Special Area of Conservation (SAC): Inner Dowsing, Race Bank and North Ridge

SAC Selection Assessment

Version 5.0

Version Control

Version and date	Amendments made	Issued to and date
Version 5.0 (20th August 2010)	Text amendments from pSAC to cSAC status	Submission to Europe (20th August 2010)
Version 4.3 (13th May 2010)	Minor text amendments	Natural England Executive Board and JNCC Marine Sub Group (14th May 2010)
Version 4.2 (6th May 2010)	Text amended with NE & JNCC comments	JM, JT and JNCC QA
Version 4.1 (4th May 2010)	Internal review	Internal QA
Version 4.0 (29th April 2010)	Post-evidence consultation amendments	Internal QA
Version 3.0 (10th November 2009)	Minor modification to text from dSAC to pSAC status	Formal consultation (27th November 2009)
Version 2.0 (4th June 2009)	-minor modifications of text -Update of Annex I reef area figures -Removal of appendix 2	Launched at start of informal dialogue (September 2009)
Version 1.0 (25th November 2008)	- map layout revised - comments incorporated from JNCC and NE	JNCC Joint Committee (25th March 09), Chief Scientists Group (13th Feb, 09), NE advised Defra (4th Feb 09), Natural England Board (11th Dec 2008)

Cover image of *Sabellaria spinulosa* reef taken by sediment profile imagery camera © Cefas.

1. Introduction

This document provides detailed information about the Inner Dowsing, Race Bank and North Ridge SAC and evaluates its interest features according to the Habitats Directive selection criteria and guiding principles. The Inner Dowsing, Race Bank and North Ridge site crosses the 12 nautical mile boundary; therefore it lies partly in inshore and partly in offshore waters and is being progressed jointly by Natural England and the Joint Nature Conservation Committee (JNCC).

The advice contained within this document is produced to fulfil requirements of Natural England under The Conservation of Habitats and Species Regulations 2010 and JNCC under Part 2 of the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended), relating to the conservation of natural habitat types and species through identification of Special Areas of Conservation (SACs) in UK waters. Under these Regulations, Natural England and JNCC are required to provide advice to Defra to enable the Secretary of State and Competent Authorities to fulfil their obligations under the Regulations.

Sites eligible for designation as Special Areas of Conservation (SACs) are selected on the basis of the criteria set out in Annex III (Stage 1) to the Habitats Directive and relevant scientific information. SACs are considered only if they host a Habitats Directive Annex I habitat or Annex II species. Socio-economic factors are not taken into account in the identification of SACs to be proposed to the European Commission[1].

In addition to information on the Annex I habitats, this document contains i) a map of the site, ii) its name, location and extent, iii) the data resulting from application of the criteria specified in Annex III (Stage 1) to the Habitats Directive and iv) a glossary of terms mentioned in the text. Natural England and JNCC have adhered to the format established by the Commission for providing site information. This format is set out in the 'Natura 2000 Standard data form' (Commission of the European Community, 1995) (prepared by the European Topic Centre for Biodiversity and Nature Conservation on behalf of the European Commission to collect standardised information on SACs throughout Europe).

[1] Following European Court of Justice 'First Corporate Shipping' judgement C-371/98 (7 November 2000)

2. Inner Dowsing, Race Bank and North Ridge: cSAC Selection Assessment

1. Site name	2. Site centre location
Inner Dowsing, Race Bank and North Ridge	Degrees and minutes **0°43'14"E 53°15'26"N** (Datum: WGS84)
3. Site surface area	**4. Biogeographic region**
84,514 ha; **845 sq km** (UTM Zone 31 Northern hemisphere WGS84)	Atlantic

3. Interest feature(s) under the EU Habitats Directive

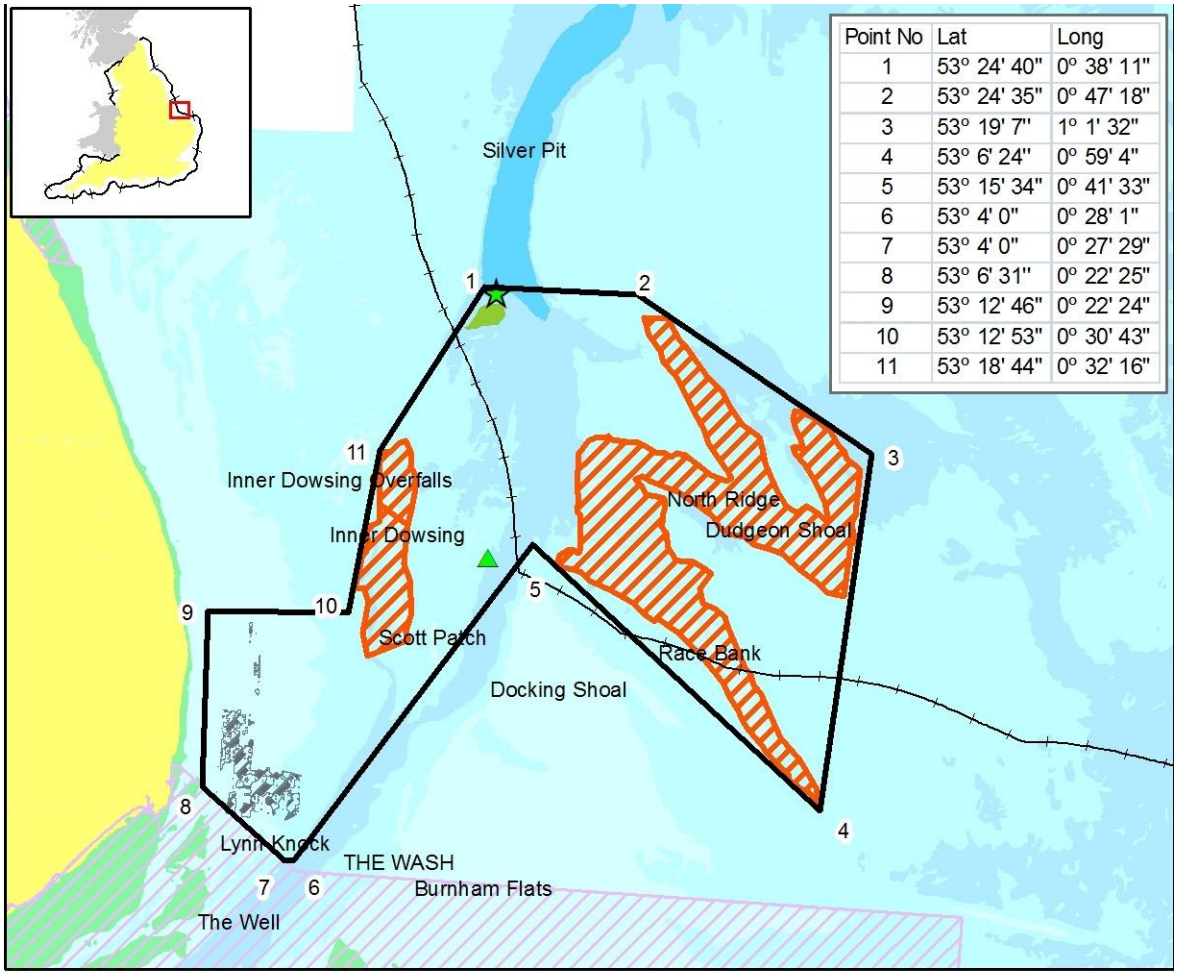
This site is listed for the features set out below. For further information please see European Commission, DG Environment, (2007): Interpretation Manual of European Union Habitats. EUR 27, July 2007:

http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

1110 *Sandbanks which are slightly covered by sea water all the time*
1170 Reefs

1364 Grey seal (*Halichoerus grypus*) (non-qualifying)
1351 Harbour Porpoise (*Phocoena phocoena*) (non qualifying).

4. Map of candidate SAC boundary[2]



candidate Special Area of Conservation
Inner Dowsing, Race Bank and North Ridge

- candidate Special Area of Conservation
- Special Areas of Conservation
- Silver Pit South Sabellaria Reef
- Lynn Knock Sabellaria Reefs
- Silver Pit South Reef (point)
- Docking Shoal Sabellaria Reef (point)
- Sandbanks which are slightly covered by sea water all the time
- England 12nM Territorial Seas Limit

Depth Areas

- Drying
- <=10m
- <=20m
- <=50m
- <=100m
- Land

EU Site Code: UK0030370
Version number: 1.5
Longitude: 0° 43' 14" E
Latitude: 53° 15' 26"N
Projection: UTM 31N (WGS84)
Area of SAC: 845.14 sq km 84,514 ha

Theme ID: 1452092
Grid Ref: TF918774
Version: 7
Plotted: 21/07/2010
Plot ID: 5

Scale 1:500,000 Map 1 of 1
0 2.5 5 10 Kilometers

N

Candidate Special Area of Conservation Directive 92/43/EEC
Submitted to the EC by the Secretary of State for Environment, Food and Rural Affairs. Date: 20/08/2010

[2] Larger copies of maps are available on request from Natural England, Regulatory Services, Floor 1 West, Northminster House, Peterborough. PE1 1UA

5. Site summary

The Inner Dowsing, Race Bank and North Ridge site is located off the south Lincolnshire coast in the vicinity of Skegness, extending eastwards and north from Burnham Flats on the North Norfolk coast, occupying The Wash Approaches. Water depths are generally shallow and mostly less than 30m below chart datum. The area encompasses a wide range of sandbank types (banks bordering channels, linear relict banks, sinusoidal banks with distinctive 'comb-like' subsidiary banks) and biogenic reef of the worm *Sabellaria spinulosa*. These features lay almost entirely on the glacial till of the Bolders Bank Formation which is responsible for much of the evident surface topography, especially glacial mounds, channels and hollows (Cooper *et al,* 2008).

The group of banks within the Wash Approaches are generally between 15 to 20km long and 1.5 to 3km wide. They arise from the basal layers by 7 to 12m with crest heights generally less than 5m BCD. The sedimentary component of the banks is fine to medium sands, predominantly being derived from coastal erosional processes over the last 5,000 years following the last glacial retreat and marine inundation (Cooper *et al,* 2008).

Inner Dowsing in the west of the site is a sandbank comprising coarse sand with some areas of gravel and possessing a distinctive elongate shape. It is thought to be a relict bank sitting on a linear basement layer carved by glacial processes (ENTEC UK Ltd, 2008a). The tidal currents in the area maintain the feature and probably shape the veneer of sand bedforms in the overfalls at the northern end of Inner Dowsing. The Race Bank/North Ridge/Dudgeon Shoal sandbank system is a good example of a sinusoidal sandbank that also has a complex pattern of smaller sandbanks associated with it. These smaller features form a unique 'comb-like' pattern running east from the main line of the sandbank ridges. The tops of the sandbanks are characterised by low diversity communities dominated by polychaete worms and mobile amphipod crustaceans.

The areas between these main sandbank features are composed of mixed sand and gravelly sands, predominantly as veneers over glacial tills (Cooper *et al,* 2008). They are part of the wider oceanographical system that feeds the flood tide into the Wash and over the sandbanks at the entrance to the Wash. In these areas a diverse mosaic of biotopes occur dominated by the ascidian *Molgula* sp. along with a number of nemertean worms and polychaetes of the genera *Pomatoceros, Caulleriella, Polycirrus, Pholoe,* and *Lumbrineris*.

Abundant *Sabellaria spinulosa* agglomerations have consistently been recorded within the boundary of the cSAC (Foster-Smith & Hendrick, 2003). Survey data indicate that reef structures are concentrated in certain areas of the site, with a patchy distribution of crust-forming aggregations across the site. The main areas of *S. spinulosa* reef are found along the Lincolnshire coast south of Skegness at Lynn Knock and Skegness Middle Ground (south-east part of the site); just north of Docking Shoal bank; and associated with the southern edge of Silver Pit (in the northern area of the site) (Woo, 2008; Foster-Smith & Hendrick, 2003; Brutto, 2009; Limpenny *et al,* 2010).

Typically in the environs of The Wash and its approaches areas of high *S. spinulosa* density support attached epifauna of bryozoans, hydroids, sponges and anemones. Additional fauna also includes polychaetes, squat lobsters, crabs, the common lobster *Homarus gammarus* and notably the commercially exploitable pink shrimp *Pandalus montagui*. Reefs formed by *S. spinulosa* allow the colonisation by other species not associated with adjacent sediment habitats. The habitat creates a diverse community of epifaunal and infaunal species, increasing biomass and possibly supporting higher trophic interactions (foodweb links) (Hendrick, 2007; Pearce, 2007). Diverse *S. spinulosa* reef communities are found on the flanks and toes of sandbanks and associated with bedforms along troughs and swales. In other parts of the site, diverse communities are found associated with the sand mason worm *Lanice conchilega* and the tube-building amphipod

Ampelisca sp., or as part of a hydroid / bryozoan turf on gravelly sediments (Foster-Smith & Hendrick, 2003; Brutto, 2009).

5.1 Inner Dowsing, Race bank and North Ridge cSAC Annex I Habitat Comparison

This site is located within the Southern North Sea Regional Sea (Defra, 2004). Listed below (Table 5.1) are existing SACs and cSACs within the same area that also contain sandbanks as a qualifying Annex I habitat. A brief summary of the type of sandbank at each location is included. A number of sites for sandbanks in the Southern North Sea Regional Sea are proposed for designation in order to ensure sufficient sandbank habitat is represented with the Natura 2000 network of sites for the UK, and because sandbank habitat in UK waters is located primarily in the southern North Sea and Irish Sea. Several sites are proposed also to ensure representation of the range of sub-types of this habitat within the SAC network. The different sites represent different sub-types of sandbank habitat, from sheltered estuarine and sandbanks, vegetated sandbanks, to different physiographic types associated with headlands, and offshore shelf sandbanks. Each has a slightly different range of sediment types, salinity and exposure to tides and wave action which results in different ranges of associated biological communities.

Table 5.1 SACs, possible SACs and candidate SACs which have 'sandbanks which are slightly covered by sea water all the time' as a qualifying feature

Site	Description of relevant qualifying features
The Wash and North Norfolk Coast SAC	One of the largest expanses of inshore sublittoral sandbanks in the UK, and representative example of this habitat type on the more sheltered east coast of England. Headland associated, estuary mouth sandbanks and sandy mounds are all found at this site. The sandbanks vary in composition from coarse gravelly sand to muddy sand, and some support eelgrass beds. Salinity is variable/reduced and coastal influence is strong. Benthic communities on sandflats in the deeper, central part of the Wash are particularly diverse (brittlestar beds, polychaete *Lanice conchilega*, and the bivalve *Angulus tenuis* are present). The banks also provide nursery grounds for commercial fish species. This site is also designated for *Sabellaria spinulosa* reef interest feature (see table 6.2 below).
Essex Estuaries SAC	Estuary mouth sandbanks in variable/reduced salinity and subject to strong coastal influence. These subtidal sandbanks are unvegetated and composed of gravelly and muddy sand.
Humber Estuary SAC	Estuary mouth sandbanks in variable/reduced salinity and subject to strong coastal influence. These subtidal sandbanks are unvegetated and composed of muddy sand.
North Norfolk sandbanks and Saturn reef cSAC	The North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters (Graham *et al*, 2001). They are subject to a range of current strengths which are strongest on the banks closest to shore and which reduce offshore (Collins *et al*, 1995). The outer banks are the best example of open sea, tidal sandbanks in a moderate current strength in UK waters. The banks support communities of invertebrates which are typical of sandy sediments in the southern North Sea. This site is also recommended for *Sabellaria spinulosa* 'reef'' interest feature . The Saturn *S. spinulosa* biogenic reef, first discovered in 2002, consisted of thousands of fragile sand-tubes made by ross worms which have consolidated together to create a solid structure rising above the seabed. More recent survey in 2003 did not find the extensive reef feature although the site is still being put forward on the basis that the site provides favourable conditions for reef formation.

Dogger Bank pSAC	The Dogger Bank is the largest single continuous expanse of shallow sandbank in UK waters and was formed through glacial processes and submergence through sea-level rise. Its location in open sea exposes the bank to substantial wave energy and prevents colonisation of the sand by vegetation. Sediments range from fine sands containing many shell fragments on top of the bank to muddy sands at greater depths supporting invertebrate communities characterised by polychaete worms. Sand eels are an important prey resource found at the bank supporting a variety of species including fish, seabirds and cetacean.
Haisborough, Hammond and Winterton cSAC	The main sandbank ridge is composed of alternating ridge headland associated sandbanks in a characteristic S-formation. The sandy sediments within the site are very mobile in the strong tidal currents. Infauna of the sandy bank tops are consequently impoverished, and made up of communities which are able to withstand dynamic sediment environments. On the flanks of the banks, and towards the troughs, where there is less water movement, sediments tend to be slightly more stable and gravelly and are dominated by diverse infaunal and epifaunal communities. This site is also designated for *Sabellaria spinulosa* reef interest feature (see table 6.2 below).
Margate Sands and Long Sands cSAC	This site is characterised by two distinct areas of Estuary mouth associated sandbank features; Margate Sands banks which are composed of well sorted sandy sediments, with muddy and gravelly sediments in the troughs and the highly dynamic Long Sands sandbank which is composed of sand and gravel. The Margate Sands banks are more biologically diverse than the Long Sands bank and are dominated by polychaete worms and amphipods. The troughs of all the banks are more biologically diverse than the peaks.

The biogenic reef within the Inner Dowsing, Race Bank and North Ridge site is of the same type as the reef in The Wash and North Norfolk Coast SAC (Table 5.2). Given the bathymetry and sediment particle sizes at Lynn Knock, Docking Shoal and Silver Pit it is likely that the epifaunal communities associated with these reefs will be similar to those at The Well and Lynn Deeps reef in the Wash. It is not currently known what ecological links exist between the Outer and Inner Wash reefs, however given the predominant water currents associated with the Lincolnshire coast and the Wash (Wingfield *et al,* 1978; Ke *et al,* 1996; H R Wallingford, 2002) it is likely that connectivity of larval supply exists between the reefs in the approaches to The Wash and those contained within The Wash and the existing SAC.

In addition both Haisborough, Hammond and Winterton cSAC and, North Norfolk Sandbanks and Saturn Reef cSAC also contain Annex I *Sabellaria spinulosa* reef feature (Table 5.2). There are also other sites in the region that contain reef feature and a brief summary of the type of reef at each site is included.

Table 5.2 SACs and candidate SACs which have 'Reef' as a qualifying feature

Site	**Description of relevant qualifying features**
Flamborough Head SAC	Bedrock and boulder chalk reefs which extend from the infralittoral to the circalittoral zone. The presence of many overhangs and vertical faces adds to the topographic complexity of the interest feature. These full salinity reefs are subject to strong coastal influence and high to moderate energy levels. Some typically northern species reach the edge of their range at this site (e.g. the northern alga *Ptilota plumosa*).

Thanet Coast SAC	Chalk bedrock reefs with associated chalk-boring fauna and flora. This inter-tidal and infralittoral feature has relatively high topographic complexity and is strongly influenced by coastal processes. It is in full salinity and exposed to moderate energy levels. The reefs are comparatively impoverished, owing to the harsh environmental conditions. Species present include an unusually rich littoral algal flora, essentially of chalk-boring algae
The Wash and North Norfolk Coast SAC	Amongst many features this site is also designated for *Sabellaria spinulosa* reef interest feature. These subtidal reefs stand up to 30cm proud of the seabed and extend for hundreds of metres. The reefs are diverse and productive habitats which support many species that would not otherwise be found in predominantly sedimentary areas. Associated motile species include large numbers of polychaetes, mysid shrimps, the pink shrimp *Pandalus montagui*, and crabs.
North Norfolk sandbanks and Saturn reef cSAC	The Saturn *Sabellaria spinulosa* biogenic reef, first discovered in 2002, consisted of thousands of fragile sand-tubes made by ross worms which have consolidated together to create a solid reef structure rising above the seabed. More recent surveys have not found extensive reef structures in the same location. It is possible that the reef was damaged by anthropogenic activity, and as the site clearly provides favourable conditions for *Sabellaria spinulosa* reef formation, the site is proposed with the possibility of allowing extensive reef structures to recover.
Haisborough, Hammond and Winterton cSAC	There are three spatially distinct areas of *Sabellaria spinulosa* biogenic reef located within the cSAC. Two of the reefs, Haisborough Tail reef and Winterton Ridge reef, are associated with the troughs and swales between closely-spaced sandbanks. The third reef, Haisborough Gat reef, is located on a glacial till plain with coarse sands and epifaunal encrusted gravels. All of the reefs are well-developed, generally elevated greater than 5cm, covering large areas of seabed (>90ha) with a high per cent of coverage and consolidation. Typically the reef support epifaunal species of sponges, hydroids, bryozoans and anemones with mobile predators such as crabs and pink shrimp *Pandalus montagui*.

6. Feature characterisation and delineation of site boundary

6.1 Sandbank data sources

An initial appraisal of the occurrence of Annex I sandbank habitat was completed on Natural England's behalf by Entec in 2008 (Entec UK Ltd, 2008a, b). This work resourced data from a variety of sources including windfarm and aggregate surveys, dedicated survey and modelling (Table 10.1). After the assessment by Entec in 2008 more data became available via the SeaZone Digital Survey Bathymetry (DSB) (SeaZone Solutions Ltd, 2009a), digitised through funding from the Marine Aggregate Levy Sustainability Fund. Further data was also provided by the aggregates industry and through the consultation on a previous version of this document.

The DSB data provided good spatial coverage of Inner Dowsing, Race Bank and North Ridge cSAC with the exclusion of the western part of the site in the vicinity of the north end of Inner Dowsing bank and the Dowsing Overfalls. In this latter area, supplementary data provided from the SeaZone coastal Digital Elevation Model was used (SeaZone Solutions Ltd, 2009b). From both datasets, an accurate delineation of Annex I sandbank features was undertaken using a slope analysis in GIS. Guidance by Klein (2006) on delineating sandbanks was applied, using a slope angle of 0.5° for delineating the edges of the bank features. The main bank structures themselves were easily identifiable by viewing the 1° slope layer alongside the 0.5° slope layer. Once identified, these sandbank features were cross-referenced with sedimentological data to confirm that they consisted of sandy sediment, as defined in the Annex I sandbank definition (EU, 2007). This process was conducted for all sandbank features that fell within and around the (cSAC) site boundary. Seismic (sub-bottom profile) data was reviewed and analysed to assess sediment

depth profiles across some of the banks. This data was used to assess whether sandbank features met the definition as described by the EC Guidance (Commission of the European Community, 2007) or whether the features were actually just composed of thin sediment veneers overlying glacial till deposits.

Recent biological data was reviewed from several sources to validate both the assemblages and communities associated with the sandbanks, and those not considered part of the designated features (Amec, 2007; Brutto, 2009; Centrica, 2007, 2008, 2009a, 2009b; EMU, 2005a, b; MALSF, 2010; MES ,2003). This process assisted in assessing the biological component of the sandbanks and thereby refining the delineation the features derived from geological and geomorphological assessments.

6.2 *Sabellaria spinulosa* reef data sources

The site contains three known locations of *Sabellaria spinulosa* reef Annex I habitat and allows for the natural variability in distribution of *S. spinulosa* reef. The reefs occur at: the Lynn Knock reef along the Lincolnshire coast south of Skegness (south-west part of the site); just north of Docking Shoal and Burnham Shoal, the Docking Shoal reef; and associated with the southern edge of Silver Pit (in the northern area of the site), named Silver Pit South reef (Woo, 2008; Foster-Smith & Hendrick, 2003; Brutto, 2009). The extent of reefs have been mapped for The Lynn Knock and Silver Pit South reefs due to the remote sensing (acoustic) data provided for evaluation. Point data to indicate the location of The Docking Shoal reef has been used as Natural England and the JNCC are awaiting spatial extent data for this reef.

The acoustic data took the form of high resolution swathe bathymetry and sidescan sonar data for the Silver Pit South reef (Brutto, 2009) and Acoustic Ground Discrimination System data for The Lynn Knock reef (Woo, 2008). Ground-truth data in the form of grab samples and drop-down video and stills imagery were reviewed and assessments of: tube height; aggregations; patchiness (percentage cover); extent; and associated fauna were recorded. The observations were tested using the reef assessment guidance from JNCC (Gubbay, 2007).

It should be noted that the mapped extents of reef are currently restricted by the available acoustic data. It is likely (but not currently proven) that the reefs extend beyond the current mapped extents. The Docking Shoal reef is presently only indicated as point data, rather than having its extent mapped. Best practice for determining reef extent demonstrates that side scan sonar should be used to map the habitat feature (Gubbay, 2007; Limpenny *et al*, 2010). It is anticipated that side scan sonar for some reefs will be forthcoming during 2010. When available this data will be analysed and used to map reef extent.

6.3 Site boundary delineation

The boundary around the Inner Dowsing, Race Bank and North Ridge cSAC has been drawn using the guidance provided by JNCC (2008) (see Appendix 1). The key parts of this guidance are that the site boundary should be defined as simply as possible with a minimum number of straight lines, and should include the minimum area necessary to ensure protection for the Annex I habitat of interest. More complex shapes drawn more tightly around feature of interest are favoured over simple square/rectangular boundaries, to reduce the area of ‘non-interest-feature’ included within the site boundary. Where it is justified to protect the features of the site from the effects of mobile gear on the seabed at some distance from a vessel on the surface, a margin in proportion to the water depth may be added to the extent of the feature when defining the site boundary. The cSAC contains Annex I sandbanks at depths of predominantly <25m BCD. Therefore, a margin of 100m was used around each sandbank feature except where a straight line between two points was the more sensible option to avoid an overcomplicated boundary following the guidance.

7. Assessment of interest feature(s) against selection criteria

A full explanation of the application of the site selection criteria can be found on JNCC's website at www.jncc.gov.uk/page-4165 .

7.1 Sandbanks which are slightly covered by sea water all the time

Annex III selection criteria (Stage 1A):

7.1.1 Representativity (a)

The Inner Dowsing, Race Bank and North Ridge site lies off the Lincolnshire coast and contains a wide range of sandbank types (banks bordering channels, linear relict banks, sinusoidal banks with distinctive subsidiary banks) and associated channels not fully represented in other sites. The site holds a significant position at the entrance to the Wash and is important with respect to tidal flows and sediment transport processes into the Wash and along the Norfolk coast. Topographically the sublittoral sandbanks within the site conform well to the Annex I definition, and within the site there are examples of banks composed of different sediment types. The banks are largely composed of gravelly sand with areas of sandier and muddier sediments also present.

A wide range of biological communities are associated with these sandbanks. In the west and east of the site, the sediments are predominantly sandy gravel containing moderate to low diversity communities. Other sections of the site contain sandier sediments with different infaunal communities. The biological diversity at the site is therefore considered to incorporate a large number of the biological communities associated with Annex I sublittoral sandbanks.

The Inner Dowsing, Race Bank & North Ridge Sandbanks have been graded A (excellent representativity)

7.1.2 Area of habitat (b)

The area of Inner Dowsing, Race Bank and North Ridge Annex I sandbank habitat within the site, based on slope analysis, occupies 21,826 ha. The majority of this habitat area is in waters shallower than 20m.

The evaluation of relative surface area is approximate as it is not possible to calculate an accurate total extent figure for Annex I shallow sandbank habitat for UK waters. A best minimum estimate, based on the mapped area of sandy sediments in less than 20m water depth, of 1,720,000 hectares has been used to assess area of habitat, as these areas will always be part of the Annex I habitat. This figure gives the following thresholds for the grades of this criterion (CEC, 1995):

A – extents between 258,000 and 1,720,000 ha (15-100% of total resource)
B – extents between 34,400 and 258,000 ha (2-15% of total resource)
C – extents less than 34,400 ha (0-2% of total resource)

Inner Dowsing, Race Bank and North Ridge Annex I sandbank habitat occupies a minimum area of 20,955 ha (based on the area of sandy sediments within the 20m contour, Chart Datum). This value is equivalent to 1.22% of the UK total resource (based on the area of sandy sediments within the 20m contour, CD) and is graded C.

The actual area of sandbank feature can extend below the 20m depth contour (CEC, 2007). Therefore an additional maximum estimate of UK sandbank resource has been calculated based on the mapped area of sandy sediments in less than 50m water depth that adjoin areas of sandy sediment in less than 20m water depth. This figure of 8,010,000 hectares is an over-estimate used to provide an additional assessment of area of habitat, and is under review. This figure gives the following thresholds for the grades of this criterion (CEC, 1995):

A – extents between 1,201,500 and 8,010,000 ha (15-100% of total resource)
B – extents between 160,200 and 1,201,500 ha (2-15% of total resource)
C – extents less than 160,200 ha (0-2% of total resource)

Inner Dowsing, Race Bank and North Ridge Annex I sandbank habitat occupies a maximum area of 21,826 ha (based on the actual area of Annex I sandbank habitat, which extends deeper than 20m). This value is equivalent to 0.27% of the UK total resource (based on the area of sandy sediments within the 50m contour, CD) and is graded C.

The site contains between 0-2% of the national Annex I sandbank resource, and is graded C.

7.1.3 Conservation of structure and functions (c)

Degree of conservation of structure
Within the site there are a number of activities which have affected, and may continue to affect, the structure of the sandbanks.

Fishing activity occurs within the site boundary, the majority of commercial fishing is for seed' mussel using benthic dredges and lobster, crab and whelk using static gear, although some beam trawling takes place to the north and west of Inner Dowsing and within The Well channel. Trawling the seabed with towed gear is known to disturb the surface sediments, leaving tracks which slowly fill-in over time and previous seabed damage may not now be visible. Extensive crab potting occurs around the Race Bank and Dudgeon Shoals, and potting for crab and lobster in the Silver Pit area to the north east of Inner Dowsing. Within 6nm, under 10 metre vessels set gill,, trammel and entangling nets, targeting bass in the summer, skate and sole in spring. Between 6nm and 12nm the main method of fishing is demersal trawling by over 15m vessels targeting cod during the winter and skate during the winter.

No gas fields occur within the site, but a number of pipelines carrying gas and chemicals cross the northernmost tip of the site. The installation and maintenance of these is unlikely to affect the structure of the main sandbanks within the site, as they do not cross the main sandbank features.

Two windfarms are currently constructed and operating in the western part of the site. A further array is due to start construction in 2011, also west of Inner Dowsing bank with another two windfarms in the south-east and east of the site currently in the consent application process. The installation and operation of these windfarms may cause modification to the structure of the sandbank as a result of the piling, drilling of turbine bases, deposition of drill spoils and scour protection and the installation of cabling. The onshore cable route for the constructed arrays runs westward away from the site towards Skegness. The cable routes for the other three projects are consented or proposed to run through the south part of the cSAC and into The Wash SAC. The Environmental Statements for the windfarm developments deemed construction activities not to have a significant impact on the sandbank habitat (Centrica, 2007, 2009a & b).

Licenced aggregate extraction occurs within the site boundary. The primary impact of aggregate extraction is the removal and lowering of seabed surface (along with associated infauna and epifauna) within the path of the draghead. No designated sandbank features are currently coincidental with any aggregate extraction licence areas. Secondary impacts associated with the production of sediment plumes at these sites are negligible (in context of background suspended sediment concentrations) and high suspended sediment loads would be unlikely to affect the communities in this area as they are evolved to exist in high turbidity waters (Hitchcock & Drucker, 1996; Newell *et al*, 1998; CIRIA, 2000; Newell *et al*, 2002). `

It is considered that human activity within this site is likely to have had an effect on the physical structure of the sandbanks, and on the biological communities which they support.

The Inner Dowsing, Race Bank and North Ridge sandbank feature is graded III (average or partially degraded structure).

Degree of conservation of functions
Structurally, Race Bank appears to be broadly stable over time. Records dating back to 1828 indicate that the location of the banks has not significantly altered, although there have been slight changes in bank morphology over this time. The same is true of Inner Dowsing, although the crest level of this bank has been quite variable over time (Centrica, 2007). Sandwaves indicate that there is movement of sediment within the area.

The operation of consented windfarms and the extraction of aggregates from currently licenced areas is forecast to continue into the future.

The prospects of this feature to maintain its structure in the future, taking into account known pressures and management of activities through appropriate mechanisms (Defra, 2007), are good.

The Inner Dowsing, Race Bank and North Ridge sandbank feature is graded II (good prospects)

Restoration possibilities
Parts of the Inner Dowsing, Race Bank and North Ridge site are subject to aggregate extraction, windfarm construction, cable laying, and fishing activity. Restoration methods would be likely to focus on appropriately management of activities assessed to be causing damage to the structure and function of the Annex I sandbanks and overall it is considered that the prospects of habitat restoration are good. Given the natural sediment dynamics of the area, including the influx of sediments from the north, the possibility of renewing the physical structure of the banks, and associated benthic communities is good.

The site has been graded II (restoration possible with average effort)

Overall grade:
The Inner Dowsing, Race Bank and North Ridge sandbanks have been graded III for the conservation of structure sub-criterion, a score of II for the conservation of function sub-criterion, and a score of II for the restoration possibilities sub-criterion.

The overall grade for the conservation of structure and function criterion is grade C (average or reduced conservation value).

7.1.4 Global assessment (d)

The site has been highly graded for criterion 1A(a), an average grade for criterion 1A(b) and has scored poorly in criterion 1A(c) (conservation of structure and function criterion). This is largely as a result of anthropogenic impacts within the site. However, the site contains excellent examples of Annex I sandbank.

The site is graded B for the global assessment criterion.

7.2 Reefs

Annex III selection criteria (Stage 1A):

7.2.1 Representativity (a)

The *Sabellaria spinulosa* reef habitat is located in the vicinity of Lynn Knock, Docking Shoal and Silver Pit in The Wash approaches. These sites represent *S. spinulosa* biogenic reef in an open, tide-swept situation on sand and gravelly sand habitat. The interest features are located in full

salinity waters, with coastal influences. Remote sensing data and ground-truthing images of the reefs show the core areas of structure to rise above the seabed (Woo, 2008; Brutto, 2009; Limpenny *et al*, 2010). The reefs demonstrate good consolidation over their extents.

Despite the widespread occurrence of the species *S. spinulosa*, there are few known areas of well developed biogenic reef formed by *S. spinulosa* in UK waters (and very few in other European waters).

The Inner Dowsing, Race Bank & North Ridge reefs have been graded A (excellent representativity)

7.2.2 Area of habitat (b)

An evaluation of relative surface area is approximate as no accurate total extent figure is available for Annex I reef habitat for UK waters. The closest approximation available for the entire resource (bedrock, cobble and biogenic reef) in UK waters is 7,180,000 hectares. This total extent figure gives the following thresholds for the grades of this criterion (Commission of the European Community, 1995):

A – extents between 1,077,000 and 7,180,000 ha (15-100% of total resource)
B – extents between 143,600 and 1,077,000 ha (2-15% of total resource)
C – extents less than 143,600 ha (0-2% of total resource)

Based on interpreted AGDS survey and sidescan sonar data, respectively, the reefs at Lynn Knock and Silver Pit South have been mapped. The Docking Shoal reef still requires interpretation of spatial data to allow quantification of extent. Therefore this reef is currently represented by point data until the full spatial assessment can be made. Currently the known area of reef is approximately 1502 hectares. This site's feature therefore falls within the '0-2%' bracket for Area of Habitat and is graded C.

The site therefore contains between 0-2 % of the national Annex I reef resource, and is graded C.

7.2.3 Conservation of structure and functions (c)

Degree of conservation of structure
The biological and physical structure of the biogenic reef in this area is mainly intact. The Docking Shoal reef has temporal data which demonstrates that the reef has changed cyclically since 1999 due to natural processes (Foster-Smith & Hendrick, 2003; Woo, 2008; ENTEC UK Ltd, 2008a; Limpenny *et al*, 2010). A temporal dataset for Lynn Knock reef is also being developed by Eastern Sea Fisheries Joint Committee with input from Centrica.

The greatest vulnerability of *S. spinulosa* reefs is considered to be physical disturbance typically from fisheries activities, aggregate dredging and cable and/or pipeline installation.

Where direct interaction with aggregate extraction operations, turbine scour protection, pipeline and cable protection, trawling for shrimp or finfish, dredging for oysters and mussels, net fishing and potting occurs then they can cause physical damage to erect *S. spinulosa* reef communities (English Nature, 1999; Vorburg, 2000; Hendrick, 2007). The associated physical impact is thought to break the reefs down into small chunks, thus disaggregating the habitat available to the rich infauna and epifauna associated with the physical structure of the reef. The individual worms, meanwhile, are apparently unable to re-build tubes once dislodged from them (Schafer, 1972).

Indirect effects of changes in currents, affecting sediment, food and larval supply to *S. spinulosa* reefs, caused by construction, for example windfarm structures, pipelines, extensive rock armouring, could have significant effects on this habitat (Vorburg, 2000).

The physical presence of reef itself appears to act as a settlement cue for newly recruiting larvae (Wilson, 1970). Larvae are triggered to settle in response to proteins released by adult worms. Indeed this chemical attractant remains present and active even in the absence of live worms, i.e. dead reef still attracts recruitment. Hence, small sections of reef, or areas outlying the main reef, may act as reef precursors. These may be vulnerable to physical impact even if activities avoid the core areas of reef. Recent research has demonstrated that under certain environmental parameters evolution and development of *S. spinulosa* reef has been observed in a period of 6 to 18 months (Pearce *et al*, 2007).

Marine aggregate extraction activity at the Docking Shoal reef location is not currently environmentally monitored, therefore the impact of the extent of the activity is not known. Best practice for other known areas of reef is to exclude them from any active dredge zones with buffer zones to mitigate direct physical impact and possible secondary impacts. A similar approach would also minimize impacts from towed fishing gear. The Inner Dowsing area is targeted by commercial fishermen harvesting mussel 'seed' with benthic dredges and trawling for shrimp also occurs. Consideration of possible effects on near-bed sediment transportation by offshore windfarm turbine arrays and effects on reef development, either beneficial or detrimental also need to be considered.

The Inner Dowsing, Race Bank and North Ridge reef feature is graded II (structure well conserved).

Degree of conservation of function
The recent ESFJC surveys (Woo, 2008) have detected reef structures in the south western area at Lynn Knock. The indications are that the system is functioning naturally to be able to support such a feature. The Docking Shoal reefs have changed cyclically since 2000 due to natural processes (Foster-Smith & Hendrick, 2003; Woo, 2008; Entec, 2008; Limpenny *et al*, 2010). The limited time-series data for the Silver Pit South reef demonstrate that the reef is well-consolidated with a highly representative and established community. Therefore evidence for the reefs indicates that the ecological functioning of the system is good. The historic presence of the Docking Shoal reef (1997-2001 & 2005), the presence of the Lynn Knock and Skegness Middle Ground reefs and the Silver Pit South reef, and high abundance of crusts in the area indicates that the outer Wash environs are particularly suitable for the development of substantial and extensive reef structures. *S. spinulosa* is also known to preferentially settle on suitable habitat where the species has been present before (Hendrick and Foster-Smith, 2006; UK Biodiversity Group, 1999; Wilson, 1970). Therefore marine operations in the area should be managed to allow the natural cycle of reef development to continue to occur.

The Inner Dowsing, Race Bank and North Ridge reefs are graded II (good prospects)

Restoration possibilities
As the site has been graded II for both the conservation of structure and the conservation of function sub-criteria, there is no formal requirement to assess the restoration possibilities sub-criterion

Overall grade:
The Inner Dowsing, Race Bank and North Ridge reefs have been graded II for the conservation of structure sub-criterion, a score of II for the conservation of function sub-criterion.

The overall grade for the conservation of structure and function criterion is grade B (good conservation) for reefs

7.2.4 Global assessment (d)

The suggested grades for Stage 1A criteria a)-c) are A, C and B respectively.

The assessment of Area of Habitat (criterion b) is made with reference to the area of *all* sub-types 2of reef habitat combined (bedrock, cobble and biogenic). Because the *Sabellaria spinulosa* reef at this site occupies a relatively small area in relation to the total UK reef resource, its grade for this criterion is C as reefs overall are widely distributed and extensive in UK waters. The ross worm species *S. spinulosa* itself is widely distributed and common in UK waters, occurring as individuals and also forming 'crusts' of many individuals on sandy and mixed coarser sediments as well as rock. However, substantial reef structures formed by *S. spinulosa* could be considered rare as they are relatively small (less than 1000ha). Due to the scarcity of this sub-type of reef habitat in UK and European waters, a high proportion of the habitat should be protected.

Given the grades awarded for criteria a)-c), the rarity of *S. spinulosa* biogenic reef in UK waters, and the large extent and good development of this reef subtype, the reef has been graded A (excellent conservation value) for the global assessment.

The reef feature is graded A (excellent conservation value)

7.3 Summary of scores for Stage 1A criteria

Inner Dowsing, Race Bank and North Ridge	Representativity (a)	Relative surface (b)	Structure and function (c)	Global assessment (d)
Sandbanks	**A**	**C**	**C**	**B**
Reefs	**A**	**C**	**B**	**A**

For the global assessment criteria the sandbank feature is graded B (good conservation value) and the reef feature is graded A (excellent conservation value). The reason for the difference in global assessment between the features is due to the fact that the sandbank Annex I habitat is good at a national level whilst the Annex I reef habitat is outstanding due to the rarity and conservation value of *Sabellaria spinulosa* reef in a European context.

7.4 Harbour porpoise *Phocoena phocoena*

Annex III selection criteria (Stage 1B):

7.4.1 Size and density of the population of the species present on the site (a)

Small numbers of harbour porpoise *Phocoena phocoena* are also regularly observed within the site boundary (Centrica, 2007). Due to the highly mobile nature of harbour porpoises, and the small size of the proposed SAC the Inner Dowsing, Race Bank, & North Ridge cSAC is considered to be grade D, i.e. a non significant presence, for this species. As such, no other indication is required for the additional evaluation criteria concerning this species within the site.

7.5 Grey seals *Halichoerus grypus*

Annex III selection criteria (Stage 1B):

7.5.1 Size and density of the population of the species present on the site (a)

Grey seals occur in the wider area and, from satellite telemetry work, grey seals appear to forage in or very near the area (Matthiopoulos *et al* 2004; Matthiopoulos, 2007). At this time, however, it is not possible to estimate what proportion of the population utilises the area, or how important the area is with respect to the physical and biological factors essential to their life and reproduction. Additionally, there is no evidence that the site is any more important for this species than other areas in the North Sea. Therefore, grey seals are considered to be grade D, i.e. a non significant

presence. This grading may be revised at a later date depending on the outcome of data analyses to be commissioned by JNCC that will enable a more detailed assessment of the importance of areas for seals at sea.

8. Bordering sites

The southern edge of the site boundary is adjacent to the Wash & North Norfolk Coast SAC.

9. Supporting scientific documentation

Scientific information on the topography, habitats and species present within the Inner Dowsing, Race Bank and North Ridge site boundary is available from a number of sources. These are listed in table 9.1. The location of sampling sites is shown in figure 9.1

Table 9.1 Sources of data within the Inner Dowsing, Race Bank, & North Ridge site boundary

Reference	**Description**
AMEC, 2007. Docking Shoal Environmental Statement: Ecology Baseline Report.	Baseline survey of windfarm site
CEFAS, 1998. Annual monitoring of the Phase 2 dredging uplift at Area 107 aggregate extraction site (year 3).	Monitoring data from aggregate site
CEFAS, 1999. Annual monitoring of the Phase 2 dredging uplift at Area 107 aggregate extraction site (year 4).	Monitoring data from aggregate site
CENTRICA, 2007. Lincs Offshore Windfarm Environmental Statement	Baseline survey of windfarm site
CENTRICA, 2008. Docking Shoal Offshore Windfarm Environmental Statement: Volume 1 Offshore.	Baseline survey of windfarm site
CENTRICA, 2009a. Race Bank Offshore Windfarm Environmental Statement: Volume 1 Offshore.	Baseline survey of windfarm site
CENTRICA, 2009b. Docking Shoal and Race Bank Supplementary Environmental Information.	Supplementary environmental survey data in support of Environmental Statements for two windfarm sites
DFR, 1996a. Annual Monitoring of the Phase 2 Dredging Uplift at Area 107 Aggregate. Directorate of Fisheries Research, Burnham-on-Crouch.	Monitoring data from aggregate site
DFR, 1996b. Environmental Status Report of North East Area 107 Aggregate Extraction Site: Post Dredging Phase 1 Uplift, Directorate of Fisheries Research, Burnham-on-Crouch.	Monitoring data from aggregate site
DFR, 1997. Annual Monitoring of the Phase 2 Dredging Uplift at Area 107 Aggregate Extraction Site (Year 2), Directorate of Fisheries Research, Burnham-on-Crouch.	Monitoring data from aggregate site
EASTERN SEA FISHERIES JOINT COMMITTEE, 2008. Unpublished *Mytilus edulis* and *Sabellaria spinulosa* resource survey data.	Survey of Inner and Outer Wash

Reference	Description
EMU Ltd, 2006. Lincs Offshore Windfarm Baseline Benthic Survey 2005. REPORT No. 06/J/I/03/0813/0603. Report to RES.	Baseline survey of windfarm site
EMU Ltd, 2005a. Lynn & Inner Dowsing Offshore Wind Farm Monitoring Programme (inc. Lincs. Baseline Surveys) Mussel Survey Draft Report No. 05/J/1/03/0685/0548 and EMU Ltd, 2005b. Lynn & Inner Dowsing Offshore Wind Farm Monitoring Programme (inc. Lincs. Baseline Surveys) Fisheries & Epibenthos surveys Final Report No. 05/J/1/03/0685/0508	Baseline survey of windfarm site
ENTEC UK LTD, 2003. Area 481 Benthic and Epibenthic Survey Report. Report to United Marine Aggregates Ltd and Van Oord ACZ.	Survey of aggregate site
INSTITUTE OF ESTUARINE AND COASTAL STUDIES, 1999. Biological baseline survey of Inner Dowsing (Area 439) & North Dowsing (Area 400). Report prepared for Entec UK for Hanson Aggregates Marine Ltd.	Survey of aggregate site
MARINE AGGREGATE LEVY SUSTAINABILITY FUND (MALSF), 2010. Humber Regional Environmental Characterisation preliminary data. www.marinealsf.org.uk	Survey data to set an environmental characterisation of the seafloor at a large regional scale
MARINE ECOLOGICAL SURVEYS (MES) LTD, 2003. Marine Aggregate Extraction Application Area 106 (480). Environmental Statement. Report prepared for Hanson Aggregates Marine Ltd.	EIA of aggregate site
MARINE ECOLOGICAL SURVEYS (MES) LTD, 2000. Benthic biological resources in and adjacent to Triton Knoll (Area 440) and Outer Dowsing (Area 441). Report prepared for Coastline Surveys Ltd, Gloucestershire.	Survey of aggregate site
SEAZONE SOLUTIONS LTD, 2009a. Digital Survey Bathymetry (DSB)	Bathymetric data used to map base of sandbanks
SEAZONE SOLUTIONS LTD, 2009b. Coastal Digital Elevation Model	Bathymetric data used to map base of sandbanks
UNICOMARINE, 2000. Analysis of macroinvertebrate samples taken in 1999 from the Docking Shoal, Race Bank and Area 107. Report 107X9 to CEFAS.	Survey of fishing grounds

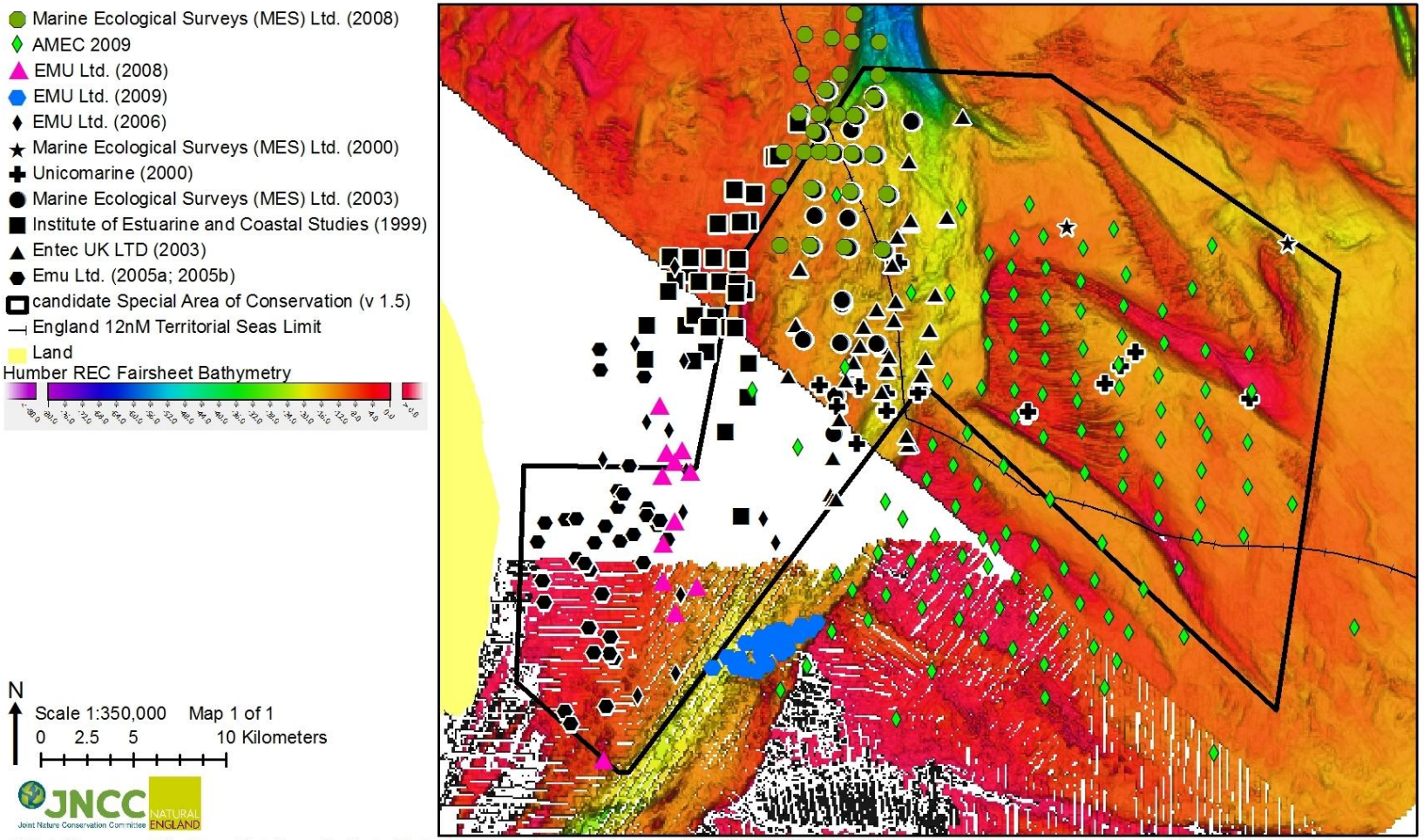


Figure 9.1 The distribution of survey sample sites for the surveys referred to in table 9.1

10. Site overview and conservation interest

10.1 Sediment Conditions and Bathymetry

The Inner Dowsing, Race Bank and North Ridge site derives its name from the prominent sandbank structures found along the south Lincolnshire coast and the area north and east of Burnham Flats and Docking Shoal. The area holds a significant position at the entrance to The Wash and is important with respect to tidal flows and sediment transport processes into the Wash and along the Norfolk coast.

The key sandbanks within the site are: the linear bank of Inner Dowsing with its distinctive elongate shape and consisting primarily of coarse sands. This bank is situated on a plain of glacial till to the west of a channel feeding into The Wash (Cooper *et al*, 2008); The Race Bank, North Ridge and Dudgeon Shoal sinusoidal sandbanks have been classified as alternating ridge headland associated banks (Dyer & Huntley, 1999). They show the S-shaped formation which is also present in the Haisborough banks off the north Norfolk coast (and included within the Haisborough, Hammond and Winterton cSAC). These banks, situated to the east of a channel running into The Wash, display a complex pattern of smaller, 'comb-like', sandbanks. These distinct streamer-like bedforms extend downstream to the east and are uniquely distinctive of this particular bank system. The group of banks within the site are generally between 15 to 20km long and 1.5 to 3km wide. They arise from the basal layers by 7 to 12m with crest heights generally less than 5m BCD. The sedimentary component of the banks is fine to medium sands, predominantly being derived from coastal erosional processes over the last 5,000 years following the last glacial retreat and marine inundation (Cooper *et al*, 2008). These features lay almost entirely on the glacial till of the Bolders Bank Formation which is responsible for much of the evident surface topography, especially glacial mounds, channels and hollows (Cooper *et al*, 2008).

The Race Bank, North Ridge and Dudgeon Shoal sandbank group is separated from Inner Dowsing by The Well channel and sandbanks on opposite sides of the channel have differing patterns of sediment movement. Sediment arrives at Inner Dowsing from the north, and from there is carried into the inner Wash. Bedforms in the area indicate that at least some of the movement of sediment into the inner Wash occurs along The Well channel. On the eastern side of the channel, movement of sediment around Race Bank, North Ridge and Dudgeon Shoal is more complex. Sediment moves southwards through the channel and then eastwards across Docking Shoal. There is evidence of a clockwise movement of sediment around Race Bank and North Ridge and bedforms indicate that sediment moves North West along southern flanks and south east along northern flanks (HR Wallingford *et al*, 2002). Internal dipping reflectors indicate that these banks may be exhibiting a south westward migration which counter-intuitive given the predominant near-bed sediment transport pathways Cooper *et al*, 2008).

The general trend of sediments around the banks is one of coarse gravelly sediments in the east of the site, becoming slightly more sandy towards the west. Around the east and south of the Inner Dowsing bank, sediments are mainly composed of sandy gravel or muddy sandy gravel, with occasional patches of sandier sediments. An inshore gravel shoal slopes into deeper water, and there is evidence of strong tidal currents running north-south through the deeper channel (Offshore Wind Power Ltd, 2002). To the north of Inner Dowsing, sediments range from gravelly muds to coarse sands containing shell debris, with muddier sediments in the north. Tidal disturbance of sediments on the Inner Dowsing bank appears to be greater in the southern sections indicating finer sediments and / or increased tidal currents (IECS, 1999).

10.2 Benthic Invertebrate Communities

To the north west and west of Inner Dowsing, between Inner Dowsing and North Ridge, the silty sand and gravel deposits support diverse communities characterised by a range of species (Fig.

9.1) including *Sabellaria spinulosa*, other polychaetes including *Harmothoe* sp., *Pholoe inornata*, *Cirratulus filiformis* and *Protodorvillea kefersteini*, sipunculid and nemertean worms, bivalves such as *Abra alba* and *Nucula nucleus* and crustacea such as *Pisidia longicornis* (MES, 2003). High density *S. spinulosa* has also been recorded in this area (Entec, 2003, AMEC, 2007). Low diversity communities are found within The Well channel, characterised by a few hardy polychaete and bivalve species (Fig. 9.1). On the western flank of Inner Dowsing there are patches of a *Lanice conchilega - Ampelisca* sp. community. *S. spinulosa* is common in trawls from this area, but appears not to form reefs. Other common epifauna in trawls include pink shrimp (*Pandalus montagui*), queen scallop (*Aequipecten opercularis*) and a number of large bryozoans (*Flustra foliacea* and *Bugula* spp.), along with species of crab (*Liocarcinus depurator, Cancer pagurus*, *Necora puber*) (Entec, 2003, MES, 2003).

In the area between Inner Dowsing and Docking Shoal / Well Channel the seabed communities are characterised by low species abundance and richness (Plate 1). Communities in this part of the site consist of a few polychaete species (*Nepthys* spp.*, Spio* spp.*, Glycera* sp.*, Eteone longa, Pholoe inornata*), nemertean worms and the ascidian *Molgula manhattensis*. Towards the tip of Docking Shoal, largely polychaete dominated communities are present, the genera *Glycera* sp.*, Ophelia* sp. and *Spio* spp. are abundant, along with the bivalve *Goodallia triangularis* (AMEC 2007; Centrica, 2008, 2009a & b).

Samples collected in the Race Channel (which separates Race Bank from Docking Shoal) indicate the presence of a diverse mosaic of biotopes on gravelly muddy sand (Fig 9.1) (AMEC, 2007; Centrica, 2008, 2009a & b). The most dominant organisms are the ascidian *Molgula manhattensis* along with a number of nemertean worms and polychaetes of the genera *Pomatoceros, Caulleriella, Polycirrus, Pholoe,* and *Lumbrineris*. *S. spinulosa* is also present, along with an attached fauna including diverse bryozoan and hydroid turfs, *Ampelisca spinipes* and *Balanus crenatus*. The *S. spinulosa* in this region, is of low to moderate density and found in an encrusting form or mixed with an hydroid/bryozoan turf, but no significant reef structures have been identified.

Currently, little information is available regarding the communities present on Race Bank and Dudgeon Shoal. Available data indicate that *Sabellaria* communities are present, in conjunction with other tube-builders such as *Lanice conchilega* and *Ampelisca* spp. These support attached epifauna including sea anemones, and tunicates such as *Ascidiella aspersa*, along with bryozoa *Electra pilosa*, *Flustra foliacea*, sponges *Scypha ciliata* and hydrozoa *Halecium halecinum*. Small bivalves are also present *Mytilus edulis*, *Nucula nucleus* along with mobile epifauna such as the porcelain crab *Pisidia longicornis* and the scale worm *Harmothoe impar* (Unicomarine, 2000). To the north of North Ridge and Dudgeon Shoal, communities appear to be diverse in terms of species, with no particular taxon dominating in terms of abundance. Species typical in this area include fauna attached to gravels (the barnacle *Balanus crenatus*, low density *Sabellaria spinulosa*, the tunicate *Dendrodoa grossularia),* the amphipod *Urothoe marina*, the porcelain crab *Pisidia longicornis* and the polychaete *Pholoe inornata* (MES, 2000).

In areas where *Sabellaria* abundance is high, but no reef has formed (Plate 2), a diverse additional fauna has been recorded including the bivalves *Abra alba*, *Mytilus edulis* and *Mysella bidentata*, the polychaetes *Pomatoceros lamarki*, *Caulleriella* sp. and *Mediomastus fragilis* and the amphipod *Aoragacilis* sp. In gravelly areas a diverse attached epifauna is present, including bryozoans *Flustra foliacea*, *Crisia aculeate, Vesicularia spinosa, Conopeum reticulum* and *Electra pilosa*, sponges *Leucosolenia botryoides* and *Scypha ciliata*, hydroids *Hydrallmania falcata*, *Tubularia indivisa*) and tube building worms (*Pomatoceros* sp.). The tube building amphipod *Ampelisca diadema* is also abundant in some areas. Mobile epifauna include a variety of brittlestars and small crabs (Emu, 2006). There are a number of areas within this part of the site where mussel *Mytilus edulis* density is high. Pink shrimp *Pandalus montagui* are also abundant in this part of the site, and brown crab (*Cancer pagurus*) and lobster *Homarus gammarus* are present to the south west of Inner Dowsing (Emu, 2002).

To the north of Inner Dowsing sandbank, where sediments are muddier and more stable, *Sabellaria* reef supports high diversities of polychaetes, anthozoans and encrusting epifauna (Plates 3 & 4). On the southern parts of the bank the communities are less diverse and are characterised by hardy polychaetes such as *Ophelia* spp.*, Spio* spp.*, Spiophanes* spp. and *Glycera* sp. More stable sections of the bank support communities containing bivalves Mytilacea, *Goodallia triangularis*, low density *S. spinulosa* and the tube-building amphipod *Ampelisca* spp. Trawl surveys in this area have recorded low numbers of pink and brown shrimp, the starfish *Asterias rubens*, small crabs such as *Liocarcinus depurator* and the larger brown crab *Cancer pagurus* (IECS, 1999, AMEC, 2007).

The *Sabellaria spinulosa* reefs located at Lynn Knock, Docking Shoal and Silver Pit South appear to be typical for the region. They arise from the surrounding coarse sandy seabed to heights of between 5cm to 10cm (Limpenny *et al,* 2010; Woo, 2008; Brutto, 2009). The reefs are consolidated structures of sand tubes showing seafloor coverage of between 30 per cent to areas where reef occupies 100 per cent of the sediment. Some parts of the reefs appear to be acting as sediment traps, with exposed tube height accordingly reduced within the core parts of reefs.

The Docking Shoal *Sabellaria* reef has been extensively studied (Foster-Smith *et al,* 1999; Foster-Smith & Hendrick, 2003; Limpenny *et al,* 2010). Data show that whilst the positions of core reef temporally shift location, this area of sandbank has supported stable reef mosaics for a significant number of years (1997-2005). During 1999 the core areas of reef were no longer present (not detectable by repeat surveys) indicating the temporal variability of *S. spinulosa* reef dynamics. However it is known that the reefs in this area naturally cycle (alternate) with dense beds of *Lanice conchilega* (Addison & Lawler, 2003). This is of itself an interesting natural dynamic. More recent data (Limpenny *et al,* 2010) indicates that during 2005 and 2006 these reefs were again well represented in the vicinity of marine aggregate extraction licence area 107.

The Lynn Knock reef was first recorded in detail in 2007 by the Eastern Sea Fisheries Joint Committee (Woo, 2008). It consists of fragile sand-tubes made by *S. spinulosa* which have consolidated to create a mosaic of crusts and solid structures rising above the seabed (Woo, 2008).

The Silver Pit South reef is represented by detailed acoustic and ground-truth data from marine aggregate licence characterisation and baseline surveys (Brutto, 2009). The reef is located along the southern edge of the Silver Pit seabed feature and well mapped from available high resolution side scan sonar data. There are indications from grab samples that the reef extends northwards within the Silver Pit itself. The reef at its southern extremity merges into an extensive consolidated *Sabellaria spinulosa* crust with an associated diverse epifaunal matrix.

The data indicate that the reefs are representative of those found elsewhere in the Southern North Sea region, most notably in The Wash and at the Haisborough, Hammond and Winterton cSAC. Species associated with the reefs include colonising fauna such as the hydroid *Nemerstesia antennina*, the bryozoan *Flustra foliacea* and the anemone *Sagartia elegans*. The crevices and nooks within the reef structure provide habitat for the squat lobster *Munida rugosa* and the brittlestars *Ophiocomina nigra* and *Ophiothrix fragilis*. The pink shrimp *Pandalus montagui* was also present, both on and swimming around the reefs, and the crabs *Necora puber* and *Cancer pagurus* and the common lobster *Homarus gammarus* were also seen in excavated depressions within the reefs.

10.3 Fish and mammals

The Inner Dowsing, Race Bank and North Ridge site is known to contain spawning grounds for herring *Clupea harengus*, lemon sole *Microstomus kitt* and sole *Solea solea* (Cefas, 2001;

Centrica, 2007), and provides nursery grounds for cod (*Gadus morhua*), herring, sole, lemon sole and plaice *Pleuronectes platessa* (Cefas, 2001; Scira Offshore Energy Ltd, 2006; Centrica, 2007).

To the west and south of Inner Dowsing, cod, sole and thornback ray *Raja clavata* are the dominant commercial species caught in trawls (Emu, 2002). Trawl surveys on the Inner Dowsing sandbank have recorded whiting and sole as the dominant fish, along with other common fish species such as dragonet *Callionymus lyra*, weever fish *Echiichthys vipera*, sandeel *Ammodytes* sp. and pogge *Agonus cataphractus* (IECS, 1999). To the west of Inner Dowsing, commercial species are relatively rare in trawl surveys, with dragonet, painted goby *Pomatoschistus pictus* and sea scorpion *Taurulus bubalis* being the most commonly recorded species (MES, 2003).

Small numbers of harbour porpoise are regularly observed within the boundary (Centrica, 2007). The site is close to the entrance of the Inner Wash, which supports a colony of common seal (*Phoca vitulina*). Consequently, seal sightings within the site are reasonably frequent (Scira Offshore Energy, 2006; Centrica, 2007), and this area is likely to be a feeding ground for seals (there are no haulout sites within the boundary). However, there is no evidence that this site is any more important for seals than other inshore sandbanks in the Wash, and seals have not been considered as a qualifying feature for this site.

11. Photographic plates

Plate 1 Gravelly sandwaves (from Limpenny *et al,* 2010)

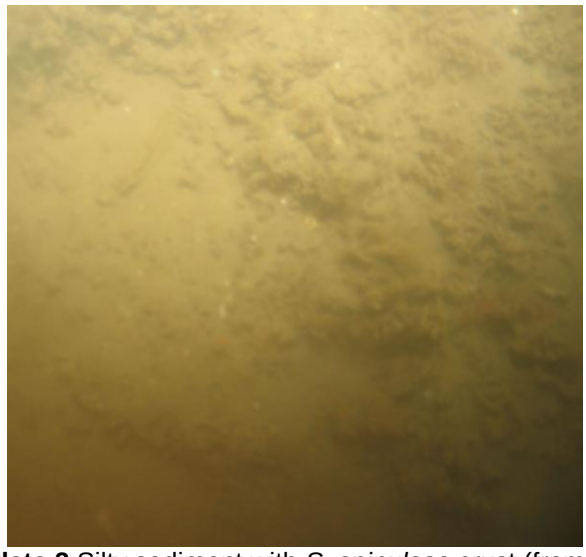


Plate 2 Silty sediment with *S. spinulosa* crust (from Limpenny *et al,* 2010)

Plate 3 *Sabellaria spinulosa* reef (from Limpenny *et al,* 2010)

Plate 4 *Sabellaria spinulosa* reef with velvet swimming crab (from Limpenny *et al,* 2010)

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13. Glossary

Abiotic Devoid of life

Aggregate dredging involves the removal of marine sand and gravel for use in construction or beach nourishment projects. The sediment resources are removed under a regulatory permission issued specifically for that purpose.

Amphipods are shrimp-like crustaceans ranging from 1mm to 140mm in length Marine amphipods may be pelagic (living in the water column) or benthic (living on the seabed). Pelagic amphipods are eaten by seabirds, fish, and marine mammals.

Banner Banks are generally only a few kilometres in length with an elongated pear-shaped form (Dyer and Huntley, 1999). They commonly lie in the lee of fixed obstacles such as headlands, islands, submerged rock shoals and gaps in rock ridges. They are sometimes paired on either side of the obstacle, with one larger than the other indicating a net direction of sand transport (Stride, 1982). Banner banks may also occur in areas with rapid deepening of water away from the coast and are less evident off coasts with a low offshore slope (Dyer and Huntley, 1999). Examples occur in the English Channel, Irish Sea and North Sea.

Bedforms Ripples moulded by a flow of water. Bedforms range in size from ripples in the sand, a few centimetres apart, to 'dunes' tens of metres in length.

Benthos Those organisms attached to, or living on, in or near the seabed.

Biotic Relating to, produced by, or caused by living organisms.

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.

Bivalves A class of molluscs which are laterally flattened and have a shell made of two hinged valves.

Bryozoans are tiny colonial animals that generally build stony skeletons of calcium carbonate, superficially similar to coral (although some species lack any calcification in the colony and instead have a mucilaginous structure).

Crinoids A class of echinoderms having a cup-shaped body with feathery arms, attached to the substratum, sometimes by a stalk'.

Crustaceans A class of invertabrates which includes crabs, shrimps and barnacles.

Crustose Forming a thin crust on the substratum.

Dredging plumes

- **Fishing** Bottom trawling stirs up the sediment on the sea floor due to gear contact, resulting in plumes of suspended particulate matter potentially many kilometers long. These plumes will decrease light transmission through the water column and may also affect benthic fauna and flora when the particles settle. The effect of these plumes will decrease with time and distance.

- **Aggregate dredge plumes** Marine aggregate extraction can result in increased sediment concentrations in the water column – dredge plumes - either from the disturbance of the seabed by or through the return of excess water and associated suspended sediment from the dredging vessel itself through either overspill returns or screening. The most significant input will result from overspill/screening returns, however because the sediments being dredged are relatively coarse the majority of suspended sediment concentration will settle out relatively quickly – typically within 200m of the point of return. The remaining fine sediment component, along with associated organic matter, can extend considerably further, however the concentrations of these will also dissipate over time and distance.

Epifauna Animals living on the surface of the seabed.

Estuary mouth Dyer and Huntley (1999): "…in general linear sand ridges are associated with the mouths of macro-tidal estuaries (wide mouth), and tidal deltas are associated with meso-tidal or micro-tidal estuaries (narrow mouth)." The banks are generally "aligned with the tidal current flow and migrate away from their steeper face." Examples include Long Sand and Gunfleet Sand (in the Thames Estuary) and banks in The Wash.

Foliose Bearing leaves or leaf-like structures.

Fauna Animal life in an area.

GIS Geographic Information System.

Habitat The place in which a plant or animal lives.

Headland associated sandbanks Dyer and Huntley (1999): "Tidal eddies produced by headlands can create 'banner banks, but when the headland is retreating 'alternating ridges' can be formed which can become isolated from the coast as it recedes." "With very slow retreat the surplus sand will accumulate as a banner bank in a position of convergence. With coastline retreat, a series of alternating banks will result with each successive one more distant from the shoreline." Banner banks are only a few km in size and have an elongated pear-shaped form with the broad end being orientated towards the tip of the headland. Alternating ridges may be linear or V or S shaped.

Hydroids Solitary and colonial animals with a cylindrical; body which is closed at one end with a mouth surrounded by tentacles at the other.

Infauna Bethic animals which live within the seabed.

Linear Sandbanks are elongated banks which can be up to tens of kilometres long and less than ten kilometres wide. They lie generally parallel or at a slight angle to peak tidal currents. They can be found in open seas but are also common in large estuaries such as the Thames Estuary.

Long lining A commercial fishing technique that uses hundreds or even thousands of baited hooks hanging from a single line.

Maerl Twig-like unattached (free living) calcareous red algae, often a mixture of species and including species which form a spiky cover on loose small stones.

Megaripple Mounds or ridges of sand which are asymmetrical, and are produced under water by flowing water. The external morphology is similar to the smaller 'ripple' and larger 'sandwave, with a gently sloping, upsteam side, and a steeper downstream side.

Nemerteans A phylum of invertebrate animals also known as *ribbon worms* or *proboscis worms*

Open shelf ridge Dyer and Huntley (1999): 'Nearly all shallow tidal seas, where currents exceed about 05 m s-1 and where sand is present, have ridges. These can be up to 80km long, and typically average 13km width and tens of metres in height. Their spacing tends to be proportional to their width. The bank crests are flat in shallow water, but are sharp when water depth is large enough to limit wave effects.' Examples include South Falls and Indefatigables.

Polychaete A class of marine annelid worms.

Potting The setting of traps (pots) on the seabed to fish for lobsters, crabs etc.

Sand wave A large, ridge-like structure resembling a water wave on the upper surface of a sedimentary bed that is formed by water currents. Also known as sand ridge.

Sandy mounds Distinct sandbanks (i.e. elongated, rounded or irregular 'mound' shapes) which cannot be categorised as any of the other types.

Seagrass(es) Higher plants (angiosperms) that are adapted to living submerged in seawater.

Shoaling localized shallowing of water.

Sinuous Banks are 'S' or 'V' shaped sandbanks and are common off the Norfolk coast and in the southern North Sea. They are large scale features and may occur in extensive groups which can include linear banks. Good examples are Haisborough Bank and Winterton Shoal.

Sinusoidal having a succession of waves or curves.

Static gear Any gear which is set in position and not moved during the fishing process. Examples include:

- Gill nets which are set at or below the surface, on the seabed, or at any depth in-between.
- Setting pots on the seabed to capture lobsters and crabs.
- Long lining when a single line is set to capture cod, skate, bass and whiting.

Submarine cables Cables which are laid beneath the seabed to carry telecommunications or power to offshore installations or different countries

Trawling Towing equipment behind a vessel for commercial fishing principally for cod, plaice and sole. Bottom trawls collect demersal (living on or near the seabed) species and mid-water trawls collect pelagic (living in the water column) species. Examples of towed gears include beam trawls, dredges and trawl nets.

Turbidity This is a measure of the attenuation of light in the water column and can be caused by the light adsorption properties of the water, plankton, suspended particulate organic matter and dissolved colour.

Appendix 1

Guidelines on drawing boundaries (taken from JNCC, 2008)

1 Introduction

Previous UK guidance on defining SAC boundaries states that "as a general principle, site boundaries have been drawn closely around the qualifying habitat types … for which the sites have been selected, taking into account the need to ensure that the site operates as a functional whole for the conservation of the habitat type… and to maintain sensible management units". Further "the seaward boundaries of the sites have been drawn as straight lines, to ensure ease of identification on charts and at sea" (Brown *et al*, 1997, McLeod *et al*, 2005). The guidance presented below is an expansion of previous guidance on defining boundaries for marine SACs, specifically for sites which are not connected to the coastline, and which may be in deep water (200m to more than 1000m).

2 Guidance

Actual site boundaries will be determined on a site specific basis, following the general guidance set out below.

2.1. The habitat area of interest will be identified and mapped. In many cases in waters away from the coast, this will involve some form of modelling, such as use of seabed geological data (interpolated from seismic tracks and samples), interpreted sidescan sonar, acoustic and/or bathymetric data.

2.2 The minimum area necessary in order to ensure the essential level of protection for the Annex I habitat of interest will be defined. More complex site shapes drawn more tightly around feature of interest are favoured over simple square/rectangular boundaries (to reduce the area of 'non-interest-feature' included within the site boundary). However, boundaries should still be as simple as possible, using a minimum number of straight lines and vertices. Contrary to previous JNCC boundary guidance (JNCC, 2004) site boundary co-ordinates do not have to be defined by whole degrees and minutes. It is recommended that site boundary coordinates will be provided in degrees, minutes, seconds.

2.3 Where habitat of interest occurs in a number of separate 'pieces' with 'non-interest-feature' habitat between, the preference is to include all 'pieces' within a site boundary to enable effective conservation of the feature of the site and to maintain its ecological function. However, where small, isolated instances of habitat occur at some distance from the main location of the habitat, these may be excluded from the site if their inclusion would result in large areas of 'non-interest-feature' being included within the site boundary.

2.4 The area defined fewer than 2 above may then be extended if necessary in the following circumstances:

i). to ensure an essential level of protection from potentially damaging activities at the site, taking into account water depth at the site and possible location of mobile gear on the seabed in relation to location of a vessel at the sea surface. Activities which are location specific, always subject to prior consent and have clear reliable methods of enforcement are already controlled under existing procedures such as licensing of these activities. Mobile activities which may affect seabed habitats, such as fishing and anchoring, are not subject to prior consent procedures and therefore need special consideration. The length of warp used by boats when trawling is largely determined by water depth. The following table gives the

appropriate distance beyond the seabed extent of the habitat by which the site boundary at the sea surface may be extended (based on generalised trawl warp lengths, SERAD, 2001):

Water Depth	Ratio warp length: depth	Approx. length of trawl warp	Boundary extension to be added to the habitat area of interest
Shallow waters (≤ 25m)	4:1	100m at 25m depth	4 * actual depth
Continental shelf (50-200m)	3:1	600m at 200m depth	3 * actual depth
Deep waters (200 to over 1000m)	2:1	2000m at 1000m depth	2 * actual depth

Note that the margin is incorporated as a minimum measure to reduce the likelihood of habitat damage from demersal fishing. However, these boundaries are SAC boundaries, not management boundaries. Ultimately Competent Authorities are responsible for considering which management actions might need to be taken under The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) to reduce the risk of damage to the features associated with human activities, whether within or outside the site boundary. As a consequence, future management measure may have different boundaries to the SAC site boundary.

ii). For mobile habitats (for example, sandbanks), to ensure the minimum area necessary to allow conservation of the structure and functions of the habitat. Such extension will be determined on scientific understanding of the structure and functions of the habitat