natural change.	Excessive disturbance can cause stress and result in reduced food intake and or/ increased energy expenditure.
	Saltmarsh	Extent	Area (ha..), to be measured once per reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Saltmarsh habitats provide important feeding and roosting areas for all qualifying Annex I species.
Internationally important Annex 1 bird populations	Saltmarsh	Vegetation structure	Range of sward heights measured periodically (frequency to be determined).	Range of sward heights should not deviate significantly from an established baseline, subject to natural change.	Sward height provides a suitable habitat for grazing birds, the vegetation being an important food source. Sward height should not exceed 10 cm for grazing birds. Grazing barnacle geese preferentially graze sward height between 2-3cm.
		Presence and abundance of food species	Presence and abundance of soft leafed grasses and herbs, 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.	Maintenance of the correct species as food availability is essential for the grazing birds. Characteristic food species include *Trifolium repens*, *Puccinellia maritima*, *Festuca rubra* and *Triglochin maritima*.
Internationally important Annex 1 bird populations	Intertidal mudflats and sandflats	Extent	Area (ha..), to be measured once per reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Intertidal mudflats and sandflats are important roosting areas.

Feature	Sub-feature	Attribute	Measure	Target	Comments
		Presence and abundance of prey species	Presence and abundance of prey species, measured periodically (frequency to be determined).	Presence and abundance of prey species should not deviate significantly from and established baseline, subject to natural change.	Maintenance of the correct species as food availability is essential for many species. Bivalve molluscs and marine worms are important prey species for qualifying birds.
Internationally important migratory waterfowl		Disturbance in roosting and feeding areas	Reduction or displacement of birds measured using 5 year peak mean information on populations.	No significant reduction in numbers or displacement of birds from an established baseline subject to natural change.	Excessive disturbance can cause stress and result in reduced food intake and or/ increased energy expenditure.
	Saltmarsh	Extent	Area (ha..), to be measured once per reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Saltmarsh habitats are important feeding and roosting grounds for a number of bird species.
Internationally important assemblage	Saltmarsh	Vegetation structure	Range of sward heights measured periodically (frequency to be determined).	Range of sward heights should not deviate significantly from and established baseline, subject to natural change.	Varying sward heights provide suitable habitats for grazing birds, the vegetation being an important food source. A diverse range of sward heights will also provide cover for birds taking refuge, as well as providing suitable nesting areas. Sward height should be tailored to suit a range of grazing birds. Varying heights are preferentially grazed by different species.
	Rocky scar grounds	Extent	Area (ha..), to be measured once per reporting cycle.	No decrease in extent from baseline, subject to natural change.	Rocky scar grounds are important feeding areas for a number of bird species.
		Presence and abundance of prey species	Presence and abundance of prey species, measured periodically (frequency to be determined).	Presence and abundance of prey species should not deviate significantly from an established baseline, subject to natural change	Rocky scar grounds are important feeding areas for a number of bird species.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important assemblage		Disturbance in roosting and feeding areas	Reduction or displacement of birds measured using 5 year peak mean information on populations.	No significant reduction in numbers or displacement of birds from an established baseline subject to natural change.	Excessive disturbance can cause stress and result in reduced food intake and or/ increased energy expenditure.
	Subtidal sandbanks	Extent	Area (ha..), to be measured once per reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Subtidal sandbanks are important feeding areas for diving birds.
		Presence and abundance of prey species	Presence and abundance of prey species measured periodically (frequency to be determined).	Presence and abundance of prey species should not deviate significantly from an established baseline, subject to natural change.	The abundance of these species are an important food source for diving birds. of fish, molluscs and worm

Note: Extreme events (such as storms reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Solway and may well be missed by routine monitoring.

7 Introduction to the advice on operations

This section includes information in support of the advice required under Regulation 33(2)(b).

English Nature and Scottish Natural Heritage have a duty under Regulation 33(2)(b) of the Conservation (Natural Habitats &c.) Regulations 1994 to advise other relevant authorities as to any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated. Information on how this advice has been developed is given in Section 7.2, and on how it may be reviewed and updated in the future, in Section 7.4.

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 Solway 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 a three step process has been used involving:

- an assessment of **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 an explanation of the reasoning behind the advice and identifies 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 Solway 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, saltmarshes are highly sensitive to coastal defences as these prevent their natural inward migration, in a phenomenon referred to as coastal squeeze.

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

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 to make it available to all on the World Wide Web (www.marlin.ac.uk).

7.2.2 Exposure assessment

This has been undertaken for the Solway European marine site by assessing the relative exposure of the interest or their component sub-features on the site to the effects of broad categories of human activities currently occurring on the site. For example some stretches of the site have a relatively high exposure to nutrient enrichment from diffuse land run off, in particular around Moricambe Bay on the Cumbrian coast, which drains areas of extensively farmed land.

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). For example a subtidal sandbank may be sensitive to abrasion by benthic fishing gear, but it may not be currently vulnerable within the Solway due to the limited benthic fishing taking place and existing management controls. 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 and Scotland to assess the effects of activities and identify priorities for management within their areas of responsibility; and
- is appropriately robust to take into account the development of novel activities or operations which may cause deterioration or disturbance to the interest features of the site and should have sufficient stability to need only infrequent review and updating by English Nature and Scottish Natural Heritage.

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' for 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 formally consult English Nature or Scottish Natural Heritage 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 and Scottish Natural Heritage know about current activities and patterns of usage at the Solway European marine site. It is expected 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 4) 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.

8 Advice on operations

This section is provided in compliance with Regulation 33(2)(b) of the Conservation (Natural Habitats &c.) Regulations 1994

8.1 Summary of advice on operations

8.1.1 Estuaries

In pursuit of the conservation objective for estuaries (Section 5.1), the relevant and competent authorities for the Solway 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:

- Physical loss through removal.
- Physical damage through siltation and/or abrasion and/or selective extraction.
- Increased synthetic and/or non-synthetic and/or radionuclide toxic contamination.
- Nutrient and/or organic enrichment.
- Biological disturbance through the introduction of non-native species and/or translocation.
- Biological disturbance through the selective extraction of species.

8.1.2 *Salicornia* and other annuals colonising mud and sand (Pioneer saltmarsh)

In pursuit of the conservation objective for pioneer saltmarsh and other annuals colonising mud and sand (Section 5.2) the relevant and competent authorities 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:

- Physical loss through removal.
- Physical damage through siltation and/or abrasion and/or selective extraction.
- Increased synthetic and/or non-synthetic and/or radionuclide toxic contamination.
- Nutrient and/or organic enrichment.
- Biological disturbance through the introduction of non-native species and/or translocation.
- Biological disturbance through the selective extraction of species.

8.1.3 Atlantic salt meadows (saltmarsh)

In pursuit of the conservation objective for Atlantic salt meadows (Section 5.3), the relevant and competent authorities 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:

- Physical loss through removal.
- Physical damage through abrasion.
- Increased synthetic and/or non-synthetic and/or radionuclide toxic contamination.
- Nutrient and/or organic enrichment.
- Biological disturbance through the introduction of non-native species and/or translocation.

8.1.4 Mudflats and sandflats not covered by seawater at low tide

In pursuit of the conservation objective for mudflats and sandflats not covered by seawater at low tide (Section 5.4), the relevant and competent authorities 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:

- Physical loss through removal.
- Physical damage through siltation and/or abrasion and/or selective extraction.
- Increased synthetic and/or non-synthetic and/or radionuclide toxic contamination.
- Nutrient and/or organic enrichment.
- Biological disturbance through the introduction of non-native species and/or translocation.
- Biological disturbance through the selective extraction of species.

8.1.5 Sandbanks which are slightly covered by seawater all the time

In pursuit of the conservation objective for sandbanks which are slightly covered by seawater all the time (Section 5.5), the relevant and competent authorities 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:

- Physical loss through removal.
- Physical damage through abrasion and/or siltation.
- Increased synthetic and/or non-synthetic and/or radionuclide toxic contamination.
- Nutrient and/or organic enrichment.

8.1.6 Internationally important populations of regularly occurring Annex 1 species

In pursuit of the conservation objective for habitats of nationally important populations of the regularly occurring Annex 1 species (Section 5.6), the relevant and competent authorities 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:

- Physical loss through removal.
- Physical damage through abrasion.
- Visual disturbance and/or disturbance by noise.
- Increased synthetic and/or non-synthetic toxic contamination.
- Biological disturbance through the introduction of non-native species and/or translocation and/or selective extraction of species.

8.1.7 Internationally important populations of regularly occurring migratory waterfowl

In pursuit of the conservation objective for habitats of, internationally important populations of regularly occurring migratory species (Section 5.6) the relevant and competent authorities are advised to manage human activities within their remit such that they do not result deterioration or disturbance to habitats or species for which the site has been selected through any of the following;

- Physical loss through removal.
- Physical damage through abrasion and/or selective extraction.
- Visual disturbance and/or disturbance by noise.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient enrichment.
- Biological disturbance through the introduction of non-native species and/or translocation and/or selective extraction of species.

8.1.8 Internationally important assemblages of waterfowl

In pursuit of the conservation objective for habitats that support an internationally important assemblage of waterfowl (Section 5.6), the relevant and competent authorities are advised to manage human activities within their remit such that they do not result deterioration or disturbance to habitats or species for which the site has been selected through any of the following;

- Physical loss through removal.
- Physical damage through abrasion and/or selective extraction.
- Visual disturbance and/or disturbance by noise.
- Increased synthetic and/or non-synthetic toxic contamination.
- Nutrient enrichment.
- Biological disturbance through the introduction of non-native species and/or translocation and/or selective extraction of species.

Table 2 showing operations which may cause deterioration or disturbance to the Solway European marine site interest features at current levels of use[8]

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

EN/SNH advice under Regulation 33(2), operations which may cause deterioration or disturbance		Interest feature							
Categories of operations	**Examples of current operations**	**Estuaries**	**Atlantic salt meadows**	**Pioneer saltmarsh**	**Intertidal mudflats and sandflats**	**Subtidal sandbanks**	**SPA Annex 1 species**	**SPA migratory wildfowl**	**SPA 20,000+ assemblage**
Physical loss									
Removal	Coastal Development (e.g. flood and sea defence, land claim) Aggregate extraction Maintenance dredging Suction dredging for shellfish Tractor dredging for shellfish Shrimp trawling	☯	☯	☯	☯	☯	☯	☯	☯
Smothering	Disposal of dredged material								
Physical damage									
Siltation	Maintenance dredging Suction dredging for shellfish Tractor dredging for shellfish	☯		☯	☯	☯			
Abrasion	Mobile benthic fishing Tractor dredging for shellfish Anchoring Coastal Development (e.g. flood and sea defence, land claim) Recreational activities Mussel harvesting	☯	☯	☯	☯	☯	☯	☯	☯
Selective extraction	Aggregate extraction	☯		☯	☯			☯	☯

EN/SNH advice under Regulation 33(2), operations which may cause deterioration or disturbance		Interest feature							
Categories of operations	**Examples of current operations**	**Estuaries**	**Atlantic salt meadows**	**Pioneer saltmarsh**	**Intertidal mudflats and sandflats**	**Subtidal sandbanks**	**SPA Annex 1 species**	**SPA migratory wildfowl**	**SPA 20,000+ assemblage**
Non-physical disturbance									
Noise	Wildfowling Low flying aircraft Jet skiing						☰	☰	☰
Visual	Recreational activities (e.g. boating, bird watching, dog walking) Bait collection , cockle harvesting						☰	☰	☰
Toxic contamination									
Introduction of synthetic compounds	Industrial effluent discharges	☰	☰	☰	☰	☰	☰	☰	☰
Introduction of non-synthetic compounds	Industrial and sewage effluent discharges	☰	☰	☰	☰	☰	☰	☰	☰
Introduction of radionuclides	Power station discharges (e.g. Chaplecross, Selafield)	☰	☰	☰	☰	☰	☰	☰	☰
Non-toxic contamination									
Nutrient enrichment	Industrial and sewage effluent discharges Agricultural run-off	☰	☰	☰	☰	☰	☰	☰	☰
Organic enrichment	Industrial and sewage effluent discharges Localised organic enrichment (e.g. animal dung)	☰	☰	☰	☰	☰	☰	☰	☰
Change in thermal regime	Discharge of warm water (e.g. from a power station, such as Chaplecross)								
Changes in turbidity	Suction or tractor dredging								
Changes in salinity	Water abstraction from inflowing rivers								

EN/SNH advice under Regulation 33(2), operations which may cause deterioration or disturbance		Interest feature							
Categories of operations	**Examples of current operations**	**Estuaries**	**Atlantic salt meadows**	**Pioneer saltmarsh**	**Intertidal mudflats and sandflats**	**Subtidal sandbanks**	**SPA Annex 1 species**	**SPA migratory wildfowl**	**SPA 20,000+ assemblage**
Biological disturbance									
Introduction of microbial pathogens	Industrial and effluent sewage discharges								
Introduction of non-native species	Introduction of *Spartina anglica*	▤	▤	▤	▤		▤	▤	▤
Selective extraction of species	Bait collection (e.g. ragworm, lugworm, peeler crab) Mussel harvesting Cockle harvesting Shrimp trawling	▤		▤	▤		▤	▤	▤

[8]This advice has been developed using best available scientific information and informed scientific interpretation and judgement (as at September 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 in Table 3. 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 and Scottish Natural Heritage 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 September 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.

8.2 Interest feature and sub-feature specific advice on operations

This section includes information in support of the advice required under Regulation 33(2)(b).

This advice relates to the vulnerability of the interest features and sub-features of the Solway European marine site to current levels of human usage as summarised in Table 3 and detailed in Table 4. Further explanation of the sensitivity of the interest features or sub-features follows with examples of their exposure and therefore their vulnerability to damage or disturbance from the listed categories of operations. This enables links between the categories of operation and the ecological requirements of the European marine site's interest features, as set out in Section 3, to be made.

8.2.1 Estuaries

i) Physical loss

- The Solway Firth estuarine complex is characterised by its size, naturalness, extent and variety of habitats, including nationally important species and communities. The loss of this estuarine habitat, or parts of it, would be detrimental to favourable condition.

- All the sub-features of the estuary are sensitive to removal and most are sensitive to smothering. Due to coastal development, pioneer saltmarsh and Atlantic salt meadows are particularly vulnerable to removal. Activities such as these have effects which may also impact upon the intertidal mudflats and sandflats, subtidal sediments and rocky scar ground.

- The Solway estuarine complex is reliant on sustaining its morphological equilibrium through maintaining its sediment budget. Removal or smothering of sediment will cause loss of marine communities, which will consequently effect the composition and distribution of estuarine habitats.

ii) Physical damage

- Most estuarine communities are relatively tolerant of the naturally turbid or silty conditions that occur in estuaries. This is also true of the Solway although, unusually, it has a lower silt composition and a higher fine sand content. Changes in the grain size of intertidal and subtidal sediments, caused by an increased input of fine material, can alter their community composition. Modification of the natural sedimentation patterns can impact upon the condition of the estuary. Although the risk of siltation from ongoing activities are low, the intertidal mudflats and sandflats, subtidal sandbanks, pioneer saltmarsh and scar ground communities are considered to be sensitive to siltation. Should activities which cause siltation increase in scale a higher vulnerability rating may be required.

- All estuarine habitats and communities can be physically damaged through abrasion. Rocky scar ground communities are particularly sensitive and vulnerable to abrasion caused by the turning over of rocks during the collection of ragworms for fishing bait. Ragworm collection does occur on the Solway, but not on very regular basis, sensitivity is therefore high and vulnerability is only considered moderate because of its infrequent occurrence. Other abrasive activities include raking for mussels.

- The selective extraction of part of an interest feature such as the removal of worms for bait from intertidal mudflats and sandflats and particularly intertidal scar grounds may alter its ecology, affecting not only the biological composition of the sediments but also having implications on the food supply of birds. Bait digging for both lugworms and ragworms occurs on the site. Intertidal mudflats and sandflats and intertidal scar grounds are therefore considered moderately vulnerable to the effects of this activity.

iii) Toxic contamination

- All the sub-features of the estuary are considered both highly sensitive and potentially vulnerable to the effects of toxic contamination. This is because industrial and sewage effluent discharges, for example, introduce synthetic and non-synthetic compounds into the Solway, to which many of the communities or species of the estuarine habitats are sensitive.

- Synthetic and non-synthetic compounds and radionuclides can bioaccumulate and bioconcentrate in biological systems, building up in the food chain and becoming available to higher predators in potentially lethal dosages. Heavy metals in particular, which are introduced into the estuary through sewage and industrial effluent discharges and from antifouling paints on vessels, may have a range of effects on many different animal and plant species. Their toxic effects on infaunal invertebrates, rocky scar communities and accumulation in saltmarsh grasses are of greatest concern.

- All estuarine sub-features within the Solway, particularly Atlantic salt meadows and pioneer saltmarsh, are considered sensitive to oil. The toxic and smothering effects of oil are well documented and particular attention should be given to both diffuse and point sources of oil within the estuary.

iv) Non-toxic contamination

- A significant increase in nutrients (e.g. phosphates and nitrates) as a result of effluent discharges or agricultural run-off may alter the diversity of communities living within the estuary. Some species, such as certain ephemeral green algae, thrive in response to increased nutrients, often at the expense of other species. As a consequence, ecological communities may be altered.

- Similarly, an excessive increase in the organic loading of, for example intertidal sediments, can affect the infaunal community structure. Discharge of effluent, particularly of domestic sewage, is a notable source of organic enrichment within the estuary.

- Activities which result in an input of non-toxic contaminants (from diffuse or point sources) that significantly alter the physical and chemical regime (e.g. salinity profile or temperature) of the water or sediment within the estuary, have the potential to cause damage to sensitive communities or species within the site. This would therefore be detrimental to favourable condition of the estuary interest feature.

v) Biological disturbance

- Biological disturbance can occur through the selective extraction of species from the estuary, or through the introduction or translocation of non-native species to the estuary. Both these processes can result in an altered community structure. Saltmarsh communities and intertidal mud and sand are particularly sensitive to the introduction of cord grass *Spartina anglica* which has been known to quickly change the structure of the existing saltmarsh and intertidal sand and mud. Currently the extent of cord grass throughout the site is low.

- Similarly, the removal of certain marine animals such as peeler crabs, lugworms and ragworms, through bait collection, may affect the ecological balance of the marine communities. Scar grounds are especially sensitive to the removal of important elements of the community such as ragworms. This practice may cause biological disturbance through removing a key predator of other marine invertebrates, and key food source for other estuarine predators such as fish and birds. Importantly, scar grounds have very long recovery periods from biological disturbance.

8.2.2 Pioneer Saltmarsh

i) Physical loss

- Pioneer saltmarsh is sensitive to removal and/or smothering. Activities, such as coastal development, occur on the site in the vicinity of pioneer saltmarsh and may result in the loss of this interest feature. It is therefore considered vulnerable to their effects.

ii) Physical damage

- Pioneer saltmarsh, which is composed of annual species, may suffer physical damage through the abrasive effects of activities including certain fishing techniques such as bait collection. These uproot *Salicornia* spp. plants and destabilise the mudflats on which they grow. A change in siltation patterns can also effect the formation (or otherwise) of pioneer saltmarsh.

iii) Toxic contamination

- Pioneer saltmarshes are sensitive to toxic contaminants which, for example, have direct and/or indirect effects on the plant and animal communities which live within them. *Salicornia* spp. can bioaccumulate contaminants which can have effects on other species that use this plant.

iv) Biological disturbance

- The invasive cord grass *Spartina anglica* can significantly impact upon pioneer marshes through direct competition. Currently the extent and distribution of cord grass is low, therefore, vulnerability to this effect is considered to be low. However, should there be a significant spread of this species then it is likely that the vulnerability rating would rise.

8.2.3 Saltmarsh

i) Physical loss

- All the sub-features of saltmarsh are considered both sensitive and vulnerable to physical loss by removal. The saltmarsh sub-features form a closely interrelated transition and removal of any one or more of the sub-features will affect the overall community structure of the interest feature. For example, land claim, may result in removal of saltmarsh. Man-made physical barriers, such as seawalls prevent the inland migration of marshes, in relation to sea level rise.

ii) Physical damage

- Saltmarshes, most of which are grazed throughout the year, are vulnerable to undergrazing, overgrazing and poaching which all can affect saltmarsh diversity and structure.

- Recreational activities on saltmarsh, such as the use of four wheel drive vehicles, can physically damage its structure, for example by compaction. It can often take long periods of time to recover from the impacts of such activities, with furrows remaining visible for years after the event.

iii) Toxic contamination

- Saltmarshes are sensitive to toxic contaminants which can have direct and/or indirect effects on the plant and animal communities which live within them. Saltmarsh plants can bioaccumulate contaminants which have effects on other species that use them.

iv) Biological disturbance

- The invasive cord grass *Spartina anglica* can significantly impact upon lower- and mid-saltmarsh communities through direct competition. Due to current low levels of exposure, vulnerability to this effect is considered to be low.

8.2.4 Mudflats and sandflats not covered by seawater at low tide

i) Physical loss

- Intertidal mudflats and sandflats are particularly vulnerable to coastal developments such as flood and coast defence works and land claim. Aggregate extraction occurring on the site can result in the removal of this habitat. Loss of these intertidal habitats, which are themselves natural sea defences and which contribute significantly to the reduction of tidal and wave energy within the estuary, may result in a deterioration of the condition of other interest features on the site. Currently aggregate extraction at the site is occurring at a low level.

ii) Physical damage

- Activities that result in abrasion such as dredging, hand gathering of cockles using rakes and digging for bait, can cause the destabilisation of the sediment which may increase erosion rates. This may alter the structure and function (both physically and biologically) of any sub-features of the flats and ultimately could lead to loss of the interest feature.

iii) Toxic contamination

- All the sub-features of mudflats and sandflats are considered vulnerable to the introduction of synthetic and non-synthetic compounds. Such compounds can have both lethal and sub-lethal toxic effects on marine species, and may alter their species diversity and composition within the sediment. Larval stages of invertebrates are in many cases more sensitive than the adults. Sub-lethal effects are more difficult to observe and assess but often can be as detrimental as lethal effects.

iv) Non-toxic contamination

- Within the Solway estuary complex, the habitats considered to be at greatest threat from non-toxic contamination are the intertidal mudflats and sandflats and are consequently given a moderate sensitivity. The effects of agricultural run-off and domestic sewage can locally lower oxygen levels, making the flats anoxic. Many infaunal communities require a good supply of oxygen whilst some estuarine species are more tolerant of eutrophication and organic enrichment and thrive in such conditions. The consequence of this is an alteration of community composition.

- Localised eutrophication can also result in increased volumes of ephemeral algae and areas covered by algal mats. Algal mats, amongst others, are responsible for suppressing the aeration of burrowing worm and bivalve tunnels and as a consequence, species requiring better ventilation may be disadvantaged and the community structure may change.

- Intertidal sediments can act as sinks for nutrients, metals and radionuclides. If disturbed, these can be released into the water column and become available for uptake by animals and plants. This may be an area of concern with activities such as suction dredging.

v) Biological disturbance

- The removal of particular species or groups of species from the intertidal sediments occurs on the site through activities such as bait digging, albeit at a relatively low level. Targeting different species can have a variety of effects on the habitats. Characteristic species of the interest feature such as lugworms and peeler crabs (collected at specific times of the year) play an important and complex role in the functioning of the ecology of the intertidal flats. Each of these species also occurs in different parts of the habitat, which may be disturbed through the collection process.

- The introduction of the invasive cord grass *Spartina anglica* can significantly impact upon mudflats as it is an aggressive pioneer marsh species, changing the sediment structure as it stabilises it with its roots, which subsequently alters the infaunal community of the flats. It is a recognised problem in many parts of the UK, although it is not a major issue for the Solway.

8.2.5 Subtidal sandbanks

i) Physical loss

- Within the estuary subtidal sandbanks may be lost as a result of aggregate extraction, coastal defences and certain fishing methods. As previously mentioned, within an estuary system the maintenance of the sediment budget and balance is vital to ensuring site integrity. Subtidal sandbanks act as important sources of sediment to the other habitats, removal or loss of these may have knock on affects elsewhere in the site. Currently the scale of such activities is low. Therefore a vulnerability rating of moderate has been given. Should the scale or intensity of these activities increase the vulnerability rating may rise to high.

ii) Physical damage

- Subtidal sandbanks may be damaged as a direct result of aggregate extraction and possibly as an indirect result of construction of coastal defences or certain fishing methods. Subtidal sandbanks are important sources of sediments and are an integral part of the estuary sediment budget and their loss may have significant knock-on effects elsewhere. The current scale of relevant activities is low and therefore the vulnerability rating has been determined as moderate. Should the scale or intensity of these activities increase, the vulnerability rating may rise to high.

iii) Toxic contamination

- Subtidal sediments are sensitive to toxic contaminants for the reasons given for intertidal sediments previously (see Section 7.6.4).

iv) Non-toxic contamination

- As with intertidal mudflats and sandflats, organic matter can accumulate in subtidal sediments, reducing the oxygen content and altering the community structure and species diversity.

8.2.6 Special Protection Area interests

i) Physical loss

- Birds rely on intertidal sediments, rocky scars and saltmarshes for feeding and roosting. Loss of these habitats through removal or smothering will be detrimental to their condition. Examples of activities which occur on the site, that may lead to loss of habitat include dredged spoil disposal, land claim and aggregate extraction. Currently exposure levels of all these activities is low.

ii) Physical damage

- Habitats within the Solway which support SPA interests such as the saltmarsh, intertidal sediments and rocky scars, are particularly sensitive to those types of physical damage which reduce food availability to the birds, or change the suitability of habitats for roosting or feeding.

- Waterfowl also have the potential to become entangled in litter or debris. At current exposure levels however, vulnerability to this threat appears to be low.

iii) Non-physical disturbance

- Waterfowl are sensitive to both visual and noise disturbance, which can have the effect of displacing them from their roosting, feeding or breeding grounds. Birds affected by these types of disturbance may move to an alternative and perhaps less favourable site, or increase their energy expenditure through flight. These sort of responses, affect the birds' energy budgets and thus their survival and possible reproductive success. Overwintering waterfowl are birds which migrate often large distances and are particularly sensitive to disturbance.

iv) Toxic contamination

- There is documentary evidence of the effects of bioaccumulation of toxic compounds in birds, from heavy metals. Effects of such toxic compounds are variable, but include reductions in breeding success and in extreme cases mortality of individuals e.g. waterfowl which accumulate lead shot in their gizzards. There is little history of heavy industry or mining within the site, which may have been sources of many of these toxic compounds, but potential issues may arise from their impact from diffuse and off-site sources. Given the potentially high sensitivity of birds to the effects of toxic substances there may be need for further information upon which to base any future monitoring.

v) Non-toxic contamination

- Nutrient and/or organic enrichment can affect habitats important to birds, such as intertidal sediments and rocky scars, for the reasons previously mentioned. This can particularly affect birds by reducing the availability of their food source by, for example, increasing growth of algal mats on the intertidal mud flats. This can reduce the numbers of invertebrates on which they feed as well as the diversity of their food supply. Similarly, contamination by substances such as oil can reduce the quality of a habitat for feeding or roosting.

vi) Biological disturbance

- Selective extraction of certain species from a habitat necessary to support birds, can affect its community structure and function. The ability of that habitat to continue to support those birds can be therefore reduced. An example of this would be the selective extraction of ragworms for fishing bait. The ecological implications of removing this species from the food web may be great.

- Similarly, the introduction of the invasive cord grass *Spartina anglica* can significantly impact upon the ecology of mudflats. The ability of the mudflats to support bird species may therefore be compromised.

Table 3 Assessment of the relative vulnerability of interest features and sub-features 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. The table also incorporates relative sensitivity scores used in part to derive vulnerability

The vulnerability and sensitivity ratings identified in the table relate the interest features and their sub-features to the **categories of operations which may cause deterioration or disturbance.** For example, saltmarsh, pioneer saltmarsh, intertidal mud and sand and intertidal scar ground are all considered to be highly sensitive and vulnerable to the process of physical loss through removal. The markings given do not specifically relate to individual examples of operations identified.

Relative vulnerability of the feature or sub-feature

High Vulnerability

Moderate vulnerability

Relative sensitivity of the feature or sub-feature

●●●● High sensitivity
●●● Moderate sensitivity
●● Low sensitivity
● No detectable sensitivity

Categories of operation which may cause deterioration or disturbance	Examples of current operations*	Estuaries Including Annex I habitats and other sub-features								
		Atlantic salt meadows (saltmarsh)		Pioneer saltmarsh	Intertidal mudflats and sandflats			Subtidal sandbanks	Rocky scar ground	
		Mid and low marsh communities	Upper marsh communities	*Salicornia* spp. communities	Muddy sand communities	Sandy mud communities	Gravel and sand communities	Infralittoral gravel and sand biotopes	Intertidal scar	Subtidal scar
Physical loss										
Removal	Coastal development (e.g. flood and sea defence, land claim) Aggregate extraction Maintenance dredging Tractor dredging for shellfish Suction dredging for shellfish Shrimp trawling	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●	●●●
Smothering	Disposal of dredged spoil	●●●	●●●	●●●	●●●	●●●	●●	●●	●●●	●●●

* This is not a comprehensive list of activities taking place on the site. It is a list of examples to help identify similar activities which may cause harm

Categories of operation which may cause deterioration or disturbance	Examples of current operations*	Estuaries Including Annex I habitats and other sub-features								
		Atlantic salt meadows (saltmarsh)		Pioneer saltmarsh	Intertidal mudflats and sandflats			Subtidal sandbanks	Rocky scar ground	
		Mid and low marsh communities	Upper marsh communities	*Salicornia* communities	Muddy sand communities	Sandy mud communities	Gravel and sand communities	Infralittoral gravel and sand biotopes	Intertidal scar	Subtidal scar
Physical damage										
Siltation	Maintenance dredging Suction dredging for shellfish Tractor dredging for shellfish	●●	●●	●●	●●●	●●●	●●●	●●●	●●●	●●●
Abrasion	Mobile benthic fishing Anchoring Recreational activities Mussel harvesting Grazing Livestock trampling	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
Selective extraction	Aggregate extraction Bait collection (e.g.lugworms, ragworms or peeler crabs)	●●	●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
Non- physical disturbance										
Noise	Wildfowling Recreational activities (e.g. off-road vehicles, jet skis) Low flying aircraft	●	●	●	●	●	●	●	●	●
Visual	Recreational activities (e.g. boating, windsurfing) Recreational activities (e.g. dog walking, bird watching, bait collection)	●	●	●	●	●	●	●	●	●

* This is not a comprehensive list of activities taking place on the site. It is a list of examples to help identify similar activities which may cause harm

Categories of operation which may cause deterioration or disturbance	Examples of current operations*	Estuaries- Including Annex I habitats and other sub-features								
		Atlantic salt meadows (saltmarsh)		Pioneer Saltmarsh	Intertidal mud and sand			Subtidal sandbanks	Rocky scar ground	
		Mid and low marsh communities	Upper marsh communities	*Salicornia* communities	Muddy sand communities	Sandy mud communities	Gravel and sand communities	Infralittoral gravel and sand biotopes	Intertidal scar	Subtidal scar
Toxic contamination										
Introduction of synthetic compounds	Industrial effluent discharges	●●●	●●●	●●●	●●●	●●●	●●●●	●●●	●●●	●●●
Introduction of non-synthetic compounds	Industrial and sewage effluent discharges	●●●	●●●	●●●	●●●	●●●	●●●	●●	●●●	●●●
Introduction of radionuclides	Power station discharges	●●	●●	●●	●●	●●	●●	●●	●	●
Non- toxic contamination										
Nutrient enrichment	Industrial and sewage effluent discharges Agricultural run off	●●	●●	●●	●●●	●●●	●●●	●●	●●	●●
Organic enrichment	Untreated effluent discharge Localised organic enrichment (e.g. animal dung)	●●	●●	●●	●●●	●●●	●●●	●●●	●●	●●
Change in thermal regime	Discharges of warm water (e.g. from a power station)	●●	●●	●●	●●●	●●●	●●●	●●●	●●●	●●●
Changes in turbidity	Suction or tractor dredging	●●	●	●●	●●	●●	●●	●	●●	●●
Changes in salinity	Water abstraction from inflowing rivers	●	●	●	●●	●●	●●	●●	●	●

* This is not a comprehensive list of activities taking place on the site. It is a list of examples to help identify similar activities which may cause harm

Categories of operation which may cause deterioration or disturbance	Examples of current operations*	Estuaries Including Annex I habitats and other sub-features								
		Atlantic salt meadows (saltmarsh)		Pioneer Saltmarsh	Intertidal mud and sand			Subtidal sandbanks	Rocky scar ground	
		Mid and low marsh communities	Upper marsh communities	*Salicornia* communities	Muddy sand communities	Sandy mud communities	Gravel and sand communities	Infralittoral gravel and sand biotopes	Intertidal scar	Subtidal scar
Biological disturbance										
Introduction of microbial pathogens	Industrial and sewage effluent discharges	●	●	●	●	●	●	●	●	●
Introduction of non-native species and translocation	Introduction of *Spartina anglica*	●●●	●●	●●●●	●●●	●●●	●●	●●	●●	●●
Selective extraction of species	Bait collection (e.g. lugworms) Bait collection (e.g. ragworms) Bait collection (e.g. peeler crabs) Cockle harvesting Shrimp trawling Hand gathering shellfish	●	●	●●●	●●●	●●●	●●●	●●●	●●●	●●●

* This is not a comprehensive list of activities taking place on the site. It is a list of examples to act as a trigger in identifying similar activities which may impact upon the integrity of the site.

Categories of operation which may cause deterioration or disturbance	Examples of current operations*	SPA interest features				
		Annex 1 populations		Internationally important populations of migratory waterfowl and an important assemblage		
		Saltmarsh	Intertidal mudflats and sandflats	Saltmarsh	Intertidal mudflats and sandflats	Rocky scar ground
Physical loss						
Removal	Coastal development (e.g. flood and sea defence, land claim) Aggregate extraction Maintenance dredging Tractor dredging for shellfish Suction dredging for shellfish Shrimp trawling	●●●●	●●●●	●●●●	●●●●	●●●●
Smothering	Disposal of dredge spoil	●●●	●●●	●●●	●●●	●●●
Physical damage						
Siltation	Maintenance dredging Suction dredging Tractor dredging	●●	●●	●●	●●	●●
Abrasion	Mobile benthic fishing Tractor dredging Anchoring Recreational activities Mussel harvesting Grazing Livestock trampling	●●	●●●	●●	●●●	●●●
Selective extraction	Aggregate extraction Bait collection (e.g. lugworms) Bait collection (e.g. ragworms)	●●	●●	●●	●●	●●●

Categories of operation which may cause deterioration or disturbance	Examples of current operations*	SPA interest features				
		Annex 1 populations		Internationally important populations of migratory waterfowl and an important assemblage		
		Saltmarsh	Intertidal mudflats and sandflats	Saltmarsh	Intertidal mudflats and sandflats	Rocky scar ground
Non- physical disturbance						
Noise	Wildfowling Recreational activities (e.g. off-road vehicles, jet skis) Low flying aircraft	●●●●	●●●●	●●●●	●●●●	●●●●
Visual	Recreational activities (e.g. boating, windsurfing) Recreational activities (e.g. dog walking, bird watching, bait collection)	●●●●	●●●●	●●●●	●●●●	●●●●
Toxic contamination						
Introduction of synthetic compounds	Industrial effluent discharges	●●●	●●●	●●●	●●●	●●●
Introduction of non-synthetic compounds	Effluent and sewage discharges containing heavy metals	●●●	●●●	●●●	●●●	●●●
Introduction of radionuclides	Power station discharges	●●	●●	●●	●●	●●
Non- toxic contamination						
Nutrient enrichment	Effluent and sewage discharge Agricultural effluents / run off	●●●●	●●●●	●●●●	●●●●	●●●●
Organic enrichment	Untreated effluent discharge Localised organic enrichment (e.g. animal dung)	●●	●●●	●●	●●●	●●●
Change in thermal regime	Discharge of warm water (e.g. from a power station)	●	●	●	●	●●
Change in turbidity	Suction or tractor dredging	●	●	●	●	●
Change in salinity	Water abstraction from inflowing rivers	●	●●	●	●●	●

		SPA interest features				
Categories of operation which may cause deterioration or disturbance	**Examples of current operations***	**Annex 1 populations**		**Internationally important populations of migratory waterfowl and an important assemblage**		
		Saltmarsh	Intertidal mudflats and sandflats	Saltmarsh	Intertidal mudflats and sandflats	Rocky scar ground
Biological disturbance						
Introduction of microbial pathogens	industrial and sewage effluent discharges	●	●●	●	●●	●●
Introduction of non-native species	Introduction of *Spartina anglica*	●●●	●●●	●●	●●●	●●●
Selective extraction of species	Bait digging for lugworms Bait digging for ragworms Bait digging for peeler crabs Cockle harvesting Shrimp trawling Hand gathering shellfish	●●●	●●●	●●●	●●●	●●●

English Nature's and Scottish Natural Heritage'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 September 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.

* This is not a comprehensive list of activities taking place on the site. It is a list of examples to act as a trigger in identifying similar activities which may impact upon the integrity of the site.

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10 Glossary

Abiotic	Non biological, physical parameters and/or influences.
Annex I habitats	A natural habitat(s) listed in Annex 1 of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex II Species	A species listed in Annex II of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex IV Species	A species listed in Annex IV of the Habitats Directive in need of strict protection.
Assemblage	A collection of plants and/or animals characteristically associated with a particular environment.
Attribute	Characteristic of an interest feature/sub-feature which provides an indication of the condition of the interest feature or sub-feature to which it applies.
BAP	Biodiversity Action Plan.
Benthos	Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides.
Biodiversity	The total variety of life in earth. This includes diversity within species, between species and of ecosystems.
Biogeographical transitions	The gradual change in community composition due to geographical influences.
Biotope	The physical habitat with its biological community; a term which refers to the combination of physical environment and its distinctive assemblage of conspicuous species.
Characteristic	Special to or especially abundant in a particular situation or biotope. Characteristic species should be immediately conspicuous and easily identified.
Circalittoral	The rocky subtidal zone below that dominated by algae (animal dominated subtidal zone).
Community	A group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and identifiable by means of ecological survey from other groups.
Competent authority	Any minister, government department, public or statutory undertaker, public body or person holding a public office that exercises legal powers (see also relevant authority).
Conservation objective	A statement of the nature conservation aspirations for the 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.
Eulittoral	The main part of the intertidal zone characterised by limpets, barnacle, mussels, fucoid algae and with red algae often on the lower part.
European marine site	A European site (SAC or SPA) which consists of, or in so far as it consists of, marine areas.
Favourable Condition	A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function within an individual Natura 2000 site in the long term. The condition in which the habitat or species is capable of sustaining itself on a long term basis.
Favourable conservation status	A range of conditions for a natural habitat or species at which the sum of influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function through the EC in the long term. The condition in which the habitats or species is capable of

	sustaining itself on a long term basis.
Flocculation	The action of clay particles sticking together in saline conditions, effectively increasing particle size, encouraging settlement.
Fluvial	Produced by rivers, fluvial sediments are bought into the system by rivers.
GIS	Geographical Information systems. A system for capturing, storing, checking, integrating, manipulating analysing and displaying digital data which are spatially referenced to a geographical region.
Geomorphology	The study of the form of the earth's crust and the processes which shape the physical features of the earth's surface. In estuarine terms this means the form and function of the estuary and its inter-relationship with processes elsewhere.
Habitat	The place in which an animal or plant 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.
Halophyte	A plant which is adapted to life in saline conditions.
Infralittoral	The subtidal zone in which upward facing rocks are dominated by erect algae, typically kelps.
Integrity	The coherence of the sites' ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or levels of populations of the species for which it was classified.
Interest Feature	A natural or semi-natural feature for which a European site has been selected. This includes the Habitats Directive Annex 1 habitat, or specific component of their fauna and flora, or any Annex II species and any population of bird species for which an 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 1 habitat are also considered to be interest features.
Isostatic uplift	The upwards movement of land in relation to the sea.
Littoral	The margins of a body of water, an area which is occasionally washed by the tide.
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.
NVC	National Vegetation Classification - a classification system for plant communities to provide standardised descriptions of names and systematically arranged vegetation types from all natural, semi-natural and major artificial habitats in England, Scotland and Wales, using a standard methodology.
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.

Plan or project	In general, any operation which requires an application to be made for specific statutory consent, authorisation, licence or other permission. Specifically, any proposed development that is within a relevant authority's function to control, or over which a competent authority has a statutory function to decide on applications for consents, authorisations, licences or permissions.
Ramsar site	A site held on the list of wetlands of international importance, especially as habitats for wildfowl, under the Ramsar convention.
Relevant authority	The specific competent authority which has powers or functions which have, or could have, an impact on the marine environment within or adjacent to a European marine site.
Restore	The action required for an interest when it is not considered to be in a favourable condition.
Saltmarsh terrace	Terraces formed during rapid stages of salt marsh development and isostatic uplift of land.
Saltpan	A hollow within saltmarsh once filled with water which has evaporated, leaving behind a saltpan.
Sediment budget	Sediment within the system, being imported or lost.
Sensitivity	The intolerance of a habitat, community or individual of a species to damage from an external factor.
Special Area of Conservation (SAC)	An area designated under the European Habitats Directive 92/43/EEC.
Special Protection Area (SPA)	An area designated under the European Birds Directive 79/409/EEC.
Sublittoral	An area constantly covered by the sea.
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.

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			
		High (3)	**Medium (2)**	**Low (1)**	**None detectable (0)**
Relative exposure of the interest feature	**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 NVC saltmarsh communities, sub-communities, transitional grassland communities of the Solway

SM8	Annual *Salicornia* salt-marsh
SM10	Transitional low marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Suaeda maritima*
SM13	*Puccinellia maritima* saltmarsh
SM13-1	*Puccinellia maritima* saltmarsh, sub community *Puccinellia maritima*
SM13-4	*Puccinellia maritima* saltmarsh, sub-community *Plantago maritima - Armeria maritima*
SM16	*Festuca rubra* saltmarsh
SM18	*Juncus maritimus* saltmarsh
SM18-2	*Juncus maritimus* saltmarsh, Sub-community *Oneathe lachenalu*
SM28	*Elymus repens*, strandline community
MG9	*Holcus lanatus-Juncus effusus* rush pasture
MG10	Mesotrophic grassland *Holco-Juncetum effusi*
MG11-1	*Festuca rubra-Agrostis stolonifera-Potentilla anserina* Inundation grassland, Sub-community *Lolium perenne*

APPENDIX III MNCR 97.06 BIOTOPES

MNCR code 97.06,	Description	Previous codes	IECS Survey Codes
Littoral Rock and other hard substrata			
LR.L.YG	yellow grey lichens on supralittoral rock	SUR.YG. (96.7)	LR.K.YG
Moderately Exposed Littoral Rock			
MLR.BF.PelB	*Pelevtia canaliculata* and barnacles on moderately exposed littoral fringe rock	LRK.PEL in part (6.95)	
MLR.Eph.Ent	Enteromorpha spp. on FW influences or unstable upper eulittoral rock	MLR.Eph.Ent (96.7), LRK.ENT (6.95)	LMXD.Ent.P (in part) LRK.ENT, LMXD.Ent (in part)
MLR.Sab.salv	*Sabellaria alveolata* reefs on sand abraded eulittoral rocks	MLR.Sab (96.7), LMXD.sab (6.95)	LMXD.SAB.MYT
Sheltered Littoral Rock (fucoid shores)			
SLR.F.Pel	*Pelevtia canaliculata* on sheltered littoral rock	LRK.Pel (in part 6.95)	LRK.Pel, LMXD.Pel (in part)
SLR.F.Fspi	*Fucus spiralis* on moderately exposed to very sheltered upper eulittoral rock	LRK.FSP (6.95)	LMXD.Pel.Fsp (in part), LMXD.Pel.P
SLR.F.Fves	*Fucus vesiculosus* on sheltered mid eulittoral rock	LRK.FVES.LIT (6.95)	
SLR.F.Asc.Asc	*Ascophyllum nodosum* on full saline mid eulittoral rock	LRK.ASC.ASC (6.95)	LRK.ASC
SLR.F.Fcer	*Fucus ceranoides* on reduced salinity eulittoral rock	LRK.FCER (6.95)	LRK.FCER
Sheltered littoral Rock (fucoid shores, mixed substrata)			
SLR.FX.BLlit	Barnacles and *Littorina littorea* on unstable eulittoral mixed substrate	LMXD.BLIT (in part 6.95)	LMXD.BAL
SLR.FX.FvesX	*Fucus vesiculosus* on mid eulittoral mixed substrata	LMXD.FVES (6.95)	LMXD.FVES
SLR.FX.FcerX	*Fucus ceranoides* in reduced salinity eulittoral mixed substrata	LMXD.FCER (6.95)	LMXD.FCER
SLR.FX.EphX	Ephemeral green and red seaweeds on variable salinity or disturbed eulittoral mixed substrata	LMXD.EPH (6.95)	LMXD.EPH
Sheltered Littoral Rock (mussel beds mixed substrata)			
SLR.MX.MytX	*Mytilus edulis* beds on eulittoral mixed substrata	LMXD.MYT (6.95)	LMXD.MYT.BRN (in part) LMXD.MYT.PBL (in part)
Littoral Gravels and Sands			
LGS.Sh.Bar.sh	Barren shingle or gravel shores	LMXD.BAR (6.95)	LMXD.BAR, LPEB.BAR
LGS.S.Bar.Snd	Barren coarse sand shores	LSND.BAR	LSND.BAR
LGS.S.Tal	Talitrid amphipods in decomposing seaweed on the strandline	LMXD.TAL (6.95)	LSED.TAL
LGS.S.AP	Burrowing amphipods and polychaetes in clean sand shores	LSND.AP (6.95)	
LGS.S.AP.P	Burrowing amphipods and polychaetes (often *Arenicola marina*) in clean sand shores	LGS.AP.Are (97.6) LGS. Ap.Sco (97.6)	LSND.CP.S
LGS.S.AP.Pon	Burrowing amphipods *Pontocrates sp.* and *Bathyporeia sp*. in lower shore clean sand	LGS.AP.Ang (97.6)	
LGS.Est.Ol	Oligochaetes in reduced or low salinity gravel or coarse sand shores	LMGR.Hed (6.95)	LSND.Oli
Littoral Muddy Sands			

LMS.MS.BatCor	*Bathyporeia sp*. and *Corophium sp.* in upper shore slightly muddy fine sands	NA	LMSND.COR (in part), LMSND.MC, LSND.COR
LMS.MS.PCer	Polychaetes and *Cerastoderma edule* in fine sand and muddy sand shores	LMSND.PC (6.95)	LSND.P.B
LMS.MS.MacAre	*Macoma balthica* and *Arenicola marina* in muddy sand shores	LMS.AreBv (96.7)	LMSND.AR.B, LMSMD.COR.AR.B
Littoral muds			
LMU.Sm	Saltmarsh	NA	LMXD.PUC.SPA, LMUD.SPA, LMUD.PUC, LMUD.FES
Littoral muds, sandy mud shores			
LMU.SMu.HedMac	*Hediste diversicolor* and *Macoma balthica* in sandy mud shores	LMU.HedMac.Nhom (in part 96.7), LMUD.HM (6.95)	NA
LMU.SMu.HedMac. Pyg	*Hediste diversicolor*, *Macoma balthica* and *Pygospio elegans* in sandy mud shores	LMU.HedMac (in part 96.7)	
LMU.SMu.HedMac. Are	*Hediste diversicolor*, *Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores	LMU.HedMac.Cer (in part 96.7)	
LMU.SMu.HedMac. Mare	*Hediste diversicolor*, *Macoma balthica* and *Mya arenaria* in sandy mud shores	NA	
Littoral muds, soft mud shores			
LMU.MU.HedOl	*Hediste diversicolor* and oligochaetes in low salinity mud shores	LMUD.HO (6.95)	LSND.OLI
Additional Biotopes Identified By IECS survey 1995			
Exposed Littoral Rock			
ELR.MB.MytB	*Mytilus edulis* and Barnacles on very exposed eulittoral rock	LRK.MB	LRK.MB
ELR.MB.BPat	Barnacles and *Patella sp.* on exposed or moderately exposed or vertical sheltered, eulittoral rock	LRK.BP	LRK.PB
Sheltered littoral Rock, mixed substrata			
SLR.FX.AcsX	*Ascophyllum nodosum* on mid eulittoral mixed substrata	LMXD.ASC	LMXD.ASC
Sublittoral Sediments MNCR 97.06 Subtidal biotopes (amended from Cutts and Hemingway 1996)			
IGS	Infralittoral gravels and sands	NA	SMXD.NepA (in part) SMXD.Mic (in part)
IGS.FaS	Shallow sand faunal communities (incl. *Nephtys cirrosa, Magelona mirabilis, Lanice conchilgea, Fabulina fabula and Bathyporiea)*	NA	SSND.Nep.Mg.A SSND.Mg.B
IGS. Fas.Ncir.Bat	*Nephtys cirrosa* and *Bathyporiea* spp. in infralittoral sand	NA	SSND.Nep.A SSND.Bat.P (in part) SMXD.Mod.P.C (in part)
IGS. Fas.Mob	Sparse fauna in infralittoral mobile clean sand	NA	SSND.P.Imp

APPENDIX IV Summary of the Solway's current regularly occurring bird species

SPECIES	5 year maxima (1992-93 to 1997-98)	Current qualifying threshold
Svalbard barnacle goose (Annex 1)	19,433	120
whooper swan (Annex 1)	228	160
bar-tailed godwit (Annex 1)	2,940	1,000
pink-footed goose	15,502	2,250
pintail	3,094	600
shelduck	3,132	3,000
oystercatcher	37,550	9,000
knot	11,332	3,500
dunlin	16,201	14,000
curlew	5,303	3,500
redshank	3,011	1,500

Regularly occurring migratory species

SPECIES	5 year maxima (1992-93 to 1997-98)	Current qualifying threshold
golden plover (Annex 1)	5,767	2,500
ringed plover	360	290
grey plover	1,151	430
black tailed godwit	99	70
sanderling	278	230
scaup	2,741	110
goosander	113	90
great crested grebe	176	100
cormorant	548	130

Source: WeBS 1997-98: Wildfowl and wader counts

APPENDIX V Solway European marines site management group - membership

AGENCY	ADDRESS	TEL NO:	FAX NO:	REP./POS./DEPT.
Allerdale Borough Council	Allerdale House, New Bridge Road WORKINGTON CA14 3YJ	01900 326 435	01900 735346	JOHN CAIN Environmental Health Service Manager
Annan District Salmon Fishery Board	Beechbush, Hoddom LOCKERBIE DG11 1AR	01576 300542		NICK CHISHOLM (Representative)
Associated British Ports Ltd	Dock Office, New Dock, Silloth, CARLISLE CA5 4JG Port Office, Ramsden Dock Road, BARROW-in-FURNESS LA14 2TW	016973 31358 01229 822911	016973 31358 (ring first) 01229 835822	CAPTAIN C PUXLEY Dock & Marine Superintendent JOHN GREEN Port Manager
Carlisle City Council	Civic Centre, Rickergate, CARLISLE. CA3 8QG	01228 817000	01228 817199	ALAN EALES Head of Local Plans
Cumbria County Council	County Offices, KENDAL LA9 4RQ	01539 773430 01539 773427	01539 773439	JOHN HETHERINGTON Landscape & Conservation Group Leader MIKE SMITH
Cumbria Sea Fisheries Committee	Sea Fisheries Office 6 Duncan Square, WHITEHAVEN CA28 7CN The Courts CARLISLE CA3 8LZ	01946 693047 0836 628872	01946 590430	DAVID DOBSON Chief Fishery Officer MIKE HAWKINS JEFF BROWN Secretary (for information only)
Dumfries & Galloway Council	Environment & Infrastructure Planning & Environmental Consultancy Group Newall Terrace DUMFRIES DG1 1LW	01387 260064/260215	01387 260149	JIM SMITH Environmental Manager EUAN HUTCHISON
English Nature	Juniper House, Murley Moss Oxenholme Road KENDAL LA9 7RL	01539 792800	01539 792830	KAREN SAMPSON Conservation Officer
Environment Agency	Ghyll Mount, Gillan Way, Penrith 40 Business Park, Penrith, Cumbria, CA11 9BP	01768 866666	01768 865606	STEVE GARNER Team Leader Ecology
Ministry of Agriculture Fisheries & Food - Sea Fisheries Inspectorate	Bradley's Chambers, 26 London Road FLEETWOOD FY7 6JG	01253 872589	01253 779414	MICHAEL PARKER District Inspector
Nith District Salmon Fishery Board	Tigh Nan Iasgairean Underwood DUMFRIES DG2 0JJ	01387 721592	01387 721592	JOHN PRINCE Chairman
North West Water Ltd	West Water Operations, Hallwood Road, Lilly Hall Industrial Estate, WORKINGTON CA14 4PN	01900 706790	01900 706791	GLEN SAVAGE Territory Manager
Scottish Environmental Protection Agency	Rivers House, Irongray Road DUMFRIES DG2 0JE	01387 720502	01387 721154	ALASTAIR McNEILL Pollution Control Manager
Scottish Natural Heritage	Carmont House, The Crichton Bankend Road, DUMFRIES DG1 4ZF	247010	259247	LYNN WALKER Area Officer
Scottish Fisheries Protection Agency	Russell House King Street AYR KA8 0BE	01292 610177	01292 610877	ALEX WATSON Fishery Officer COLIN CAMPBELL Senior Fisheries Inspector
West of Scotland Water Authority	Marchmount House, Marchmount DUMFRIES DG1 1PW	01387 250000	01387 270225	MALCOLM McCUBBIN Waste Water Treatment Manager

APPENDIX VI 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, as a matter of Government policy, for potential SPAs, candidate SACs and listed Ramsar Sites for the purpose of considering development proposals affecting them.

English Nature's 'Habitats regulations guidance note: The Appropriate Assessment (Regulation 48)', is at Appendix II for further information.

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.

Review of consents .7 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.